A Rapra Review Report comprises three sections, as follows:

1. A commissioned expert review, discussing a key topic of current interest, and referring to the References and Abstracts section. Reference numbers in brackets refer to item numbers from the References and Abstracts section. Where it has been necessary for completeness to cite sources outside the scope of the Polymer Library database, these are listed at the end of the review, and cited in the text as a.1, a.2, etc.

2. A comprehensive References and Abstracts section, resulting from a search of the Polymer Library database. The format of the abstracts is outlined in the sample record below.

3. An index to the References and Abstracts section, derived from the indexing terms which are added to the abstracts records on the database to aid retrieval.

---

**Source of original article**

- **Macromolecules**
  - 33, No.6, 21st March 2000, p.2171-83

**Title**

- EFFECT OF THERMAL HISTORY ON THE RHEOLOGICAL BEHAVIOR OF THERMOPLASTIC POLYURETHANES

**Authors and affiliation**

- Pil Joong Yoon; Chang Dae Han
- Akron, University

**Abstract**

The effect of thermal history on the rheological behaviour of ester- and ether-based commercial thermoplastic PUs (Estane 5701, 5707 and 5714 from B.F. Goodrich) was investigated. It was found that the injection moulding temp. used for specimen preparation had a marked effect on the variations of dynamic storage and loss moduli of specimens with time observed during isothermal annealing. Analysis of FTIR spectra indicated that variations in hydrogen bonding with time during isothermal annealing very much resembled variations of dynamic storage modulus with time during isothermal annealing. Isochronal dynamic temp. sweep experiments indicated that the thermoplastic PUs exhibited a hysteresis effect in the heating and cooling processes. It was concluded that the microphase separation transition or order-disorder transition in thermoplastic PUs could not be determined from the isochronal dynamic temp. sweep experiment. The plots of log dynamic storage modulus versus log loss modulus varied with temp. over the entire range of temps. (110-190C) investigated. 57 refs.

**Location**

- GOODRICH B.F.
- USA

**Accession no.** 771897

---

**DOCUMENT DELIVERY SERVICE**

Almost all of the documents which are listed in the References and Abstracts section are available in full text form, as photocopies or pdf files from Rapra Technology Ltd’s Document Delivery Service. Documents can be delivered by a variety of methods, including email, post or fax. Customers may pay for individual copies at the time of ordering by credit card or alternatively open up a deposit account. See the back of this report for further information.

*Please contact the Document Delivery Department for availability, current prices and delivery methods.*

**Document Delivery Department**

Rapra Technology Limited, Shawbury, Shrewsbury, Shropshire SY4 4NR, United Kingdom

Telephone: +44 (0)1939 250383  Fax: +44 (0)1939 251118  Email: documents@rapra.net
RAPRA REVIEW REPORTS VOLUME 13

Series Editor Dr. S. Humphreys, Rapra Technology Limited

Rapra Review Reports comprise a unique source of polymer-related information with useful overviews accompanied by abstracts from hundreds of relevant documents. A Rapra Review Report is an excellent starting point to improve subject knowledge in key areas. Subscribers to this series build up a bank of information over each year, forming a small library at a very reasonable price. This series would be an asset to corporate libraries, academic institutions and research associations with an interest in polymer science.

Twelve reports are published in each volume and these can be purchased individually or on a subscription basis.

Format: Soft-backed, 297 x 210 mm, ISSN: 0889-3144

Order individual published Rapra Review Reports (see the following pages for a list of available titles), or purchase a subscription to Volume 13 (12 issues).

ORDER FORM

<table>
<thead>
<tr>
<th>Title of Publication</th>
<th>Price £/$/€</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would like to order the following Rapra Review Report(s) at £80 / US$120 / €136 each</td>
<td></td>
</tr>
<tr>
<td>Report Number(s) ........................................................................................................ (please state quantity if more than one)</td>
<td></td>
</tr>
<tr>
<td>Please add postage at the following rates: UK £5 total, Overseas £7 / US$11 / €10 per item</td>
<td></td>
</tr>
<tr>
<td>Subtotal:</td>
<td></td>
</tr>
<tr>
<td>I would like to order .......... subscription(s) to Volume 13 of the Rapra Review Report Series at</td>
<td>£630 / US$882 / €1071 each</td>
</tr>
<tr>
<td>Please add postage at the following rates: UK £35 total, Overseas £65 / US$110 / €110 per subscription</td>
<td></td>
</tr>
<tr>
<td>Total Order Value:</td>
<td></td>
</tr>
</tbody>
</table>

All prices are subject to change and orders will be charged at the price indicated on www.polymer-books.com on the date of processing

- Remittance enclosed
- Please invoice my company
- Please charge my credit card
  American Express / Visa / Mastercard (delete as appropriate)
  Card Number: ______________________

Signature: ______________________ Exp. date: _________________
Issuing Bank: ______________________

Full Name: ______________________
Company: ______________________
Job Function: ______________________

Cardholders Name (as on card): ______________________
Cardholders Address: ______________________

Delivery Address (if different from Cardholder's Address): ______________________

Postcode: ______________________ Country: ______________________
Telephone: ______________________ Fax: ______________________

If you would like to receive regular electronic updates informing you of new titles and offers please enter your E-mail address below.
E-mail: ______________________

Please add postage at the following rates: UK £35 total, Overseas £65 / US$110 / €110 per subscription

IMPORTANT - Value Added Tax (VAT)

The above prices do not include VAT. Customers in EU member countries may be liable to pay VAT if their Registration Number is not supplied. Please enter your EU Registration Number (VAT - BTW - IVA - TVA - MWST - MOMS - FPA) below:

VAT Number: ______________________

Subtotal: ______________________

Subtotal: ______________________

Total Order Value: ______________________

All prices are subject to change and orders will be charged at the price indicated on www.polymer-books.com on the date of processing

Values added tax (VAT) The above prices do not include VAT. Customers in EU member countries may be liable to pay VAT if their Registration Number is not supplied. Please enter your EU Registration Number (VAT - BTW - IVA - TVA - MWST - MOMS - FPA) below:

VAT Number: ______________________

Please remit to: Publications Sales, Rapra Technology Limited
Shawbury, Shrewsbury, Shropshire
SY4 4NR, United Kingdom
Tel. +44 (0)1939 250383
Fax: +44 (0)1939 251118
E-mail: publications@rapra.net

www.rapra.net
## Previous Titles Still Available

### Volume 1
- Report 10: Communications Applications of Polymers, R. Spratling, British Telecom.

### Volume 2
- Report 17: Extrusion, G.M. Gale, Rapra Technology Ltd.
- Report 19: Recycling and Disposal of Plastics Packaging, R.C. Fox, Plas/Tech Ltd.
- Report 20: Pultrusion, L. Hollaway, University of Surrey.
- Report 21: Materials Handling in the Polymer Industry, H. Hardy, Chronos Richardson Ltd.
- Report 22: Electronics Applications of Polymers, M.T. Goosey, Plessey Research (Caswell) Ltd.
- Report 24: Recent Developments in Materials for Food Packaging, R.A. Roberts, Pira Packaging Division.

### Volume 3
- Report 26: Polymers and Structural Composites in Civil Engineering, L. Hollaway, University of Surrey.
- Report 32: Fluoroelastomers - Properties and Applications, D. Cook and M. Lynn, 3M United Kingdom Plc and 3M Belgium SA.
- Report 33: Polyamides, R.S. Williams and T. Daniels, T & N Technology Ltd. and BIP Chemicals Ltd.
- Report 36: Developments in Additives to Meet Health and Environmental Concerns, M.J. Forrest, Rapra Technology Ltd.

### Volume 4
- Report 39: Failure of Plastics, S. Turner, Queen Mary College.
- Report 41: Polymeric Materials from Renewable Resources, J.M. Methven, UMIST.
- Report 42: Flammability and Flame Retardants in Plastics, J. Green, FMC Corp.

### Volume 5
- Report 48: Biomedical Applications of Polymers, C.G. Gebelein, Youngstown State University / Florida Atlantic University.
- Report 49: Polymer Supported Chemical Reactions, P. Hodge, University of Manchester.
- Report 54: Joining of Plastics, K.W. Allen, City University.
- Report 57: Physical Testing of Thermoplastics, S.W. Hawley, Rapra Technology Ltd.

### Volume 6
- Report 58: Food Contact Polymers, J.A. Sidwell, Rapra Technology Ltd.
- Report 59: Coextrusion, D. Djordjevic, Klöckner ER-WE-PA GmbH.
- Report 60: Conductive Polymers II, R.H. Friend, University of Cambridge, Cavendish Laboratory.
- Report 61: Designing with Plastics, P.R. Lewis, The Open University.
- Report 63: Reinfoced Thermoplastics - Composition, Processing and Applications, P.G. Kelleher, New Jersey Polymer Extension Center at Stevens Institute of Technology.
- Report 65: Cure Assessment by Physical and Chemical Techniques, B.G. Willoughby, Rapra Technology Ltd.
Volume 11

Report 121  Polyamides as Engineering Thermoplastic Materials, I.B. Page, BIP Ltd.


Report 123  Polymer Blends, I.A. Utracki, National Research Council Canada.


Report 126  Composites for Automotive Applications, C.D. Rudd, University of Nottingham.


Report 129  Failure of Polymer Products Due to Photo-oxidation, D.C. Wright.

Report 130  Failure of Polymer Products Due to Chemical Attack, D.C. Wright.

Report 131  Failure of Polymer Products Due to Thermo-oxidation, D.C. Wright.

Report 132  Stabilisers for Polyolefins, C. Kröhnke and F. Werner, Clariant Hunningue SA.

Volume 12

Report 133  Advances in Automation for Plastics Injection Moulding, J. Mallon, Yushin Inc.

Report 134  Infrared and Raman Spectroscopy of Polymers, J.L. Koenig, Case Western Reserve University.


Report 136  Radiation Curing, R.S. Davidson, DavRad Services.

Report 137  Silicone Elastomers, P. Jerschow, Wacker-Chemie GmbH.


Report 139  Rubber Analysis - Polymers, Compounds and Products, M.J. Forrest, Rapra Technology Ltd.

Report 140  Tyre Compounding for Improved Performance, M.S. Evans, Kumho European Technical Centre.

Report 141  Particulate Fillers for Polymers, Professor R.N. Rothon, Rothon Consultants and Manchester Metropolitan University.

Report 142  Blowing Agents for Polyurethane Foams, S.N. Singh, Huntsman Polyurethanes.


Report 144  Rubber Curing Systems, R.N. Datta, Flexsys BV.

Volume 13


Report 146  In-Mould Decoration of Plastics, J.C. Love and V. Goodship, The University of Warwick


Report 149  Analysis of Plastics, Martin J. Forrest, Rapra Technology Ltd.

Rigid Plastics Packaging - Materials, Processes and Applications

F. Hannay, Nampak Group Research & Development

ISBN 1-85957-358-4
Contents

1 Introduction ........................................................................................................................................ 3

2 Container Moulding Processes ........................................................................................................ 3
  2.1 Extrusion ..................................................................................................................................... 3
  2.2 Sheet Extrusion/Thermoforming ............................................................................................... 4
  2.3 Injection Moulding .................................................................................................................... 6
  2.4 Extrusion-Blow Moulding (EBM) ............................................................................................... 7
  2.5 Injection Blow Moulding ........................................................................................................... 9
  2.6 Injection-Stretch Blow Moulding ............................................................................................. 9

3 The Main Polymers Used in Rigid Packaging Applications .......................................................... 12
  3.1 Polyethylene ............................................................................................................................... 12
  3.2 Polypropylene (PP) .................................................................................................................. 14
  3.3 Polystyres .................................................................................................................................. 14
  3.4 Styrenic Polymers ..................................................................................................................... 16
  3.5 Polyvinyl Chloride (PVC) ......................................................................................................... 16
  3.6 Polyacrylonitrile (PAN) ............................................................................................................ 16
  3.7 Identification of Polymers for Recycling .................................................................................. 17

4 High Barrier Polymers for Multilayer Containers ......................................................................... 17
  4.1 Polyamide Barrier Polymers .................................................................................................... 17
  4.2 Ethylene-Vinyl Alcohol Copolymer (EVOH) .......................................................................... 18
  4.3 Thermoplastic Epoxies ............................................................................................................. 19
  4.4 Further Development of Barrier Polymers ............................................................................. 20

5 Other Barrier Enhancement Processes ............................................................................................. 21
  5.1 Organic Coatings ....................................................................................................................... 21
  5.2 Inorganic Vapour Deposited Coatings ..................................................................................... 21
  5.3 Fluorination of HDPE for Solvent Barrier ............................................................................. 22

6 Rigid Plastics in Secondary Packaging ............................................................................................ 22

7 Rigid Plastics Packaging for Non-Food Applications ................................................................... 23

8 Rigid Plastics Packaging for Foods ................................................................................................ 23
  8.1 Fresh and Near-Fresh Foods ................................................................................................. 23
  8.2 Frozen Foods ............................................................................................................................ 24
  8.3 Shelf-Stable Foods ................................................................................................................... 24
1 Introduction

Plastics’ desirable properties such as toughness, light weight and the design freedom that they offer, have made them a natural choice for both rigid and flexible packaging materials. Flexibility is said to be one of the great advantages of plastic materials in many applications. The word ‘plastic’ has come to imply mouldability and flexibility. It is therefore necessary to clarify what we mean when we use the term ‘rigid plastics packaging’ in contrast to flexible packaging.

Typical containers covered by our definition of rigid plastics include bottles, jars, tubs, buckets and pails. These are self-supporting, freestanding containers. Most have walls thicker than 0.25 mm. There will always be grey areas in definitions of this type. For example trays produced in form-fill-seal operations may be considered to be flexible packaging, but are little different in form and rigidity to thin pre-formed trays or punnets classed as rigids.

The rapid advancement of rigid plastics in packaging has been influenced by the parallel development of plastic raw materials and plastics conversion processes. Low density polyethylene, polystyrene, high density polyethylene, polyvinyl chloride (PVC) and polypropylene have taken their places in the rigid packaging spectrum as blow moulding, injection moulding and thermoforming processes developed to mould containers from these materials with increasing speed and efficiency. Polyester (or polyethylene terephthalate (PET)) has been known since 1941 as a fibre polymer and as a flexible packaging material. It was only in 1975, after the injection-stretch blow moulding process was invented and commercially developed, that PET’s unique properties could be used to meet the challenge of packaging carbonated drinks in a plastic container.

Developments in packaging processes and technology have contributed to the growth in plastics packaging. Advances in filling machines and systems capable of handling lightweight containers at high speed have been important. New decoration techniques have widened the scope for rigid plastics in packaging. Developments in food processing have opened new opportunities for the use of plastics and will continue to have a large influence in the future.

In this review, the main plastic conversion processes relevant to rigid packaging are briefly described and development trends in these processes reviewed. Similarly, the main packaging polymers, barrier polymers and developments in these areas are discussed. While all the major polymers are discussed, it is clear that in recent years, PET and enhancement of the properties of PET containers has dominated development work in rigid packaging.

2 Container Moulding Processes

The moulding processes used to manufacture plastic containers are varied. They require melting of the plastic, shaping or moulding it and then cooling to form the rigid container. In many cases the processes compete with each other to make the same type of container. For example, yoghurt cups may be made either by thermoforming or injection moulding. In the end the most appropriate manufacturing process for a particular container will depend on cost considerations, the number of containers required and the product specifications. Table 1 compares manufacturing processes and typical applications.

Each process could justify a study on its own. For those unfamiliar with plastics conversion processes a brief description of the relevant basic processes is provided, followed by a review of moulding developments of importance to rigid packaging.

2.1 Extrusion

Extrusion is a process for melting and mixing plastics before forming. It is the basis of most plastic conversion processes (see Figure 1). An extruder consists of a raw material hopper, a heated barrel containing a rotating feed-screw and an extrusion head. The extrusion head contains a die that determines the shape of the plastic extrudate. Plastic granules are fed from the hopper by the screw. The plastic is melted by a combination of heat from the barrel and shear heat generated by the mechanical action of the screw. The action of the screw mixes the molten plastic and feeds it through the die. The shape and type of die determines the end product to be produced.

Let us consider sheet extrusion as an example. An extruder feeds melt through a slot-shaped die to form a sheet of molten plastic. This passes over a series of rollers that control the final sheet thickness and cool the sheet. The sheet is then commonly wound onto reels for subsequent use.
By using a number of extruders to feed different plastic materials, via a combining device, or feedblock, to a common die, multilayered structures of different materials, with different properties can be formed. We refer to this as co-extrusion. Extrusion feedblocks and dies are precision engineering components and can be extremely complex, particularly when a large number of materials are used in a co-extrusion. The development of co-extrusion has made it possible to combine materials with diverse properties. This has made an important contribution to the development of sophisticated plastics packaging.

2.2 Sheet Extrusion/Thermoforming

Wide-mouth containers such as tubs, trays and cups are commonly produced by thermoforming. Thermoformed containers are usually tapered and the process requires that the mouldings have a mouth wider than the container body as the process cannot mould undercuts. For this type of container, thermoforming competes with injection moulding. Variations of the process allow for the production of multilayer barrier containers and even heat-resistant/oven-resistant trays (52, 358).

2.2.1 The Thermoforming Processes

The thermoforming process, illustrated in Figure 2, starts with plastic in sheet form. The sheet is softened by heating in an oven, or by passing it over a bank of heaters. The hot sheet is then placed over a hollow mould. In the vacuum forming process, a vacuum draws it into the mould. In the pressure-forming process, a positive pressure applied above the sheet blows the sheet into the mould cavity. The mould cavity must be vented to prevent air from being trapped between the sheet and the mould surface.

A plug-assist device may be used to push the sheet into the mould cavity to ensure optimum wall-thickness distribution in the final moulding. The shape of the plug will determine the final material distribution in the moulding (381). Only the outer surface of the container is formed by the mould. The inner surface is formed by air pressure. Thermoformed containers will therefore not have the same dimensional accuracy as their injection-moulded counterparts (188, 406).

A feature of the thermoforming process is that the container has to be punched out of the remaining sheet. This may be done by incorporating cutters in the mould or by indexing the mouldings to a separate punching station. The web of material remaining after the

<table>
<thead>
<tr>
<th>Process</th>
<th>Container types</th>
<th>Main polymers used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermoforming (TF)</td>
<td>Tapered cups, tubs, trays and lids</td>
<td>Polystyrene (PS), polypropylene (PP), APET and PVC</td>
</tr>
<tr>
<td>Injection moulding (IM)</td>
<td>Cups, tubs, trays, pails, tubes, caps and closures</td>
<td>Polystyrene, polypropylene, polyethylene, and PET for ISBM preforms</td>
</tr>
<tr>
<td>Extrusion blow moulding (EBM)</td>
<td>Bottles, bottles with integral handles, jars and drums</td>
<td>Polyethylene, polypropylene and PVC</td>
</tr>
<tr>
<td>Injection blow moulding (IBM)</td>
<td>Cosmetic jars, bottles and vials</td>
<td>Polystyrene, polypropylene, polyethylene</td>
</tr>
<tr>
<td>Injection-stretch blow moulding (ISBM)</td>
<td>Bottles and jars. Carbonated drinks bottles</td>
<td>Predominantly PET, some polypropylene</td>
</tr>
</tbody>
</table>
containers are punched out is referred to as skeletal waste. For an economic process this has to be reground and recycled back into the system. In container moulding, the skeletal waste may form 40% to 60% of the material output.

A thermoforming machine may be coupled directly to its own dedicated sheet extruder to form a continuous extrusion/thermoforming line. This saves energy, as the sheet does not have to be fully cooled and then reheated. The extruder feeds into a temperature-conditioning unit that cools the sheet to optimum forming temperature.

2.2.2 Thermoformed Multilayer Barrier Containers (181, 378)

Co-extrusion of multilayer structures is a well-developed technology and hence the manufacture of multilayer sheet has become fairly commonplace. With ready availability of suitable sheet, it is a relatively easy step for a thermoformer to produce multilayer containers.

The earliest multilayer containers were simple two-layer structures of two similar materials. Cups with a glossy crystal polystyrene outer skin over high impact polystyrene are a good example. Similar examples, often seen on the shelves today are two-colour tubs; a bright colour on the outside and a clean white inner layer. As we have seen, thermoforming produces a high proportion of skeletal waste. Two-tone containers mean two-tone waste that has to be reprocessed. This led to three-layer sheet extrusion; a colour layer/mixed colour regrind/a white layer.

To produce containers with high gas barrier properties requires co-extrusion of plastic materials with very different melting points and different melt viscosity. Layers of adhesive copolymers are needed to ensure good adhesion between dissimilar polymers. The thickness of expensive high gas-barrier polymers needs to be precisely controlled. As a result, the feedblocks and sheet extrusion dies required to produce the complex co-extruded structures available today are precision engineering tools based on high level technology.

Trays used for shelf-stable ready meals are a good example of the complex material combinations in use today. These typically consist of polypropylene (PP) as the structural layer and ethylene-vinyl alcohol copolymer (EVOH) as the gas barrier. The wall structure consists of virgin or pigmented PP/mixed PP+EVOH regrind/adhesive/EVOH/adhesive/virgin PP.

2.2.3 Ovenable Containers

The development of crystallisable grades of PET (CPET) as described in Section 3.3.1 has made it possible to thermoform PET trays that can be used for heating food in conventional household ovens. A heat-setting step is added to the process. Sheet extruded from CPET is rapidly chilled to ensure that crystallisation does not occur. This sheet is then reheated and thermoformed in the conventional manner. The formed component is then transferred to a crystallisation station. This is a second mould that is heated to the optimum crystallisation temperature of the PET. The thermoformed article is held in the mould under pressure while the PET crystallises. The transparent amorphous PET becomes white and heat resistant. Ovenable CPET trays are reported to resist temperatures up to 220 °C.
2.3 Injection Moulding

Injection moulding is a very widely used process. Common injection moulded packaging items include tubs, buckets, rigid tubes, screw caps and various closures and fitments.

2.3.1 The Basic Injection Moulding Process

An injection moulder consists of a purpose-built extruder coupled to a clamping press that is fitted with an interchangeable mould. A common form of injection moulder has a reciprocating screw extruder as the injection unit. The screw has a one-way valve, or check-ring at its tip. The moulding cycle starts with the screw in a forward position in the barrel. The screw rotates in the barrel, feeding molten plastic forward, through the check-ring to the front of the barrel. As melt builds up ahead of the screw, the screw is pushed back in the barrel by the melt pressure. When a suitable pool of melt has accumulated ahead of the screw, the screw is rapidly moved forward, acting as a piston, injecting the molten plastic, under high pressure, into the clamped mould. The mould is filled and, after a cooling period, the clamp opens and the finished moulding is ejected from the mould. This is illustrated in Figure 3.

In conventional injection moulding all the surfaces of the moulded component are formed and cooled by contact with the mould. High dimensional accuracy is therefore possible. The relatively high injection pressures mean that there is good replication of the mould surface. Very detailed or high gloss surface finishes can be achieved.

There are many variations of the basic injection-moulding machine. Some machines have a continuously operating, non-reciprocating screw that feeds into a separate accumulator, with injection being done by a separate piston. There are also many variations of mould clamping systems, i.e., hydraulic, mechanical and hybrid hydraulic assisted mechanical clamps. Screw drives may be hydraulic or electric. All-electric injection moulders appear to be becoming more popular.

The mould itself is a critical part of the process. Moulds can vary from a simple single-cavity tool to very complex multi-cavity moulds. Melt channels, called runners, feed molten plastic from the injection unit to the mould cavities. In simple moulds, these may be cold runners, which are ejected with the mouldings and have to be reground and reprocessed. More complex moulds have hot-runners that provide a constant melt...
pathway between the injection unit and the mould cavities.

2.3.2 Injection Moulding Developments

Many of the developments over the years have been aimed at improving injection moulding machine efficiencies, reducing the dead time in the cycle and improving machine control systems. Mould manufacturing developments have made important contributions to efficiency. Hot runner systems are continuously being improved to permit more cavities in the same mould area and to reduce the residence time of the molten material in the runner system. Attention has also been given to post-mould handling to improve efficiencies. Using pick-and-place robots to remove hot components from the mould and place them in secondary cooling tools has reduced cycle times. In in-mould labelling (IML) systems (11, 348), robots are also used to place labels in the mould thus eliminating a down-stream operation (161).

2.3.2.1 Coinjection Moulding

Two-colour moulding has found a number of non-packaging applications as diverse as key-pads with moulded-in characters and multicolour automotive lighting clusters (12). Two (or more) injection units are coupled to a single mould clamping unit fitted with a multi-cavity mould and moving mould cores. The first material or colour is injected into the first cavity. The mould opens and the component is transferred on the mould core to the next cavity. The moulded component now forms part of the mould as the second material is moulded over it.

This process has found applications in the luxury end of the packaging market for the manufacture of multicolour components. For example, soft, elastomeric materials are moulded over harder materials to produce caps and closures with a soft-touch gripping area.

Of more importance to the future of rigid packaging is the ability to use coinjection systems to produce multilayer barrier containers. In the mid-1980s the American Can Company patented a multilayer injection process used to produce plastic food cans. These had a PP/EVOH/PP structure, giving excellent gas barrier properties and competing with multilayer thermoformed containers. Continental PET Technologies, working with Husky Injection Systems developed the technology to produce multilayer PET/EVOH/PET preforms for subsequent stretch-blow moulding into high barrier ketchup bottles. A surge of environmentalism then saw the development of coinjection systems to encapsulate post-consumer recycled PET between two layers of virgin material. More recently intensive developments to improve multilayer preform injection moulding systems have been driven by the prospect of packing beer in barrier PET bottles (205, 212).

Much of the technology in these moulding systems lies in the design of the mould hot runner systems. Some systems rely on the sequential injection of the different materials into the mould, while others use simultaneous injection systems. At present this is an area of intense development and intense patent litigation.

2.3.2.2 Selective Foaming

The patented Coralfoam process uses chemical blowing agents with careful control of cooling rates in selected parts of the mould and moving mould components to foam only selected areas of injection moulded components. The process can be used to foam a thick, insulating grip ring around a thin-walled cup for packaging foods that can be reheated and eaten from the container (90, 333).

2.3.2.3 Other Significant Injection Moulding Process Developments

Gas-assist injection processes have been used to produce articles with a hollow core. Applications of this technology in rigid plastics packaging are limited. Perhaps it could be used to mould thick handles on an otherwise thin-walled packaging item, or other similar application. The process and its variations can be complex. An extension of gas-injection is water-assisted injection which may accomplish similar goals, with higher cooling speeds.

It is claimed that wall thickness’ of circular tubs and pails can be significantly reduced, without loss of mechanical properties by using the Orbital Turbulent Injection Process developed by Demag Ergotech and Poranunt in Thailand (53, 287).

2.4 Extrusion-Blow Moulding (EBM) (264)

Extrusion-blow moulding is a bottle making process. It can be used to produce containers from as small as a
Rigid Plastics Packaging - Materials, Processes and Applications

A conventional extruder feeds molten plastic to an extrusion head that produces a hollow tube of molten plastic called a parison. Two halves of the hollow blow-mould close over the parison. As the mould closes, the base of the parison is sealed. Air is blown into the hot parison, inflating it in the water-cooled mould. After cooling, the blown bottle is ejected from the mould. It then has to be trimmed to remove the tail that is formed during the base sealing. Excess material around the neck of the bottle is also trimmed. The principle of extrusion-blow moulding is illustrated in Figure 4.

The distinctive base weld-line is a way of identifying a bottle as being extrusion blow-moulded. An important feature of the process is that a container with an integral handle can be formed as part of the blowing process.

Trim-scrap produced in the blow-moulding operation is significant. The amount of scrap depends on the bottle design but may typically be between 20% and 50% of the bottle weight. It is therefore critical to the economics of the process, that this scrap is regranulated and blended into virgin polymer for re-extrusion into new bottles.

2.4.1 EBM Machine Configurations

There are a large number of different types of extrusion-blow moulding machines. There are machines with an intermittent reciprocating screw extruder and machines with continuous extrusion systems. The extruders may feed a single head, producing a single parison. A small capacity machine may only have a single cavity mould producing 2 to 3 million bottles a year. Multiple head extruders extrude a number of parisons, simultaneously feeding a multi-cavity mould. High-speed rotary, or wheel blow moulders have continuous extruders feeding up to 14 moulds on a rotating wheel producing 40 million per annum. There are horizontal wheels and vertical wheels (384).

In North America, wheel machines are favoured for high output blow moulding. In Europe the so-called long-stroke blow moulders have been developed and are favoured for high output. These machines have extrusion heads producing between 6 and 16 parisons simultaneously. A large mould with the same number of cavities is fitted to the clamping unit, which may have a stroke of more than 650 mm. Clearly this is a separate subject and cannot be discussed in detail here (264, 303).
2.4.2 Co-Extrusion-Blow Moulding (149, 384)

The technology to co-extrude a multilayer parison is well developed. It is possible to manufacture containers with layers of different materials. This has been widely used as a way of incorporating post-consumer plastic scrap. As an example, a three-extruder blow-moulder, with a three-layer extrusion head may used to produce a bottle with a coloured outer skin, a core layer of reclaimed material and an inner layer of virgin plastic in contact with the product.

Polymers with high gas barrier properties, such as ethylene-vinyl alcohol copolymer (EVOH), can be incorporated in a multilayer bottle structure. Squeeze bottles for tomato ketchup based on polypropylene (PP) are a good illustration of the use of this technology. A typical ketchup bottle consists of 6 layers as follows: PP outer skin/mixed bottle trim-scrap/adhesive copolymer/EVOH/adhesive copolymer/virgin PP.

2.5 Injection Blow Moulding

As the name suggests, this process is a combination of injection moulding and blow moulding. It is used to manufacture high quality bottles and jars.

An injection blow-moulding machine usually has three mould stations. Tube-like parisons, or preforms, are injection moulded at the first station. While still hot, these are transferred on mandrels to the blowing station where they are inflated in a set of blow moulds. The blown containers are then transferred to the ejection station, see Figure 5.

Because the parisons are injection moulded, injection blown containers have a high quality neck finish and a better surface finish than extrusion blown containers. Tooling costs are high because a preform mould and blow mould are required. The process is usually used for smaller containers and finds its main applications in the pharmaceutical and cosmetics field.

2.6 Injection-Stretch Blow Moulding (283, 328, 329)

Injection-stretch-blow-moulding (ISBM) was developed specifically to manufacture carbonated drinks bottles from polyethylene terephthalate (PET). PET has a sharp melting point and a low melt viscosity and is not suitable for extrusion blow moulding. In principle ISBM is a variation of injection blow moulding. A tube-like preform is first injection moulded. This preform is much shorter than the final bottle. The preform is conditioned to a temperature just above the glass transition temperature of the PET, but well below the crystalline melting point. It is then transferred to the blow mould. Here a stretch rod enters the preform. This rapidly stretches the preform longitudinally while very high-pressure air inflates the preform into the cold mould, see Figure 6.

A unique feature of ISBM is that the container is blow moulded below the melting point of the plastic material. Combined with longitudinal and axial stretching of the preform, this results in biaxial orientation of the polymer molecules. Biaxial orientation imparts exceptional strength and creep resistance to the container. It also enhances the gas barrier properties. This strength, creep resistance and relatively good gas barrier is what makes the PET carbonated beverage bottle possible.

A further consequence of the fact that the bottles are formed below the melting point of the material is that it is not possible to form an integral handle in the container, as can be done in extrusion-blow moulding. This limitation is partially addressed by fitting a clip-on injection-moulded handle after moulding. Alternatively, the preform may be moulded with a small handle attached to the neck. The preform is then blown with the handle portion out of the blow mould. This limits the number of preforms in a given mould area and may require careful placement and orientation of the preform in the blow mould.

Although still used mainly for PET bottle and jar manufacture, much development work is being done on ISBM of polypropylene and there are some
commercial PP bottle operations. Stretch-blow moulded clarified PP copolymers have a gloss and clarity approaching that of PET. The biaxial orientation results in a vast improvement in impact strength compared to extrusion-blown PP containers.

2.6.1 ISBM Process Variations

The ISBM process can be split up into three stages, i.e., injection moulding, temperature conditioning and stretch-blowing. ISBM machines are classified into three types.

2.6.1.1 Two-Stage ISBM

Preform moulding and bottle blowing are performed in two entirely separate operations. Preforms are moulded on large, multi-cavity injection moulders. They may then be stored or shipped to a remote blow-moulding site. The preforms then have to be reheated from ambient to blowing temperature prior to blow moulding. The 2-stage process lends itself to high-speed production of large quantities. It also has the advantage that preform moulding can be centralised and blow moulding decentralised, with bottles being blown at a number of sites, close to or in the filling plant. This has economic advantages, as shipping fairly densely packed preforms is much more cost-effective than shipping large volumes of empty containers over long distances.

2.6.1.2 Single-Stage ISBM

This process more closely resembles conventional injection-blow moulding. The preforms are injection moulded and bottle blown in the same machine. Multiple preforms are moulded at the injection station. After partial cooling in the injection mould, they are indexed to a temperature conditioning station. They then move into the blow moulds where blowing and stretching take place. These machines have the same number of blow moulds as they have injection cavities. Their output rate is determined by the cooling time that is required in the injection moulds. This limits the machine efficiency somewhat. Single-stage machines are better suited to applications not requiring large quantities. An advantage is that the preforms are not handled between stages. Single-stage bottles therefore
have a better, blemish-free surface. This offers advantages in containers for cosmetic products. Single-stage ISBM is also commonly used in the manufacture of wide-mouth PET jars.

### 2.6.1.3 One-and-a-Half Stage ISBM

This rather odd term was coined to describe the latest generation of modified single-stage machines. They are a compromise between the single-stage and two-stage processes, but remain a single machine process. To increase the efficiency of the blowing portion of the single-stage process, these machines have more preform cavities than blow mould cavities. Preforms are injection moulded as in a single-stage process. They are then transferred to a post-mould cooling/holding station. They are then reheated in groups, with the size of the group matching the number of blow moulds. For example, a machine may have 6 preform cavities and only 2 blow moulds. The blow moulding cycle is three times faster than the injection cycle. Six preforms are moulded and transferred to the holding station. From there they are transferred in pairs, first through a re-heating oven, then to the pair of blow moulds. Three blowing cycles take place during the preform moulding.

### 2.6.2 Heat-Set PET Bottles (110, 290)

PET has the unusual ability to exist either in a completely amorphous state or in a highly crystalline state. This is discussed in more detail in Section 3.3.1. When sufficient heat is applied to a PET container held in a mould, the degree of crystallinity increases. This increases the temperature resistance of the PET. The process is called heat-setting. It can be used to produce PET bottles that can withstand hot filling. The degree of heat-setting may be controlled to yield different levels of heat stability. Unfortunately heat-setting adds significantly to the bottle cost.

Standard PET containers blown in cold moulds may withstand filling at up to 60 °C. Partial heat-setting may be applied by using heated moulds. The amount of heat that can be applied is limited and the blowing process is slowed down considerably. Bottles produced with partial heat-setting may withstand filling to about 75 °C. The hot fill temperature achieved will depend on the process, the bottle weight and the filling procedure.

To achieve an 80 to 85 °C resistance, a purpose-built blow moulder with a second set of blow moulds is required. There are a number of commercially available processes. Essentially, the bottles are first blown in heated moulds and then transferred to cooled moulds where they are stabilised to final dimensions. Capital costs are obviously significantly higher than for standard blow moulding.

In both these processes, only the body of the bottle is heat set. The neck remains amorphous and is therefore liable to distort at high temperatures. There are two options to avoid neck distortion. The necks may be made very thick and the filled containers cooled as soon as possible after filling. Alternatively the preform neck may be crystallised in a separate operation before blowing. Neck crystallisation processes are covered by patents. They involve heating only the neck in a mould to a temperature high enough to induce crystallisation. The optimum crystallisation depends on the particular grade of PET but could be as high as 160 °C. In the process the necks become opaque white. This is a distinguishing feature of this type of container.

It is possible to produce PET bottles capable of withstanding fill temperatures in excess of 95 °C with a special blowing process. Neck crystallisation is essential. A blow/shrink/blow process is used. The first blow step is a conventional PET bottle blowing operation using oversized moulds. The oversized bottle is then passed through a crystallising oven where it shrinks to smaller than the required size. Crystallisation takes place and stresses are relaxed. The mouldings are then transported to a second blowing machine where they are re-blown and cooled to form the final container.

It is clear that all heat setting adds substantially to the container cost both in terms of reduced output per mould and with increased investment cost. Modified PET resins with improved heat resistance and improved crystallisation properties are under development.

### 2.6.3 Multilayer Barrier Bottles (175)

PET bottles have moderate gas barrier properties, but they are not sufficient for packing oxygen sensitive food products. Driven by the huge potential for a successful PET beer bottle, extensive development work has been focussed on producing multilayer PET bottles. This has had some technical success, but the jury is still out on the commercial success. This ability to produce high barrier bottles, together with heat-setting, or aseptic filling technology must have spin-offs for other critical food packaging applications.

Having said that, the heart of barrier PET bottle technology lies not in the blow moulding process, but
in multilayer preform injection moulding, as discussed in Section 2.3.2.1. Barrier properties can also be achieved by coating monolayer PET bottles. This is discussed in Section 5.

2.6.4 ISBM Polypropylene Containers

Much has been said about PET ISBM bottles. The process has also been successfully applied to polypropylene (PP). Stretch-blow moulded clarified PP random copolymers can produce tough containers that almost rival PET in clarity. Their commercial success has been limited by the very high oxygen permeability of PP when compared to PET. Developments in multilayer preform technology need to be applied to polypropylene to widen the scope for ISBM.

3 The Main Polymers Used in Rigid Packaging Applications

Packaging materials need to be low cost and must process efficiently. Plastics packaging is no exception. The bulk of plastic materials used in packaging applications are the large volume commodity plastics. Where special properties, like high gas barrier, are required, specialised materials are in use, but as a minor component in multilayer structures. Today rigid plastics packaging is dominated by high density polyethylene (HDPE) and PET with PET actively gaining market share on many fronts. There is also a lot of activity and development in PP container materials. This section covers the properties of commodity plastics used in rigid packaging, either as monolayer containers, or as the structural layer in multilayer containers. Some more specialised polymers that find niche applications as monolayer containers are included.

Factors to consider when selecting one of the common plastic materials for a particular application are summarised in Table 2. Oxygen permeability and moisture vapour transmission rates of these materials are compared to the high barrier materials in Section 4.

3.1 Polyethylene

3.1.1 High Density Polyethylene (HDPE)

HDPE is widely used to extrusion-blow mould containers for milk, household chemicals, automotive products and large drums for industrial chemicals. Bottles for healthcare products, toiletries and cosmetics may be extrusion- or injection-blow moulded. Thin-walled dairy pots, pails and buckets are injection moulded. HDPE is also used for injection-moulded caps and closures.

HDPE is a low cost material with an excellent balance between stiffness and toughness, over a wide temperature range. In its natural state it is a translucent, milky white material. This can be a drawback in applications where see-through clarity is important. It is easily pigmented and thus is available in a wide range of colours.

HDPE is an excellent moisture barrier and is well suited to packaging moisture sensitive products. It has poor gas barrier properties and is not suitable, in monolayer containers, for oxygen sensitive products. It has good chemical resistance, resists strong acids and alkalis but may swell in hydrocarbon solvents. HDPE containers used for these solvents will gradually lose their contents through permeation. This may cause a partial vacuum to form in the containers, resulting in panelling, or distortion of the container side-walls.

Environmental stress cracking of HDPE can occur in contact with some polar compounds, including detergents. When packaging these products in HDPE a stress-crack resistant grade must be specified and care taken to ensure the container or component is of a stress-free design.

3.1.2 Low Density and Linear Low Density Polyethylene (LDPE and LLDPE)

LDPE and LLDPE are not widely used in rigid packaging. They are more flexible than HDPE and find some application in squeeze bottles. They are also used in flexible snap-on closures and as plugs and inserts for bottles.

The low density polyethylene family of polymers has been extended to include very low density and ultra low density polymers (VLDPE and ULDPE). The use of metallocene and other advanced polymerisation catalysts has resulted in soft, flexible and elastic polyethylene based materials. Potential applications for these materials in rigid packaging include closure liners and soft-touch surface applications. They are also being evaluated as impact modifiers for polypropylene.
<table>
<thead>
<tr>
<th></th>
<th>LDPE</th>
<th>HDPE</th>
<th>PP</th>
<th>PVC</th>
<th>PET</th>
<th>PS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food approval</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Approximate hot fill temperature</td>
<td>80 °C</td>
<td>95 °C</td>
<td>120 °C</td>
<td>50 to 65 °C depending on type</td>
<td>60 °C standard, 85 °C partial heat-set, 95+ °C full heat-set</td>
<td>60 to 95 °C depending on type</td>
</tr>
<tr>
<td>Oxygen barrier</td>
<td>Very poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Moderate to good</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Moisture barrier</td>
<td>Good</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Poor</td>
</tr>
<tr>
<td>Impact strength</td>
<td>Excellent</td>
<td>Good</td>
<td>Poor to good depending on grade</td>
<td>Poor to good depending on grade</td>
<td>Excellent</td>
<td>Poor to moderate depending on grade</td>
</tr>
<tr>
<td>Clarity</td>
<td>Moderate</td>
<td>Poor</td>
<td>Poor to good depending on grade</td>
<td>Good</td>
<td>Excellent</td>
<td>Poor to excellent depending on grade</td>
</tr>
<tr>
<td>Main applications</td>
<td>Soft caps</td>
<td>Bottles, caps and closures</td>
<td>Pots and tubs, screw caps, hinged caps, some bottles</td>
<td>Bottles</td>
<td>Carbonated beverage and other bottles</td>
<td>Yoghurt and cheese pots</td>
</tr>
<tr>
<td>Moulding processes</td>
<td>Injection moulding, extrusion-blow moulding</td>
<td>Injection moulding, extrusion-blow moulding</td>
<td>Injection moulding, extrusion-blow moulding, thermoforming</td>
<td>Extrusion-blow moulding, thermoforming</td>
<td>Stretch-blow moulding, thermoforming</td>
<td>Injection moulding, thermoforming</td>
</tr>
</tbody>
</table>
### 3.2 Polypropylene (PP)

Generally, PP has similar chemical resistance and gas and moisture vapour barrier properties to HDPE. Physical properties can be varied widely through copolymerisation.

#### 3.2.1 PP Homopolymer

PP homopolymer is a rigid, hard material with relatively poor impact strength. It is fairly clear with a good surface gloss and resists boiling water. It is used for both injection moulded and thermoformed thin-walled pots and tubs. It has good hinge strength and is therefore widely used for flip-top screw caps and hinged container lids. Another common application is in injection moulded tablet containers.

#### 3.2.2 PP Block Copolymer

PP block copolymer is considerably tougher than homopolymer. It commonly contains ethylene as co-monomer. The higher the ethylene content the tougher the polymer. It finds similar applications to the homopolymer but with greater toughness. This makes it suitable for containers for refrigerated or frozen products. PP block copolymers are sometimes also referred to as impact copolymers or heterophasic copolymers.

#### 3.2.3 Random Copolymers

Random copolymers, usually with ethylene, are being used increasingly in rigid plastics packaging applications. They have better impact strength than PP homopolymer but are still brittle below 10 °C. Developments in clarifying or nucleating agents for PP have resulted in random copolymers with exceptional clarity. This has led to them being used in clear injection moulded pots, tubs and buckets. There is growing use of these materials to produce clear tubs and punnets by thermoforming. Environmental pressures on PVC have resulted in a need for an alternative material for clear bottles. PET has met much of this need, but PET cannot be used for bottles with an integral handle. There is thus growing interest in extrusion-blow moulded clarified PP copolymer for PVC bottle replacement. In some instances this may require co-extrusion to match the barrier properties of PVC. A big plus for PP is that it can be hot filled. Indeed PP random copolymers have been used in multilayer, coextrusion-blow moulded ketchup bottles for many years.

Developments in catalyst and polymerisation technology are also broadening the range of polypropylenes available and improving efficiencies. We can look forward to improved processability as well as a range of new copolymers with unique properties.

### 3.3 Polyesters

#### 3.3.1 Polyethylene Terephthalate (PET)

PET is best known in the form of stretch-blow moulded carbonated soft drinks bottles. PET bottles and jars are also used for cosmetics, toiletries, mineral water, refrigerated fruit juices and foods such as edible oils, peanut butter and condiments. Thermoformed PET is used in clear trays and heat resistant food containers. Compared to other commodity plastics, PET has good gas barrier properties but is not considered a high gas barrier polymer. For packaging products that are very sensitive to oxidation, the use of multilayer structures or barrier coating is required.

PET has the unusual ability to exist in a completely amorphous, glassy state, or in a highly crystalline state. When cooled rapidly from molten, it solidifies into a clear amorphous material. If allowed to cool slowly, the polymer molecules form into an ordered crystalline state. The amorphous material is virtually glass clear with a glass transition point of about 80 °C (depending on the grade). When heated above this temperature, it becomes soft and pliable. As it is further heated, it reaches its crystallisation temperature. As it crystallises, it becomes hard and opaque white. Crystalline PET melts at about 255 °C.

The rate and temperature at which PET crystallises can be modified. Crystallisation can be retarded by copolymerisation or enhanced by the addition of traces of a nucleating agent.

#### 3.3.1.1 Oriented PET

When amorphous PET is stretched on heating to above its glass transition but below the crystallisation temperature, the tangled amorphous molecules become orientated in the direction of stretching. This dramatically increases the strength in the direction of stretch. In the stretch-blow moulding process the
amorphous preform is stretched in both the length and the width. This results in longitudinal and hoop orientation. We refer to this as biaxial orientation. It is the ability to be formed into a biaxially oriented structure that gives stretch-blow moulded PET bottles their exceptional strength and resistance to creep and that makes PET suitable for its main rigid packaging use, the carbonated soft drink bottle. The highly stretched state of the PET molecules resists further stretching under the pressure of carbonation.

If the biaxially oriented PET is held in its oriented state and further heated to its crystallisation temperature, small crystallites form between the oriented PET molecules, tying them together. The crystallites formed in orientation crystallisation are small enough not to interfere with the clarity of the PET. This is the basis of the heat-setting process that increases the heat resistance of the moulded article.

Since the successful introduction of the carbonated soft drink bottle the use of oriented PET in packaging applications has grown rapidly. Its sparkling clarity, good gas barrier properties and excellent impact strength make it a very useful packaging material. For many years the drinks market consumed most of the PET polymer capacity and development activity, inhibiting the use of PET bottles for other applications. Today it is seen in many clear bottle applications and has replaced many PVC bottle applications. Cooking oils, mineral waters, household detergents and beauty products have all been packaged in PET containers. PET is now challenging traditional HDPE applications like dairy bottles.

### 3.3.1.2 Amorphous PET (APET)

Although standard bottle grades of PET are used to thermoform amorphous containers (without orientation), crystallinity can occur with thick material or where cooling is slow for other reasons. Crystallisation affects the clarity, strength and dimensions of the moulding. In these cases, a slow crystallising grade of PET may be used. This is usually a PET copolymer where the co-monomer inhibits crystallisation. It remains glass clear but the gas barrier properties are somewhat compromised by including the co-monomer. APET competes with PVC and oriented polystyrene in thermoformed trays and punnets. It is not suitable for hot filling and cannot be heat set. Vordian’s glycol modified PET, referred to as PETG, is also used in extrusion-blow moulding.

### 3.3.1.3 Crystalline PET (CPET)

CPET contains additives that accelerate crystallisation. The main application is for thermoformed ‘dual-ovenable’ food trays. The crystallisation results in a rigid, opaque tray that retains its shape when heated up to 220 °C. these trays are thus suitable for reheating food in both microwave and conventional ovens.

### 3.3.2 Polyethylene Naphthalate (PEN) and PET-Naphthalate Copolymers (421, 439)

PEN is not considered one of the main plastics packaging materials since its relatively high cost has prevented its widespread use in rigid packaging. However, it is a close relation of PET so is included in this section. The gas barrier properties of PEN are 4 to 5 times better than PET. It also has better heat resistance and creep resistance.

PEN was initially seen as the route to the plastic beer bottle. In addition to its low oxygen permeability and heat resistance, it is also a good barrier to UV light, offering critical protection for beer. Unfortunately the high cost of PEN has limited its use to a few returnable, refillable beer bottles. Current commercial packs are the 380 ml Carlsberg and Tuborg refillables in Europe with a 6-month shelf life, and the 1.25 litre Norwegian Magnum beer bottle.

Much development work has been done on PET/naphthalate copolymers in an attempt to find a compromise material. It has been shown that PET can be copolymerised with up to 10 mole % naphthalate and PEN can be copolymerised with up to 10 mole % terephthalate. Low naphthalate PET copolymers are referred to as PETN and high naphthalate copolymers as PENT. Blends of PENT and PETN can give intermediate properties, however the blending technology is complex and is yet to find significant commercial application.

PETN copolymers have found some useful applications. Copolymers with less than 1% naphthalate retain the excellent UV light blocking property of PEN and are being offered commercially as UV screening grades of PET. New grades of PET appearing on the market, offering improved heat resistance and heat-setting properties are based on PETN copolymer technology.
3.4 Styreneic Polymers

3.4.1 Polystyrene

Polystyrene is one of the original rigid plastics. In its unmodified form it is hard and very brittle. It is also glass-clear and commonly (but incorrectly) referred to as crystal polystyrene. Since it is actually an amorphous polymer, it is better to refer to it as general purpose polystyrene (GPPS). Rigid packaging applications are generally confined to thick, high gloss injection moulded components for cosmetic applications. Jar closures, lip-stick applicator covers and decorative screw caps are applications that come to mind.

Rubbery impact modifiers added to polystyrene can greatly increase the toughness. This also turns it milky and reduces gloss. These grades are sometimes referred to as TPS (toughened polystyrene) or HIPS (high impact polystyrene). Their high rigidity and ease of processing resulted in wide use of toughened PS in rigid packaging. The most common uses are in thermoformed and injection moulded dairy pots and tubs. Grades with very high levels of modifier have found use as ice cream containers. Polystyrene is susceptible to stress-cracking in the presence of fats and oils and this has prevented its use in tubs for yellow fats such as margarine. Relatively poor gas barrier properties are also a limitation.

Polystyrene has seen increased competition from polypropylene in many applications. This has come about as the relative cost of PP has reduced and as the processability of PP has improved, through the development of thermoforming and thin-wall injection moulding techniques specifically for PP.

3.4.2 Butadiene-Styrene Copolymers (BDS)

Clear, tough materials can be produced by copolymerising styrene with butadiene. Increased levels of butadiene increase toughness. These materials are better known by the trade names K-Resin (from Phillip’s Petroleum) and Styrolux (from BASF) (15, 29). Essentially they are a clear HIPS-like material. To reduce cost, BDS is often blended with GPPS. Injection moulding, extrusion-blow moulding and thermoforming grades are available.

3.4.3 Other Styrenic Copolymers

Styrene-acrylonitrile (SAN) and acrylonitrile-butyadiene-styrene (ABS) are usually considered as engineering materials but have found limited application as rigid packaging. SAN may be used for high gloss, high clarity injection mouldings, mainly for cosmetic applications. ABS thermoforms as easily as HIPS but has better resistance to oils. This has led to special grades of ABS being used for thermoformed margarine tubs. It has been replaced to a large extent by thermoformed and injection moulded polypropylene tubs.

3.5 Polyvinyl Chloride (PVC)

PVC is a very versatile material. Its properties can be altered by the addition of plasticisers and impact modifiers. In its rigid form it contains no plasticisers but impact strength can be tailored to requirements by the addition of impact modifiers. It has moderately good gas barrier properties and has found many packaging applications. Edible oils, mineral water, toiletries, cosmetics, shampoos and household detergents have been packed in PVC bottles. Thermoformed rigid PVC has also been widely used in clear punnets and trays.

Recent environmental pressures against the use of PVC have resulted in it being replaced in many packaging applications by alternative materials. PET is a natural alternative because of its high clarity. Where no oxygen barrier is needed, clarified polypropylene copolymers can be a substitute, sacrificing some sparkle and clarity.

3.6 Polyacrylonitrile (PAN) (107, 305)

Blow moulding grades of PAN were developed in the 1970s in an attempt to find a polymer with low gas permeability and the physical properties required to package carbonated soft drinks. PAN succeeded in the gas barrier requirements but was overtaken in the race by the development of stretch-blow moulded PET. BP Chemicals’ Barex PAN copolymer is today used in some niche applications as a result of its good gas barrier properties and excellent chemical resistance. Some fruit juice bottles have appeared on the shelves and Barex has been used for products like correcting fluid, which contain difficult to pack solvents.
3.7 Identification of Polymers for Recycling

To assist in sorting plastic containers for recycling, manufacturers often emboss a polymer identification symbol under the base of the container. These symbols were first recommended by the Society of the Plastics Industry Inc. (SPI) in the USA, but have been adopted widely throughout the world. The use of the symbols is voluntary and it must be stressed that the purpose is to identify the polymer used. They are not a claim for recyclability. Whether a particular container or material can be effectively recycled or not, depends on local conditions.

Figure 7 illustrates the identification symbols used almost universally. ‘1. PET’ is the most common symbol used for polyester bottles, however in the USA the abbreviation ‘PETE’ is used to avoid a trademark infringement. ‘7. Other’ is often used on multilayer containers. Where it has been demonstrated that the minor components in a multilayer container have no adverse effect when the containers are recycled together with monolayer containers made from the same main polymer, the symbol for the main polymer is used.

The increasing use of automatic identification systems in plastic container recovery plants is likely to reduce the need for these symbols.

4.1 Polyamide Barrier Polymers (61)

Although nylon 6 and nylon 66 are widely used as a gas barrier layer in flexible packaging applications, they are not the most effective high barrier polymers. The gas permeability of these nylons also increases at high humidity. They are not often used as a gas barrier layer in rigid applications. The good chemical resistance makes nylons suitable as a solvent barrier layer. Both nylon 6 and nylon 66 are used in multilayer HDPE bottles for agricultural chemicals and other solvent based products. The nylon layer is then used in direct contact with the packed contents.

MXD6 nylon is a close relation to nylon 6, but through the use of different monomers, the polymer chain is modified to reduce the tendency to crystallise. MXD6 is classed as a semi-crystalline nylon. It has excellent gas barrier properties and is not as sensitive to humidity as nylon 6. It has found application as a gas barrier layer in multilayer PET bottles. It has better adhesion to PET than EVOH and is reported to be more resistant to delamination.

Amorphous nylon, as its name suggests, does not crystallise. It has good gas barrier properties. In contrast to nylon 6, the barrier improves with increasing relative...
humidity. It has found application in multilayer bottles where an improved oxygen barrier is needed. When used in direct contact with fruit juices packed in a HDPE/adhesive/nylon bottle container it is reported to prevent flavour scalping, or the preferential absorption of flavour components by the polyethylene.

<table>
<thead>
<tr>
<th>Material</th>
<th>Oxygen permeability (cm³.mm/m².day.atm at 23 °C)</th>
<th>Moisture vapour transmission rate (MVTR) (g.mm/m².day at 95% relative humidity (RH))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amorphous PET</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Oriented PET bottle grade</td>
<td>1.8 to 2.1</td>
<td>1.5</td>
</tr>
<tr>
<td>PEN</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>PETG</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Rigid PVC bottle grade</td>
<td>3 to 4</td>
<td>0.8 to 1.1</td>
</tr>
<tr>
<td>HDPE - 0.96 density</td>
<td>42</td>
<td>0.08</td>
</tr>
<tr>
<td>LDPE - 0.92 density</td>
<td>184</td>
<td>0.2</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>38 to 58</td>
<td>0.08 to 0.11</td>
</tr>
<tr>
<td>ABS</td>
<td>42</td>
<td>4.2</td>
</tr>
<tr>
<td>Polystyrene</td>
<td>172</td>
<td>4.2</td>
</tr>
<tr>
<td>PAN - Barex</td>
<td>0.4</td>
<td>2</td>
</tr>
<tr>
<td>MXD6 Nylon</td>
<td>0.1</td>
<td>0.57</td>
</tr>
<tr>
<td>Amorphous nylon – 0% RH</td>
<td>0.75</td>
<td>0.27</td>
</tr>
<tr>
<td>Amorphous nylon – 100% RH</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Nylon 6 &amp; 66 - dry</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Nylon 6 &amp; 66 - wet</td>
<td>2.7</td>
<td>2 to 4</td>
</tr>
<tr>
<td>EVOH (32-mole % ethylene) - dry</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>EVOH (32-mole % ethylene) - 50% RH</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>EVOH (32-mole % ethylene) - 100% RH</td>
<td>0.4</td>
<td>2.3 to 2.7</td>
</tr>
<tr>
<td>EVOH (44-mole % ethylene) - dry</td>
<td>0.04 to 0.08</td>
<td></td>
</tr>
<tr>
<td>EVOH (44-mole % ethylene) - 50% RH</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>EVOH (44-mole % ethylene) - 100% RH</td>
<td>0.8</td>
<td>1.5 to 2</td>
</tr>
<tr>
<td>Blox 0000 Thermoplastic epoxy</td>
<td>0.3</td>
<td>1.47</td>
</tr>
<tr>
<td>Blox 4000 Thermoplastic epoxy</td>
<td>0.04</td>
<td>1.52</td>
</tr>
</tbody>
</table>

4.2 Ethylene-Vinyl Alcohol Copolymer (EVOH)

Pure polyvinyl alcohol has very low oxygen permeability but has no practical application in rigid packaging because it dissolves in water and is difficult
to process. By forming vinyl alcohol copolymers with ethylene the processability and the resistance to moisture improves. The gas permeability also increases with increasing ethylene content. Fortunately EVOH copolymers with between 30% and 50% ethylene have been found to offer good processability while retaining low gas permeability.

The oxygen barrier properties of EVOH are adversely affected by moisture. The higher the ethylene content the less susceptible it is to moisture. Thus, for applications near 100% relative humidity, it is better to use a higher ethylene content copolymer. This is illustrated in Table 3 for two typical commercial grades of EVOH, containing 32-mole % and 44-mole % ethylene.

Because of this effect of moisture on permeability, EVOH is most frequently used in multilayer structures, between layers of high moisture barrier resins like polyethylene or polypropylene. When designing barrier containers with EVOH, consideration must be given to the conditions to which the containers will be subjected, including storage, filling, processing and distribution. This is particularly important for retort processed packs (296).

Figure 8 illustrates the effect of humidity on the oxygen permeability of EVOH. The graph, compiled by Kuraray, refers to the EVOH grades by their trade name EVAL. For comparison, other polymers included in the graph are LDPE, PP in the form of biaxially oriented film (BOPP), oriented PET (OPET) and nylon 6 films (OPA-6), MXD6 nylon, rigid or unplasticised PVC (UPVC), polyvinylidene chloride (PVDC) and polyacrylonitrile (PAN). Permeability is shown as the oxygen gas transmission rate (O₂GTR) through 20 micron thick films.

EVOH is also used in multilayer structures as a solvent barrier. In these applications it is preferable to have the EVOH on the inner layer, in direct contact with the solvent.

In coinjection moulding PET preforms with a PET barrier layer, no adhesive or tie layer is used. Delamination of the barrier layer after bottle blowing can be a problem with EVOH and new grades are under development to enhance the adhesion of EVOH to PET (229).

4.3 Thermoplastic Epoxies

Dow Plastics have recently introduced a new family of thermoplastic epoxy resins, under the trade name of ‘Blox’ (186). They are melt processible by all the common plastic conversion methods. They are intended...
for use in multilayer structures as a gas barrier and are reported to have good adhesion to polar polymers like nylon and polyester.

4.4 Further Development of Barrier Polymers (260)

The wide range of barrier polymers discussed have been able to satisfy all but the most demanding packaging challenges. A cost-effective solution is still needed to allow foods and beverages that are very sensitive to oxygen to be packed in plastic containers. The challenge of the plastic beer bottle (192) has driven developments aimed at reducing the cost and improving the efficiency of barrier resins used in multilayer plastic containers. Tremendous effort is focussed on PET containers, but some of the advancing technologies are applicable to other forms of multilayer rigid plastics packaging.

4.4.1 Nanocomposites (61, 62, 230)

Minute clay filler particles called nanoparticles are being investigated for their potential to reduce gas permeability when incorporated into plastic materials. Due to the very high aspect ratio (surface area-to-width ratio) of these clay platelets, gas molecules permeating through the plastic are forced to follow a tortuous path, thus reducing the rate of permeation. Only a small amount of filler is needed. Since the particles are so small, there is little adverse effect on the colour of the polymer.

Much of the work on nanocomposites has been with polypropylene, aimed at improved structural properties. This is unlikely to result in barrier grades of PP since PP is inherently a poor gas barrier. Nanocomposites based onnylons appear to have had the most success as barrier resins. Honeywell (formerly Allied-Signal) have introduced nano-nylon grades commercially. Work is being undertaken on EVOH nanocomposites, with reduced sensitivity to moisture. PET nanocomposites are also under investigation.

4.4.2 Oxygen Scavengers (247)

Oxygen scavengers are compounds that react preferentially with oxygen, preventing it from oxidising sensitive food products. Most commercial application of these scavengers or oxygen absorbers has been aimed at reducing or eliminating oxygen from the container headspace after filling. Sachets filled with absorbers such as Mitsubishi’s Ageless have been used inside packages in Japan and other eastern countries for a number of years. Oxygen scavengers have been blended into closure lining compounds to remove headspace oxygen from glass beer bottles. While they have been very effective, they do not have the capacity to absorb oxygen permeating through the walls of a plastic container.

To improve the performance of plastic barrier containers, oxygen scavenging compounds are now being incorporated into the bottle walls. There are many different approaches under investigation. Much of the work is proprietary or covered by patent. Details of the various approaches will not be discussed here. There are some factors that need to borne in mind when discussing oxygen-scavenging containers.

Oxygen scavengers do not improve the gas permeability of the material. They reduce oxygen ingress into the container simply by removing the oxygen as it passes through the container wall. They will also react with and remove oxygen from the sealed container headspace. They will not affect the permeation of gasses other than oxygen. The use of a scavenging compound will not, for example, reduce carbonation loss from beverage or beer bottles.

Oxygen scavengers have a finite capacity for oxygen. The container must be designed to contain sufficient scavenger to remain effective beyond the expected shelf life of the product. Some scavengers will be active immediately after moulding and will have a limited life, even when the containers are stored empty. For this reason the most effective scavenger systems incorporate the scavenger within a barrier layer, in a multilayer structure. Other scavengers require a trigger to activate the scavenging process. An ultraviolet light source on the filling line is used as a trigger in at least one system. Other systems require moisture to initiate the scavenging process. In most cases multilayer structures are also required as the scavenger systems have not all been approved for direct contact with foods. These materials require a food contact material as a functional barrier layer between the scavenger and the foodstuff.

Most of the activity relating to oxygen scavengers in rigid packaging has been aimed at PET bottles. Continental PET Technologies (now O-I Plastics) and Crown Constar both have their own scavenging systems for multilayer PET bottles based on MXD6 nylon, with a catalyst added to initiate oxidation. BP Amoco’s Amosorb DFC is a polyester based scavenger that is
FDA approved for direct food contact. It thus has the advantage that it can be used as a blend in monolayer PET containers. Further barrier coating is required if carbon dioxide impermeability is required. Darex, working with Kurary, developed EVOH materials with an internal scavenger, under the trade name, Dareval. Honeywell have nylon-based oxygen scavenging compounds which they claim to tailor to the end-use requirements. They have also extended the use of oxygen scavengers to their nylon nanocomposite materials. Most of the activity with these materials appears to be directed towards multilayer PET, however they may well find application in other rigid and flexible plastic applications (99, 215, 340).

Other scavenging systems initially developed for flexible packaging applications may find application in rigid containers such as multilayer PP or HDPE bottles. These include Chevron Chemicals OSP (oxygen scavenging polymer) (209) and Ciba’s Shelfplus O2 (39).

A number of commercial or semi-commercial products have been mentioned. This is a very active field of development. One can be certain that new materials and technologies will appear, some replacing the current favourites.

5 Other Barrier Enhancement Processes

5.1 Organic Coatings (184)

External organic coatings have not been used extensively for reducing the permeability of plastic containers. In the mid-1980s to early 1990s polyvinylidene chloride (PVDC) flow coatings were applied to 2 litre PET beer bottles in the United Kingdom. Although initially they were successful, they appear to have disappeared from the market place. The coating halved the gas permeability, which was good enough for these large containers with a controlled shelf life. It was not adequate for smaller, single serve bottles.

Organic coatings have also joined in the race for the single-serve PET beer bottle. Both PPG and DuPont have developed PET bottle coating systems. DuPont offer a 2-coat electrostatic spray process. The first coat is a water soluble, high gas barrier layer. A water-resistant protective coating is then sprayed over this. The solubility of the coating is said to assist in recycling. As yet there have been no prominent commercial applications of this technology (184).

PPG’s Bairocade gas barrier coatings are epoxy-amine materials, applied by electrostatic spray. The high barrier grade has been used in the developing PET beer bottle market. Bairocade coatings have also found commercial application in coating small PET bottles for carbonated soft drinks in hot countries where carbonation loss limits shelf life. Graham Container in the USA applies Bairocade as oxygen barrier coatings on PET fruit juice bottles (66, 137, 138, 153, 225).

5.2 Inorganic Vapour Deposited Coatings

Silicon oxide coatings have proved themselves as glass-like barrier coatings for PET film. When the challenge of improving the barrier properties of PET for the beer container arose, silicon oxide treatment seemed to be a natural candidate. In recent years a number of processes have been developed to apply silicon oxides or amorphous carbon barrier coatings to PET bottles. The silicon oxide (SiOx) coatings appear to be virtually glass clear while amorphous carbon coatings have a brownish-yellow tint. They all rely on some form of plasma coating process (250).

Sidel’s Actis process has received much publicity (111, 163, 165, 190, 196, 201, 255). This is a continuous process, applying an amorphous carbon coating to the inside of the bottle. Coating speeds of 10,000 bottles/hour are claimed. It uses acetylene as carbon source. As the coating is inside the bottle it is protected from scuffing and scratching. Although Sidel promoted Actis strongly as a beer bottle coating, they now appear to have realised that it may find other less demanding packaging applications. They now promote a lower level of coating as ‘Actis Lite.’ This may be suitable for products such as fruit juices, and adds less of a tint to the bottle.

The Mitsubishi DLC (diamond-like carbon) (371) coating, developed in conjunction with Kirin Brewery in Japan is an amorphous carbon coating, very similar to Actis. It is also an internal plasma coating process, but uses a hydrocarbon as the source of carbon. A 2000 bottle/hour pilot coater has been demonstrated and a high-speed commercial machine is under development.

The Bestpet silicon oxide coating process was a joint development between the Coca-Cola Company, Krones and Leybold (118). It was initially developed to produce...
small carbonated beverage bottles with improved carbonation retention and is in commercial use in this application. Coating speeds are reported to be 20,000 bottles/hour. The barrier properties have been enhanced to bring it into the beer bottle league. It is a continuous process, applying the silicon oxide to the outside of the container. Recent developments have included the application of an organic spray coating over the silicon oxide to protect it against scuffing and to enhance the barrier properties (2).

Tetrapak’s Glaskin (56) is an internal silicon oxide coating. It is applied in a batch process, using pure silicon as the source of the oxide. Coating speeds are believed to be 18,000 per hour.

All of these processes rely on sophisticated machinery, operating at high vacuum, at high speed. This makes them very expensive. In their favour is that the coatings are extremely thin and raw material costs are low. Until the cost of high gas barrier PET bottles is reduced their use will be limited. Atmospheric plasma coating processes are under development. These do not require high vacuum and may result in lower cost coaters. At present the coating dwell times are very long. This is a major hurdle that will have to be overcome before a commercial atmospheric plasma bottle coater becomes a reality.

5.3 Fluorination of HDPE for Solvent Barrier (84)

High density polyethylene has proved to be a very versatile packaging material but is permeable to hydrocarbon solvents. Co-extrusion with nylon or EVOH to overcome this limitation has been discussed. An alternative solution is to fluorinate the HDPE container.

When an HDPE container is exposed to fluorine in a mixture with an inert gas such as nitrogen, the fluorine reacts with the polyethylene surface, replacing the hydrogen atoms in the polymer chain. This effectively forms a fluoropolymer layer on the surface of the container. It becomes a very effective barrier against the permeation of solvents, particularly hydrocarbons. The layer is really only atoms thick so it has no effect on the physical properties of the container. The material can also be reprocessed or recycled as pure HDPE.

Fluorination can be carried out as a post-moulding secondary batch process, or it can be integrated into the blow moulding process by using the appropriate blend of fluorine and nitrogen to blow the containers. As fluorine is a very reactive and dangerous gas, fluorination is a process that is left to experts in the field.

Batch fluorination is carried out by a specialised service-provider. The mouldings, or containers are stacked in a vacuum chamber. All the air is evacuated and replaced by the fluorine mixture. After a given time, the chamber is again evacuated and flushed to remove all traces of fluorine. The fully fluorinated containers are then removed. Both the inner and outer surfaces are fluorinated.

To fluorinate on-line during the blow moulding operation, the moulder has to have sophisticated gas mixing and handling equipment installed. No gas leakage can be tolerated. The blow moulder is modified to handle the reactive blowing gas mixture. After blowing, the vent gasses must be extracted and passed through a scrubber to remove any traces of unreacted fluorine.

Although it adds significantly to the container cost, fluorinated HDPE containers are quite widely used, particularly with high value products such as concentrated agricultural chemicals.

6 Rigid Plastics in Secondary Packaging

The use of rigid plastics in secondary packaging applications, such as crates and shipping pallets is growing rapidly (235). Timber pallets still dominate their market, but plastics are gradually making inroads. Plastic pallets are more expensive than their wooden counterparts, but are gaining acceptance because of their durability, reusability and their ability to be easily cleaned and sterilised (105). The zero moisture content of plastic pallets is also a significant advantage in many applications. Plastic pallets can be injection moulded or made from thermoformed components. Structural foam moulding techniques have proved successful. Recycled plastics are finding application in pallet moulding. Even mixed PET scrap, blended with proprietary modifiers has been used for moulding pallets (97). Pallet design and material selection is critical, as pallets need to withstand long-term creep.

There is ongoing debate as to whether to use returnable crates to replace shrink-wrap and corrugated cartons in transit packaging (114, 162). There is no single answer, but plastic crates have made significant inroads
into these applications. HDPE is widely used as a
returnable crate material but faces a challenge from
new grades of polypropylene block copolymer (100).
The materials used for reusable crates need to be
adequately stabilised to withstand the rigors of multiple
washings and repeated use. Light stability is also critical
to ensure that the crate does not fail during its life
expectancy. This may be as long as 10 years. Studies
have shown that at the end of their useful life, crates
and pallets may be reground and recycled, providing
that the material is properly restabilised (86, 154, 240).

7 Rigid Plastics Packaging for Non-
Food Applications

The non-food sector covers household chemicals,
automotive products, agricultural and industrial
chemicals as well as health and beauty products and
pharmaceuticals. The use of rigid plastic containers is
well established in this sector. Polyethylene and
polypropylene bottles, tubs and pails are used in most
of these areas. In household chemicals and automotive
products, PVC bottles are being replaced by PET and
in some instances, by clarified polypropylene. Co-
extruded HDPE and fluorinated HDPE containers can
meet the needs of all but the most aggressive
agricultural and industrial chemicals. HDPE drums are
used for a wide range of industrial chemicals (286).

Plastic containers are widely accepted in the health and
beauty market, where container appearance becomes
more important than cost. The mouldability and the
flexibility of design offered by plastics makes them
attractive. Factors such as gloss and clarity are
important in material selection. Newer moulding
techniques such as coinjection moulding are used to
overmould rigid plastic items with soft, rubbery
polymers to produce containers, closures and
components with a soft-touch feel in hand grip areas.

Pharmaceutical and medical packaging provides a
particular challenge to any new materials. The long-
term stability testing required for the approval of any
material to be used for packaging pharmaceuticals
inhibits rapid change. Nevertheless, the high purity and
low levels of low molecular mass extractable
compounds in modern polymers made with
methylene and other modern catalysts must make
them attractive materials in this critical field of
application. The leading pharmaceutical suppliers have
stringent hygiene requirements. Plastics moulding
machine suppliers are working to ensure that their
machines can be run successfully in clean room
production systems (38, 45, 78).

8 Rigid Plastics Packaging for Foods

Food packaging can be very demanding, depending on
the susceptibility of the food to spoilage through
microbiological activity or oxidation. Naturally the
plastics packaging material must be approved for use
in contact with foods. Today most plastics likely to be
considered for food containers will meet the
requirements of the United States Food and Drug
Administration (FDA), or conform to the requirements
of European legislation on food contact materials.

8.1 Fresh and Near-Fresh Foods

Packaging of truly fresh foods places very little demand
on the container, but stringent demands on hygiene,
storage and distribution systems. Typical fresh foods
have a short shelf life and are handled through chilled
distribution channels. In many cases, the food may be
prepared, packed and sold under one roof. Typical
products range from fresh sandwiches to prepared
salads or heat-and-eat meals. The modern consumer’s
desire for freshness and convenience has led to rapid
growth in this area. Foamed polystyrene and clear, solid
wall trays and tubs thermoformed or injection moulded
from styrenic materials, PVC, PET and polypropylene
can be seen in the chill cabinets of our shops and
supermarkets.

The recent surge in popularity of ‘organic foods’ has
resulted in an interest in trays made from biodegradable
or compostable plastics for fresh produce (3, 34).
Modified starch based materials are being used.
Thermoplastic biopolymers are also becoming
available (87) for this application. These are materials
synthesised from renewable resources and include
Cargill-Dow’s polylactic acid (PLA) and degradable
polyesters from DuPont and Eastman (51).

One step away from fresh foods are ‘near-fresh’ foods.
These are foods that appear to be fresh and are as good
as fresh. They rely on controlled or modified
atmosphere packaging systems (CAP or MAP) to give
them an extended shelf life. They are packed with a
very specific gas mixture in the container, to retard
ripening or to prevent microbiological deterioration and
oxidation. The gas mixture is very specific to the
product being packed. Many of these products require
high gas barrier containers such as multilayer thermoformed trays with barrier lidding systems. Form-fill-seal tray and lidding systems are often used, blurring the line between rigid and flexible packaging. Some CAP products such as cut vegetables continue to respire after packing. In contrast to barrier properties, these packs need to have controlled high gas permeation rates. Microperforated lidding or lidding systems with a small patch label with controlled permeability may be used to achieve this.

8.2 Frozen Foods

Frozen foods rely on the low temperatures of the deep freeze to prevent spoilage or oxidation of the food. High barrier co-extrusions are not needed. The main function of the plastic container is to provide physical protection for the packed product. Low temperature impact strength is obviously an important requirement. Rigid plastics found in deep freeze packaging include high impact polystyrene, high density and low density polyethylenes and high impact polypropylene block copolymers.

An interesting product category in frozen foods is the frozen ready-meal. For convenience, the meal needs to be heated to serving temperature in the package. Polypropylene trays are suitable for heating foods in a microwave oven. Crystalline polyester, or CPET trays claim to be ‘dual-ovenable.’ They can be used for heating in the microwave or in a conventional oven.

8.3 Shelf-Stable Foods

Shelf-stable foods do not need refrigeration or heat sterilisation to prevent microbiological spoilage. They are self-preserving by way of their formulation. They include dry products, foods with high oil, salt, acid or sugar content and foods with added preservatives. They are normally filled at ambient temperature, so the choice of plastic material for the container is wide. The nature of the product needs to be considered when selecting the best material. Dry products or products with a high salt content may need a good moisture barrier such as HDPE or PP. Some products such as cooking oils may be moderately oxygen sensitive, requiring a plastic material such as PVC or PET, with relatively low oxygen permeability. Not many products in this category are very susceptible to oxidation, but if necessary PP/EVOH/PP multilayer bottles or jars can be used.

8.4 Processed Foods

The packaging of processed foods probably provides rigid plastic with its greatest challenge. Heat resistance needs to be combined, in many cases, with good oxygen barrier properties. The term ‘processed’ refers to foods that require heat-treatment to ensure that the product is microbiologically stable (223). The amount of heat required depends on the type of food. Some foods need to be hot-filled or filled at ambient temperature and pasteurised in the container. Other products need full retort sterilisation.

Hot filling requires the food product to be heated and then packed and sealed hot. After sealing, the pack is cooled. The heat of the food sterilises the inner surfaces of the package. Depending on the nature of the product, hot-fill temperatures may range from 60 °C to 95 °C. The plastic container and closure must be able to withstand the high temperature during filling and sealing. On cooling, the product inside the container shrinks resulting in a partial vacuum in the sealed pack. The package must either be sufficiently rigid to resist paneling due to this vacuum, or it must be designed to panel in a controllable manner, without distortion. Container design is therefore critical. Polypropylene containers, both mono- and multilayer are the most suitable for hot filling. Heat-set PET may also be used, however PET containers are more prevalent in hot-filled beverage applications (see Section 9.2) than in food products.

Pasteurisation involves filling and sealing the container at ambient or slightly elevated temperature. The entire sealed pack is then heated to the temperature required for sterilisation and held at that temperature for a time. It is then cooled. The temperature and time required depend on the product packed. A typical pasteurisation process would take 15 minutes at 70 °C. Pasteurisation places fewer physical demands on the package than hot filling, since it does not have to cope with paneling on cooling. The container and closure system must obviously withstand the internal pressures that develop within the container during pasteurisation. HDPE and PP containers are used for pasteurised products. One example of a pasteurised rigid plastic container is the multilayer PP sauce bottle. More recent developments with heat resistant and heat-set PET seem set to ensure wider use of PET for pasteurised food containers.

The latter part of the 1980s saw a frenzy of developments in retort processable plastic food containers. This was driven by rapid growth in the use of microwave ovens, the quest for convenience and
on-the-go meals. Shelf-stable (non-refrigerated) ready meals appeared in thermoformed, multilayer PP/EVOH/PP trays with heat-sealed aluminium foil lids. Coinjection moulding was developed to produce PP/EVOH/PP cans such as the ‘Lunch-Bucket’ for meals away from home (441). Heat-set PET also made its mark in retort trays although gas barrier properties were a limitation. Many of these products soon faded from the market place. Perhaps they were introduced before their time, as there now seems to be a renewal of interest in the ‘home meal replacement’ market (41).

Even though the retortable ‘plastic can’ has not yet been a resounding success in the market place, all this development has demonstrated that rigid plastics can meet the most demanding packaging challenges. Retort processing involves cooking the food in the sealed container. A typical retort temperature is 121 °C. Heating time depends on the nature of the food product and on the shape of the container. Complete sterilisation must be achieved. Underprocessing and inadequate seals can have serious health implications. Rigid plastic containers have shown that they can withstand the high temperature processing while maintaining safe, convenient seals and at the same time, protecting the food from oxidation.

9 Rigid Plastics Packaging for Beverages

The beverage market is very dynamic. New products are challenging the traditional. Established drinks as plain as milk are trying to reposition themselves and find new markets. Packaging has a role to play as new, distinctive packaging is needed to capture the attention of the consumer. There is much competition between metal, glass and plastic packaging. Rigid plastics compete against flexible packaging. PET, PP and HDPE vie with each other for new positions. As far as container types are concerned, bottles, with or without handles are the only real rigid plastics contender in this market.

9.1 Carbonated Soft Drinks Bottles

Carbonated beverage packaging in plastic containers is the sole domain of PET. A container for carbonated soft drinks must be able to withstand the high pressures resulting from the carbonation and must retain the carbonation in the drink. It must do this at minimum cost. Injection-stretch blow moulded PET provides sufficient gas barrier to minimise carbonation loss through permeation. The stretch-blow process ensures that the container has the necessary creep resistance.

The PET beverage bottle’s initial success was in 1.5 litre and larger bottles. Carbonation loss prevented the use of smaller PET containers. As preform design improved, ISBM moulding technology advanced and PET grades were refined, bottle properties improved sufficiently to permit the use of smaller containers in mild climates (302). Permeation loss remains a problem in tropical areas. Multilayer PET technology and silicon oxide coatings are being used to overcome these losses.

9.2 Beer Bottles

In recent years, the plastic beer bottle has dominated development activity in the plastics packaging arena. Beer is extremely sensitive to oxygen. It is also affected by light. Many beers are pasteurised in the bottle. Pasteurisation temperatures are moderate, below 70 °C, but the combination of temperature and carbonation pressure places enormous demands on a plastic material.

The oxygen sensitivity has been addressed by developments in coinjection moulding (see Section 2.3.2.1) combined with many barrier material and oxygen scavenger options (Section 4), as well as other external and internal barrier coating options. Light protection is available from suitable pigments, combined with UV absorbing polymers or additives. A number of companies claim to have overcome the pasteurisation hurdle using proprietary processes. These presumably involve the newer heat-resistant low naphthalate PET copolymers and heat-setting techniques (158).

The vision of a plastic beer bottle has spawned so many PET bottle developments and barrier options that it has led to some confusion in the market place. Many potential users of PET barrier bottles appear to be standing back, afraid to choose the wrong technology. Time will tell which barrier technologies become commercial successes. These developments have opened many opportunities to pack other oxygen sensitive or pasteurised products in PET containers.
9.3 Still or Non-Carbonated Beverages

Many of the non-carbonated drinks should really be classed as liquid foods. As with foods, (discussed in Section 8), depending on the nature of the product, they may require refrigerated storage and distribution. They may be shelf stable or may require heat processing to ensure stability. Aseptic packaging is an alternative to hot filling of some beverages. The liquid is sterilised before filling. It is then filled into pre-sterilised containers and sealed, all under controlled sterile conditions (223).

Fresh milk, drinking yoghurts and fruit juices are cold filled and distributed under refrigeration. Shelf life is short. Traditionally, HDPE has been used. PET is now challenging HDPE (217), particularly in fruit juices and dairy products with a premium image. PP is also a candidate, although its poorer impact strength at low temperatures is a disadvantage. Container decoration is playing a role in improving the shelf-presence. Colourfully printed, full height, contour-hugging shrink sleeves are being widely used.

Water, fruit squashes, concentrates and some sports drinks containing preservatives are cold filled. Providing that good hygiene is practised during filling, these products are shelf stable. PVC and PET bottles are widely used for clarity and sparkle. HDPE and PP bottles are also found in applications that do not need oxygen barrier. Extrusion-blown HDPE containers with integral handles are widely used for larger water bottles.

Fruit juices and sports drinks without any preservatives need to be hot filled to provide a shelf stable pack. These products are currently packed in heat-set PET bottles. Vacuum relief panels are characteristic of these hot filled bottles. Normally hidden below the label, they compensate for the product shrinkage on cooling, after hot filling, avoiding panelling and distortion of the bottle. Many fruit juices, particularly in single-serve size bottles, require protection from oxidation. This has limited the opportunities for plastic packaging. However single-serve fruit juices are available in epoxy-amine coated PET bottles (199, 206). Other PET barrier options such as multilayer bottles and plasma coated bottles are also possibilities.

Long-life milk is most commonly packed in foil-lined paperboard cartons. The milk is UHT sterilised and aseptically packed. However, UHT milk is also aseptically filled into HDPE bottles. These bottles may be moulded on a purpose-built sterile blow-moulder that blows the bottles with sterile air and immediately seals them. On entering the sterile filler, the external surface of the sealed bottle is then chemically sterilised, the bottle trimmed, filled and sealed. Alternatively bottles may be blown on a conventional blow moulder, but the bottle then needs to be fully sterilised chemically prior to filling. As milk can develop off-tastes as a result of long-term exposure to visible light, HDPE bottles for long-life milk are usually multilayer co-extrusions. They consist of a virgin HDPE white outer skin, a layer of mixed regrind, a black pigmented HDPE light barrier layer and a white virgin HDPE layer in contact with the milk.

As an alternative to aseptic filling, milk, and particularly flavoured milk drinks are sometimes conventionally filled and sealed in HDPE containers. The sealed containers are then heat-processed at between 115 °C and 120 °C, in a retort or hydrostatic tower to sterilise the pack.

10 Food and Beverage Packaging
Developments

Recent trends in food and beverage packaging are influencing the way in which rigid plastic packs are manufactured and used. This is likely to be ongoing as food processing technology continues to evolve. New methods of food processing are likely to bring more opportunities for plastics.

10.1 Integration of Blowing and Filling Operations

In recent years there has been a movement to bring container manufacturing and filling closer together. The so-called hole-in-the-wall dairy bottle operations are a good example (89). Two-stage PET stretch-blow moulding has de-skilled the bottle blowing part of this operation making it very attractive for the filler to buy PET preforms and to blow his own bottles on-site. This has been taken a step further as the manufacturers of the blowing machines have become involved in the manufacture of filling equipment and vice versa. The result is that bottle moulders can now be directly linked as an integrated blow/fill/seal line (218, 224). This is likely to improve bottle hygiene and will be particularly important in the advancement of aseptic processing.

10.2 Aseptic Processing versus Hot-Fill

The move to plastics packaging from other materials has resulted in an increase in the number of aseptic and
hot-filling operations. In some cases, the nature of the product determines which process should be used. Aseptic processing is preferred if a product’s taste is likely to be affected by heat, while products containing solid particles are probably better hot filled. There are many products that can be either aseptically or hot filled. To decide on the best option for these products, the total packaging cost needs to be considered.

Hot filling does not require sterile, clean room conditions. Bottles do not have to be sterilised or moulded under sterile conditions. Hot fill bottles have to withstand the high fill temperatures and resist panelling on cooling. As a result, they are usually heavy and there are many design constraints. Heat-set blowing cycles are long, resulting in a 20 to 40% loss of output on the blow moulder.

Aseptic bottles can be blown at standard machine speeds and are lighter. There are fewer constraints on bottle design. The need for bottle sterilisers and specialised aseptic filling machines adds significant costs to the aseptic filling operation. It is anticipated that developments in clean-blowing and more efficient aseptic fillers will see the advance of aseptic filling of plastic bottles.

**10.3 Alternative Processing Techniques**

Non-thermal food pasteurisation techniques under development may have a significant effect on the options available for packaging foods in plastic containers. These favour cold fill options, eliminating the need for heat setting. Full discussion of these techniques is really in the field of the food scientist. The new technologies include pulsed-light sterilisation, ultra high pressure processing and microfiltration (223).

**11 Future Trends**

Technology is already in place for rigid plastics to meet the most demanding packaging challenges. There is potential for greater penetration into packaging applications presently dominated by metal cans and glass. To achieve this, two areas need to be addressed. The marketers need to raise the profile of sophisticated plastic containers to ensure greater public acceptance. The polymer manufacturers, machine builders and plastics converters need to work to improve the efficiency of high performance container manufacturing systems.

High oxygen barrier systems need to become more cost-effective. As demand increases, the cost of barrier polymers should decline. Improvements in barrier effectiveness of the materials may also assist in reducing material costs. Multilayer co-extrusion processes have resulted in efficient manufacturing systems for thermoformed, high barrier containers, but the cost-effectiveness of coinjection systems needs to be improved to see wider use of high barrier PET bottles and jars. PET containers will benefit from improvements in heat-setting technology.

Environmental issues will continue to be of importance in packaging development. New high performance packages will have to demonstrate their environmental acceptability before being widely introduced. Recyclability and the effect on existing collection recycling schemes will have to be considered.

Biopolymers will gradually start to make their presence felt. Production of biopolymers is being scaled up from pilot plants to commercial production units. The relatively high cost and limited availability of these materials will restrict their use to specialised applications. Their use will only make environmental sense where composting facilities are available for disposal.
# Abbreviations and Acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>acrylonitrile-butadiene-styrene</td>
<td>PLA</td>
<td>polylactic acid</td>
</tr>
<tr>
<td>APET</td>
<td>amorphous PET</td>
<td>PP</td>
<td>polypropylene</td>
</tr>
<tr>
<td>BDS</td>
<td>butadiene-styrene copolymer</td>
<td>PS</td>
<td>polystyrene</td>
</tr>
<tr>
<td>BOPP</td>
<td>biaxially oriented polypropylene</td>
<td>PVC</td>
<td>polyvinyl chloride</td>
</tr>
<tr>
<td>CAP</td>
<td>controlled atmosphere packaging</td>
<td>PVDC</td>
<td>polyvinylidene chloride</td>
</tr>
<tr>
<td>CPET</td>
<td>crystallisable grades of PET</td>
<td>RH</td>
<td>relative humidity</td>
</tr>
<tr>
<td>E</td>
<td>ethylene</td>
<td>SAN</td>
<td>styrene-acrylonitrile copolymer</td>
</tr>
<tr>
<td>EBM</td>
<td>extrusion blow moulding</td>
<td>SPI</td>
<td>Society of the Plastics Industry Inc.</td>
</tr>
<tr>
<td>EVOH</td>
<td>ethylene-vinyl alcohol copolymer</td>
<td>TF</td>
<td>thermoforming</td>
</tr>
<tr>
<td>FDA</td>
<td>Food and Drug Administration (US)</td>
<td>TPS</td>
<td>toughened polystyrene</td>
</tr>
<tr>
<td>GPPS</td>
<td>general purpose polystyrene</td>
<td>UHT</td>
<td>ultra heat treated</td>
</tr>
<tr>
<td>GTR</td>
<td>gas transmission rate</td>
<td>ULDPE</td>
<td>ultra low density polyethylene</td>
</tr>
<tr>
<td>HDPE</td>
<td>high density polyethylene</td>
<td>UPVC</td>
<td>unplasticised polyvinyl chloride</td>
</tr>
<tr>
<td>HIPS</td>
<td>high impact polystyrene</td>
<td>UV</td>
<td>ultraviolet</td>
</tr>
<tr>
<td>IBM</td>
<td>injection blow moulding</td>
<td>VLDPE</td>
<td>very low density polyethylene</td>
</tr>
<tr>
<td>IM</td>
<td>injection moulding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IML</td>
<td>in-mould labelling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISBM</td>
<td>injection-stretch blow moulding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LDPE</td>
<td>low density polyethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LLDPE</td>
<td>linear low density polyethylene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAP</td>
<td>modified atmosphere packaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MVTR</td>
<td>moisture vapour transmission rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPA-6</td>
<td>oriented nylon 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPET</td>
<td>oriented polyethylene terephthalate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSP</td>
<td>oxygen scavenging polymer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAN</td>
<td>polyacrylonitrile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEN</td>
<td>polyethylene naphthalate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PENT</td>
<td>high naphthalate PET copolymers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PET</td>
<td>polyethylene terephthalate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PETG</td>
<td>glycol modified PET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PETN</td>
<td>low naphthalate PET copolymers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Abstracts from the Polymer Library Database

Item 1
*Modern Plastics International*
32, No.8, Aug.2002, p.49
NEW OPTIONS TRANSFORM HEAT-SET CONTAINERS
Defosse M

Heat-set PETP bottles typically weigh 5-10% more than other bottles due to extra material used for vacuum panels that are located on the sides of bottles. These panels prevent bottles from warping or crumpling from the vacuum created by hot-fill contents. Snapple Beverage has announced it will replace the glass packaging it uses for its iced teas and juice drinks with 20-oz hot-fillable, stretch blow moulded PETP bottles from Graham Packaging. The bottles have a bell-shaped upper profile and feature Graham’s Active Cage vacuum panel technology. An Active Cage panel can be smaller in size and thinner, and allows the frame of the bottle to move or flex while absorbing the hot-fill vacuum. Water bottler Ty Nant of Wales enlisted industrial designer Ross Lovegrove to create what are believed to be the first asymmetric PETP bottles. The bottles have ripple effects and an organic shape.

WORLD
*Accession no.862653*

Item 2
*Modern Plastics International*
32, No.8, Aug.2002, p.39
MULTILAYER-BOTTLE CONCERNS BOOST BARRIER COATING PROSPECTS
Defosse M

Feedback from potential end-users indicates there is still a substantial market for bottles with some form of barrier to protect beverages from microorganisms, oxygen ingress and carbon dioxide ingress, but fading interest in multilayer bottles. Sipa is developing an organic external-coating technique which should eliminate scuffing and scratching, problems associated with external coatings. SIG Coproplast is understood to be working with Schott HiCotec on a plasma coating solution. Meanwhile, stretch blow moulding machine manufacturer Krones says it has, through its Topcoat system, solved the problems (such as pinholes) that appeared with its Bestpet plasma coating lines.

WORLD
*Accession no.862648*

Item 3
*ENDS Report*
No.330, July 2002, p.36
TESCO Follows Sainsbury’s with Biodegradable Packaging

One year after Sainsbury’s introduced biodegradable packaging for its organic range of fresh produce, rival Tesco has followed suit and may extend its use to all fresh produce if it proves successful. The market could grow significantly if the cost of composting in-store food waste falls below that of landfill. Biodegradable packaging and refuse sacks have the advantage of being compostable along with organic household waste or food waste. Tesco’s biodegradable packaging is made from GM-free corn and polylactic acids by Sharp Interpack. Sainsbury’s product is made from potato starch and cellulose fibres and is supplied by Apac and Potatopack.

TESCO STORES LTD.  EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
*Accession no.862635*

Item 4
*Plastics News International*
July 2002, p.13
BREAKTHROUGH IN PET RECYCLING TECHNOLOGY

In co-operation with the Buhler Technology Group, Schmalbach-Lubeca has developed an improved recycling system for the production of new beverage bottles from post-consumer PETP containers. Schmalbach-Lubeca will more than treble the production volume of its recycling plant in Beaune, France from 6,000 to around 20,000 tons annually (about 600 million PETP bottles per year) while significantly reducing production costs. The new recycling system from Buhler, said to be the first of its kind in the world, will be commissioned in Beaune late this year. Details are given.

SCHMALBACH-LUBECA AG; BUHLER TECHNOLOGY GROUP
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; GERMANY; WESTERN EUROPE
*Accession no.860916*

Item 5
*European Plastics News*
HOT AND COLD
Vink D

A description is given of how the thermoforming company, Manifattura Plastica, replaced a steel ice cream container without changing its appearance. The container is a multilayer construction of PS and steel film and is produced by vacuum forming. The company’s plans for expansion are also detailed and some information is given on its other products.

MANIFATTURA PLASTICA
NEW HIGH-FLOW GRADES STACK UP IN PERFORMANCE

Colvin R

Several new impact block copolymer grades of PP, which offer a balance of impact strength, flow and stiffness and are suitable for the manufacture of injection moulded stackable containers, such as pails, buckets and crates, are briefly described. They include Stamylan P612MK10 from DSM, BG373MO from Borealis, Clyrell EC440P from Basell, Eltex PRW265 from BP and PPC10642 from Atofina.

DSM; BOREALIS; BASELL; BP; ATOFINA
USA

GOOD-BYE WOOD, HELLO PLASTIC

Goldsberry C

The impact of new regulations, which will affect the import and export of wood containers and pallets, on the industrial pallet and container moulding industry is considered and the trend away from cardboard and wood containers towards reusable plastics pallets and shipping containers is discussed.

USA

EXTRUSION BLOW MOLDING OF CLARIFIED POLYPROPYLENE RIGID CONTAINERS

Miller T M; Yu T C

ExxonMobil Chemical Co.
(SPE,South Texas Section; SPE,Thermoplastic Materials & Foams Div.; SPE,Polymer Modifiers & Additives Div.; Society of Plastics Engineers)

The results are reported of a study of the effect of commercially available (EXACT) plastomers (metallocene catalysed ethylene/alpha-olefin copolymers) on the drop impact resistance of extrusion blow moulded PP bottles. A comparison is made of the processing conditions of the plastomer/PP blend with those of neat clarified PP and HDPE and the clarity, gloss, top load and drop impact resistance of the bottles are discussed.

5 refs.
USA

NEW PEBBLE DISPENSER HAS SPRING UNIT OF DELRIN

McPherson S; Viehoff D

DuPont Engineering Polymers; Resin Express

A new type of all-in-one packaging/dispenser unit, conceived by Invicta Plastics Ltd. of Leicester (UK) for Cadbury Trebor Bassett's well-loved 'Trebor mints' candy brand, is delighting young consumers with its attractiveness and ease of use. The user-friendly design of the new unit is based around a small door and integrated spring made of Delrin acetal resin. The packaging/dispenser unit, nicknamed the 'pebble' as its rounded form resembles a small, brightly coloured stone, was launched in mid-2001. It provides hygienic, easy and consistent dispensing of the small 'Trebor Mini Soft Mints' that it contains, due to the door and integrated spring of Delrin, which is injection moulded in one part. 'Trebor Mini Soft Mints' is a new range for Cadbury Trebor Bassett, specifically targeted at young children. Delrin was selected for the door and integrated spring because of its excellent stiffness, flex and low friction properties and because the acetal resin is food approved. The 'pebble' was developed by Invicta, a designer and manufacturer of plastic point of sale and promotional products; the company holds a patent on the product. Details are given.

INVICTA PLASTICS LTD
EUROPEAN COMMUNITY; EUROPEAN UNION; UK;
WESTERN EUROPE

References and Abstracts
IN-MOULD DECORATION OF PLASTICS
Love J C; Goodship V
Warwick,University
Edited by: Ward S
(Rapra Technology Ltd.)
Rapra Review Report No. 146

Variations of in-mould decorating are reviewed, for the production of fully or partially decorated components straight from a variety of moulding processes. Such techniques can produce primers, labelling, graphics, natural patterns and automotive-style paint finishes, and are widely used in many packaging and automotive applications. Chosen techniques can involve the use of a film, powder, granules or liquid paint, and the lack of reliance on traditional paint shops is claimed to provide a selection of cost, space, processing time and environmental benefits. In-mould film technologies, injection-in-mould paint, on-mould painting, and in-mould primer technologies are reviewed. 480 refs.

MULTI-MATERIAL INJECTION MOULDING
Goodship V; Love J C
Warwick,University
Edited by: Ward S
(Rapra Technology Ltd.)
Rapra Review Report No. 145

A review is presented of multi-material injection moulding processes. Coinjection, bi-injection, and interval injection moulding techniques are discussed, followed by sections on multi-shot moulding (B1) and overmoulding. The selection of materials is discussed, with reference to material bonding properties and general material properties. 387 refs.

Nordcontenitori is asserting its role as a supplier of logistics systems and, together with Whirlpool, is approaching environmental problems with concrete plans. The partnership has developed the Leonardo, a minimal structure made up of 12 profiles of R-PETP, with L-shaped and square sections, which is encased in four corner sections of injection-moulded PP, completed by two sheets of PS and four angled lengths in the same material. The solution allows the packaging to be produced at the same construction stage as the appliance itself.

FOCUS ON MILK AND DAIRY PACKAGING
Plysu and BlowMocan are both companies whose names have been strongly associated over the past 20 years with quality and consistent names supply to the UK dairy market. As with many of its dairy customers, i.e. Dairy Crest, Arla Foods, Express and the Co-ops, size matters and through Nampak’s acquisition of Plysu in late 1999 the two companies have now been integrated and renamed Nampak, to create a credible European market leadership position as a supplier of plastic containers. Nampak’s Liquid Foods Division which serves the UK dairy market currently has four satellite (mother) plants and three in-plants with a fourth under construction, due to be up and running by the end of spring 2003. In total over 4.5 million bottles are produced from these sites each and every day of the year with a complete range of imperial and metric sizes and a variety of neck finishes. Details are also given of recent developments in milk and dairy packaging from Viscose Closures, ITW Autosleeve, Dawson, Tetra Pak, Owens-Illinois Plastics, Rapak and Elopak.

It is explained here that, in March 2000, an explosion and fire at the K-Resin styrene butadiene block copolymer (SBC) plant in Texas, operated by Chevron Phillips, caused a supply crisis in the market. Many customers were forced to switch to other materials. Today, SBC producers...
hope to lure back processors with a surge of new resin capacity, new domestic suppliers, and new grades and applications. This article reports fully on the developments.

KRATON POLYMERS; NOVA CHEMICALS; CHEVRON PHILLIPS CHEMICAL CO.LP; BASF CORP.; ATOFINA PETROCHEMICALS; CHEMICAL MARKET RESOURCES; SHELL CHEMICAL; ASAHI ASIA; BELGIUM; EUROPE-GENERAL; EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; MEXICO; NORTH AMERICA; SOUTH KOREA; WESTERN EUROPE; WORLD
Accession no.855924

Item 16
Macplas International
BLOW MOULDING MACHINERY FOR FOOD CONTAINERS

This detailed article highlights technological developments and innovative applications in the field of blow moulding machines used for the manufacture of food packaging containers. Amongst the new machines drawn to our attention are the new PB4000/D line of extrusion blow moulding machines from Plastimac, the FV 2500 and the FV 5000 from Magic MP, and new solutions devised by Automa for blow moulding food and beverage containers.

PLASTIMAC; MAGIC MP; AUTOMA; SIPA; UNILOY MILACRON; PLASTIBLOW; DRINK CUP; MULTIPACK GROUP; SIAPI SRL
EASTERN EUROPE; EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; ITALY; POLAND; USA; WESTERN EUROPE
Accession no.855900

Item 17
Modern Plastics International
32, No.5, May 2002, p.34
BIMODAL BOTTLE GRADES OFFER LIGHT WEIGHT, HIGHER STRENGTH
Defosse M

Compared to standard HDPE, bottles moulded with bimodal PE can be lightweighted with no loss of strength, or feature improved properties at the same weight. Recent catalyst and reactor technology developments have enabled bimodal grade production with improved economics. Polimeri Europa found that its new bimodal grade could yield, from a 40g parison, a 1L bottle with a topload strength of 251 N, greater than that of one produced by unimodal HDPE, and ESCR of the bimodal grade was above 100 h, three times that of some unimodal grades. Equistar officials note that with its bimodal grade, processors can increase the amount of post-consumer recyclate in each bottle by up to 25% with virtually no property loss.

WORLD
Accession no.855045

Item 18
Modern Plastics International
32, No.5, May 2002, p.28-9
ASEPTIC AND HOT-FILLING GAIN WITH PACKAGING MARKET SHIFT
Defosse M

Global demand for aseptic and hot-fill plastics packaging has more than doubled in the last three years, according to SIG Corpoplast. Schonwald Consulting says the number of aseptic-fill bottles in Europe should leap from 6.8 billion to over 16 billion by 2006. Almost two-thirds of these are PETP, followed by HDPE and small numbers of PP and PVC. The North American hot-filler container market is about 13 billion units/year. Most packaging consultants contend that hot-filling has higher total packaging cost than aseptic. The disadvantages of aseptic bottling include the need for cleanroom conditions and better-trained employees. Manufacturers of single- and two-stage stretch blow moulding machinery are actively pursuing the heat-set bottle market. Extrusion blow moulding is also being used to make bottles for aseptic and hot-filling.

WORLD
Accession no.855041

Item 19
Plastics News(USA)
PACTIV PAYING 72.5M US DOLLARS FOR WINKLER
Pryweller J

Pactiv plans to buy Winkler Forming, expanding into food containers made from a hotly competitive specialty material. Winkler thermoforms and extrudes plastic sheet from amorphous PETP, a temperature-resistant, clear material suited to maintain its toughness and flexibility over long distances. Pactiv already makes a variety of food-packaging containers, but none from APETP. Sales of APETP containers are growing at a compounded annual rate of 6%, faster than the rate for PS containers and some other materials. Winkler has enough manufacturing capacity to boost its production by 40%, and Pactiv hopes to capitalise on that potential with an aggresive sales force and distribution system. Winkler generated sales of about 50m US dollars for the 12-month period ended March 31. Pactiv recorded sales of 2.81bn US dollars in 2001.

PACTIV CORP.; WINKLER FORMING INC.
USA
Accession no.855021
Item 20
British Plastics and Rubber
April 2002, p.30
SPECIALITY MACHINE FROM SIG FOR POLYCARBONATE WATER COOLER BOTTLES
SIG Blowtec has introduced a new machine to make 20L polycarbonate water cooler bottles as an alternative to blowing them on the BlowTec 2-20 machine. Development of the new machine, the BlowPac 2-10PC, was aided by the work already done to provide the polycarbonate processing capacity for its predecessor, with a special screw and special feed zone geometry. To cut costs, the clamp force has been reduced from 30 to 20 tonnes and a modular design was developed for the machine frame and other load bearing elements which saves money during assembly and transport. Output is 140 bottles/hour.
SIG BLOWTEC
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.853181

Item 21
Packaging Technology & Science
14, No.6, Nov./Dec.2001, p.267-74
INFLUENCE OF ACTIVE PACKAGING ON THE SHELF LIFE OF MINIMALLY PROCESSED FISH PRODUCTS IN A MODIFIED ATMOSPHERE
Franzetti L; Martinoli S; Piergiovanni L; Galli A Milan,University degli Studi
The effectiveness of an innovative foam plastic tray, provided with absorbers for volatile amines and liquids, on the shelf life of different fish products packed under a modified atmosphere (40% CO2:60% N2), is evaluated in comparison with a standard tray. Fillets of sole (Solea solea), steaks of cod (Merluccius merluccius) and whole cuttlefish (Sepia fillouxi), placed in the two different kinds of trays, are kept at 3 deg.C. Microbiological (TBC-, Gram-negative-, H2 S-producing bacteria and lactic acid bacteria) and chemical (surface pH, TMA headspace) analyses are carried out after 3, 7 and 10 days of storage. The new packaging, associated with a rigorous control of storage temperature, increases shelf life up to ten days. In fact, the innovative tray sequestrates the greater part of trimethylamine from the headspace and leads to delayed microbial growth, especially of Gram-negative and H2S-producing bacteria, and in addition it favours the growth of bacterial strains such as Moraxella phenylpiruvica, which are not involved in off-flavouring production (especially H2S), because of their lypolytic activity. 21 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.852845

Item 22
Recycling PET Review
3, No.2, July 2001, p.3
GUIDELINES FOR THE INTRODUCTION OF NEW PET BARRIER BOTTLES
PETP bottle recycling in Europe is reported to have reached a volume of more than 250 Ktpa in the year 2000 and is still expanding. This result greatly contributes to the public and legal acceptance for PETP bottles in Europe and is also beneficial for the entire plastic packaging industry. The PETP bottle industry is facing a crucial period with the introduction of new PETP-based bottles combined with barrier materials, showing exceptional properties. These new bottles will be introduced, allowing to broaden the market access to unprecedented levels. At the same time these new bottles will affect the recycling industry, challenging existing recovery schemes due to the incorporation of new materials mixed with polyester. There is a fundamental interdependence between the new bottle introduction and the recovery challenge. Should the industry fail to demonstrate economically feasible and reliable recovery techniques, the authorities could restrict the market access by legal barriers or economic instruments. Supported by the PETP industry, PETCORE has established guidelines in collaboration with the European national plastic packaging recovery organisations. Details are given.
EUROPE-GENERAL
Accession no.852285

Item 23
Plastics News International
April 2002, p.20
SYSTEM MONITORS PET BOTTLE QUALITY
The features of an innovative on-line wall thickness measurement system, called the Agr TopWave PETWall system, installed by Southeastern Container Inc. to ensure that every bottle produced meets Coca-Cola specifications. The system monitors the wall thickness and material distribution of every container and helps Southeastern Container to achieve consistent bottle quality by detecting shifts or process problems as they occur.
SOUTHEASTERN CONTAINER INC.; COCA-COLA USA
Accession no.852910

Item 24
Plast' 21
No.106, Nov.2001, p.72-3
Spanish
PETP AND BOTTLE BLOW MOULDING: A MARRIAGE OF CONVENIENCE
The use of PETP in blow moulded beverage bottles is discussed with reference to developments aimed at
improving barrier properties, light stability and resistance to high temperatures experienced in hot filling and pasteurisation. The recyclability of PETP bottles is also examined.

EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.851782

Item 25
Macromolecular Materials and Engineering
PAINT SOLVENT PERMEATION RESISTANCE OF POLYETHYLENE, POLYETHYLENE/ POLYAMIDE AND POLYETHYLENE/MODIFIED POLYAMIDE BOTTLES
Yeh J-T; Shih W-H; Huang S-S
Taiwan, National University of Science & Technology
Permeation rates for mixed paint solvents and for the individual constituents of paint solvents through polyethylene (PE) and PE blends with nylon 6 (PA) and nylon 6 blended with ethylene-acrylic acid copolymer (MPA) were determined by weight loss measurements on solvent filled blow moulded bottles. It was found that PE/MPA bottles were by far the most resistant to permeation by white spirits with PE being quite poor. Polar solvents such as alcohols, ethers and ketones permeate almost as slowly through PE as through PE/PA and PE/MPA blends. It was found that permeation rates of mixed solvents through PE could be estimated using a simple mixing rule with regard to summation of the permeation rates of the constituents, but this did not apply to PE/MPA blends where permeation rates of mixed solvents was higher than anticipated from the constituents. From morphological studies of the structure of the blends, the permeation rates appear to be related to structure where elongated and defined laminae are seen in the PE/MPA blend, but less so in the PE/PA blends. 22 refs.
TAIWAN
Accession no.851062

Item 26
Plastics News(USA)
14, No.9, 29th April 2002, p.13
APR URGES AGAINST THE USE OF OPAQUE WHITE PETP
Toloken S
The Association for Postconsumer Plastic Recyclers is advising the packaging industry not to use opaque white PETP bottles because they are difficult to separate from other bottles and can contaminate clear PETP.
US, ASSOCIATION OF POSTCONSUMER PLASTIC RECYCLERS
USA
Accession no.850971

Item 27
Journal of Testing & Evaluation
EFFECT OF AGING OF THE ‘PRODUCT/PACKAGE’ SYSTEM ON THE MECHANICAL PROPERTIES OF PLASTIC PACKAGING
Ayad R; Safa L; Bureau G; Marull S
Reims, University; Laboratoire de Biologie Vegetale
The effect of ageing of four cosmetic formulations on the mechanical properties of plastics packaging was studied. Four thermoplastic materials in the form of bottles were used, i.e. PE, PP, PETP and polyethylene terephthalate glycol copolymer. Bottles were filled with cosmetic formulations and placed in a steam room at 42°C for 15 days, 1 month, 2 months or 3 months. The bottles were periodically emptied and the mechanical properties and performance (tensile tests, compression and under-pressure tests) were studied, as well as the wall thickness, Tg, crystallinity and kinetic sorption by FTIR spectrometry. A significant change of mechanical properties was observed after the sorption of cosmetic components into the materials, the change depending on the type of material (especially for PE and PP) and on the cosmetic formulation. 21 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.850244

Item 28
European Plastics News
29, No.4, April 2002, p.39-40
CLEARING THE WAY FOR PP
Vink D
Sauer Polymertechnik has the ability to make extrusion blow moulded bottles with angled necks and both oval and round cross-sections in the same bottle by control of the material distribution in the parison. Although the company’s production is limited to extrusion blow moulding, it has already prepared to start one-stage injection stretch blow moulding with a machine from Magic. Sauer claims that transparent PP containing Milliken’s Millad 3988 clarifying agent has comparable cycle times with PETP. The company processes 15,000 t/y of plastics made up of around 11,500 tonnes PE, 4,500 tonnes PP and 1000 tonnes PETP. Sauer group turnover reached Euro47.5m in 2001.
SAUER POLYMERTECHNIK
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.849660

Item 29
Plastics News International
March 2002, p.34
WITH NEW SBS, LESS IS MORE
BASF’s recently released third generation SBS offers an increase in toughness that allows less of it to be used in blends with general purpose PS for thermoformed food packaging. With the new Styrolux 3G 55, the amount of SBS used in SBS-rich extrusion blends can be reduced by up to 20% without any adverse effect on the toughness of the blend, it is briefly reported.

**Item 30**

*Plastiques & Elastomeres Magazine*


French

**EVAL BACKS EVOH**

Topuz B

An examination is made of the barrier properties and barrier packaging applications of Exceval AQ and other EVOH grades produced by Eval, a Kuraray subsidiary, with particular reference to PETP beer bottles developed by Darex Container Products using a thin layer of DarEval EVOH to act as a barrier to oxygen and carbon dioxide. The use by Linpac of Eval’s EVOH as a gas and water vapour barrier in trays for the modified atmosphere packaging of meat, fish and fresh foods is also described. Production capacities are presented for Eval’s operations in Belgium, Japan and the USA, and some planned capacity expansions are reported.

**KURARAY; EVAL CO.; EVAL EUROPE; DAREX CONTAINER PRODUCTS**

BELGIUM; EUROPEAN COMMUNITY; EUROPEAN UNION; JAPAN; UK; USA; WESTERN EUROPE

Accession no.849565

**Item 31**

*European Plastics News*

29, No.3, March 2002, p.28

**GLASS OUT, PLASTICS IN**

Vink D

Plastiques Gosselin was founded in 1965 with the aim of replacing glass laboratory products with plastics. The company makes plastics parts in two ways: by aseptic production, with packing of the parts taking place beside the moulding machine; and by dedicated cleanroom production, covering both plastics processing and packaging for petri dishes. The company makes 200 million petri dishes/year in tools up to 16 cavities. Netstal machines are used exclusively for petri dish production. Hesta Graham blow moulding machines are used to produce 100-2,500ml PP and PETP bottles. The latest Gosselin product is the Cut Box, a 0.45L, 360g PP box which incorporates a slider which cuts off the needles from glass and plastic syringes, or opens a recess to store removable needles.

**PLASTIQUES GOSSELIN**

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE

Accession no.847742

**Item 32**

*Medical Device & Diagnostic Industry*

24, No.1, Jan.2002, p.80/8

**FLEXIBILITY AND CUSTOMIZATION EXPAND PACKAGING OPTIONS**

Caraballo W

Multivac Inc.

This article focuses on thermoform-fill-seal technology, which incorporates a wide range of variables that offer manufacturers flexibility in the design and modification of every area in the packaging process. Section headings include: customisation, the process (film unwind and feed, heating and forming, filling, sealing, separation, printing and labelling, and control systems), options (customisation, package shapes, film choices, flexibility, modular designs, variable machine speed, microprocessor controls, space savings, and information processing), limitations, cost, and finally, conclusions.

**DONBAR INDUSTRIES; BECTON DICKINSON; MEDRAD; SAFETY 1ST INC.; ASPEN SURGICAL PRODUCTS INC.**

USA

Accession no.845682

**Item 33**

*Plastics and Rubber Weekly*

26th Jan.2001, p.11

**PETP TAKES OVER PVC’S SWEET TASTING SUCCESS**

Britvic soft drinks’ leading dilutables brand Robinson is underlining PETP’s ongoing penetration of the beverage bottle sector by completing the switch from PVC packaging for its market leading one-litre concentrates. With PETP also in use for the company’s fast growing line-up of youth market drinks, the PETP policy is well advanced. The changeover is necessitating major investment at local blow moulder Alcan Fibrenyle, which is a long-standing key supplier to Robinsons. New Nissei ASB machines will shortly be installed at Fibrenyle’s Becles plant. The new machines will be larger versions of the Nissei ASB PB85/110 - 16/4MS installed recently. With 32 cavity preform capacity and eight blowing stations, the new units will provide double the capacity and will be suited to the high volume production required to meet demand for the Robinsons range.

**ALCAN FIBRENYLE**

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no.844259
WILL CONSUMERS EMBRACE BIOPOLYMERS?
Rosenzweig M
Cargill Dow has started a full scale plant to produce up to 140,000 t/y of its NatureWorks polylactic acid polymers. Novamont recently more than doubled capacity for its starch-based Mater-Bi polyester copolymer to 20,000 t/y. Last year, NatureWorks debuted on a small scale packaging and candy twistwrap films in Japan and thermoformed food containers in Europe. Mater-Bi trash and shopping bags have been out for a couple of years in Europe. The key attraction of biopolymers, and the driver for their current use, is their inherent biodegradability. Packaging is a key potential market. A test funded by Germany’s Federal Ministry of Agriculture aims to assess how the 200,000 people of Kassel, Germany, value biopolymers-based packaging and if they are willing and able to sort them out for composting.

INFLUENCE OF PETP BOTTLE WEIGHT, CLOSURE PERFORMANCE AND FILLING TECHNIQUE ON THE OXYGEN CONTENT OF SOYA COOKING OIL
De Oliveira L M; Sarantopoulos C; Bordin M; Nakandakari Y
Brazil, Institute of Food Technology
The use of PETP bottles for edible oil in Brazil is increasing but there is a trend to reduce bottle weight for economic reasons, which decreases the oxygen barrier of the package. The barrier performance of a 20g PETP bottle for 900ml soya oil, submitted to gas flushing with gaseous N2 and pressurisation with liquid N2, is compared with a 27g PETP conventional bottle. During eight months’ storage at 25 deg.C the internal pressure, dissolved oxygen and oxygen in the headspace are evaluated and do not change significantly. Liquid N2 pressurisation does not improve the efficiency of reducing O2 in the headspace compared to N2 gas flushing. 9 refs.

WHEN DUST IS THE ENEMY
The importance of dust control in the injection moulding of plastics medical components and food and drug packaging containers is discussed, and developments by Arburg and Demag Ergotech in clean room production systems are examined.

OXYGEN ABSORBERS
Rosenweig M
The subject of this article is oxygen absorbers (also called oxygen scavengers), which are used in packaging to
References and Abstracts

protect food from oxygen and thus extend its shelf-life, maintaining the taste, flavour and nutritional value of the foodstuff. Highlighted here are new developments in the field, such as a film with a built-in scavenger from Cryovac Inc. of the USA, “Shelfplus” products from Ciba Specialty Chemicals, and “Oxyguard” from Toyo Seikan Kaisha of Japan.

BRG TOWNSEND; CRYOVAC INC.; CHEVRON PHILLIPS CHEMICAL CO.; US,FOOD & DRUG ADMINISTRATION; CIBA SPECIALTY CHEMICALS; TOYO SEIKAN KAISHA; BP AMOCO
EUROPE-GENERAL; JAPAN; NORTH AMERICA; SWITZERLAND; USA; WESTERN EUROPE
Accession no.838579

Item 40
Plastics News International
Dec. 2001, p.20
PP/TPE OVERMOLDED CD STORAGE CASE ACHIEVES DISTINCTIVE APPEARANCE

Allsop Inc. and GLS, a compounder of thermoplastic elastomers, have created a CD storage case, the CD Sport 10, with a unique appearance and tactile feel, which complements the design and function of the case. The disks are protected from exterior impact by a PP shell onto which a clear thermoplastic elastomer (Versaflex CL-40) is overmoulded in a multi-shot moulding process.

ALLSOP INC.; GLS CORP.
USA
Accession no.837205

Item 41
Canadian Plastics
59, No.11, Nov.2001, p.13-4
PACKAGING UPDATE - THE CONTENDERS
de Fonseka C; Macdonald C

Today, PETP is in high demand for packaging “home meal replacements” and also for hot-fill containers for teas, juices, sauces, etc. This detailed article investigates new developments in resins and technologies which are sparring for a market share in these young and vigorous packaging categories.

SCHMALBACH-LUBECA PLASTIC CONTAINERS USA INC.; GRAHAM PACKAGING CO.; AMCOR PET TECHNOLOGIES; SIDEL; PPG; KRONES AG; BP AMOCO; ZHONG FU INDUSTRIAL GROUP; KORTEC INC.; EASTMAN CHEMICAL CO.; KOSA; BATTENFELD GLOUCESTER; HANSEN BEVERAGE CO.; US,FOOD MARKETING INSTITUTE; CHANTLER PACKAGING; PHILLIPS CANADA; CHINA; USA
Accession no.836828

Item 42
Revue Generale des Caoutchoucs et Plastiques
78, No.794, April 2001, p.29-30
French
PLASTICS IN THE SERVICE OF WATER QUALITY
Taverdet J L
Monnet J.,University

Processes developed by Universite Jean Monnet for the prevention of water contamination are described. These include the microencapsulation of pesticides and fertilisers in polymer membranes for controlled release and protection against rainwater, and surface treatments for PVC bottles designed to limit the migration of plasticisers and other additives into mineral water.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.835458

Item 43
Revista de Plasticos Modernos
81, No.536, Feb.2001, p.236-43
Spanish
ETHYLENE-VINYL ALCOHOL COPOLYMERS AND THEIR APPLICATIONS IN FOOD PACKAGING
Cerrada M L
Instituto de Ciencia y Tecnologia de Polimeros

The gas barrier properties of ethylene-vinyl alcohol copolymers are examined as a function of ethylene and vinyl alcohol content, and their use in combination with other plastics in films, bottles and other containers for food packaging is discussed. Results are presented of a study of the crystal structure of three copolymers having different compositions. 11 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.835448

Item 44
Revista de Plasticos Modernos
81, No.536, Feb.2001, p.221-8
Spanish
HIGH BARRIER POLYMERIC MATERIALS AND STRUCTURES FOR THE PACKAGING OF PERISHABLE FOODS
Gavara R; Catala R
Instituto de Ciencia y Tecnologia de Alimentos

The barrier properties of plastics used in flexible, rigid and semi-rigid food packages are examined and methods used to improve these properties are discussed. These include the use of barrier resins such as PVDC, EVOH and polyamides in laminated structures and the treatment of plastics films with metals or metal oxides. 31 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.835446

© Copyright 2002 Rapra Technology Limited
Item 45
Revista de Plásticos Modernos
81, No.536, Feb.2001, p.164/70
Spanish
CLEAN PRODUCTION WITH INJECTION BLOW MOULDING MACHINES
Jomar Corp.

The clean room production of plastics bottles for the pharmaceutical industry is discussed with reference to the use of machines produced by Jomar. Procedures for the sterilisation and packaging of bottles and aspects of bottle design are examined.
USA
Accession no.835439

Item 46
Plastics and Rubber Weekly
2nd Nov.2001, p.10
144-CAVITY PREFORMS WITH A LOT OF BOTTLE

Both Netstal and Husky exhibited 144-cavity preform moulds on their stands at K. In both cases, the moulds are designed to run in existing 600-tonne preform moulding machines. Both systems are able to make preforms with a maximum neck diameter of 28mm and a weight of up to around 30g. The Netstal moulding system is equipped with a modified handling system allowing an additional cooling cycle to be carried out on the machine. The machine was demonstrated producing a 20.8g preform for a 500ml soft drinks bottle on a 9.8 second cycle time, giving it a 52,000 preform an hour production capability.
NETSTAL AG; HUSKY INJECTION MOLDING SYSTEMS LTD.
CANADA; SWITZERLAND; WESTERN EUROPE
Accession no.834646

Item 47
Plastics and Rubber Weekly
16th Nov.2001, p.12
WISEMAN’S QUICK FIX

Whitehead J

Polybottles produced at Wiseman Dairies’ newly opened plant in Droitwich are decorated with stretch sleeve labels and not the paper labels employed elsewhere in the chain. The glue-free PE labels have been supplied by ITW AutoSleeve on equipment from PCD of France. Droitwich is the fastest milk installation on which PCD has worked, with typical throughputs of 300 bottles a minute. Three machines have been installed. Droitwich’s hole-through-the-wall HDPE bottle facility supplied by Alpla of Austria is almost halfway to completion, with three of the seven planned units now in place. Present output is 250,000 polybottles a day in five sizes.
WISEMAN R.,DAIRIES
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.834631

Item 48
Plastics and Rubber Weekly
26th Oct.2001, p.27
LESS IS MORE WITH STYROLUX

The use of BASF’s Styrolux styrene butadiene block copolymer (SBS) as a component with crystal PS in a tougher, stiffer packaging medium is well established. Now the company has introduced the third generation of Styrolux, which gives a better performance from a lower proportion of Styrolux. BASF points to an improvement of more than 50% in elongation at break for the Styrolux 3G55 extrusion grade. Efficient use of the rubber means blends actually have higher stiffness than conventional blends at a comparable level of toughness, it is claimed.
BASF AG
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.834673

Item 49
Plastics News(USA)
13, No.36, 5th Nov.2001, p.26/34
SPRECKELSEN MCGEOUGH STICKS ITS BOTTLE NECK OUT

Pryweller J

Working to solve the problem of leaking plastic bottles, a British development company has launched a unique process to weld injection moulded necks to blow moulded containers. Spreckelsen McGeough has launched a manufacturing joint venture with a large Australian bottle maker and a technology agreement to work with a European producer. The patented turnkey technology is called Bonded Aluminium Plastic or BAP. At issue is a fundamental mismatch between the extrusion blow moulded container and the injection moulded cap and closure. In the BAP system, aluminium foil is pre-welded to the inside of an injection moulded bottle spout using induction heating. After the blow moulded container is filled, the snap-on neck again is heated and attached to the bottle. A pull ring is placed at the centre of the foil for easy opening and tamper resistance.
SPRECKELSEN MCGEOUGH LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.834635

Item 50
Plastics News(USA)
13, No.36, 5th Nov.2001, p.1/33
AMBER, BARRIER BOTTLES MIGHT DISRUPT RECYCLING

Toloken S
The advances that are letting PETP crack new markets like beer, fruit juices and smaller soft drink bottles, could spell significant trouble for recyclers, according to a new Environmental Protection Agency-funded report. It calls on industry to develop guidelines for testing new products and renews calls for product designers to give more weight to recycling. The report claims that barrier layers and more widespread use of amber bottles will result in significant costs for recyclers. Problems will develop when barrier bottles get to be about 15% of the bottle stream and amber bottles surpass 10%. Barrier layers cause hazing, yellowing or black specks in streams of clear PETP. 

ENVIRONMENTAL PROTECTION AGENCY
USA
Accession no. 834531

Item 51
European Plastics News
28, No.5, May 2001, p.49-50
GREEN PROGRESS
Warmington A

Suppliers of biodegradable plastics continue to report progress in 2001. Novamont believes that the market will grow from 24,000 tonnes in 1999 to 120,000 in 2003, mainly in packaging, compost bags, hygiene goods, disposable food service ware and agriculture. Novamont is doubling its capacity for Mater-Bi starch-based materials to 20,000 t/y this summer. Cargill Dow will bring on 140,000 tonnes of polyactic acid capacity in the US in late 2001. National Starch claims perceived consumer preference is the main reason why renewable materials, like starch and PLA, are expected to remain dominant in the biodegradable plastics market. Polyvinyl alcohol is a material of growing interest in the biodegradable sector because of its solubility in water, which makes it ideal for applications like single-use packaging in certain applications and laundry bags.

WORLD
Accession no. 831400

Item 52
Plastiques Flash
No.316, Feb./March 2001, p.88-90
French
COMPLEMENTARITY OF WELEX AND ITS
Details are given of extrusion/thermoforming lines supplied by Extrudex of France for use in the production of plastics food packaging containers, and which consist of extruders manufactured by Welex and rotary thermoforming machines from ITS. Developments by Welex in its Mark III series of extruders are also reviewed.

EXTRUDEX; ITS; WELEX INC.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; USA; WESTERN EUROPE
Accession no. 831300

Item 53
Modern Plastics International
31, No.9, Sept. 2001, p.47
ROTATING NOZZLES GIVE TUBS AND PAILS ADDED STRENGTH
Mapleston P; Moore S

Wall thicknesses of circular tubs and pails can be cut by 20-30%, reportedly without loss of mechanical properties, thanks to a process co-developed by Demag Ergotech and an Australian mould engineer working for Poranunt in Bangkok. The Orbital Turbulent Injection Process relies on high-speed injection via a special rotating head with multiple slot-type nozzles arranged in two concentric circles. It is claimed flow lengths over 500mm at wall thicknesses of under 1.2mm with a 3 MFI PE can be obtained. Use of multiple nozzles allows lower injection pressures, so parts can be moulded on smaller machines.

DEMAG ERGOTECH GMBH
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no. 829709

Item 54
Dallas, Texas, 6th-10th May, 2001, paper 579
STUDY ON THE BOTTOM DESIGN OF PETALOID CARBONATED PET BOTTLE TO PREVENT BOTTOM CRACK
Min-Young Lyu; Hak Cheol Kim; Hee Cheol Shin; Jae Sik Lee; Sung-Taek Joo; Yong Hwan Kim
Samyang Central Research Institute; Akron, University; Chungnam, National University (SPE)

Cracking in the petaloid-shaped bases of poly(ethylene terephthalate) (PETP) carbonated drink bottles was investigated. The tensile properties of injection moulded PETP samples of different molecular weights were determined, and bottles blown using injection moulded preforms. Cracking was studied by pressurising the bottles and immersing the base in 0.2 wt% NaOH solution. Cracking in commercial bottles of different petaloid shapes was also studied. Stresses in the base were studied by computer simulation using commercial software. Cracking was attributed to material which had not been stretched to the strain hardening point, and occurred in circumferential “valleys”. The maximum stress was reduced by modifying the shape of the base, which also relocated the maximum stress area to the sidewall, which was a safer region. 17 refs.

KOREA; USA
Accession no. 829416

Item 55
Plast’21
No.100, March 2001, p.69-70
Spanish
BLOW MOULDING: THE COMING REVOLUTION

Types of plastics used in blow moulded bottles and other containers are reviewed, and trends in electrical and electromechanical blow moulding machines are examined.

EUROPEAN COMMUNITY; EUROPEAN UNION; JAPAN; SPAIN; WESTERN EUROPE
Accession no.828674

Item 56
International Bottler & Packer
75, No.9, 2001, p.17
PETP CONTAINERS AND BLOW MOULDING MACHINERY

Tetra Pak has announced it is seeking a buyer for its PET Preform and Stretch Blow Moulding machine businesses. This decision is part of the company’s ongoing revision of its plastics strategy. Tetra Pak has also taken the decision to focus its efforts within barrier solutions on Glaskin coated barrier PETP bottles and cease its Sealica preform barrier solution. Tetra Pak has a total annual production of 1.9 billion preforms. However, though successful, PET Preforms is a commodity business and no longer fits within the strategic plans of the company. Similarly, on the SBM side, Tetra Pak remains a small player in this field, focusing on low speed, linear machines.

TETRA PAK LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.828499

Item 57
Asian Plastics News
Sept.2001, p.1-6
BREAKING THE BEER BARRIER

Wong S

Zhuai Zhongfu Industrial Group looks set to become the first beverage packaging producer in China to produce PETP bottles for beer. The company has placed an order for four sets of injection moulding machines for PETP preforms from Husky and blow moulding machines for PETP bottles from Sidel. Production will start in early November of this year and annual output of PETP beer bottles is expected to reach 180 million by the end of 2002. Zhongfu claims to be China’s first beverage packaging producer of PETP bottles, starting production in 1985. The company’s bottles can be used for a variety of applications such as carbonated soft drinks, mineral and distilled water, and hot-filled drinks.

ZHUHAI ZHONGFU INDUSTRIAL GROUP
CHINA
Accession no.828495

Item 58
Plastics and Rubber Asia
16, No.105, Sept. 2001, p.15
BETTER AND PETER

The Contiform stretch blow moulding machines from Krones are described. The Contiform processes preforms for non-returnable bottles with absolute mould-matching for the finished containers, plus multilayer preforms. The company offers three models which cover outputs from 7,200 - 30,000 bph. The design of the machines is described, including recent enhancements such as a lightweight mould carrier and blow nozzle. With BESTPET Plus, the barrier-enhanced silica-treated PETP. Krones can now produce an affordable PETP bottle, which can be used for beer. The company’s URRC process can be used to recycled the containers, brief details of which are given.

KRONE
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.827671

Item 59
Packaging Communique
Aug.2001, p.3
PET MATERIAL OF CHOICE FOR BEER BRANDS

Association of Plastics Mfrs.in Europe

The use of PETP in the European beer packaging market is briefly discussed. The advantages of PETP beer bottles over conventional packaging are mentioned and the recyclability of the bottles is considered.

EUROPE-GENERAL
Accession no.827276

Item 60
Dallas, Texas, 6th-10th May, 2001, paper 477
BLENDS OF STARCH WITH POLY(VINYL ALCOHOL)/ETHYLENE COPOLYMERS FOR USE IN FOAM CONTAINERS

Nobes G A R; Orts W J; Glenn G M; Gray G M; Harper M V
US,Dept.of Agriculture,Agricultural Res.Service (SPE)

Foamed blends of starch with poly(vinyl alcohol-co-ethylene) (PVOH) were evaluated as an alternative to foamed polystyrene for disposable packaging applications. Wheat starch, PVOH, deionised water and plasticiser were mixed and conditioned prior to extrusion using a twin-screw extruder. The prepared blends were characterised by modulated differential scanning calorimetry, X-ray diffraction, and measurement of tensile strength, tensile modulus and elongation at break following ageing for time periods ranging from several
days to several months. The optimum blend composition, based on miscibility, strength, and ageing characteristics was 60-65% starch, 25-30% PVOH, and 5-10% plasticiser. 7 refs.

USA
Accession no.827207

NEW HIGH BARRIER, OXYGEN SCAVENGING POLYAMIDES FOR PACKAGING APPLICATIONS
Socci E P; Akkapeddi M K; Worley D C
Honeywell International Inc. (SPE)
Polyamides based on polyamide-6 (PA-6) and blends of PA-6 with amorphous polyamides for high oxygen barrier food packaging applications are described. The oxygen barrier properties are also enhanced by the addition of a proprietary oxygen scavenging moiety and/or nanoclays. The nanoclay is introduced during polymerisation rather than melt compounding, so giving better barrier properties and lower haze levels. The polyamides are suitable for cast and blown film, and as barrier layers in coextrusion blow moulded bottles and co-injection stretch blow moulded poly(ethylene terephthalate) bottles.

USA
Accession no.827185

STRUCTURE-PROPERTY RELATIONSHIPS IN POLYAMIDE BASED NANOCOMPOSITES
Bagrodia S; Germinario L T; Gilmer J W; Tant M R
Eastman Chemical Co. (SPE)
Nanocomposites were prepared by the addition of small quantities of organo-montmorillonite clay to polyamide, and co-injected with poly(ethylene terephthalate) to form the middle layer in trilayer preforms, which were used to form 500 ml bottles by stretch blow moulding. The nanocomposite middle layer was peeled from the bottles and characterised by wide-angle X-ray diffraction, atomic force microscopy, and transmission and scanning electron microscopy. Whole bottle oxygen transmission rates and sidewall permeabilities were determined. The clay particles exhibited extensive exfoliation and the platelets aligned themselves parallel to the film surface during blow moulding. The clay particles provided a more tortuous path for oxygen diffusion, resulting in a 6-fold increase in barrier properties. 9 refs.

USA
Accession no.826888

FIRMS TOUT PASTEURISABLE PETP BEER BOTTLES
Doba J
A beer bottle having improved barrier properties and oxygen-scavenging material capable of withstanding in-bottle heat pasteurisation has been developed by a US-Chinese partnership between Kortec Inc. and Zhong Fu Industries. The recyclable bottle includes an ethylene-vinyl alcohol copolymer in its manufacture and the barrier-scavenger layer, which provides oxygen protection and CO2 retention, is a polyamide blend.

KORTEC INC.; ZHONG FU INDUSTRIAL GROUP
USA
Accession no.826386

CLARIFIERS SEE THEIR WAY TO BROAD PROCESSING SUCCESS
Defosse M

© Copyright 2002 Rapra Technology Limited
Clarifiers, with demand growing between 7% and 10%/year, are successfully riding the wave of processor demand for transparent packaging in food and beverage containers. Much of that success has been derived from increasing demand for PP, as clarified PP accounts for over 90% of clarifier use. Milliken says clarified PP demand in blow moulding and thermoforming is soaring. Clarified PP is relatively inexpensive, matching HDPE in cost, but offering clarity competitive to that of more expensive PETP, PS or polycarbonate, and hot-filling stability to 100°C, beyond that of PETP and HDPE.

**References and Abstracts**

**Item 66**
**Materie Plastiche ed Elastomeri**
65, Nos.11/12, Nov./Dec.2000, p.826-7
Italian
SINGLE-STAGE BLOW MOULDING PROCESS IDEAL FOR BEER
Comini A
Results are presented of a study by Sipa and Universita di Bologna of the amount of oxygen present in the walls of PETP bottles, and details are given of a process developed by Sipa for the production of PETP bottles with improved oxygen barrier properties for beer and other oxygen sensitive products. The bottles are produced by a single-stage blow moulding process and immediately treated with an external plastics barrier coating.
SIPA; BOLOGNA,UNIVERSITA
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.825560

**Item 67**
**Plast'21**
No.99, Jan./Feb.2001, p.24-6
Spanish
PACKAGING IN THE FOOD SECTOR: A NOURISHING SUCCESS
Applications of plastics in food packaging are examined with particular reference to films and bottles in which barrier properties are of primary importance. Materials developments by a number of companies are reviewed.
SEMO; BAYER AG; GE PLASTICS; MOBIL PLASTICS EUROPE; DU PONT DE NEMOURS E.I.& CO.INC.; ATOFINA; TETRA PAK; DOW PLASTICS; TICONA
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; GERMANY; USA; WESTERN EUROPE
Accession no.825335

**Item 68**
**Revista de Plasticos Modernos**
80, No.533, Nov.2000, p.488-9
Spanish
BOTTLE WITH HIGH TRANSPARENCY AND IMPACT RESISTANCE
Details are given of a propylene copolymer bottle, developed by Dex-Plastomers in collaboration with Henkel and Sauer, in which Exact plastomers are used to improve impact strength without adversely affecting transparency. Technology developed by Dex-Plastomers and DSM Polyethylenes for the production of soft-touch bottles using Exact 8201 plastomer in combination with PE or PP is also examined.
DEX-PLASTOMERS; HENKEL KGAA; SAUER GMBH; EXXON MOBIL CORP.; DSM POLYETHYLENES BV
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; NETHERLANDS; USA; WESTERN EUROPE
Accession no.825296

**Item 69**
**Modern Plastics International**
31, No.7, July 2001, p.34
USA
HIGHER OUTPUT, BETTER PARTS LEAD DEVELOPMENTS IN EXTRUSION BLOW MOLDING
Defosse M
Machinery developments for the extrusion blow moulding of packaging are described. A shift in demand for PETP stretch blow moulded packaging has meant extrusion blow moulders are often competing for share at the commodity end of the market, it is reported. Ways to improve economic performance in this segment is to increase output while keeping material use per container to a minimum. Recent extrusion blow moulding machinery developments are claimed to have focussed on helping processors achieved these aims. Trends in machine design are described, and include wheel machines in both vertical and horizontal formats, shuttle machines and electric drives.
USA
Accession no.824373

**Item 70**
**Packaging Technology & Science**
14, No.3, May/June 2001, p.119-27
PACKAGING MATERIALS FOR FERMENTED MILK: EFFECTS OF MATERIAL CRYSTALLINITY AND POLARITY ON FOOD QUALITY
Jansson S E A; Edsman C J; Gedde U W; Hedenqvist M S
Swedish Packaging Research Institute; Arla Foods Innovation; Sweden,Royal Institute of Technology
The results are reported of an investigation into the effects of material crystallinity and polarity on the quality of fermented milk in pouches. Materials tested included LDPE, HDPE and a laminate of aluminium, PE and oriented PETP. Polarity was evaluated by comparing an
aliphatic polyketone with PE having a similar crystallinity. Measurements were made of whey syneresis, viscosity, Bifidobacteria content, undesired yeast and mould to determine food quality and the carbon dioxide and oxygen contents in the pouches were determined by headspace analysis. 14 refs.
EUROPEAN UNION; SCANDINAVIA; SWEDEN; WESTERN EUROPE
Accession no.824075

Item 71
Molecular Crystals & Liquid Crystals
Vol.354, 2001, p.303-7
MULTILAYER COATINGS PREVENTING STORAGE TANKS FROM LEAKING PETROLEUM PRODUCTS TO THE ENVIRONMENT
Sawicki I
Poznan,S.Czarniecki Military College
Details are given of the use of glass fibre-reinforced saturated polyester to prevent leakage from petrol storage tanks. An additional wall was used in the tank consisting of a two-layer coating made of a double fleece material that is stiffened by the resin and an outer laminate layer made of the GRP. Leakage monitoring was undertaken using a permanent monitor and leakage signalling installation by both wet and dry systems. 3 refs.
EASTERN EUROPE; POLAND
Accession no.823849

Item 72
Plastics Technology
47, No.8, Aug.2001, p.45/8
SEE-THROUGH PLASTIC CANS ENLIVEN PAINT PACKAGING
Leaversuch R
The most striking example of the shift to transparent paint cans in the UK is a 750cc, 55g PETP can being injection stretch blow moulded by RPC Containers in Blackburn, Lancashire. RPC uses technology licensed from PCC Group. The PETP can is being used to package three special-effect, metallic colours launched by Kalon Decorative Products. PCC’s technology enables RPC to blow mould a PETP container with a box rim and drip grooves, all made in a single machine in one step. The breakthrough by PCC and RPC is the incorporation of a lever lid in a PETP can. Meanwhile, RPC is pioneering a second approach to see-through paint cans. The company has long used its own patented technology to injection mould 2.5L and 5L opaque PP cans, which have widely replaced steel ones for water-based paints in the UK.
RPC CONTAINERS LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.823334

Item 73
Plastics Technology
47, No.8, Aug.2001, p.19
WATER-BOTTLE COMPETITION PROMPTS MACHINERY ADVANCES
Demand for returnable 3- to 6-gal polycarbonate water bottles is growing 10%/year in the US and 20%/year in Europe. Three suppliers of extrusion blow moulding machinery for PC bottles are upgrading equipment to improve neck quality. Graham Machinery Group will unveil the model C-30, an upgrade of its B-30 reciprocating-screw system for 1- to 5-gal PC bottles. The C-30 is said to yield PC bottles with scar-free necks that have improved precision and surface flatness. Uniloy Milacron has introduced the RS13500 P/C, a variant of its basic RS3500 reciprocating-screw machine that has been optimised for moulding 3- to 6-gal PC water bottles. SIG Plastics Technologies’ Blow Pac 2-10 PC and 2-20 PC accumulator-head systems are claimed to hold bottle-weight variance to +/-2-3 g vs. +/-10-15 g for reciprocating-screw units.
GRAHAM MACHINERY; UNILOY MILACRON; SIG PLASTICS TECHNOLOGIES
USA
Accession no.823308

Item 74
Plastiques & Elastomeres Magazine
52, No.9, Dec.2000, p.27/30
French
LUXURY AND PLASTICS: THE MARRIAGE IS AFFIRMED
Gouin F
A review is presented of developments in plastics packaging for cosmetics and perfumes featured at the Luxe Pack exhibition, held in Monaco in October 2000.
FUTURA PLASTICS; TECHPACK; MBF PLASTIQUES; DU PONT DE NEMOURS E.I.,& CO.INC.; NIQB-PLASTIQUE; EASTMAN CHEMICAL CO.; AUGROS; AURIPLAST; ARMEP; RAFFIPACK; REXAM; REBOUL; VPI; MT PACKAGING
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; MONACO; USA; WESTERN EUROPE
Accession no.821972

Item 75
Packaging Technology & Science
14, No.2, March/April 2001, p.79-86
STABILITY OF FRUIT JUICE DRINKS IN ASEPTIC PACKAGES
Alves R M V; Sarantopoulos C I G L; Saran E S; Bordin M R
Brazil,Institute of Food Technology

© Copyright 2002 Rapra Technology Limited
Cashew and passion fruit juice drinks were aseptically filled in cartons and in three types of plastic packages (oxygen transmission rates 1.40, 2.96 and 13.74 cc(STP)/sq m/day at 25°C, 75% RH and 1 atm), with nitrogen gas flushing. The carton packs were of LDPE/double layer carton/LDPE/Al foil/LDPE and the plastic films were of LLDPE/ethylene-vinyl alcohol copolymer or LLDPE/PVDC. No adverse effect on product sterility was found, nor were any significant changes in pH and acidity detected during storage at 23 to 27°C. A decrease of the oxygen concentration in the headspace of the cashew juice drink plastic packs was observed, which appeared to be caused by consumption of that gas in oxidation reactions. Passion fruit juice drink proved to be less sensitive to oxygen than cashew, as an increase in oxygen concentration was detected in the headspace of the three plastic packs. 15 refs.

BRAZIL

Accession no.821758

Item 76

Journal of Materials Science
36, No.8, 15th April 2001, p.1891-900

INFLUENCE OF COMPOSITIONS OF MODIFIED BLENDS OF POLYAMIDE/ POLYVINYL ALCOHOL ON THE METHANOL/ GASOLINE FUEL BARRIER PROPERTIES OF POLYETHYLENE/MODIFIED BLENDS OF POLYAMIDE/POLYVINYL ALCOHOL BOTTLES

Yeh J-T; Wang L-H; Chen K-N; Jou W-S
Taiwan, National University of Science & Technology

Details are given of the modification of polyamide, PVAL and their blends through reactive extrusion. Methanol/gasoline fuel permeation resistance of bottles of the modified resins were compared with pure PE. Phenomena were investigated in terms of the melt shear viscosities, chemical structure and morphology of the barrier resins. 21 refs.

CHINA

Accession no.819903

Item 77

British Plastics and Rubber
June 2001, p.4-6

BLOW MOULDING MACHINES ARE A SIGNIFICANT PART OF SINGLE SOURCE SUPPLY IN PACKAGING

SIG Group set up its Plastics division last year with the purchase of Thyssen Krupp Kunststofftechnik, comprising the Kautex, Fischer-Muller and Corpoplast brands of extrusion and injection stretch blow machines. SIG also bought German filling machine manufacturer Hambrla and has opened a mould making division, with the emphasis on PETP bottle moulds. Earlier this year, SIG bought the wet filling part of Italian manufacturer Sasib which makes machines for filling, labelling, palletising and transporting bottles. The R&D focus for the next few years will be on the adoption of electric drive, either as the sole motive power or in combination with hydraulics in larger machines. For PETP injection stretch blow moulding, SIG has two clearly differentiated machine ranges. Corpoplast builds two-stage machines, while the PETtec range are single stage machines.

SIG GROUP; THYSSEN-KRUPP KUNSTSTOFFTECHNIK
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; SWITZERLAND; WESTERN EUROPE

Accession no.819146

Item 78

Packaging Digest
38, No.6, June 2001, p.78/80

LOWER PARTICULATE CONTENT IN HDPE BOTTLES

Abrams B

Captive Plastics needs to produce HDPE bottles for leading drug suppliers that meet stringent cleanliness requirements. The company claims assurance of the lowest bio-burden now possible under Current Good Manufacturing Practices as dictated by Federal requirements is improved by producing injection blow-moulded bottles in a specially designed Class 10,000 equivalent production area. In the totally enclosed area are three 75- and one 50-ton injection/blow moulders.

CAPTIVE PLASTICS INC.
USA

Accession no.819091

Item 79

Packaging Digest
38, No.6, June 2001, p.76

PETP PUSHES POTENT PAIRING

Abrams B

Colgate-Palmolive has introduced its Colgate 2in1 toothpaste/mouthwash combination in a unique PETP 4.6-oz bottle. The injection blow moulded PETP bottle incorporates a tamper-evident touch for its hinged closure, injection moulded in PP. The pressure-sensitive label is printed on a PE film.

COLGATE-PALMOLIVE CO.; DUPONT CO.
USA

Accession no.819090

Item 80

Retail Packaging
4, No.3, May/June 2001, p.8

PET TECHNOLOGIES MAKES IT HAPPEN

Brief details are given on some new containers made by PET Technologies from PETP. These containers are a pill jar for a new range of Chinese and ayurvedic herbal supplements, a 125 ml juice and water container for the
airline industry, a squeezable container for washing-up liquid and a square container for fruit juices, which replaces an HDPE bottle.

PET TECHNOLOGIES LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.818725

Item 81
Packaging Digest
38, No.5, May 2001, p.47/50
PHARMACEUTICAL BLISTER-PACKS INJECT SAVINGS
Hartman L R
Sky Pharmaceuticals’ success with its unusually large, easy-to-dispense-from blister packaging is highlighted. The company thermoforms, fills and seals its large-format packaging using Pentapharm rigid PVC blister films from Kloeckner Pentaplast of America and horizontal thermoform/fill/seat equipment from Kloeckner Medipak. The packaging, which is suitable for various unit-dose generic drugs, vitamins and supplements, is designed to ease customer labour by as much as 75% and save the company as much as 20% in production costs.

SKY PHARMACEUTICALS; KLOCKNER PENTAPLAST; KLOCKNER MEDIPAK USA
Accession no.818719

Item 82
Plastiques & Elastomeres Magazine
52, No.8, Nov.2000, p.8-12
French
RIGID FOOD PACKAGING: EVOLUTION WITHOUT REVOLUTION
Gouin F
Applications of plastics in food packaging containers are examined, and reference is made to developments by a number of packaging manufacturers and materials suppliers.

WORLD
Accession no.818379

Item 83
Packaging Review South Africa
27, No.3, March 2001, p.37
WORLDS FIRST SINGLE-PIECE PETP LEVER-LID PAINT CAN
RPC Containers’ revolutionary one-piece PETP lever-lid paint container has been selected by Kalon Decorative Products for three special effects paints, part of a major new range exclusively developed for independent paint retailers. Kalon is launching the range under its new Johnstone’s No Ordinary Paint brand, marking the first move of this famous trade brand into the retail sector. As part of its one-stop packaging service, RPC is also supplying 2.5-litre and five-litre clear PP containers and 75ml Snap Secure containers (for tester pots). Details are given.

RPC CONTAINERS; CONSOL PLASTICS
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.818097

Item 84
Packaging Review South Africa
27, No.3, March 2001, p.31-2
FLUORINATION-ULTIMATE BARRIER LAYER
One of the three companies making up the Rigid Plastics division of Nampak, Megapak has completed the first phase of a planned R15-million investment programme. This first stage, representing a R5-million investment, has seen the installation of a continuous extrusion blow moulder alongside Fluoro Pack’s plant in Pelindaba. As a result, claims Megapak, where product integrity, extended shelf life and cost-efficient distribution are prerequisites to securing a competitive edge in the market, fluorinated HDPE blow moulded containers offer a commercial and functional alternative to their heavier counterparts, particularly glass and metal containers. Some company information is presented.

MEGAPAK; FLUORO PACK
SOUTH AFRICA
Accession no.818096

Item 85
International Polymer Processing
16, No.1, March 2001, p.72-8
CAUSES OF CRACKS IN PETALOID BOTTOM OF CARBONATED PETP BOTTLES
Lyu M Y; Kim H C; Lee J S; Shin H C; Pae Y
Samyang Central Research Institute; Hannam,University
Petaloid designs in the bottoms of PETP carbonated beverage bottles is widespread. Crack problems exist in the bottoms of the bottles. The causes of such cracking is investigated. The physical properties of material and tensile yield stress variations according to the stretch ratio of PETP are examined. Stretch ratio and strength in the bottoms of blown bottles analysed are analysed. Crack tests to observe crack phenomena are performed. Distributions of effective stress and maximum principal stress are examined by computer simulation to seek the influence of bottle design on cracking. It is concluded that cracking occurs not only due to insufficient strength of PETP but also due to the petaloid design. The stretch ratio in bottle blowing should be higher than strain hardening point of PETP for enhanced mechanical strength. Cracking of PETP bottles occurs due to crazing. 25 refs.

KOREA
Accession no.818037
References and Abstracts

**Item 86**

**Polymer Engineering and Science**  
41, No.5, May 2001, p.771-81  
**RECYCLED AND RESTABILIZED HDPE BOTTLE CRATES: RETENTION OF CRITICAL PROPERTIES AFTER HEAT AGING**  
Kartalis C N; Papaspyrides C D; Pfaendner R; Hoffmann K; Herbst H  
Athens, National Technical University; Ciba Spezialitatenchemie Lampertheim GmbH  

Oven ageing was applied for about 8800 hours in order to evaluate the long-term thermal stability of post-used HDPE material recycled from bottle crates. For recycling, the remelting-restabilisation technique was applied. Crystallinity and melt flow rate were monitored during heat ageing to study the effect of restabilisation. TS and tensile impact strength were followed, together with the time until embrittlement. These data were enriched with microphotographs of the surfaces of the specimens. Repigmentation was used to evaluate the role of new pigments in the final performance of the recycled material. The results obtained showed that restabilisation was essential for improving the long-term thermal stability of the post-cure crate material, allowing its reuse in the original application. 22 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; GREECE; WESTERN EUROPE  
Accession no.817912

**Item 87**  
**Italia Imballaggio**  
No. 5, May 2001, p.124-5  
Italian; English  
**HEATEFORMED BIOPLASTICS, OR RATHER NATURPAKS**  
Biodegradable thermoformed rigid transparent packaging trays and containers for food have been produced by Termoplast. Called NaturPaks, the containers are made from an innovative, plant-derived polylactide which is compostable according to ISO, CEN ASTM, and DIN draft regulations. They can be disposed of together with food for compost waste collection.

TERMOPLAST  
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE  
Accession no.817516

**Item 88**  
**Packaging Review South Africa**  
27, No.4, April 2001, p.37  
**IML: ADVANTAGES OUTWEIGH COSTS**  
The advantages of in-mould labelling plastic packaging containers are discussed. For injection moulded products, the biggest advantages is said to be design, with the in-mould label becoming an integral part of the container, and adding extra levels of consumer security and product protection. Most PP containers are labelled with biaxially oriented PP film, which increases container durability, and provides a stronger structure with higher impact strength and puncture resistance. Since the label adds strength, it is also possible to reduce the wall thickness of the container. The process is briefly outlined.

TRESPAPHAN SA  
SOUTH AFRICA  
Accession no.817049

**Item 89**  
**Plastics and Rubber Weekly**  
1st June 2001, p.14  
**“HOLE THROUGH THE WALL” OPENS UP COMPETITION**  
Whitehead J  

This spring has seen a surge of activity in the “hole through the wall” concept for on-site blow moulding of HDPE bottles for the dairy industry. The HTW approach is a key feature of Robert Wiseman Dairies’ 35m pounds sterling facility at Droitwich and is being used at Arla Foods’ dairy in London. There is now major competition between the big blow moulders supplying this sector, for example Nampak and TetraPak.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE  
Accession no.816828

**Item 90**  
**Plastics and Rubber Weekly**  
1st June 2001, p.10  
**CORALFOAM FINALLY FITS THE BILL**  
Smith C  

Coralfoam founder Peter Clarke will receive the first royalty payments for parts produced using his Coralfoam foam injection moulding technology during Q2 this year, almost six years after launching the process to the plastics industry. Two products are now in commercial production using Clarke’s original CFT1 process, which employs chemical blowing agents and careful control of cooling rates in the moulded part to create selectively foamed areas as the mould opens. Huhtamaki Van Leer is making a foamed lip PP soup cup for New Covent Garden Soup Company. In the US, Coralfoam is being used by a large disposable cutlery manufacturer to produce a spork (a spoon with prongs) for California’s school meals services.

CORALFOAM LTD.  
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE  
Accession no.816825

**Item 91**  
**Packaging Magazine**  
4, No.12, 14th June 2001, p.24
PETP BOOST FOR ASEPTIC FILLING
Pidgeon R

New beverage products and innovative packaging concepts mean that filling technology must combine high efficiency and maximum microbiological safety. Very often the solution is aseptic filling. PETP is giving further impetus to the aseptic filling sector because it can cope with carbonated drinks. However, to achieve successful aseptic PETP filling, specific conditions and requirements have to be fulfilled by machine and process technology: germ free processing of the bottles, caps and the product itself.

MESSE MUENCHEN
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.816762

Item 92
Asian Plastics News
June 2001, p.15
TRANSPORTING WAFERS
Wong S

Yasojima Proceed specialises in using high-performance engineering plastics to manufacture products that are designed to protect and transport critical materials used to manufacture microchips and electronics. Products made from PEEK now account for 25% of the company’s sales revenue. PEEK is mainly used to create wafer carriers, which are designed for the storage and transport of semiconductors during production. Each wafer carrier is made up of eight parts that are welded and bonded together. Yasojima has recently introduced retainer rings, made from PEEK or PPS, which are mounting tools for lapping and polishing wafers.

YASOJIMA PROCEED CO.,LTD.
JAPAN
Accession no.816675

Item 93
Canadian Plastics
59, No.2, Feb.2001, p.19/21
INNOVATIONS ENHANCE BOTTLE OUTPUT, QUALITY
LeGault M

This article reviews the latest innovations in bottle production, highlighting a quick mould change technology, services aimed at reducing design and prototyping time for preforms, a preform programme, a new line of colourable PETP resins, and bottles for hot-filling applications.

SEMOPAC; UNILOY MILACRON; SCHMALBACH-LUBECA PLASTIC CONTAINERS USA; NOVAPAK CORP.; EASTMAN CHEMICAL CO.; FREEDONIA GROUP; HORMEL FOODS
CANADA
Accession no.815746

Item 94
Plastics Additives & Compounding
3, No.3, March 2001, p.30-4
CLARIFYING AGENTS EXTEND SCOPE FOR POLYPROPYLENE IN PACKAGING

Miliken Chemical has developed Millad 3988 clarifying agent, which is claimed to overcome some of the problems relating to the use of PP in packaging applications, in particular, its inherent haziness. The use of clarifying agents in PP result in finished parts with enhanced transparency, clarity and surface gloss, and in addition, faster process cycles and improved physical properties can also be achieved. Millad 3988 is claimed to overcome the limitations of heat stability, and can be processed up to 285 degrees C without plate-out. It is reported to have no organoleptic deficiencies and provides good clarity. Processing considerations are examined with reference to thin wall injection moulding and thermoforming.

MILLIKEN CHEMICAL
EUROPE-GENERAL; USA
Accession no.815472

Item 95
Plast’21
No.96, Oct.2000, p.79-80
Spanish
ASEPTIC BOTTLING LINES: CONTROLLED CONTAMINATION
Nervo G
Procomac SpA

Machinery developed by Procomac for the sterilisation and aseptic filling of plastics beverage bottles is described. Microbial contamination is prevented by covering the sterilisation and filling zones with PVC film or sheet. The advantages of this form of contamination control over the use of clean rooms are discussed.

EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.814811

Item 96
Modern Plastics International
31, No.5, May 2001, p.112
ROLL OUT THE COMPOSITE BEER BARRELS
Defosse M

EML Produktie believes plastics can replace steel kegs for shipping beer from vat to tap. The BB/30 composite barrels developed and manufactured by the company are marketed to brewers for use in export markets. Cost of the barrels is comparable to metal ones and shelf life of beer in the containers is up to six months. Transport costs can be reduced as no return freight must be paid. There are no maintenance and cleaning costs as the BB/30s are designed to be torn apart for recycling or landfilling after use. The bags used to hold the beer are an aluminium-
lined flexible plastic. These bags are encased in extrusion blow moulded HPDE spheres, which are then filament wound with continuous glass fibre.

Item 97
Modern Plastics International
31, No.4, April 2001, p.44
PETP, HDPE CHALLENGE WOOD IN PALLETS
Colvin R
Developments in the use of recyclate are starting to challenge the commanding position of wood in pallets. One such development involves mixed PETP scrap modified with a proprietary additives recipe developed by Remaplan Anlagenbau. When used in a transfer moulding machine designed by the company, pallets can be produced more than twice as fast as most injection moulded HDPE or PP transport pallets, 30 sec vs. 85 sec. Transfer moulding can also save 25% in production costs, the company claims. APME has financed development of two pallet types to meet the polymer industry’s needs. Pallets made from recycled bottle-grade HDPE with a small PP fraction went into production last year.
REMAPLAN ANLAGENBAU GMBH
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.814463

Item 98
Plastics Network
No.14, 2001, p.25-8
PEELING AWAY THE LAYERS
Cornell D
Cornell D.D., Associates LLC
The use of PETP bottles for beer is discussed with reference to the problems of thermal stability, UV and visible light stability, and gas barrier properties. Two methods for improving the barrier properties are described, i.e. addition of layers with better gas-blocking capability than PETP alone and use of oxygen scavengers in one of the layers. Recycling of the bottles is considered.
USA
Accession no.813800

Item 99
Recycling PET Review
3, No.1, April 2001, p.1/4
AMOSORB COPOLYESTER, BEST PACKAGING BY BP
It is reported that PETP can continue to grow and replace more glass, aluminium and steel in the packaging industry by achieving higher performances; the best way is to get there with PET only, without adding other materials. This was the challenge facing Amoco, now BP, when it commenced development of its new Amosorb product family. Market studies show that a special PETP grade that blocks oxygen could be used for packaging oxygen sensitive beverages or food - and would open new markets for PETP: food, beer, juices, etc. Details are given.
AMOCO; BP AMOCO CHEMICALS
EUROPE-GENERAL
Accession no.812848

Item 100
Macplas
25, No.221, Sept. 2000, p.88-90
Italian
DEVELOPMENTS IN POLYPROPYLENE FOR TRANSPORT PACKAGING
Lehtinen J
Borealis
The use of plastics in returnable transport containers and the advantages of high-impact heterophasic propylene copolymers in this application are discussed. The properties and injection moulding characteristics of PP grades developed by Borealis are examined and compared with those of HDPE.
EUROPEAN UNION; FINLAND; NORWAY; SCANDINAVIA; WESTERN EUROPE
Accession no.812758

Item 101
Macplas
25, No.221, Sept. 2000, p.58/66
Italian
PRODUCTION OF PETP BOTTLES BY INJECTION STRETCH BLOW MOULDING
Canali G
Cesap
An account is given of the different stages involved in the manufacture of injection stretch blow moulded PETP bottles, including the drying of granules, the injection moulding of preforms, and the stretch blow moulding process itself. Polymer behaviour during each stage is examined, and the influence of processing variables on the quality of bottles produced is discussed.
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.812756

Item 102
Packaging Digest
38, No.3, March 2001, p.50/5
DAIRY FILLING/CASING REACHES NEW HEIGHTS
Mans J
Santee Dairies’ new 100m US dollars plant runs 34,000 gallons per hour of milk, juice and soy products on 10
filling lines. HDPE gallon and half-gallon bottles are blow moulded by Reid Plastics in a separate building built by Santee on its plant site and are conveyed to the upper level of the dairy building on overhead cable conveyors. Eight and 16-oz HDPE bottles are made at another Reid Plastics facility and delivered to the dairy by truck. A detailed description of the plant operations is given.

SANTEE DAIRIES; REID PLASTICS INC.
USA
Accession no.810121

Item 103
Packaging Magazine
4, No.7, 5th April 2001, p.27-8
LIQUID REFRESHMENT
Kaleido L

Developments in Drinks Packaging was held recently at the Institute of Directors. Despite the recent talk about drinks moving over to PETP packaging, this was not possible for energy drinks, since many need to be hot-filled, claimed Ashley-Carter Design Consultants. However, for other drinks, including beer as well as soft drinks, the future for PETP looks very bright. Developments in closures include Bericap’s TAPSID BO2S closure for beer and oxygen-sensitive beverages.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.810087

Item 104
Plastic Solutions International
2000, p.56/8
PLASTIC BEER BOTTLES ON TRIAL

Some of the world’s leading brewers are reported to be experimenting with plastic beer bottles in a bid to reduce costs and extend the shelf life of their products. Tests have so far proved that so long as the packaging does not affect the taste of the beer, people are prepared to drink from bottles made from almost any material. A problem, however, is whether it is technically and economically feasible to recycle plastic bottles incorporating barrier materials used in the manufacturing process. Plastic beer bottles developed so far have all been based on PETP, a permeable material that admits oxygen and releases carbon dioxide. This ultimately affects the flavour and fizz of the beer. Recent developments are outlined.

PETCORE; AMCO PET TECHNOLOGIES NORTH AMERICA;
WORLD
Accession no.809603

Item 105
Plastics News(USA)
12, No.50, 12th Feb.2001, p.1/35
TINY MARKET NICHE STILL GROWING
Doba J

The pallet-producing sector of the timber industry has long benefited from its market domination, but plastic pallets are slowly are chipping away at wood’s hefty market share. Plastic now accounts for 1.3% of the US pallet market, with 6 million produced annually, compared with more than 450 million wood pallets, according to a recent study by Plastics Custom Research Services. Plastic pallets are more expensive than their wood counterparts but are gaining acceptance because of their durability, reusability and easy sterilisable surfaces. Plastic pallets are made using a variety of processes, with structural foam moulding leading the way. Details are given.

PLASTICS CUSTOM RESEARCH SERVICES;
TRIENDA CORP.
USA
Accession no.808328

Item 106
Packaging Digest
38, No.2, Feb. 2001, p.68-9
SCALES SHOULDER THE WEIGHT OF HAIRCOLOR BOTTLES

Captive Plastics, a supplier of plastic packaging for personal care products, including hair care products, has recently upgraded its facilities to improve reliability and quality concerns. L’Oreal, one of its customers, has found that the installation of eight Champ II bench scales from Obhaus Corp in Captive’s Phillipsburg plant has addressed the problem of denting of its hair colour developer bottles during shipping and storage. The two companies worked together to develop a 6 oz. HDPE developer bottle. The new digital bench scale allows Captive to fill bags for L’Oreal with exact bottle counts, eliminating crushed and deformed bottles resulting from overloaded bags. Production of the developer bottle is described.

CAPTIVE PLASTICS; L’OREAL USA INC.;
OBHAUS CORP.
USA
Accession no.807630
Item 108
Materie Plastiche ed Elastomeri
65, Nos.7/8, July/Aug.2000, p.548/54
Italian
BREATH OF INNOVATION
Versaci A
A survey is made of developments by a number of companies in machinery for the injection stretch blow moulding and extrusion blow moulding of plastics bottles and other containers.
WORLD
Accession no.807123

Item 109
Revista de Plásticos Modernos
79, No.527, May 2000, p.539/41
Spanish
TWO NEW HIGH BARRIER PETP SYSTEMS
Tetra Pak Espana
Developments by Tetra Pak in techniques for improving the barrier properties of PETP bottles for beer, fruit juice and carbonated beverages are described. In the Glaskin process a thin layer of silicon oxide is deposited on the inside of the bottle, and in the Sealica process the PETP preform is coated with Dow Chemical’s Blox thermoplastic epoxy resin.
TETRA PAK; DOW CHEMICAL CO.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.807107

Item 110
Revista de Plásticos Modernos
79, No.527, May 2000, p.514/9
Spanish
SPECIAL APPLICATIONS OF PETP PACKAGING
Sidel SA
Developments by Sidel in its SBO Series 2 machines for the blow moulding of PETP bottles are examined. These include machines for the manufacture of hot fillable and pasteurisable, wide-mouthed, small-sized, flat and complex shaped bottles.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.807107

Item 111
Revista de Plásticos Modernos
79, No.527, May 2000, p.506/8
Spanish
PLASMA TECHNOLOGY GIVES BARRIER PROPERTIES TO PETP PACKAGING
Sidel SA
A process developed by Sidel for the plasma treatment of PETP bottles to improve their barrier properties is described. The process, which uses an acetylene plasma to deposit a carbon layer on the inside of the bottle, is carried out in Sidel’s Actis 20 machine which operates in-line with the Company’s blow moulding machines.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.807106

Item 112
Chimica e l’Industria
82, No.3, April 2000, p.313-8
Italian
COEXTRUDED POLYPROPYLENE FOAM SHEETS
Delben F; Forabosco A; Casasola M Trieste, University; AMB Srl
Multi-layer sheets for use in the manufacture of food packaging containers were produced by the coextrusion of PP foam in combination with PE, an EVOH barrier layer and tie layers. Results are presented of studies of the mechanical and morphological properties, density and cell structure of foam layers based on different types of PP. 8 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.807089

Item 113
Plastics News(USA)
12, No.51, 19th Feb.2001, p.9
USA
COST COULD CAP U.S. USE OF ASEPTIC PETP
Doba J
As rumours float of Coca-Cola’s and PepsiCo’s interest in aseptic PETP bottles for milk-based and low-acid beverages, packaging experts wonder if PETP can deliver at an acceptable cost in the US. It is claimed that aseptic PETP could match the shelf life of cartons, depending on several factors including the contents and the sufficiency of the bottle’s light and oxygen barrier. An aseptic PETP filling line can cost 40-50% more than a traditional hot-fill line.
USA
Accession no.807016

Item 114
Packaging Magazine
4, No.5, 8th March 2001, p.16-7
SINGLE OR RETURN?
Prebble J
The decision as to whether to use returnable cases to replace shrinkwrap and corrugated distribution packaging in the retail supply chain is examined. It is argued that there is no distinct answer to the single trip versus multi
trip debate, but that there are significant factors to be considered as to the most appropriate transit packaging solution for each individual situation. These include the nature of distribution in terms of the feasibility of returning crates, the need for product identification, product turnover, filling/packing speeds, product/pack size and shape, type and amount of potential product damage arising from distribution, brand and marketing decisions, and cost of investment.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no.806572

Item 115

Plastics and Rubber Weekly
2nd March 2001, p.15
FULL ROUND OF ORDERS
Whitehead J

The Institute of Packaging held its conference on beer containers at Burton-on-Trent in February. Recent developments in PETP beer bottles using Sidel’s Actis plasma coating system were outlined. Benefits of the process include a seven-fold increase in carbon dioxide barrier, 30-fold in oxygen and three-fold in H2O. Bericap’s offering for the beer closure focuses on its Tapsid BO2S, a two-piece closure constructed from a shell with a patented tamper-evident brand and injection moulded in PP. The closure includes a patented coextruded multilayer disc made of up to eight layers of varying polymers. Decorative Sleeves, part of the ITW group, described the merits of shrink sleeving.

INSTITUTE OF PACKAGING
EUROPE-GENERAL
Accession no.803761

Item 116

Packaging Digest
38, No.1, Jan.2001, p.70-1
CALENTE CARRY-OUT
Hartman L R

Chevy’s Fresh Mex Mexican-style restaurants recently launched a full-scale take-out programme for entrees, called Express Mex. The company has developed a generously proportioned custom carry-out platter, sized and shaped like a large oval serving plate. The black base is made of a blend of GE Plastics’ Noryl PKN 4765 PS-based resin and high-impact PS, black colourant and a crystal PS cap layer. This is topped with a glass-clear, snap-fitting domed and divided PETP lid. Both custom components are thermoformed by Waddington North America. Noryl PKN 4765 delivers several notable characteristics that make it advantageous for microwaveable packaging.

CHEVY’S INC.; WADDITION NORTH AMERICA USA
Accession no.803706

Item 117

Houston, Tx., 27th Feb.-1st March 2000, p.215-27

NEW HIGH MELT FLOW RATE POLYPROPYLENE HETEROPHASIC COPOLYMER RESINS: IMPROVEMENTS IN DESIGN FLEXIBILITY AND PART PERFORMANCE FOR THIN WALL INJECTION MOULDING
Goldthorp J; Squire M
Montell USA Inc. (SPE,South Texas Section; SPE,Thermoplastic Materials & Foams Div.; SPE,Polymer Modifiers & Additives Div.)

Montell has developed a new family of high melt flow rate PP heterophase copolymer resins specifically designed for thin-walled injection moulded container applications. These revolutionary grades have been shown to provide improvements in overall processability and increased part design flexibility, while maintaining an exceptional balance of container stiffness and impact performance properties versus existing commercial PP TWIM grades.

USA
Accession no.803458

Item 118

Plastics Technology
47, No.1, Jan.2001, p.17
COATING GIVES PETP BOTTLES FIVE TIMES MORE BARRIER
It is briefly reported that an oxygen-barrier coating technology for PETP bottles has been improved to provide more than five times the barrier of an untreated bottle. The Barrier-Enhanced Silica-Treated PET (BESTPET) process was developed by Coca-Cola together with the University of Essen. The process uses vacuum coating technology from Balzers Process Systems and a bottle handling system from Krones. The coating process can handle 0.5L bottles at rates up to 20,000/hr. Coated bottles are said to be 100% recyclable.

COCA-COLA CO.; ESSEN,UNIVERSITY
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; USA; WESTERN EUROPE
Accession no.802149

Item 119

Asia Pacific Coatings Journal
13, No.6, Dec.2000, p.60-2
MULTI-PURPOSE TOOLS - RESINS FOR ALL OCCASIONS
Winkler M
Dow Chemical Co.

Traditionally, powder coating formulators have had to choose between the flexibility of thermoplastics and the
adhesion of thermosets, such as epoxies, when selecting resins for coating applications. However, a new thermoplastic resin, which employs epoxy resins and diamines in its synthesis, offers formulators many of the benefits of both thermoplastic and thermosetting systems. The adhesive nature of Blox resins, which can be classified as an epoxy thermoplastic polymer, has found use in coatings, binders for cellulosics and tie layers for polar polymers such as nylons and PETP. One of the newest applications for Blox resins are for use in the multilayer rigid packaging of oxygen-sensitive and carbonated beverages. Property data are presented.

USA
Accession no.801815

Item 120
Packaging Digest
37, No.13, Dec. 2000, p.60-3
ARMY WARMS TO HOT NEW CAN
Mohan A M

The development is described of a self-heating container by Ontro Inc. for the US Army for rations feeding to soldiers in the field. The design of the container is discussed, which consists of a one-piece, two-compartment body, blow moulded from one parison. Heat is generated inside the container’s inner structure through an exothermic reaction between water and calcium oxide. When a button, installed in the bottom of the container is depressed, a seal separating the two elements breaks, allowing them to mix together in the cone. The resulting heat is transferred through the cone to the beverage that surrounds it. Heat-sensitive inks on the label indicate the correct temperature has been reached. The container walls are comprised of six layers of plastic: the outer one is PP, the second is a regrind mixture of the ground spin domes cut from the container body and mixed with a small percentage of virgin PP, the third is a tie layer which adheres the regrind layer with an EVOH oxygen barrier, followed by another tie layer which adheres the EVOH layer with virgin PP on the innermost layer. The tie layer is Bynel coextrudable adhesive. Blow moulding of the container, and the choice of blow moulding machine is described.

US,ARMY; ONTRO INC.
USA
Accession no.801412

Item 121
Packaging Technology & Science
13, No.5, Sept.-Oct. 2000, p.205-10
EFFECT OF REPEATED MICROWAVE HEATING, FILL LEVEL AND TEMPERATURE ON THE IMPACT RESISTANCE OF A POLYPROPYLENE SYRUP BOTTLE
Siripatrawan U; Burgess G; Harte B R
Michigan,State University

The effects of repeated microwave heating, storage temperature and syrup fill level on the impact resistance of PP bottles were investigated using a free fall drop tester. Changes in the crystallinity of the bottle resulting from repeated microwave heating were evaluated using modulated DSC and the impact resistance of the microwave heated bottles compared with that of non-microwave heated bottles. The effect of wall thickness on the impact resistance of the bottles and the susceptibility of bottles dropped onto their handles, face, bottom and corners to failure were also examined. 12 refs.

USA
Accession no.797187

Item 122
Recycling PET Review
PETP PALLET OFFERS NEW POSSIBILITIES FOR RPETP MARKET

Using its injection compression moulding technology, Remaplan has developed an additive for recycled PETP which makes it possible to manufacture Europallets with high tensile strength. The company has developed a blend based on 80% recycled PETP. The injection compression moulding technique, combined with the excellent processing characteristics of RPETP, means the company can produce pallets at a highly competitive price. It is possible to produce around 340,000 pallets per year with the smallest machine, which amounts to 5,700 tons of processed RPETP.

REMAPLAN ANLAGENBAU GMBH
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.799196

Item 123
Packaging Review South Africa
26, No.11, Nov.2000, p.25
TWO BREWERS LAUNCH BEER IN GLASKIN PETP BOTTLES

Spendrups and Bitburger, leading brewers in Sweden and Germany respectively, have launched beer in 500ml PETP bottles using Tetra Pak’s Glaskin high-barrier layer. Glaskin is a proprietary technology that coats the inside of blown PETP bottles with a crystal-clear glass-like layer of silicon oxide, said to provide superior gas-barrier characteristics and excellent flavour retention performance.

TETRA PAK
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; SCANDINAVIA; SWEDEN; WESTERN EUROPE
Accession no.797187

Item 124
Packaging Review South Africa
26, No.11, Nov.2000, p.25
EASTERN EUROPEANS LIKE BEER IN PETP
Over a billion PETP beer bottles are consumed in Russia, Latvia and the Ukraine each year, and two-thirds of them are manufactured on Corpoplast blow moulding machines. In Eastern Europe, consumers tend to drink beer within a few days of purchase, so the question of six-months’ shelf life requires scant consideration. The PETP bottle was launched on the Russian market in 1966 by the Moskvoretzki Brewery in Moscow. With the supply of a blow moulding machine to the brewery, Corpoplast was actively involved in this development right from the start.

SIG CORPOPLAST
EASTERN EUROPE-GENERAL
Accession no.797186

Item 125
Italia Imballaggio
Nos.11-12, Nov./Dec.2000, p.86-9
Italian; English
PRODUCE, PROMOTE, COMMUNICATE
Piccinelli E

Plastohm is a multinational based in France, active in the field of plastic material conversion. The packaging division, which accounts for about half of the group’s turnover, produces in France and in Italy. Its range includes standard lines of jars, bottles and complements for cosmetics and pharmaceuticals. It has recently been integrated with PETP bottles and coextruded PE tubes from its two partners, EDP in Spain and Tu-Plast in Hungary, that Plastohm trades exclusively throughout Europe.

PLASTOHM
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; ITALY; WESTERN EUROPE
Accession no.797118

Item 126
Packaging Digest
37, No.12, Nov.2000, p.88-90
INSULATED CASE PROBES NEW SENSITIVITY LEVEL
Abrams B

Bayer’s new custom, insulated container not only protects frozen pharmaceutical medium from heat well in excess of the 72 hours it takes to ship products between two operations at opposite ends of the country, but it also shields them from damage. Using as refrigerant slabs of dry ice, the new system has as its primary container a custom two-piece container that Envirocooler makes of water-based PU foam, injection-moulded with Sealed Air’s Instapak materials, covering the components with a skin-like PE film. Up to 15 of the thin frozen bags of product can be accommodated. The bags are produced by Stedium of EV A.

BAYER CORP.
USA
Accession no.797061

Item 127
Packaging Technology & Science
13, No.4, July-Aug.2000, p.169-76
EFFECTS OF WEIGHT REDUCTION OF PACKAGING MATERIAL ON THE MECHANICAL PERFORMANCE OF PETP BOTTLES FOR COOKING OIL
de Oliveira L M; Sarantopoulos C; Bordin M; Nakandakari Y
Brazil,Institute of Food Technology

This study compares and evaluates the mechanical performance of two types of PETP bottle of different nominal weights, but identical design, and filled with 900ml of vegetable cooking oil. Two different closures, with an internal or external tamper-evident feature, were used on the 20g bottles. The 27g bottle was closed exclusively with the closure fitted with an external seal. Corrugated fibreboard cases containing 20 bottles each were submitted to a vibration test and all the components of the packaging system were subsequently evaluated with respect to important mechanical properties, such as stacking strength, drop impact strength and package integrity. 8 refs.

BRAZIL
Accession no.797052

Item 128
Orlando, Fl., 7th-11th May, 2000, paper 185
BLOW AND INJECTION MOLDING PROCESS SET-UPS PLAY A KEY ROLE IN STRESS CRACK RESISTANCE FOR PET BOTTLES FOR CARBONATED BEVERAGES
Zagarola S W
Terra Firma International Ltd. (SPE)

Two case studies of bottles blow moulded from injection moulded preforms are used to illustrate strategies to maximise the resistance of poly(ethylene terephthalate) carbonated beverage bottles to stress crack failure. It was concluded that optimisation of the processing could double or triple the stress crack resistance as determined by the time to failure in an alkali solution, and that set-ups were best optimised using statistically designed experiments. All processes in the manufacturing sequence require control to achieve consistent stress crack resistance. It is shown that a change in the average weight of the preform of only 0.3 g can dramatically change the stress crack resistance if the blow moulding process is not adjusted to accommodate the change. Over-packing the injection cavity reduces the scope to improve stress crack resistance. The base clearance and the thickness of the bottles were good indicators of process change, but could not be used to predict stress crack resistance without knowledge of the process parameters.

USA
Accession no.796504
EFFECT OF PREFORM AND BOTTLE DESIGN CHARACTERISTICS ON THE PERFORMANCE OF PET WATER BOTTLES

Martin L; Khalighi A; Dravetz R
Husky Injection Molding Systems (SPE)

A two-level, four-factor, factorial design of experiments was used to determine the influence of preform and bottle characteristics on the mechanical properties of a 500 ml poly(ethylene terephthalate) (PETP) blow moulded bottle, the results being analysed statistically. The average wall thickness, the variation in wall thickness, the empty and filled top load strength, and the side compression load strength were determined, for two grades of PETP. It was concluded that bottle design requires a compromise between design aesthetics, preform cycle time, stretch ratios, polymer grade, and mechanical properties.

NEW PET BOTTLE FOR A NEW BEER

This article first introduces Interbrew, one of the world’s leading brewery groups, whose headquarters is in Belgium. It then discusses the recent launch of a new beer by the company, and explains the packaging development process that resulted in a PETP bottle and a barrier layer applied with unique technology, produced by Schmalbach Lubea.

NOVEL MILK BOTTLE DESIGNS KEEP BLOW MOLDERS ON TOP

Defosse M

We are informed that, in the milk packaging commodity segment, processors are delivering enhanced aesthetics and reduced cost, with the latest tailored machinery. This article explores developments, under the headings: innovative designs lift sales for dairies, microcellular process slashes material use, and PETP grabs its share of the milk market.

PET LEADS THE PACK

PETP continues to set a challenging pace across the packaging sector. The product has been showing its ability to win applications from other plastics, notably through its choice for the new Fairy Liquid bottle. Key packaging player RPC points to the product’s widening use with its selection for jars to pack Cadbury’s High Lights, replacing glass in a distinctive waisted jar design. Tetra Pak UK’s PETP division says its sales for 2000 are currently 50% higher than the same time last year. The company’s latest machine, the TetraPlast LX-6, boasts a blow rate of 7,200 bottles/hour.

BARRIER PET: AN OBSTACLE COURSE

Some problems associated with the use of PETP in beer bottles are discussed, with particular reference to the difficulties in achieving the level of barrier properties required in this application. Solutions examined include the substitution of PETP with polyethylene naphthalate (PEN), the use of ethylene terephthalate copolymers or PETP blends with PEN or polyamides, the blow moulding of multi-layer preforms, and different techniques used to treat the internal or external surfaces of bottles. Developments by a number of companies are reviewed.

References and Abstracts

© Copyright 2002 Rapra Technology Limited
Item 134

**Popular Plastics and Packaging**
45, No.11, Nov.2000, p.84-8

**THERMOFORMING OF PP SHEET**
Athalye A S
Technology Transfer Pvt.Ltd.

The trend towards the thermoforming of PP sheets for the manufacture of food packaging, such as blister packaging and disposable cups, is highlighted and various aspects of the thermoforming process are discussed. These include the main processing factors, which influence the properties and performance of the thermoformed parts, including sheet prestretching and mould type, problems encountered in thermoforming, machine/mould maintenance, product trimming and computer aided manufacture using modern roll fed thermoforming machines. 3 refs.

**INDIA**

*Accession no.794691*

Item 135

158th. ACS Rubber Division Meeting - Fall 2000.
Conference preprints.
Cincinnati, Oh., 17th.-19th. Oct. 2000, paper 52

**PACKAGING OPPORTUNITIES**
Sinclair K
Flexsys America LP
(ACS,Rubber Div.)

Bulk packaging solutions from Flexsys America are discussed with reference to the advantages provided by the use of flexible intermediate bulk containers, plastic returnable pallets and plastic bulk bags. The design of these products is illustrated, and details are given of the Flexsys return process.

**USA**

*Accession no.794157*

Item 136

**Italia Imballaggio**

**STANDARD, BUT ALSO LUXURY**

Laffon has developed a new foundation stick for both luxury cosmetics and mass market brands. The heart of the idea is the rationalised design stage, making it possible to make some substantial economies of scale, producing a container that is "always the same", yet can be customised with surface treatment. The first version, from which the later variations in diameter and height are all derived, consists of an 18mm cylindrical plastic stick with hermetic seal for foundation. The stick can be produced in either PP or ABS.

**LAFFON**
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE

*Accession no.792715*

Item 137

**Plastics News(USA)**
12, No.36, 6th Nov.2000, p.22

**BIO-SAFE SOLVES PPG’S RECYCLING RIDDLE**
Doba J

Graham Packaging has adopted PPG Industries’ Bairocade gas-barrier coating for its PETP fruit juice bottles. The exterior coating preserves the shelf life of fruit juices, carbonated drinks and beer as much as three times longer than untreated bottles. The downside, however, was that the coated bottles could only be sent to a landfill, unless someone knew how to deal with such containers in the waste stream. Bio-Safe came up with a way to remove the gas-barrier coatings from PETP bottles. The company has formed an alliance with PPG, PETP recycler St.Jude Polymer and Graham Packaging to promote the technology. The product is called Plasticlean, an alkali silicate-based solution that, with added activators and detergents, separates the coating from the bottles either through a sink/float or air-separation technique.

**PPG INDUSTRIES INC.; GRAHAM PACKAGING CO.; BIO-SAFE SPECIALTY PRODUCTS CO.**

**USA**

*Accession no.792650*

Item 138

**Materials World**
8, No.8, Aug.2000, p.14-6

**PLASTIC PROVES IT CAN HOLD ITS BEER**
Bucklow I; Butler P
Crown Cork & Seal Co.Inc.

It is explained here that new barrier coatings and multilayer technologies are now enabling lightweight, unbreakable beer bottles to be made from PETP. This detailed article examines these latest developments in full.

**PPG**
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

*Accession no.792053*

Item 139

**Polymer News**
25, No.9, Sept.2000, p.314

**AWARD-WINNING ISERNIO’S FRESH MEALS CAN NOW BE HEATED IN BOTH MICROWAVE AND CONVENTIONAL OVENS**
Eastman Chemical Co.

Brief details are given of the use of Eastman Chemical’s VersaTray polyester to produce food containers for microwave and conventional ovens.

**USA**

*Accession no.791714*
FOCUS ON PET CONTAINERS AND BLOW MOULDING MACHINERY

This article highlights two new proprietary barrier coating technologies from Tetra Pak Ltd. of the UK, as exhibited at the recent BPC 2000 Exhibition. “Glaskin” technology coats the inside of blown PETP bottles with silicon oxide, and “Sealica” uses a patented injection overlay system to injection mould a high-barrier polymer onto the outside of PETP preforms. Also highlighted in this article is a new stretch blow moulding machine from the company, the Tetra Plast LX-6.

TETRA PAK LTD.; BINSTED GROUP; BITBURGER EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; UK; WESTERN EUROPE

Accession no.791530

Item 141

Adhesives Age

43, No.9, Sept.2000, p.27-8

EFFECTIVE CURE

Park M; Buehner R

UCB Chemicals Corp.

Results are discussed of migration tests carried out on HDPE and PETP bottles to determine the propensity of six acrylated radiation curable monomers to migrate into water with reference to the parameters of time and temperature. The tests focused on uncured acrylate monomers presented in a cured adhesive label formulation. The adhesive can partially soak into the paper label substrate prior to curing and can be thus shielded from the radiation source. 1 ref.

USA

Accession no.790266

Item 142

Plastics, Rubber and Composites

28, No.8, 1999, p.393-400

INDUCED CRYSTALLINITY DURING STRETCH-BLOW MOULDING PROCESS AND ITS INFLUENCE ON MECHANICAL STRENGTH OF POLYETHYLENE TEREPHTHALATE BOTTLES

Chevalier L; Linhone C; Regnier G

Cachan, Ecole Normale Superieure; Sidel SA; LTVP ENSAM

Microstructural evolution in PETP during a stretch blow process has an important influence on the final mechanical properties. To obtain information other than thickness distributions from numerical simulations of the blow moulding process, it is necessary to take into account the evolution of these characteristics (molecular orientation, crystallinity, etc). Numerical simulations of top loading tests at ambient temperature are carried out on bottles and compared with experimental results. Good agreement is obtained if appropriate anisotropic moduli are used. The results of tensile measurements made on stretch blow moulded samples and experimental tensile tests on PETP specimens are presented. The influence of draw ratio, temperature and elongational strain rate on the final strength of the bottle are analysed. A correlation between the mechanical characteristics and the induced crystallinity is demonstrated and used to predict mechanical characteristics at different locations on the bottle. 6 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE

Accession no.789938

Item 143

Plastics, Rubber and Composites

28, No.8, 1999, p.379-84

BLOW MOULDING OF LONG GLASS FIBRE COMPOSITES

Bush S F; Dreiza M; Tonkin J D

UMIST; Tenneco Packaging Ltd.

Precompounded discrete fibres have long been used as reinforcement in injection moulding, particularly with PP and nylon matrices. Usually the lengths or the fibres in the finished article have been in the range 0.2-1.00 mm and, for convenience, labelled short glass fibres. The last 15 years has seen the development of precompounded long glass fibres, having lengths in the finished article of typically an order of magnitude longer than for short glass fibres. An experiment on the blow moulding of long glass fibre reinforced virgin and recycled polymers is described. The long glass fibre compounds are made using in house technology for which the matrix interface conditions are known and can be varied. Bottles of 2l capacity with integral handles are blown as the primary test pieces for evaluating blowability of these new materials and for investigating the reinforcing structures obtained in the bottle walls. Mechanical properties are evaluated at room temperature before and after recycling and at elevated temperatures up to 100 deg.C, which are particularly relevant to the blow moulding applications envisaged. 13 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no.789936

Item 144

Modern Plastics International

30, No.9, Sept.2000, p.82-6

THERMOFORMED PACKAGING CATERS TO LIFESTYLE CHANGES

Defosse M

There is growing demand for fresh foods conveniently packed and capable of being quickly cooked. Dual-
ovenable plastics packaging, for cooking in microwave and conventional ovens, was first commercial in the mid-1980s in the US. This packaging is typically crystallised PETP. Nippon Goshei has developed a new grade of its Soanol EVOH specifically for barrier in rigid packaging. The material forms at lower temperatures than current EVOH grades. For microwaveable packaging, Dow Plastics has introduced a new PP grade which offers better stiffness and clarity. Convenience Food Systems uses expanded PP for its TiroFresh trays, citing benefits versus the standard EPS. More flexible thermoforming machinery is being introduced to handle the spate of material developments.

USA

Accession no.789169

Item 145

European Plastics News
27, No.9, Oct.2000, p.27

HOLSTEN’S PETP PROJECT
Vink D

Holsten has begun to bottle its main national Holsten Pilsener beer brand in PETP bottles with a reclosable plastic screw cap at its brewery in Braunschweig. Schmalbach-Lubeca has developed PETP bottles at six breweries throughout Europe for nine beer brands. Barrier technology can be grouped into passive methods, which simply restrict carbon dioxide, and active systems, which can bind oxygen. Schmalbach is now moving from the first generation passive systems to its Bind-Ox system with an active barrier to oxygen and a passive one for carbon dioxide, taking shelf life beyond six months.

SCHMALBACH-LUBECA AG
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.788043

Item 146

Packaging
No.5, Sept./Oct.2000, p.12-4

PACKAGING OF INJECTABLES
Guise B

Various aspects of the packaging of injectable solutions, which are free of harmful bacteria, in ampoules, vials or pre-filled syringes are discussed. Consideration is given to the types of ampoules and vials available, machinery for filling these ampoules and vials and methods of sterilising the containers. Ampoule machinery, which can handle either open or closed ampoules and fill and stopper vials and available from Rota Verpackungstechnik GmbH and the Finn-Aqua pharmaceutical GMP steam steriliser are illustrated.

ROTA VERPACKUNGSTECHNIK GMBH; FINN AQUA
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no.787146

Item 147

Modern Plastics International
30, No.8, Aug.2000, p.23-4

SUPPLIERS TOUT PROMISING BARRIER OPTIONS FOR PET BEER BOTTLES
Defosse M

Developments in beer bottles, barrier coatings for beer bottles and blow moulding machinery for making beer bottles on display at NPE are highlighted. These developments include Miller Brewing Co.’s 20 oz. PETP beer bottle, Actis 20 plasma coating system for coating about 10,000 recyclable bottles/hour from Sidel, Nissei ASB’s HBB-8 barrier coating machinery for treating PETP bottles with a diamond-like carbon coating and AmberGuard polymer for UV light protection of bottles from Eastman Chemical.

MILLER BREWING CO.; SIDEL; NISSEI ASB; EASTMAN CHEMICAL
USA

Accession no.786363

Item 148

International Polymer Science and Technology

PREDICTING THE GUARANTEED STORAGE TIMES OF INDUSTRIAL LIQUIDS IN POLYETHYLENE TEREPTHALATE BOTTLES
Rakova V G; Shchapenkova N M; Prudnikova E A; Sabsai O Y
Plastik Research & Production Association; Prodvizhenie

Test methods are described for the lifetime prediction of industrial liquids in PETP bottles, with respect to the durability of the container and the influence of its contents on storage stability. Accelerated ageing and natural ageing tests were carried out on PETP bottles filled with benzene, hexane, isopropyl alcohol, acetone, motor oil, gasoline, and distilled water. Kinetic curves of the ageing were processed by means of a second-degree polynomial and a prediction was made of up to 5 years storage. The kinetic curves obtained were used to calculate the storage times under conditions of a heated store room without controlled humidity. 4 refs.

RUSSIA

Accession no.785601

Item 149

Packaging Magazine
3, No.18, 7th Sept.2000, p.30

SOLVING SOLVENT PACKS

HDPE is the traditional method for packaging liquid inks, but solvent vapour escapes from monolayer HDPE containers via permeation, creating a partial vacuum which sucks in the side walls. Plysu has developed a coextruded construction with an inner nylon layer which
minimises panelling of the side walls and reduces solvent emissions.

PLYSU CONTAINERS LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.785075

Item 150
Packaging Magazine
3, No.18, 7th Sept.2000, p.22-3
REXAM SEEKS NEW MARKETS
Kaleido L

Rexam Closures & Containers of Portsmouth is expanding from pharmaceuticals into new, consumer-oriented markets. The rise of blisterpacks and sachets has hit bottle sales. Rexam claims to make around 40% of the injection blow moulded plastic amber bottles for the UK pharmaceuticals market. The company believes its quality standards and expertise in tamper-evident and child-resistant closures can be transposed effectively from pharmaceuticals into other markets, such as chemicals, toiletries, agriculture and the food and beverage sectors. The New Generation Push-Lok closures are moulded in PP in four sizes and can be supplied with a variety of induction heat seal and foam wadded liners. Also new from the company is its Softline range of jars for cosmetics and toiletries, injection moulded in high grade PP.

REXAM CLOSURES & CONTAINERS
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.785074

Item 151
Plastics News(USA)
12, No.26, 26th Aug.2000, p.28
SWISS LIFTING PVC BOTTLE BAN
Higgs R

The Swiss government plans to lift a 10-year ban on the use of PVC beverage bottles in the country. The decision was made because a ban can no longer be justified in the face of technological advances in recycling. Bottle waste sorting has changed with the installation of infrared and X-ray facilities to check the different plastics and advanced incinerators effectively eliminate toxic emissions from waste PVC. The legislation requires PVC bottles to be sold with a mandatory deposit on each container based on a minimum of 30 Swiss cents.

BUWAL
SWITZERLAND; WESTERN EUROPE
Accession no.784101

Item 152
Plastics News(USA)
12, No.26, 26th Aug.2000, p.7
SELF-HEATING CAN ENTERS US
Doba J

Ontro has patented technology for a fully contained self-heating can for foods and beverages. The six-layer, mostly PP, container begins heating beverages, soups or baby formula when activated by removing an aluminium disc at the bottom of the can. When water in a PP puck interacts with limestone in an internal heat generation cone within the can, heat is generated, instantly heating the product surrounding the apparatus in the middle of the can. Recently, Ontro entered into its first US manufacturing agreement with blow moulder Consolidated Container.

ONTRO INC.
USA
Accession no.785002

Item 153
Pigment & Resin Technology
29, No.3, 2000, p.176
BARRIER COATINGS FOR JUICE BOTTLES

A new generation of Bairocade gas barrier coatings for PETP containers is making its commercial debut on single-serve juice bottles manufactured by Graham Packaging. Bairocade coatings, developed and manufactured by PPG Industries, are said to be fully compatible with existing recycling technology. The epoxy-amine coatings are being applied to the exterior of 16oz bottles for Northland Cranberries and Cliffstar, and on 20oz bottles for Old Orchard Brands. The bottles, blow moulded and coated at a Graham facility in York, PA, mark the worldwide introduction of a coating specifically designed for juice bottles. Other Bairocade coatings by PPG have been applied to more than one billion bottles in the past five years for carbonated soft drinks in the Middle East and beer in Australia. Details are given.

PPG INDUSTRIES INC.; GRAHAM PACKAGING
USA
Accession no.784101

Item 154
Journal of Applied Polymer Science
77, No.5, 1st Aug.2000, p.1118-27
MECHANICAL RECYCLING OF POST-USED HDPE CRATES USING THE RESTABILISATION TECHNIQUE. II: INFLUENCE OF ARTIFICIAL WEATHERING
Kartalis C N; Papaspyrides C D; Pfandner R; Hoffmann K; Herbst H
Athens, National Technical University; Ciba Spezialitatenchemie Lampertheim GmbH

Artificial weathering is applied for about 8000 h to evaluate the light stability of post-consumer HDPE materials recycled from bottle crates. For recycling the remelting-restabilisation technique is applied. To study the effect of the restabilisation, the tensile impact strength is monitored during the artificial weathering exposure. The data are compared with microphotographs of the specimens surface. Repigmentation is used to evaluate
the role of new pigments on the final performance of the recycled material. The repigmented grades are further studied by clorimetric determinations of the colour difference (ΔE) during artificial weathering. The results illustrate that the restabilisation is mandatory for improving the light stability of the post-consumer crate material, ensuring its re-use in the original application. 23 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; GREECE; WESTERN EUROPE

Accession no.783812

**Item 155**

**Packaging Digest**

37, No.6, June 2000, p.42/4

**THERMOFORMS MAINTAIN A DELICATE BALANCE**

Abrams B

Universal Protective Packaging of the USA was called in by Viasystems Technology, a manufacturer of delicate electronic components, to explore and create new protective packaging in order to reduce damage to their products and also to reduce packaging waste. The result was thermoformed trays - full details are given here.

VIASYSTEMS TECHNOLOGY; UNIVERSAL PROTECTIVE PACKAGING; KLOECKNER-PENTAPLAST OF AMERICA; LUCENT TECHNOLOGIES; NORTHERN TELECOM USA

Accession no.783705

**Item 156**

**Packaging Digest**

37, No.6, June 2000, p.29

**MICROWAVABLE FEATS IN THREE MINUTES**

Described in this article is a new shelf-stable pouch packaging system for pasta and a sauce, and the “Smart Cooker” microwave heating tray on which the two are mixed and cooked. Full details are provided of the packaging, which took two-and-a-half years to develop.

BORDON FOODS; REXAM CONTAINERS; CURWOOD; SMURFIT-STONE; PACKAGING PARTNER USA

Accession no.783703

**Item 157**


Atlanta, Ga., 22nd-26th Aug.1999, p.293-303

**HIGH BARRIER PACKAGING: YESTERDAY, TODAY AND TOMORROW**

Brody A L; Strupinsky G

Rubbright-Brody Inc. (TAPPI)

The developments of polymer packaging barrier materials for food applications is discussed. The packaging is required to minimise the passage of oxygen which may adversely affect the food quality. The development of high-performance polymers has been successful, aided by changes in the food industry which have shortened the time between packing and usage. Promising materials include amorphous polyamides, polyethylene naphthalate, polymer blends, liquid crystal polymers, and active packaging which modifies its properties in response to changes in either the surrounding environment or the interior of the package. Active packaging may include oxygen scavengers to react with either oxygen trapped within the packaging or with oxygen passing through from the outside.

USA

Accession no.782696

**Item 158**

**Packaging Magazine**

3, No.16, 10th Aug.2000, p.3

**PETP BEER BOTTLES CAN HANDLE PASTEURISATION**

Ayshford H

KoSa’s 2201 PETP resin is designed to provide beer packagers with lightweight, thermally stable bottles that can withstand the stringent conditions of beer pasteurisation. The resin is noted for its dimensional stability, which prevents shrinkage and expansion of the container. The new polymer is suitable for pasteurised beer, juices, isotonic drinks and other hot-fill applications. The resin’s excellent melt and crystallisation properties also offer easy processability in injection moulding, stretch blow moulding and heat setting.

KOSA CORP.

USA

Accession no.782564

**Item 159**

**Plast’ 21**

Nos.88/9, Jan./Feb.2000, p.35-6

Spanish

**INCREASING THE HEAT RESISTANCE OF PETP**

Relationships between crystallinity and water absorption and the heat resistance of PETP bottles are examined. The use of heat treatment processes to increase the resistance of PETP bottles to hot filling, washing and pasteurisation temperatures is discussed with reference to developments by Sidel and Spa Monopole.

SIDEL SA; SPA MONOPOLE BELGIUM; EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE

Accession no.780287
WINNING THE CUP

Optipack, a major German producer of yoghurt cups, currently produces 2,000 million cups/year, working in four shifts, seven days a week. It aims to increase production to 2,400 million cups/year in the same production space, with the existing seven unique in-line plants at its Aretsried headquarters. Optipack’s thermoformed buttermilk cups are thinner-walled than similar injection moulded cups. The PP and PS materials used in yoghurt cups now have MFI of 100 and have contributed to the reduced thickness and weight.

OPTIPACK
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.780081

INJECTION-MOULDED PACKAGING. REQUIREMENTS AND THE SOLUTIONS PROVIDED BY NEW MACHINE TECHNOLOGY

General trends occurring in packaging, notably lighter packaging, consumer friendly packaging and globalisation, are outlined and some ways in which these trends are being met by new injection moulding techniques and machine technology are demonstrated. Attention is paid to multi-daylight mould technology, which increases productivity, use of barrier screws to improve plastifying performance, in-mould labelling and foam moulding employing supercritical gases. (Kunststoffe, 90, No.6, 2000, p.46-51).

SWITZERLAND; WESTERN EUROPE
Accession no.779770

REUSABLE TRANSPORT PACKAGING BRINGS COST SAVING

The economics and environmental advantages of the use of reusable transit packaging containers are discussed, with reference to a study by the Monash Centre for Environmental Management. Costs and benefits of reusable versus single-use containers are influenced by such factors as the type and cost of container, the expected life of the reusable container, the float size required to ensure a constant supply of recyclables at each point in the logistical chain, turnaround times, handling infrastructure costs, the cost of freight return for reusables and the waste disposal/recycling costs for single use containers. In addition, advantages/disadvantages of alternative ownership arrangements are considered.

MONASH CENTRE FOR ENVIRONMENTAL MANAGEMENT
AUSTRALIA
Accession no.779571

PLASMA TECHNOLOGY EXPLAINED

The Actis process of plasma coating PETP bottles to provide a gas barrier is described, with reference to the Actis 20 machine. The Actis 20 machine, as used by Sidel, is placed between the blowing and filling machines, where a PETP bottle can be placed inside a cavity for the plasma cycle to take place. The plasma cycle involves the creation of a vacuum in the cavity, and the injection of acetylene into the bottle where it is energised into a plasma state by the introduction of electromagnetic waves.

ACTIS
Accession no.779567

CLARIANT SHOWS COSMETICS PACKAGERS HOW TO GET ‘ECONOMICAL ELEGANCE’

Clariant Masterbatches has recently bought its own production blow moulding machine, a Uniloy Milacron BW 1000 EC single-station shuttle machine, to help customers bring to market new-look, special effect cosmetics and personal care product bottles faster. The equipment will enable the reliable production of bottles consistently and with minimal use of expensive colourants and enhancers, and maximum use of recycled material. Looks already created by the company include the first multilayer PE bottle with an anodised-aluminium look, frosted-glass, and suede effects using both PP and PE. The in-house production blow moulding capabilities has helped reduce package development time by 80%, and enabled the company to create samples of many new looks that can be reproduced easily and consistently with a formula system. Details are given of the machine.

MCHENRY; CLARIANT MASTERBATCHES
USA
Accession no.779563

SIDEL HOPES TO SMASH BARRIERS TO NEW PET BOTTLE APPLICATIONS

Doba J
Groupe Sidel is reported to have demonstrated its Actis 20 in-mould plasma coating technology at NPE. The technology treats blow moulded bottles in line to apply a barrier coating on PETP bottles. The potential for the machine is discussed, with applications in beer bottle coating, juice and soft drinks bottle coating, and other applications requiring superior barrier properties.

GROUPE SIDEL
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.779527

Item 166
Packaging Review South Africa
26, No.3, March 2000, p.43
NEW POLYMER FROM RENEWABLE RESOURCE

The joint venture between Cargill and Dow Chemical, Cargill Dow Polymers, has developed a new packaging polymer made from annually-renewable resources such as corn and wheat. This article takes a detailed look at the properties of the new material, known as NatureWorks PLA (polylactide).

CARGILL DOW POLYMERS; CARGILL; DOW CHEMICAL; BIMO; TETRA PAK; TRESPAPHAN ASIA; EUROPE-GENERAL; JAPAN; NORTH AMERICA; USA
Accession no.778854

Item 167
International Bottler & Packer
74, No.6, June 2000, p.40-4
WIDGET TECHNOLOGY

Browne J
Guinness Packaging

The development of widget technology for canned and bottled draught beers is discussed, with particular reference to the activities of Guinness Packaging. Problems encountered prior to the successful development of the Enigma widget, the floating widget and the bottle widget, are described. Other product developments in the brewing industry are also described.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.778537

Item 168
International Bottler & Packer
74, No.6, June 2000, p.30
MILK PACKAGING DEVELOPMENTS

A new plastic milk bottling plant has recently been commissioned by Tetra Pak for Robert Wiseman Dairies in Bellshill, Glasgow. The plastic bottle making facilities are next door to the customer’s premises, eliminating the need to transport empty bottles by road, and to enable the appropriate amount of bottles to be produced for the dairy’s packaging needs at a required time. The plant at Bellshill has four Graham Wheel extrusion blow moulding machines and two Techne shuttle-type extrusion blow moulders which produce HDPE bottles in 2, 4, 6 pint, and 2 and 3 litre sizes. The operation is briefly described.

TETRA PAK; WISEMAN R.,DAIRIES; GRAHAM ENGINEERING CORP.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.778536

Item 169
Packaging Digest
37, No.5, May 2000, p.90-1
CLEARLY COMPOUNDING COLOR FOR VITAMINS

Abrams B

The production of tinted PETP bottles for use in packaging pharmaceuticals and vitamins is described with reference to the operations of Waddington Jaycare, a worldwide producer of plastic packaging. The oil-based dye system is from M. A. Hanna and is called Freeze Dri Compete-F. The colour additive system is used with a recently installed dedicated injection stretch blow moulding machine. It has satisfied the FDA’s requirements for migration testing, and meets the moulder’s processing and light transmission parameters. Cited for the colourants performance are its UV resistance and ability to obscure contents while preserving the vibrant appearance of PETP.

WADDINGTON IP JAYCARE; HANNA M.A.,COLOR USA
Accession no.777818

Item 170
Packaging Digest
37, No.5, May 2000, p.38-41
L’ANZA KEEPS HAIRCARE BOTTLING IN CONTROL

Hartman L R

The redesign of haircare product bottles from L’anza Research International is described. The redesigned velvet-touch PP/HDPE bottles incorporate tall elongated designs in the long hair collection, and other products are packaged in teardrop and soft-shouldered designs. Flared PP dispensing caps in a variety of pearl and matte pastels are colour-matched to the bodies. The success of the new designs has led to an increase in demand for the products, and the company has had to automate and expand its bottling lines. Details are given of the packaging design and operation.

L’ANZA RESEARCH INTERNATIONAL USA
Accession no.777816
Item 171
*Journal of Testing & Evaluation*
27, No.4, July 1999, p.296-300
**COMPARISON OF RETURNABLE PAPER AND PLASTIC CORRUGATED PACKAGING TRAYS FOR THE UNITED STATES POSTAL SERVICE**
Singh S P; Walker R; Close D
Michigan, State University; US Postal Service

Paper and plastic corrugated materials used for packaging were compared using the example of mail trays used by the United States Postal Service. The test methods consisted of performing an accelerated test in a warehouse facility that closely simulated the everyday handling characteristics encountered by these trays in postal facilities. The results also compared differences in material-recycled content and fabrication processes. The results showed that the reusable plastic corrugated trays performed 2.5 to 3 times better than similar types of reusable paper corrugated paper trays. 4 refs.

USA
Accession no.776394

---

Item 172
*Canadian Plastics*
58, No.4, April 2000, p.24-6
**MAKING BOTTLES BETTER**
Anderton J

Recent developments in blow moulding technology and methods of optimising output by customising upstream and downstream equipment to suit the product line and volumes are discussed. Particular attention is paid to mould cooling, neck guided air conveyor systems and good maintenance of set-up sheets and plant organisation for minimising downtime and increasing efficiency.

CANADA
Accession no.774067

---

Item 173
*Chemical and Engineering News*
78, No.21, 22nd May 2000, p.25-6
**POLYMER MAKERS: NEW PLASTIC PACKAGING MARKETS OPEN UP**
Tullo A

Spring water bottled in PETP is competitive with other soft drinks and sold at every convenience store and snack counter. PETP makers are hoping for similar success in beer. In March, Miller Brewing launched its polyester 16oz and 20oz bottles for distribution across the US. The beer bottles are multilayered, with three PETP layers and two proprietary barrier layers. Anheuser Busch has done limited marketing of a wholly PEN bottle. DuPont recently introduced Edge Packaging Technologies, a family of products aimed at beer and other beverage markets. Part of the technology is an external coating that creates a barrier claimed to be 30 times better than conventional PETP.

USA
Accession no.773734

---

Item 174
*Modern Plastics International*
30, No.4, April 2000, p.56/60
**LARGE BLOW MOULDED CONTAINERS TAKE OFF**
Defosse M T

Annual demand for intermediate bulk containers is estimated at about 5 million units/year. The compounded annual growth rate is about 15-20%. Roth Container Systems capitalised on the growing IBC market last year by blow moulding HDPE IBCs for customers in Europe. SST Corp. processes drums up to 67gal on its Davis-Standard blow moulding machines for end users in the chemical, foodstuff and beverage industries. At Huhtamki Van Leer’s industrial packaging division, two grades of HDPE are coextrusion blow moulded for its UniCUBE IBCs.

WORLD
Accession no.772700

---

Item 175
*Modern Plastics International*
30, No.4, April 2000, p.28/30
**TOP PETP BOTTLE MANUFACTURERS SEEK STRATEGIC PARTNERSHIPS**
Leaversuch R D

Sipa has established a US operation for the design and manufacture of hot runners and preform moulds for PETP bottles. For preform tooling, the Thermodyne unit will offer two-stage tools with cavitation in the 16- to 48-cavity range. Resilux, a leader in monolayer preform moulds with up to 96 cavities, is set to acquire Altoplast-Claropac, a major Swiss blow moulder. Altoplast-Claropac makes three- and five-layer coinjected barrier bottle tools and designs preforms that incorporate recyclate in the bottle. Wentworth Technologies is acquiring Electra Form, a designer and maker of preform moulds for PETP bottles.

SIPA SPA; RESILUX NV; ALTPOPLAST-CLAROPAC; WENTWORTH TECHNOLOGIES; ELECTRA FORM INC.
NORTH AMERICA; WESTERN EUROPE-GENERAL
Accession no.772692

---

Item 176
*Packaging Technology & Science*
12, No.6, Nov./Dec.1999, p.251-4
**DEVELOPMENTS IN PLASTICS PACKAGING FOR THE TRANSPORT OF DANGEROUS GOODS**
Schilperoord T
TNO Institute of Industrial Technology
Several interesting developments in plastics packages and intermediate bulk containers (IBCs) for the transport of dangerous goods are of importance. Significant developments include the application of new materials and packaging concepts, the increasing re-use of packaging and the possibility of the application of recycled material. How these developments have influenced or should influence the UN recommendations and regulations on the transport of dangerous goods is discussed. The role of CEN and ISO standards, which are under development, is indicated. In this context the European project CHEMPACK funded by the EC within the framework of the Standards, Measurements and Testing programme, is outlined. This project is executed in cooperation with raw materials manufacturers, packaging/IBC manufacturers and research institutes, and is coordinated by TNO. The aim of the project is to develop harmonised test methods and procedures for the assessment of the chemical compatibility of plastics packages and IBCs. 4 refs.

EUROPE-GENERAL; EUROPEAN COMMUNITY; EUROPEAN UNION; NETHERLANDS; WESTERN EUROPE

Accession no.772297

Item 177

Journal of Testing & Evaluation
28, No.2, March 2000, p.103-8
PRODUCT/PACKAGE INTERACTION: EFFECT OF PHYSICAL, CHEMICAL AND CLIMATIC ENVIRONMENTS
Newsham M D; Giacin J R; Singh S P
Ocean Spray Cranberries Inc.; Michigan, State University

Product/package interactions are evaluated for three product/package systems: a bleach alternative laundry additive, an anti-bacterial surface cleaner and a glass surface cleaner. The package system is comprised of HDPE bottles with induction sealed closures. The physical environment is studied by comparing product/package systems that are exposed to simulated distribution testing with those that are not. The storage environments are ambient conditions at 73 deg. F, and higher temperatures at 100, 120 and 140 deg. F. Damage caused by distribution testing occurs in the bottle or in the closure component of the package. Bottle defects resulting from distribution testing are dents, abrasions and creases. Closure defects include sheared-off closures, cracks in the closure body or nozzle cover damage. Product/package systems exposed to the four storage environments are inspected for failure, defined as product leaking from the package, during the six-month study. Failures are due to environmental stress cracking. Dents in the shoulder and bottom region of the bottle are the only simulated distribution defects that impact the storage stability of the product/package systems, which often result in reduced shelf life. The primary location of all other failures is near the centre of the bottle bottom edge, which is the thinnest region of the bottle. Bleach alternative laundry additive is most aggressive product, while the two surface cleaners exhibit storage stability. Performance criteria of the failed bottles are evaluated to study impact of package system properties on product/package integrity. Yield strength, modulus of elasticity and dynamic mechanical properties of failed sample-acquired bottle side panels do not change significantly from those of the control samples. Colour changes are monitored by measuring interior and exterior surface yellowness indices of bottle side panels. Although observed spectrophotometrically, these changes are not detected visually. 2 refs.

USA

Accession no.772290

Item 178

Packaging Digest
37, No.3, March 2000, p.40/2
SHOWER POWER WITH SODA-BOTTLE STYLE
Hartman L R

This article provides a detailed description of the packaging of Aware Products' hair and skin-care products aimed at young teenagers. Full details are given of the PETP long-necked soda-bottle type containers and their exciting holographic labels, which are hot-stamped on clear film.

GRAFCO PET TECHNOLOGIES; BERLIN PACKAGING; AWARE PRODUCTS; POLY-SEAL INC.; EMSAR INC.; BEST LABEL CO.; FLEXCON; TCC ENTERPRISES; ASTOR UNIVERSAL EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; USA; WESTERN EUROPE

Accession no.772028

Item 179

Plastics News(USA)
12, No.8, 24th April 2000, p.1/2
BREWERS KEEP HOPES UP FOR PET BOTTLES
Doba J

Norman Nieder, of US brewers Anheuser-Busch Inc., was a keynote speaker at the Packaging Strategies 2000 conference held recently in Amelia Island, USA. This article reports in detail on his views on the use of PETP for the manufacture of beer bottles.

ANHEUSER-BUSCH; CONSTAR INC.; CONTINENTAL PET TECHNOLOGIES INC. EUROPE-GENERAL; USA; WORLD

Accession no.771428
Item 180
Packaging Digest
37, No.2, Feb.2000, p.72/80
FROSTED PET BOTTLES WARM COOPERATION FOR CANADIAN FACTORIES
Ennen S
This long article fully details the production of frosted PET bottles in which Russian Prince vodka is packaged for the Canadian market. Preform specialist Massiplast Inc. mixes PET base resin from Eastman Chemical and a white colourant from Clariant Masterbatches, to achieve the frosted look.
CLARIANT MASTERBATCHES; MASSIPLAST INC.; EASTMAN CHEMICAL; GENERAL POLYMERS; HUSKY INJECTION MOLDING SYSTEMS; PET-PAK CONTAINERS; MAGPLASTIC(NORTH AMERICA)INC.; KRONES; CANADIAN HEALTH PROTECTION BOARD CANADA; EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.771130

Item 181
Packaging Digest
37, No.2, Feb.2000, p.52
EPET TRAY CUTS THE MUSTARD FOR DELI MEATS, FRESH POULTRY
This article focuses on a new fresh meat and poultry packaging tray made from an expanded PETP foam known as Escofoam, from Wihuri Oy Wipak of Finland. The tray, which is produced on conventional thermoforming machinery, contains a layer of EVOH for its barrier properties. Full details are provided.
WIHURI OY WIPAK; DUPONT; WIPAK GRYSPEERT EUROPE-GENERAL; EUROPEAN COMMUNITY; EUROPEAN UNION; FINLAND; FRANCE; SCANDINAVIA; SWITZERLAND; WESTERN EUROPE
Accession no.771128

Item 182
Packaging Digest
37, No.2, Feb.2000, p.49-50
COKE "PENS" ESL BOTTLE
This article highlights the new 350ml, single-serve mini bottle being used by Coca-Cola to package Coke, which is the first of its kind to be made from a new, modified PEN/PETP blend. “HiPertuf” PEN and “Cleartuf 8406” PETP, both from Shell, were used to develop the blend, which doubles the shelf life of the Coke compared to similarly-sized conventional bottles. Full details are provided.
SHELL; ELECTRA FORM; SIDEL; COCA-COLA AUSTRALIA; USA
Accession no.771126

Item 183
Packaging Digest
37, No.2, Feb.2000, p.39/42
REFILLABLE COMPACT DISPENSES DAILY DOSE
Abrams B
This article highlights the new “Ortho Dialpak” and “Ortho Personal Pak” oral contraceptive tablet dispenser compacts, from Ortho-McNeil, a US marketer of prescription contraceptives. Full details are given of these discrete and feminine compacts, which are injection moulded from high-impact PS and then decorated. The compacts are refillable, and if women reuse the compacts for a year rather than discarding them after each month, it is estimated that 1.46 million pounds of plastic will be saved.
ORTHO-MCNEIL; ABLE DESIGN; RAZORFISH; PERMANENT LABEL; COLORWORKS; TECH GROUP USA
Accession no.771125

Item 184
Plastics Technology
46, No.4, April 2000, p.44/7
PETP PROCESSING ENHANCEMENTS HIGHLIGHT PACKAGING CONFERENCE
Knights M
At the recent Nova-Pack Americas 2000 Conference, two developmental exterior coatings that provide both barrier and bottle-decoration options were unveiled. In a two-stage coating process in development from DuPont Polyester, a PETP bottle is first coated on the outside with a proprietary water-releasable coating. Decorative and functional effects, such as gas barrier or UV protection, may be incorporated in the first or second coating layer. ICI Packaging Coatings is developing a new waterborne coating that adds colour, gloss and special effects to PETP containers, without affecting recyclability. Other highlights of the meeting included a new nylon nanocomposite barrier material, a delamination-resistant EVOH, improved preform mould cooling and a new multilayer PETP preform technology for smaller bottles.
NOVA-PACK USA
Accession no.770441

Item 185
Packaging Technology & Science
12, No.5, Sept./Oct.1999, p.241-8
MIGRATION OF TINUVIN P, A UV STABILISER, FROM PET BOTTLES INTO FATTY FOOD SIMULANTS
Monteiro M; Nerin C; Reyes F G R
UNESP
Tinuvin P migration from PETP bottles is investigated using several fatty food simulants such as olive oil, soybean oil, n-heptane and iso-octane, at exposure conditions of 2-10 days at 40 deg.C (total immersion). The stability of several UV stabilisers (BHT, Cyasorb UV 5411, Tinuvin P, Tinuvin 326 and Tinuvin 327) in n-heptane and iso-octane is also studied. After 10 days at 40 deg.C, losses of 6% and 10% in iso-octane and n-heptane respectively, are verified for Tinuvin P. Other UV stabilisers at the same experimental conditions show higher losses (up to 30% for Tinuvin 327). These results confirm that, when carrying out specific migration studies, the stability of the substance of interest should be established in the food simulant to avoid under-estimating the real migration behaviour. In order to quantify UV stabiliser migration, n-heptane and iso-octane solutions are concentrated and directly analysed by SIM mode GC-MS. For olive and soybean oils, Tinuvin P is isolated using size-exclusion chromatography and quantified by SIM mode GCMS. Iso-octane proves to be a more suitable fatty food simulant than n-heptane for the migration study of Tinuvin P from PETP. Higher levels of Tinuvin P migrate to olive and soybean oils rather than to n-heptane. These results suggest that the MERCOSUL recommended official methods for specific migration studies should be revised, since the migration levels using n-heptane as a fatty food simulant can be under-estimated when compared to edible oils. 19 refs.

PENNZOIL BRINGS INNOVATIVE DESIGN TO HDPE BOTTLE
Leaversuch R D
Pennzoil’s newly launched Rescue bottle is an odd-shaped, half-gallon, yellow HDPE container which is promoted as a better and safer way to deliver reserve fuel, enabling drivers to navigate 10 extra miles to a nearby gas station. The design challenge was to create a bottle, with built-in consumer safeguards, while retaining a superior aesthetic impact. The package has a flexible spout that attaches to a recess in the bottle’s back panel. The inner layer of the coextruded bottle is protected from chemical attack by a proprietary Aiporak inline fluorination system. Modifications of the shuttle-style blow moulded used to make the bottles were required.
PENNZOIL PRODUCTS CO.
USA
Accession no.766792

Item 188
Polymer Engineering and Science
40, No.1, Jan. 2000, p.1-10
WALL THICKNESS DISTRIBUTION IN THERMOFORMED FOOD CONTAINERS PRODUCED BY A Benco Aseptic Packaging Machine
Ayhan Z; Zhang Q H
Ohio,State University
The effects of process parameters such as forming temperature, forming air pressure and heating time on wall thickness distribution in plug-assisted thermoformed food containers were investigated. The optimum operating conditions of the packaging machine for the thermoforming process are discussed. Data are presented for high impact PS, LDPE, and PVC. 17 refs.
USA
Accession no.766399

Item 189
Composites Technology
5, No.4, July/Aug.1999, p.31-5
HIGH GLASS DELIVERY
This article examines the use of composites in the manufacture of structural containers for the transportation of everything from soup to beer, frozen and perishable goods, and corrosive and hazardous materials. The virtues of choosing composite materials over metal are explained in detail, and many examples are given of composite structural containers from manufacturers world-wide.
TRUE NORTH COMPOSITES; INTERNATIONAL STANDARDS ORGANISATION; STOUGHTON COMPOSITES; STERLING PAPER CORP.; BAYER CORP.; PPG INDUSTRIES; VETROTEX CERTAINTEDD; DOW CHEMICAL CO.; JOHNS MANVILLE; OWENS CORNING; AOC; TOMKINS
Sidel has described its plasma technology for improving the gas barrier properties of PETP bottles during manufacture. The process, Actis, uses acetylene gas as the plasma-creating medium. With microwave energy, the gas is turned into a cloud of more or less dissociated particles. The particles collide with the inner walls of the bottle creating a deposit, namely a layer of highly hydrogenated amorphous carbon. To create an effective barrier to gas, 3mg of this material in a layer 0.1mm thick is sufficient.

PETP suppliers and machinery manufacturers are reported to be eager to stake their claim to the fast-growing market for 5-gal water cooler bottles. The market growth is said to be 25% per year, and according to Krupp Kautex, 5-7 million of these coolers will be needed in Europe by 2007. Although since the late 1960s, most have been extrusion blow moulded from polycarbonate, it is thought that PETP offers a more economical advantage in addition to lack of weld lines on the base, improved clarity due to biaxial stretching during processing and elimination of secondary finishing. Details are given of machine developments, and Eastman’s Eastapak Aqua PJ003, a grade specially developed for this application.

This article discusses the need for colourful, eye-catching packaging on UK supermarket shelves, and looks in particular at packaging fruit-juice concentrates. It then discusses the advantages of the two main plastics options for juice bottles: HDPE and PETP.
combine the adhesion and durability of epoxies with the flexibility and processability of thermoplastics. Dow has initially launched two resin types, Blox High Adhesion Barrier Resins and Blox Adhesive Resins. The key market for Blox High Adhesion Barrier Resins will be as high oxygen barrier layers in multilayer PETP bottles. Blox Adhesive Resins have already found commercial applications in the US in loose-fill packaging and powder coatings.

DOW PLASTICS
USA
Accession no.761570

Item 196
European Plastics News
26, No.6, June 1999, p.19
SIDELE REVEALS BARRIER COATING ADVANCE FOR PET BEER BOTTLES
This article announces that Sidel of France has launched a new coating process which coats the inside of a single-layer PETP bottle with a layer of highly hydrogenated amorphous carbon. The technology is called “Actis” (Amorphous Carbon Treatment on Internal Surfaces). Brief details are provided.
SIDELE; JORGENSEN; PLASTIPAK
BRAZIL; DENMARK; EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; SCANDINAVIA; USA; WESTERN EUROPE
Accession no.760095

Item 197
International Bottler & Packer
73, No.6, 1999, p.35-8
PLASMA TECHNOLOGY - A NEW SCIENCE FOR STERILE FILLING
East J L
Crown Simplimatic Inc.
This is a paper which was presented at the British Bottler’s Institute conference in March 1999, which deals in detail with the subject of plasma technology, a method of sterile filling for plastic bottles. It looks at the method itself, the need for the technology, and its many advantages.
USA
Accession no.760080

Item 198
International Bottler & Packer
73, No.6, 1999, p.27/32
ASEPTIC COLD FILL
Sommi I G
Del Monte Italia
This is a paper which was presented at the British Bottler’s Institute conference in March 1999, which deals with the subject of aseptic cold filling, and reports in particular on the experiences of Del Monte Italia, when the company decided to source a suitable aseptic filling line in 1996.
TETRA PAK; PROCOMAC; SIPA
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.760079

Item 199
Packaging Digest
36, No.12, Nov.1999, p.74/80
’JUICED UP’ BOTTLES MAKE US. WORLD DEBUTS
Lingle R
A joint effort between coatings developer PPG and Graham Packaging has resulted in the commercialisation of barrier-coated PET bottles. Graham Packaging is focusing on bottled juices and teas and related oxygen sensitive blends. The launch follows three years of development to produce Bairocade epoxy-amine based barrier coated PETP bottles. Details are given of the process which applies the coating to PETP bottles downstream of a Sidel blow moulder. The coating is cured in-line by IR ovens to produce an oxygen-inhibiting barrier on the bottles’ exterior surface that complies with FDA regulations.
PPG INDUSTRIES; GRAHAM PACKAGING CO.LP
USA
Accession no.759655

Item 200
Packaging Digest
36, No.12, Nov.1999, p.54/8
RIGID PLASTICS: HERE, THERE AND EVERYWHERE
Lingle R
A review is presented of the rigid packaging industry, with historical background to the events and milestones of the industry. Developments in the plastic bottle are discussed, with beer and milk being two of the more recent products to be packaged in plastic. The increased use of PETP bottles is examined with respect to barrier properties and PEN blends. Trends and developments in closures are also described.
USA
Accession no.759653

Item 201
Additives for Polymers
Feb. 2000, p.7-8
SIDELE EXPLAINS ITS PLASMA TECHNOLOGY TO PET
Sidel SA’s plasma technology for improving the gas barrier properties of PETP bottles during manufacture is explained. Under the name Actis, the process is carried out by a 20-cavity machine that can be located in the line between the bottle blowing and filling machines. The cycle begins with the creation of a vacuum inside the...
bottle, so that the plasma state can be reached at ambient
temperature, and a compensating vacuum in the cavity
outside the bottle to prevent collapse. Microwave energy
turns acetylene gas into a cloud of more or less dissociated
particles, which ultimately collide with the inner walls,
where the sudden loss of energy causes the material to
revert to solid state, thereby creating a deposit in the form
of a layer of highly hydrogenated amorphous carbon.

SIDEL SA
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE;
WESTERN EUROPE
Accession no.759569

Item 202
Pack World
March 1999, p.8-9
BLISTER BONANZA
Pritchard R
It is explained that the display advantages of
thermoformed blister packs and clamshells are opening
up new markets for a type of packaging traditionally
associated with pharmaceuticals. This article reports on
the situation, with sections headed: unrivalled eye-
catching ability, expanding market, setting new standards,
convenience foods, recycling and incineration, and
practical and cost problems.
SUSSEX & BERKSHIRE; MULTIVAC;
GREENPEACE; FRIENDS OF THE EARTH
EUROPEAN COMMUNITY; EUROPEAN UNION; UK;
WESTERN EUROPE
Accession no.759398

Item 203
Bayer Reports
71, 1998, p.64-7
PLASTIC OUSTS GLASS - LIGHTWEIGHT
BOTTLES CALL THE TUNE
Heimerzheim P
Bayer AG
This article charts the success of the changeover from
glass bottles to polycarbonate ones, by the biggest dairy
in the Netherlands. The bottles are now manufactured
from Bayer’s “Makrolon” polycarbonate, and can be reused fifty times. Full details are provided.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY;
NETHERLANDS; WESTERN EUROPE
Accession no.759363

Item 204
Plastics Additives & Compounding
1, No.5, Oct.1999, p.30-4
RESORCINOL ADDITIVES FOR PACKAGING
EXTEND PRODUCT LIFE FOR FOOD AND DRINK
Durairaj R B
Indspec Chemical Corp.

This article gives details on the use of resorcinol-based
polymers as gas barriers in the manufacture of food and
drink packaging. Polyester, polyamides and
polyesteramides materials are used as a barrier layer in
the multi-layer containers. The high-performance
monolayer containers have the potential to extend the shelf
life of, for example beer, beyond that of the current nylon
6, nylon 6-6, MXD6, and PEN, because of its O2
permeability performance, even in very high humidity
conditions. Using PET as the main component in bottles
along with the high barrier layer reduces costs and the
barrier layer can be removed so the packaging material
can be recycled.
CONTINENTAL PET TECHNOLOGIES; CARLTON
UNITED; MITSUBISHI CHEMICAL; EASTMAN
CHEMICAL; OWENS-ILLINOIS; MITSUI
CHEMICAL CORP.
USA
Accession no.759100

Item 205
Plast’21
No.85, Oct.1999, p.111-3
Spanish
COINJECTION MOULDING FOR INNOVATIVE
PACKAGING
Kudlik N
Netstal AG
The principles of coinjection moulding and its use in the
production of multi-layer plastics packaging items are
examined. Technical features of machinery used in this
process are discussed, with particular reference to the
SynErgy 2C machine manufactured by Netstal.
HOFSTETTER O.,AG
SWITZERLAND; WESTERN EUROPE
Accession no.758826

Item 206
Plastics News(USA)
11, No.44, 20th Dec.1999, p.13
GRAHAM COMMERCIALISES NEW BOTTLE
PROCESS
Smith S S
Graham Packaging Co.LP has built a new plant to produce
a new kind of barrier coated PETP bottle for hot fill
applications, it is announced. The company is the largest
supplier of hot fill bottles to the juice industry. It is using
Bairocade barrier technology from PPG Industries Inc.,
which is capable of doubling the shelf life of juices. Brief
details are given of the operation.
GRAHAM PACKAGING CO.LP; PPG INDUSTRIES
INC.
USA
Accession no.757634
ADVANCEMENTS IN STRETCH-BLOW MOULDING TECHNOLOGY UNVEILED AT TOKYO'S IPF

The recent IPF show in Tokyo featured a slate of new Japanese stretch blow moulding machines for hot-fill containers, widemouth jars and extra-large containers. Frontier introduced its eight model, energy-saving, linear-type, two-stage BIO series units. Dry cycle time is quoted at 1.3s. A new addition to Nissei ASB’s PF series of single-stage injection stretch blow moulding machines is the PF3-1BHLL, which can mould handled PETP bottles up to 10L in capacity.

WIDEMOUTH CONTAINERS REPRESENT NEXT FRONTIER FOR BLOW MOULDED PETP

Widemouth jars represent the next major growth category for blow moulded PETP. Single-stage machines dominate the sector, with 48 cavities being the current cost/performance limit for tool design. The US market for widemouth food containers is estimated at 4-5.5 billion units. Graham Packaging has purchased a majority stake in PlasPET Florida, a blow moulder of specialty food and beverage packaging. Aoki has unveiled the SB III-350LL-100, a machine dedicated to widemouth containers. The unit enables six-cavity moulding of 1L containers with 68.5mm necks and two-cavity moulding of containers with 120mm necks.

NEW MATERIALS FOR EXTENDED SHELF LIFE PACKAGING

A developmental polymer system designed for use in applications that require a ‘total’ oxygen barrier or which require the removal of oxygen from the package headspace is described. The polymer system can be used as a layer of a coextruded blown or cast film, a coextrusion coating or a multilayered rigid container. The packages made using this system actively remove oxygen, are easy to handle and activate, have excellent clarity and good organoleptic properties. The developmental Oxygen Scavenging Polymer (OSP) system offers major improvements over existing oxygen scavengers. The OSP system is a non-sachet or pouch type scavenger which offers activation without the presence of moisture. The new system can also be used in applications that require excellent optical clarity. Examples of oxygen scavenging rates and capacities of multilayer films made from these materials are discussed.

PERMEATION BARRIER PROPERTIES OF POLYETHYLENE/MODIFIED BLENDS OF POLYAMIDE AND POLYVINYL ALCOHOL CONTAINERS AGAINST METHANOL/GASOLINE FUELS

One commercial grade of polyamide and/or PVOH resins are modified by a compatibiliser precursor to make various compositions of modified polyamide (MPA) and/or modified blends of polyamide/PVOH (MPAPV0H) through reactive extrusion. Good methanol/gasoline fuel permeation resistance together with clearly defined MPAPV0 and MPA laminar structures are found on containers blow moulded from the blends of PE/MPAPV0H and PE/MPA, respectively. The compositions of MPAPV0H and MPA resins are found to exhibit a significant influence on the methanol/gasoline fuel permeation resistance and morphology of PE/MPAPV0H and PE/MPA containers, respectively. Possible mechanisms are proposed to explain these interesting phenomena. 21 refs.
Several numerical simulations are included which offer general guidelines for new packaging developments. 3 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; NETHERLANDS; WESTERN EUROPE

Accession no.755439

Item 212
Injection Molding
7, No.10, Oct.1999, p.102/5
MULTILAYER BARRIER PREFORMS ARRIVE VIA MULTICAVITY COINJECTION
Kirkland C

The development is described of a multilayer preform manufacturing cell for use in the manufacture of PETP beverage bottles. Developed by Kortec, the company's hot runner-based coinjection system meets or exceeds the requirements of the PETP beverage container industry for multilayer preforms, and has been installed at Ball Corp.'s Plastic Container Operations. Details are given of the manufacturing cell and a non-destructive inspection unit.

KORTEC
USA
Accession no.755432

Item 213
European Plastics News
26, No.11, Dec.1999, p.25-7
BARRIERS FOR BEER

Improving the barrier performance of PETP bottles is a crucial factor if they are to succeed in the beer packaging market. Multilayer designs are currently the most widely used solution for commercial PETP beer bottles. Plasma coatings have been the subject of most of the new announcements in this area in recent months. Sidel's Actis process is said to increase the barrier properties of a single-layer PETP bottle by 30 times for oxygen and seven times for carbon dioxide. Another development is overmoulding an external layer on the preform to create a two-layer bottle.

WORLD
Accession no.754599

Item 214
Adhasion Kleben & Dichten
41, No.9, 1997, p.18/24
German
LABELLING OF PETP BOTTLES
Onusseit H
Henkel

The growing importance of PETP bottles in the drinks industry has reached a stage where procedures used in this line of work have had to be changed. Labelling has also been adapted to fit this change in materials which in turn has made the formulation of new label adhesives a definite requirement. The growth in use of the plastic bottle in the USA from the 1940s is traced, including the application of synthetic fibres, the use of ethylene glycol and the esterification of two ethylene glycol molecules with one terephthalic acid molecule in one monomer. Also examined are the packaging of carbonated fresh drinks, the market share of PETP bottles in Germany, polycondensation techniques, automated labelling techniques used on PETP bottles, adhesives for such labelling and the future development of PETP bottles.

PEPSI COLA CO.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; USA; WESTERN EUROPE; WORLD
Accession no.754448

Item 215
ZERO PERMEATION POLYESTER BOTTLE SOLUTIONS FOR PACKAGING
Cahill P J; Barski R G
BP Amoco Chemicals
(Schotland Business Research Inc.)

An outline is presented of BP Amoco's total polyester solutions for packaging, with emphasis on the packaging of beer.

USA
Accession no.753894

Item 216
Orlando, Fl., 1st-2nd Feb.1999, p.367-75
STUDIES OF THE EFFECT OF BOTTLE MATERIALS PROCESS PARAMETERS ON FLAVOUR COMPONENTS IN BEER
Kempa B-T; Dorr C
Krupp Corpoplast Maschinenbau GmbH;
Munchen,Technische Universität
(Schotland Business Research Inc.)

The requirements for plastics beer bottles, with emphasis on taste/odour effects on contents, are outlined. 4 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.753893

Item 217
Orlando, Fl., 1st-2nd Feb.1999, p.359-65
TECHNICAL AND MARKET CHALLENGES FOR PETP CONTAINERS IN THE MILK INDUSTRY
Panella R C
Franklin Plastics Inc.
(Schotland Business Research Inc.)

An overview is presented on the use of PETP containers for the packaging of milk and dairy products.

USA
Accession no.753892
INTEGRATED BLOW FILL SYSTEM

Appel O; Spang D
Krones AG
(Schotland Business Research Inc.)

An outline is presented of an integrated blow fill packaging system developed by Krones of Germany.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.753889

MULTI-MATERIAL PREFORM MOULDENING: NEW TECHNOLOGIES FOR LOWER COST PREFORMS FOR BEER

Halsall K; Rao R
Husky Injection Molding Systems Ltd.
(Schotland Business Research Inc.)

The potential for growth in the PETP industry will be fuelled by innovative technologies that enhance PETP’s capability to the meet the needs of the beer industry. Initially the consumer will drive the conversion to PETP regardless of the barrier performance and cost, because they like the package. However to have a significant penetration into this market, PETP containers will need not only improved barrier properties, but also costs that compete with existing glass and metal containers. The current technologies for multilayer preforms are reviewed, the variables that impact cost examined and a solution for economic production is identified.

CANADA

Accession no.753888

EMERGING TOMATO-BASED PRODUCTS IN PETP CONTAINERS

Tekkanat B
Schmalbach-Lubeca Plastic Containers USA Inc.
(Schotland Business Research Inc.)

Some company information is presented on Schmalbach-Lubeca Plastic Containers. Aspects covered include accelerated shelf life testing, shelf stability of food in PETP containers, enhanced performance packaging and WMHS commercial introductions.

USA

Accession no.753887

ACTIVE PACKAGING: UV-ABSORBERS IN PETP CONTAINERS TO PROTECT PHOTOSENSITIVE PRODUCTS

Andrews S M; Oertli A G
Ciba Specialty Chemicals Inc.
(Schotland Business Research Inc.)

Many food and non-food products have a limited shelf life due to photooxidation resulting in changes in colour appearance, flavour, composition or performance. Food-approved UV light absorbers (UVAs) are available which offer exceptional light absorbing capabilities for clear packaging. When added to PETP, Tinuvin 234 or Tinuvin 1577 preserve the integrity of package contents and can extend shelf life. These light absorbers also protect the PETP package itself from the unattractive yellowing which PETP undergoes when subjected to UV light. The effectiveness of using Tinuvin UV absorbors in clear and pigmented PETP packaging for preserving a variety of consumer and food products is demonstrated. 11 refs.

SWITZERLAND; USA; WESTERN EUROPE

Accession no.753886

PERFORMANCE AND ECONOMIC COMPARISON OF COLD FILL VERSUS HOT FILL FOR BEVERAGE PRODUCTS

Goldberg B A
TAPPA Group International
(Schotland Business Research Inc.)

Hot fill and aseptic technologies have dominated the US beverage market for shelf stable fruit juices, juice drinks, fruit-based beverages, isotonics and related products for many years. Hot fill is used predominantly for multi-serve as well as some single serve containers, both glass and plastic. Aseptic is used predominantly for single serve products in juice boxes. However, aseptic processing is starting to be used for various beverage products packaged in multi-serve plastic bottles. Cold fill technology is being used increasingly in the USA for various shelf-stable beverage products. These products typically use preservatives. Basically, the preservatives destroy various yeasts, moulds and bacteria. In hot filling and aseptic processing, these organisms are destroyed, and based on the processing conditions and the total product formula, preservatives are generally not required. Typically there is a cost savings achieved in utilising cold filling technology, both from the perspective of overall processing costs and packaging costs. In regard to polyester containers, more conventional soft drink type containers can be used with cold filled products which are less expensive than heat treated containers that are required for hot filled products. Cost savings for PETP containers at the 16-20 oz size are typically in the area of
References and Abstracts

15-18% for conventional PETP containers compared to heat treated/hot fillable containers. Details are given. USA

Accession no.753881

Item 223
FUTURE FOOD PROCESSING TECHNOLOGIES AND THEIR POTENTIAL IMPACT ON PETP CONTAINERS
Goodrich N
Twinpak Inc.
(Schotland Business Research Inc.)
The impact of food processing technological developments on PETP container demand is described.
CANADA
Accession no.753880

Item 224
SOON IN THE USA: THE FIRST HIGH SPEED ASEPTIC BLOW-FILL-CAP SYSTEM FOR LONG SHELF LIFE REFRIGERATED FRESH MILK
Buteux G
Sidel SA
(Schotland Business Research Inc.)
By following a pragmatic strategy directed to satisfying customers, Sidel is bringing new innovative concepts taking full advantages of the plastic bottle. All signs in the dairy industry show that consumers are willing to change to the plastic bottle whenever this package is available. Among others, the added benefit of the PETP bottle is that it can be considered as contemporary and therefore opens applications for new markets such as beverage milks.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.753879

Item 225
WORLD'S FIRST COMMERCIAL BARRIER COATED BEER BOTTLE: CASE HISTORY
Mansour J M
Amcor Ltd.
(Schotland Business Research Inc.)
A case history is given of the development of what is claimed to be the world’s first commercial barrier coated beer bottle. Aspects covered include a project overview, customer requirements, technology options and implementation.
AUSTRALIA
Accession no.753877

Item 226
TECHNICAL PACKAGING REQUIREMENTS FOR TEAS & ‘NEW AGE’ BEVERAGES
Bowers M A
Royal Crown Co.Inc.
(Schotland Business Research Inc.)
This presentation is aimed at the packaging manufacturers to continuously look at their own processes and products and how they can add value to existing packages and provide innovative design and consumer appeal and to developmental needs for new packaging designs and materials. Emphasis is placed on PETP applications as opposed to glass.
USA
Accession no.753872

Item 227
CO-INJECTION STRETCH BLOW MOULDING OF LCP/PETP MULTILAYER BARRIER CONTAINERS
Lusignea R W
Superex Polymer Inc.
(Schotland Business Research Inc.)
Liquid crystal polymers (LCPs) are combined with PETP to make high barrier multi-layer plastic bottles by co-injection stretch blow moulding for the first time. This new materials and processing technology should provide longer shelf life for beer, at equivalent cost to other plastic barrier bottles. An LCP/PETP alloy is used as a barrier layer in a multi-layer bottle made on machinery that can be scaled up to high-speed commercial production rates. The oxygen permeability of this 0.5 litre PETP bottle is reduced by more than 1.7 times with the addition of only 4.5% LCP in the total volume of the bottle. Also, the LCP/PETP bottle shows the same burst pressure as the PETP, and has significantly lower volume expansion at pressurisation due to the reinforcing effect of the LCP. Top load was higher and deflection at load is lower for the LCP/PETP bottles than pure PETP.
USA
Accession no.753871

Item 228
BARRIER DEVELOPMENTS FOR POLYESTER PACKAGES
Stewart M
A systems approach to understanding and improving package barrier and shelf life is presented. The optimum solution will differ from application to application.

USA

Accession no.753870

**Item 229**

**NEW DELAMINATION RESISTANT EVOH RESIN GRADE FOR BARRIER PETP/EVOH MULTILAYER APPLICATIONS**

Lambert S; Tai S
EVAL Company of America; Kuraray Co.Ltd. (Schotland Business Research Inc.)

EVAL XEP-438 and XEP-439 resins have been developed by Kuraray as resins which have improved delamination resistance for PETP/EVOH bottles. The delamination resistance of XEP-43 8 and XEP-43 9 is much better than that of conventional EVOH resins such as F101 and that of MXD6 nylon resin. New products are introduced with information related to delamination resistance, oxygen barrier properties and other general performance characteristics.

JAPAN; USA

Accession no.753869

**Item 230**

**EMERGING NANOCOMPOSITE TECHNOLOGIES FOR BARRIER AND THERMAL IMPROVEMENTS IN PETP CONTAINERS**

Kamena K
Nanocor Inc. (Schotland Business Research Inc.)

Clay/polymer nanocomposites are being investigated and developed worldwide by a number of public, private and corporate entities. Many of the efforts are naturally proprietary to protect intellectual properties and competitive situations. Nanocor is an active participant in developing nanocomposite technologies and clay products for a variety of polymer types including PETP. A Nanocor progress report covering the development of layered silicates for the preparation of PETP nanocomposites, and technologies related to PETP containers, is presented. This is a work in progress and an attempt to acquaint PETP processors and users with this unique concept, ongoing developments and commercial expectations.

USA

Accession no.753868

**Item 231**

*European Plastics News*

26, No.10, Nov.1999, p.80

**NEW PETP FOR ONE-WAY BEER BOTTLES**

Shell Chemicals has introduced Cleartuf Power, an enhanced grade of its Hipertuf 89010, but in PETP rather than PEN. The new grade is aimed at one-way bottles for tunnel in situ pasteurised beers. Cleartuf Power provides increased thermal and pressure stability, improved flavour stability and reduced permeation of oxygen and carbon dioxide through the bottle. To meet European shelf life requirements of six months, Cleartuf Power bottles must be combined with a barrier technology such as multilayers or coatings.

SHELL CHEMICALS CO.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no.752627

**Item 232**

**NEXT GENERATION OF POLYPROPYLENE RESINS FOR THIN WALL INJECTION MOULDING APPLICATIONS**

Kishbaugh L
Montell Technology (SPE,South Texas Section; SPE, Thermoplastic Materials & Foams Div.; SPE, Polymer Modifiers & Additives Div.)

The container used to package dairy products has evolved from the wax paper cup to HDPE and now PP. This has been driven by a continuing desire to reduce container cost and the environmental need for source reduction. The introduction of 35 g/10 minute melt flow rate (MFR) heterophasic copolymers in the early 1990s helped drive this conversion to PP. These were the first PP materials that could provide the impact performance required at 4 deg.C and still maintain the top load strength of the HDPE container but with a thinner wall. Continuing improvements in mould building and advances in injection moulding machines have allowed moulders to continue to down gauge the HDPE container. In the last two years, thermoforming has started making inroads into the thin wall injection moulded container market. These thermoformed containers are lighter than the 0.018 in. injection moulded container, and are threatening to take a significant portion of the container business. In order for injection moulding to remain competitive, a major step in melt flow rate and property performance is needed.

A new Ziegler-Natta catalyst system currently under development by Montell allows for a significant increase in the as polymerised melt flow rate of copolymers while retaining impact strength.

USA

Accession no.751151
Item 233

Modern Plastics International
29, No.10, Oct.1999, p.79

COLOUR-SHIFT EFFECTS ADD AESTHETIC APPEAL TO HDPE BOTTLES
Leversuch R D

Multi-hue effects are achieved by Clariant Masterbatches’ Spectrachrome Iridescent concentrates applied in multilayer PE bottles. The concentrates draw on a novel pigment developed and patented by Flex Products and sold as Chromaflair. The pigment offers a dramatic range of colour reflectivity that realises up to four distinct colours or shades in the same bottle, depending on the light angle or position of the light source.

CLARIANT MASTERBATCHES

USA

Accession no.749340

Item 234


TWENTY-YEAR RETROSPECTIVE ON PLASTICS: OXYGEN BARRIER PACKAGING MATERIALS
Strupinsky G; Brody A L
Rubbright-Brody Inc.
(TAPPI)

An enumeration and critical analysis is presented of the many worldwide developments and proposals of the past twenty years for oxygen barrier plastic package materials for food products. Introduced with great publicity, numerous oxygen barrier technologies have either disappeared or have evolved elsewhere. The rationales for their initiation and apparent reasons for their current positions are reviewed.

USA

Accession no.748287

Item 235

Retail Packaging
2, No.3, May/June 1999, p.15

CASE FOR PLASTIC

The advantages of rigid plastics in transit packaging are becoming more widely recognised, with a number of major supermarket chains among those changing to returnable plastic trays and pallets. The green credentials of plastic are nowhere more evident. In store, too, shoppers are being encouraged to use plastic boxes again and again, rather than add to their supply of plastic bags under the kitchen sink. Hays Crate Services, the returnable transit packaging specialist, is investing more than one million pounds sterling in expanding the pool of nesting trays it provides to food retailer Waitrose. Three months into its ten-year contract with Hays, Waitrose has changed more products to returnable transit packaging which will increase tray movements in and out of stores from five million a year to more than eight million. In the field of plastic pallets, a new, optional moulded lip has improved the Duro-Pallet from Cookson Plastic Moulding, preventing load slippage and making pallet stacking easier and safer. Details are given.

HAYS CRATE SERVICES; COOKSON PLASTIC MOULDING
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no.747596

Item 236

Packaging Digest
36, No.8, July 1999, p.42

MILLER FINE-TUNES PLASTIC BOTTLES, COMPONENTS
Lingle R

The Miller Brewing Co. is making major changes to its 5-layer plastic bottle from Continental PEP Technology. This comprehensive article supplies details of the changes which mainly involve increasing and enhancing the recyclability of the 16- and 20- oz. Beer bottles. The bottles will utilise post-consumer recycling content, and the aluminium closures will remove completely from the bottles. The bottles are made from a five-layer PETP, blow moulded by Continental.

MILLER BREWING CO.; CONTINENTAL PETP TECHNOLOGIES INC.; SILGAN CONTAINERS MFG.CORP.; NORTHSTAR PRINT GROUP
USA

Accession no.747598

Item 237

Packaging Digest
36, No.8, July 1999, p.32

CRACKERS SNACK ON INNOVATIVE CANISTER
Abrams B

Austin Quality Foods has increased its sales with a unique nonround plastics canister, extending its Dolphins & Friends crackers line for additional facings in supermarkets. This article supplies comprehensive details of the features and advantages of the innovative rectangular canister, which is made from recycled polyethylene, with an injection moulded friction-fit overcap. The canister provides excellent moisture and oxygen barriers, has a closure system made from PETP, and is recyclable.

SONOCO PRODUCTS CO.; DIXON & PARCELS ASSOCIATES; PACKAGING RESOURCES INC.; MOBIL CHEMICAL CO.; AUSTIN QUALITY FOODS
USA

Accession no.747596
CLEAR CHOICE FOR HIGHLY TRANSPARENT PP PRODUCTS
Bezuidenhout P
Polifin Ltd.

Properties and characteristics are described for Polifin’s PP 3250NC clarified random copolymer grade, which is claimed to offer exceptional clarity in injection moulded and stretch blow moulded products. Particular applications are in household storage containers, cosmetic packaging and stationery products, where it is used to impart aesthetics and chemical resistance. The material exhibits clarity, surface gloss, and low temperature toughness. Polifin 3250NC can be pigmented using Milliken Chemical’s ClearTint colourant. Its properties are compared to those of other packaging materials. 2 refs.

SOUTH AFRICA
Accession no.744468

PPG’S PET PROJECT
Esposito C C

With its success proven in the Middle East and Australia, PPG Industries is hoping to lure new US customers to its Bairocade gas barrier coatings for PETP packaging. Bairocade offers an alternative to multilayer PETP. Bottles with Bairocade gas barrier coatings can be recycled back into fibre, strapping, sheet and even single-layer food and beverage containers.

PPG INDUSTRIES INC.
USA
Accession no.743900

MECHANICAL RECYCLING OF POST-USED HIGH-DENSITY POLYETHYLENE CRATES USING THE RESTABILISATION TECHNIQUE. I. INFLUENCE OF REPROCESSING
Kartalis C N; Papaspyrides C D; Pfandnner R; Hoffmann K; Herbst H
Athens, National Technical University

A remelting-restabilisation technique is applied for the recycling of post-used, yellow-pigmented HDPE bottle crates. Multiple extrusion cycles procedure, at different reprocessing temperatures, is performed for monitoring the processing stability of the restabilised and non-restabilised material as reference. In addition, mechanical properties measurements are carried out to further study the effect of restabilisation on the performance of the recycled material. Finally, repigmentation is used to investigate the role of new pigments on the final recycled product. The results illustrate that restabilisation of post-used crates leads to careful reprocessing without severe degradation, an essential prerequisite for reuse in the original application. 26 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; GREECE; WESTERN EUROPE
Accession no.744468

ACTIVE POLYMERS
Activ-Pak products use an enabling technology that allows polymeric materials to absorb, release or transmit substances in a controlled manner over time. This new technology creates interconnecting transmitting channels within a polymeric material to facilitate diffusion of substances through the polymer. The products can be made from all types of polymers into any shape or form via any type of plastic processing. The materials can be incorporated directly into a product or into a product’s primary packaging and can be engineered to accommodate automation. Details are given.

CAPITOL SPECIALTY PLASTICS INC.
USA
Accession no.743900

PEPSI 2-L PETP GRABS HOLD
Pepsi-Cola is test-marketing a contour-shaped 2l PETP bottle named The Grip, with a built-in, easy-to-grip handle design. Available for nearly a year in the Dayton area, initially for Pepsi, Diet-Pepsi, and Caffeine Free Pepsi and Caffeine Free Diet Pepsi products, the new Grip bottle is the first to retain a grip shape under carbonation, the company claims. Details are given.

PEPSI COLA CO.
USA
Accession no.743891

BRIGHTENING UP THE PET COLOUR SCENE
ColorMatrix Europe has developed a new family of PETP additives, which will enhance the colouring of PETP preforms and bottles, it is announced. The company specialises in the provision of liquid colourant systems, and supplies three families of additive providing UV protection, acetaldehyde reduction and a variety of process aids which are claimed to provide significant opportunities.
Aoki Technical Laboratory has patented technology for a PETP bottle moulded from a preform with an integrated, hinged handle. Once the bottle has been blow moulded and filled with a product, the handles bend into an upright position for easy carrying. The company says molecular orientation of the PETP resin gives the handle impressive strength, allowing it to hold the filled bottle even as the handles are flexed upright at a 90 degree angle. An Aoki machine can turn out 10L handled bottles at a rate of 140/hour or 760 5L bottles an hour.

AOKI TECHNICAL LABORATORY INC.
USA

SIDEL claims beer breakthrough
Sidel says that it has invented a new technology to give PETP bottles the chance to compete on an equal level with glass bottles for beer packaging. The ACTIS - Amorphous Carbon Treatment on Internal Surface - process gives PETP bottles barrier properties comparable to glass bottles and metal drink cans. The company describes it as a decisive innovation in PETP packaging for the as-yet huge and untapped beer packaging market. The ideal PETP bottle for the beer market should provide a good barrier to oxygen getting into the bottle, and carbon dioxide escaping out of the bottle. In addition, there should be no aldehyde migration from the bottle into the beer. The process consists of coating the inside of a standard, single-layer PETP bottle with a layer of highly hydrogenated amorphous carbon. Brief details are given.

SIDEL SA
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE

Oxygen scavengers have been used for years to protect perishable foods and medical supplies from spoilage, mainly in the form of scavenger-bearing pouches packaged with the product. However, this approach is unsuitable for liquids, and has raised objections to having a ‘foreign body’ mixed with the product. Today, scavenger-bearing films are being built into laminated plastic containers and closures, to prevent direct contact with the product, according to speakers at a recent conference. Details are given.

USA

Developments in barrier polymers for use in packaging are reviewed, and coextrusion and plasma deposition processes used in the production of barrier packaging are examined. Methods for the modification of barrier properties through the blending of polymers are discussed, with particular reference to PETP/EVOH blends, blends of PS with low molecular weight liquid crystals, and PE/polyamide blends for automotive fuel tanks. 102 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
TRENDS IN THE RETAIL PACKAGING OF BEER: OPPORTUNITIES FOR PET
Cross C
Marketpower Ltd.

The European beer bottle markets are examined, with reference to trends in packaging materials, namely, glass bottles, both returnable and one-trip, cans, and PETP bottles. The situation is examined for Germany, Belgium, the Netherlands, Spain, France, Italy and the UK, with details of market shares. The growth of PETP for bottling water and beer is examined, with details of materials and technological developments which have enabled the material to be a contender in the marketplace.

EUROPE-GENERAL
Accession no.739874

Item 250
Modern Plastics International
29, No.7, July 1999, p.26/46
BARRIER COATING OPTIONS CAN REDUCE COST AND EXTEND SHELF LIFE IN BEER BOTTLES
Colvin R

New barrier technologies could boost the use of PETP bottles for beer and fruit-based beverages. Plasma coating provides a barrier 30 times higher against oxygen ingress and seven times higher to carbon dioxide than monolayer PETP bottles. Sidel’s Actis 20 treating equipment has 20 stations and coats 10,000 PETP bottles/h in sizes up to 0.6L. Meanwhile, Sipa has introduced equipment to spray a barrier coating on the outside of PETP bottles. The integrated production process firsts targets reducing oxygen levels trapped in PETP bottle walls.

SIDEL SA; SIPA SPA
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; ITALY; WESTERN EUROPE
Accession no.737454

Item 251
Modern Plastics International
29, No.7, July 1999, p.26/46
CRYOGENIC BLOW MOULDING RAISES HOT-FILL PERFORMANCE OF MONOLAYER CONTAINERS
Gabriele M C

Plastic Solutions Molding claims its CryoPak cryogenic two-stage blow moulding process delivers monolayer PETP containers that withstand hot-fill and pasteurising techniques for food and beverage packaging. Liquid nitrogen is introduced during stretch blow moulding of the PETP preform. The process also involves extreme heat-setting of PETP bottles through hot moulds in excess of 150°C. This elevated mould temperature is employed to build crystallinity in the container, making it more thermally stable for hot-fill applications. The higher crystallinity is said to improve barrier properties and imparts greater stiffness to the container’s top-load mechanical strength.

PLASTIC SOLUTIONS MOLDING INC.
USA
Accession no.737453

Item 252
Food Packer International
14, No.6, June 1999, p.24
EASTMAN SHEDS LIGHT ON CONTAINER PREFERENCES

Results are considered of a consumer study carried out by the University of Georgia and sponsored by Eastman Chemical, into buying preferences for packaged reheatable foods. Types of packaging tested included PP with a rigid dome, paperboard with lidding film, crystallised PETP with lidding film and CPETP with a rigid dome. Dual-ovenable packages were the first choice (92%), and despite the increased costs, 30% of consumers said they would be willing to pay more for the flexibility and convenience offered by the choice of microwave and conventional oven reheating methods.

EASTMAN CHEMICAL CO.; GEORGIA, UNIVERSITY
USA
Accession no.736646

Item 253
Plastics News(USA)
11, No.10, 26th April 1999, p.26
PRENT CATHETER PACKAGE EARNS TOP AWARD
Jackson E

A coronary imaging catheter package made by Prent was named Thermoformed Package of the Year at this year’s SPI’s Thermoforming Institute National Awards. Other winning designs included a music station, door assemblies, a heart laser cart and a dolphin-shaped candy clamshell.

PRENT CORP.; SPI
USA
Accession no.736147

Item 254
Adhesives & Sealants Industry
6, No.4, May 1999, p.44
PREDICT 30% CONVERSION RATE FROM DRUMS TO IBCS

It is predicted that 30% of the food and chemical manufacturers in the US will convert from drums to plastic intermediate bulk containers between 1998 and 2003. The IBC eliminates disposal issues, maximises safety, eases
tracking and minimises transportation costs through multiple-trip use. Meese Orbitron Dunne’s leakproof IBC is rotomoulded from PE into a single, seamless unit of uniform wall thickness.

MEESE ORBITRON DUNNE CO.
USA
Accession no.736130

Item 255
High Performance Plastics
June 1999, p.1
PLASMA MAKES PETP AS GOOD AS GLASS
(AND AS CHEAP, TOO)
Sidel has developed a new plasma technology for coating the inside of PETP bottles using equipment based on its high-output blow moulding machines. PETP bottles are produced with barrier properties claimed to be up to 30 times the normal barrier to oxygen and 7 times stronger barrier to carbon dioxide. The ACTIS process coats the internal surface of a standard single-layer PETP bottle with a layer of highly hydrogenated amorphous carbon, obtained from food gas in its plasma state.
SIDEL SA
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.734185

Item 256
New York City, 2nd-6th May, 1999, p.120-27
INJECTION/STRETCH BLOW MOULDING OF PET/LCP BLENDS FOR BETTER PRODUCT PERFORMANCE
Garcia-Rejon A; Nguyen K T; Michaeli W; Morich L; Schmidt G; Lusignea R
Canada, National Research Council; Aachen, Institute of Plastics Processing; Superex Polymer Inc.
(SPE)
Blends of polyethylene terephthalate and liquid crystalline polymer (LCP) were evaluated as candidate materials for bottles to be used for hot filling, manufactured by injection stretch blow moulding. The flow resistance of the blends decreased with increasing LCP content. The processability of the blends was evaluated by blow moulding bottles. The LCP content had a stabilising effect on the stretching and blowing process, and also enhanced the compressive load which the bottles were capable of withstanding at 70°C. The ability of the bottles to withstand hot filling increased, and the oxygen permeability decreased with increasing LCP content in the blend. 7 refs.
CANADA; EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; USA; WESTERN EUROPE
Accession no.734090

Item 257
New York City, 2nd-6th May, 1999, p.1010-6.012
HOT FILLABLE CONTAINERS MANUFACTURED FROM NEW POLYMERIC COMPOUNDS BASED ON PET/PEN COPOLYMERS AND BLENDS
Ophir A; Kenig S; Shai A; Barka’ai Y
Israel Plastics & Rubber Center; LOG Plastic Products Co.
(SPE)
Polyethylene terephthalate (PET), copolymers of ethylene terephthalate and ethylene naphthalate, and blends of PET with the copolymers were evaluated as candidate materials for the manufacture of bottles by injection stretch blow moulding, intended for hot filling. The materials were characterised by differential scanning calorimetry and dynamic thermal mechanical analysis. It was concluded that the blends were suitable materials for this application. 12 refs.
ISRAEL
Accession no.734086

Item 258
New York City, 2nd-6th May 1999, p.3931-5.
DISTRIBUTION OF MATERIAL IN AN INJECTION MOULDED CONTAINER
Aasetre S
Borealis AS
(SPE)
The distribution of material (weight) in an injection moulded container is quantified by cutting the container precisely into segments. Moulding conditions are varied, and different PP grades are used. Material distribution remains nearly uniform when increasing the packing pressure. Increasing the packing time above a certain limit, however, mainly packs material close to the gate. Material distribution is also affected by material parameters such as melt flow rate and nucleation. The shrinkage and the compressive strength of the container are related to material distribution.
NORWAY; SCANDINAVIA; WESTERN EUROPE
Accession no.734037

Item 259
COMPARISON OF EXTRUSION AND INJECTION BLOW MOULDED BOTTLES
Cribbs M R
Pennsylvania, College of Technology
(SPE)
Processing decisions are often made between blowing bottles by the extrusion or injection blow moulding
technique in companies having both capabilities. Where parison melt strength is not a problem, one of the major considerations is the strength of the resultant bottle. Using the same bottle geometry and same plastic material under optimum processing conditions for each method, tensile testing is performed. The tensile specimens are die cut from side wall panels and compared. Results show the mechanical differences generated by the two approaches.

4 refs.

USA

Accession no.734018

Item 260

**Plastics Technology**

45, No.4, April 1999, p.58-9

**BEER IN PLASTIC - SO MANY WAYS TO GET THERE**

Knights M

This article explores the many methods being tested, such as coinjection, over-moulding, barrier coatings and resin blends, to produce a plastic beer bottle that satisfies every requirement. It considers: PETP bottles, EVOH materials for barrier properties, PEN bottles, nylon, epoxy amine barrier coatings, LCP alloy, nanocomposites, and oxygen scavengers.

BP AMOCO CHEMICALS; SHELL CHEMICAL; NANACOR INC.; PPG INDUSTRIES INC.; EASTMAN CHEMICAL CO.; AMOCO POLYMERS; CONTINENTAL; EVAL CO.; HUSKY INJECTION MOLDING SYSTEMS LTD.; KRUPP CORPOPLAST; MITSUBISHI GAS CHEMICAL AMERICA INC.; SUPEREX POLYMER INC.

CANADA; USA

Accession no.733906

Item 261

**Modern Plastics International**

29, No.5, May 1999, p.47-50

**BLOW MOLDED PACKAGING MELDS STYLE AND SUBSTANCE**

Defosse M T; Moore S

The global cosmetics and toiletries packaging market stands at 9 billion US dollars per year and is experiencing rapid growth. This detailed article looks at the latest developments from key manufacturers, including multilayer structures and diverse materials, which are creating colourful, eye-catching designs.

CLARIANT; HANNA M.A.,COLOR; UNITIKA LTD.; VICTOR INTERNATIONAL PLASTICS; REVLON TECHNOLOGIES; CHEUN KYUNG CO.; MONTELL; ENGELHARDT; EASTMAN CHEMICAL CO.; ASPPELL POLYMERS; ELF ATOCHEM; UNION CARBIDE; ALGROUP WHEATON; WEEKER PLASTIC GROUP; SUPEREX POLYMER; TOPPAN PRINTING CO.; MILLIKEN CHEMICAL; SOMATER; STAK PLAST; CEBAL

ASIA; EUROPE-GENERAL; EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; GERMANY; NORTH AMERICA; SOUTH KOREA; UK; USA; WESTERN EUROPE; WORLD

Accession no.733544

Item 262

**Modern Plastics International**

29, No.5, May 1999, p.27-8

**EXPLODING DVD MARKET SPURS INNOVATIONS IN POLYPROPYLENE**

Graff G

It is reported that polypropylene producers are actively working to develop improved resin grades, to package digital versatile discs (DVD’s), the next generation of ultra-high-density optical storage media. The article then highlights several developments from key PP producers.

MONTELL NORTH AMERICA; INTERNATIONAL RECORDING MEDIA ASSOCIATION; TARGOR GMBH; ALPHA ENTERPRISES; JOYCE MOLDING; BASF CORP.; CLEAR-VU PRODUCTS; LASERFILE INTERNATIONAL; VARIOPAC EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; USA; WESTERN EUROPE

Accession no.733537

Item 263

**Materiaux & Techniques**

86, Nos.9/10, Sept./Oct.1998, p.3-5

**THOUGHTS ON CLOSURES FOR CONTAINERS FOR FOOD AND CHEMICAL PRODUCTS**

Reyne M

ENSAINS

Applications of plastics in place of cork, glass and metals in closures for containers for wines, beer and other beverages, cosmetics, perfumes and chemical and pharmaceutical products are discussed. Developments in the use of plastics in bottles and other containers are also reviewed. 2 refs.

SABATE; DU PONT DE NEMOURS E.I.,& CO.INC.; EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; USA; WESTERN EUROPE

Accession no.732506

Item 264

**Revista de Plasticos Modernos**

76, No.506, Aug.1998, p.128/32

**EXTRUSION BLOW MOULDING**

Allue S

The extrusion blow moulding process for the production of plastics containers is described, and types of machinery and polymers used in the process are reviewed.
STRUCTURAL FOAM CONTAINER COLLECTS AWARD
Antosiewicz F
A big blue 54 in., 150 lb agricultural container attracted considerable attention at Structural Plastics ’99 in Boston. Mould maker FU Precision Works of Concord, Ontario, entered the container, and later became the winner of the Materials Handling Award. The container, which can be supplied as a solid or vented box, is structural foam moulded from PE, and has a static load capacity of 15,000 lb. Brief details are given.

CLEAN MACHINES
Lee M
Henniez, the major Swiss beverage producer and bottler, has recently installed a new linear aseptic PETP blow moulding and bottling system from Tetra Pak. The launch product for the system is the new Virgin brand iced tea drink. The flash pasteurisation used in the aseptic process is considerably more gentle than the hot-fill process and does not destroy tea’s subtle flavour or its nutritional content in the same way.

POLYESTER PACKAGING CHALLENGES CONVENTIONAL MATERIALS
This article reports on the use of polyethylene terephthalate (PETP) and polyethylene naphthalate (PEN) resins for beer bottles, following improvements in the resin’s performance in response to demands. The resins’ favourable properties are highlighted.

PRACTICAL THERMAL RESISTANCE AND ICE REQUIREMENT CALCULATIONS FOR INSULATING PACKAGES
Burgess G
Several styles of insulating packages were studied, varying in construction from the ordinary expanded PS cooler to various liner-in-box arrangements with or without aluminium foil surfaces. Ice-melt tests were conducted to measure package insulating ability and the results were used to determine the thermal resistance (R-value). The R-value was then related to details connected with package construction, including wall thickness and number of layers, through a simple equation so that it can be estimated for any construction. 4 refs.
References and Abstracts

Item 271
Packaging Technology & Science
12, No.2, March-April 1999, p.67-74
STUDIES ON POLYESTER PACKAGING.
EFFECTS OF BASIC WASHING ON MULTI-USE PETP AND PEN BOTTLES
Safa H L; Bourelle F
Reims,University
Washing PETP or PEN bottles intended for reuse with sodium hydroxide solutions appeared to affect the surface of the materials. The possible hydrolysis of the ester chemical function during the process was investigated. A new method for extracting and separating neutral and acidic products from the polymers was developed, and relative quantification of the isolated molecules was carried out by gas and liquid chromatography. 11 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.726895

Item 272
Packaging Technology & Science
12, No.2, March-April 1999, p.57-65
DESIGN OF A FUNCTIONAL BOX FOR TAKE-AWAY PIZZA
Fava P; Piergiovanni L; Pagliarini E
Milan,University
Packaging for take-away pizza must guarantee adequate protection against rapid temperature decrease and water vapour elimination, to maintain quality. The performance of a traditional corrugated cardboard container was compared with that of a new package, realised with expanded PS and a water-absorbing UHDPE. The water absorption, water vapour transmission rate, thermal insulation and sensory profile tests showed that the new packaging was better than the traditional one. 13 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.726894

Item 273
Medical Device Technology
10, No.3, April 1999, p.26-8
MEDICAL PACKAGING: MORE FOR LESS?
Andrews J; Hunt N
Rexam Medical Packaging Ltd.
It is explained that the market for medical devices is governed by the need to have validated product and processes, clean manufacturing environments, and proven shelf-life, often for products which are disposable, low-unit-cost items and, as such, highly price-sensitive. This article considers the medical device packaging market, and the steps taken by packaging manufacturers to respond to these pressures while maintaining long-term viable products.
EUROPE-GENERAL; EUROPEAN COMMUNITY; EUROPEAN UNION; UK; USA; WESTERN EUROPE
Accession no.726894

Item 274
Medical Device Technology
10, No.3, April 1999, p.20/4
MATERIALS FOR PREFORMED RIGID-TRAY PACKAGES
Pilchik R
Techmark Group
This article assesses the materials used for medical device packaging that employs rigid preformed trays. It lists the basic requirements for these materials, and then summarises the properties of each that make them useful for specific medical-packaging applications. A cost model is also included to illustrate how to properly select materials of similar properties on a cost-per-part basis.
USA
Accession no.726895

Item 275
Popular Plastics and Packaging
COINJECTION BOOSTS BARRIER PROPERTIES OF PET BOTTLES - A REPORT
Trends and developments in coinjected PETP bottles are described, with reference to the advantages afforded by the process in terms of barrier properties. Some details of the market size and growth rates are included, and suppliers of resins, machinery and moulds are reviewed.
WORLD
Accession no.726347

Item 276
Plastics News(USA)
11, No.3, 8th March 1999, p.17-8
ALL TANKED UP, PLASTICS TAKE THE ROAD
Pryweller J
The emergence of plastic fuel tanks in North America has become one of the industry’s major success stories. Today, virtually every new car or light-truck platform is fitted with a plastic tank. Although plastic tanks were gradually gaining acceptance through the 1980s, the Clean Air Act of 1990 set stricter evaporative emissions standards for fuel systems. By 1991, a solution was found in the form of coextruded, six-layer HDPE fuel tanks with a layer of EVOH to prevent hydrocarbon permeation.
USA
Accession no.724511
Item 277

**European Chemical & Polymer Engineer**


**CRYOGENIC COOLING CAN PROVIDE BIG BENEFITS, BUT WILL YOU BE CONVINCED?**

Walker A

One of the newest areas of development for cryogenics is in the blow moulding of plastics. According to the liquid supplier, BOC, the application of cryogenics during blow moulding can increase the barrier properties of bottles made from PETP by 80%. Cryogenics can also reduce manufacturing cycle times and bottle weight. Plastic Solutions has developed a single-stage cryogenic process which eliminates heat setting procedures to cool the inside of PETP bottles. The company says its process confers increased stiffness and top-load on products, as well as improving their crack resistance and drop-test resistance. These results can be achieved with standard resins. Plastic Solutions claims its bottles can be hot filled, at up to 96 deg.C, with no more than 1% volume shrinkage, compared with the industry standard of 2%. The difficulty has been trying to convince industry of the breakthrough benefits. Details of other developments introduced by Twinpak, PET Power, Trevira and BOC Gases are presented.

PLASTIC SOLUTIONS; PET POWER; TWINPAK INC. WORLD

Accession no.724228

Item 278

**Packaging Digest**

35, No.12, Nov.1998, p.62/4

**SAN CYLINDER TRAVELS IN STYLE**

Abrams B

This article describes a new container innovation from cosmetics giant Elizabeth Arden - a SAN (styrene acrylonitrile) cylinder travel bottle with an ABS closure, developed specifically for air-line, duty-free shop, and cruise-ship sales. Full details are given.

ELIZABETH ARDEN; SUSSEX PLASTICS; UNION CAMP CORP.; UNITED DESICCANTS; MATICPLAST; EASTMAN CHEMICAL CO.; ACTION TECHNOLOGY; LIR USA MFG.CO. USA

Accession no.723864

Item 279

**Materie Plastiche ed Elastomeri**

No.6, June 1998, p.354-6

Italian

**PACKAGING: THE TRANSPARENCY AND LIGHT WEIGHT OF BOPS**

The use of transparent bioriented PS (BOPS) sheeting in thermoformed packaging is discussed, and the properties of Luxor BOPS produced by Glasspack of Italy are described and compared with those of some other polymers used in rigid transparent packaging. The recyclability of BOPS packaging is also examined.

GLASSPACK; PHILLIPS PETROLEUM CO. EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; USA; WESTERN EUROPE

Accession no.717078

Item 280

**Modern Plastics International**

29, No.3, March 1999, p.96-8

**COINJECTION STEERS TOOL DESIGN FOR PETP BOTTLES**

Gabriele M C

Conjection has emerged as the leading edge for preform tools and blow moulds used to process PETP bottles. Enhanced barrier capabilities is the thrust behind coinjection technology. Kortec will deliver a 48-cavity coinjection tool in Q3 for a North American processor. The tool will run on a 300-tonne GL 300 injection press moulding preforms for beverage bottles.

WORLD

Accession no.719676

Item 281

**CHP Packer International**

6, No.1, Jan./Feb.1999, p.27-33

**FOCUS ON CONTAINERS AND CLOSURES FOR COSMETICS**

The packaging of any cosmetic product is reported to be an essential element in the sale of a product and in the image portrayed by the manufacturer or marketing company. Cosmetics packaging, however, goes beyond eye-catching designs, vibrant colours and powerful graphics; it also includes the shape, texture, functionality and physical properties of the bottle or container and the associated closure. A review of recent developments by a number of UK companies is presented.

MURRAY S.,& CO.; TECH INDUSTRIES; DUPONT (UK) LTD.; PLYSU PERSONAL CARE; BEMAS INTERNATIONAL PACKAGING LTD.; STRIDE GROUP PLC; HPL HARS & CONTAINERS LTD.; INTERNATIONAL BOTTLE CO.; COURTAULDS PACKAGING PLASTICS; SAR (UK) LTD. EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no.719040

Item 282

**Plastics Southern Africa**

28, No.5, Nov.1998, p.8

**WORLD’S LARGEST SINGLE IML BUCKET**

Illman Plastics, a Germiston injection moulder, was recently taken over by Adedare Cables. Now known as Aberdare Illman Plastics, the company has recently
introduced a new state-of-the-art IML system. The article supplies details of the new high-tech in-mould labelling injection moulding technology and of the latest products being produced by Aberdare Illman, including a range of 20-litre buckets, claimed to be the largest single in-mould labelled containers in the world.

ILLMAN PLASTICS; ADEDARE CABLES; ABERDARE ILLMAN PLASTICS
SOUTH AFRICA
Accession no.718275

Item 283
Plastics Engineering
55, No.1, Jan.1999, p.35-9
BASICS OF STRETCH BLOW MOULDING PET CONTAINERS
Caldicott R J
DevTech Labs Inc.

This comprehensive article outlines the fundamental science behind stretch blow moulding polyethylene terephthalate containers. Information is supplied on bottle grade polyethylene terephthalate, container performance requirements, and the design of a variety of containers, from carbonated beverage bottles, low pressure/temperature bottles and heat set bottles, through preform design and moulding of a range of containers. The stretch blow moulding process continues to develop, providing the successful production of PETP containers which display excellent performance at commercially feasible costs. 6 refs.

USA
Accession no.718263

Item 284
Food Additives and Contaminants
16, No.1, 1st Jan.1999, p.25-36
QUALITY AND SAFETY ASPECTS OF REUSABLE PLASTIC FOOD PACKAGING MATERIALS: A EUROPEAN STUDY TO UNDERPIN FUTURE LEGISLATION
Jetten J; de Kruijf N; Castle L
TNO Nutrition & Food Research Institute; UK,Min.of Agriculture,Fisheries & Food

The objective of this study was to develop a comprehensive package of quality assurance criteria for use by industry and regulatory authorities for ensuring the quality and safety-in-use of reused plastics for food packaging. The study included thermal degradation effects, flavour carry-over caused by flavour and off-flavour substances, the influence of washing processes on the materials and the efficiency of washing processes in removing off-flavour substances and surrogate substances representing misuse chemicals as might be put in bottles by consumers. 9 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; NETHERLANDS; UK; WESTERN EUROPE
Accession no.715692

Item 285
Plastics and Rubber Asia
13, No.83, Nov./Dec.1998, p.28/30
SMOOTH APPROACH
Milacron’s industrial blow moulding machinery team has developed a way of extrusion blow moulding five gallon polycarbonate (PC) water bottles with a smooth, thick, calibrated neck interior. It developed the technology following requests from processors in China, who were following their own country’s health requirements. A smooth neck is preferred as there was concern about water stagnating on any interior grooves in the neck. This does not happen if the neck is smooth. Usually PC water bottles like this could only be made on the more expensive and slower injection blow moulding process. The process is said to duplicate the quality of injection blow moulding, but cuts capital equipment costs by 40% and cycle time by 50%. Details are given.

CINCINNATI MILACRON INC.
USA
Accession no.714103

Item 286
Plastics Technology
SUPER DRUMS: COEX TAKES ON THE TOUGHEST JOBS
Knights M

Multi-layer blow moulded drums of 30 to 55 gal size were hard to find as little as four years ago. Today, both of the top US makers of plastic drums are producing multi-layer containers, and at least three smaller firms are joining in. Total installed capacity is estimated at more than one million coextruded drums annually. Although that is a small portion of the roughly 12 million plastic drums made domestically each year, multi-layer capacity appears set to expand by at least one third in 1999. A review of US developments in this area is presented.

RUSSELL-STANLEY HOLDINGS INC.; U.S.COEXCELL INC.; GREIF BROS.CORP.; FLUOROWARE INC.; KRUPP PLASTICS MACHINERY; BEKUM AMERICA CORP.; GOULD & EBERHARDT GEAR MACHINERY CORP.; KRUPP PLASTICS & RUBBER MACHINERY USA INC.; UNILOY MILACRON
USA
Accession no.714079
Item 287
Asian Plastics News
TURBULENT INJECTION, A FASTER, BETTER PROCESS
Wong Y
Poranunt of Thailand has developed an injection moulding technology, the Orbital Turbulent Injection Process, which creates a turbulent flow, giving random orientation of the polymer chain, resulting in a stronger product. Poranunt claims it can mould a thin-walled 20-litre container that weighs only 400gm. The process uses 35% less material without loss of part strength and reduces injection pressure by 40%. Demag Ergotech is working in cooperation with Poranunt to supply injection moulding machines incorporating this new technology to world markets.
PORANUNT; DEMAG ERGOTECH
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; THAILAND; WESTERN EUROPE
Accession no.711247

Item 288
European Plastics News
26, No.1, Jan. 1999, p.22
TESTING THE WATER
Warrington A; Williams D
The penetration of PETP bottles for mineral water in Germany is discussed in the light of efforts to increase the current 3% market share. Germany’s largest bottler of mineral water is reported to be trialling reusable PETP bottles alongside glass ones, while Prognos and the IFEU Institute consider the ecological balance. Concerns about the lower reuse and recycling levels with PETP may limit growth, especially if the scheme doesn’t reach the 72% reusable/refillable requirement of the Packaging Directive.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.709919

Item 289
European Plastics News
26, No.1, Jan. 1999, p.19/21
BEER BREAKTHROUGHS
Warrington A
Developments in beer bottle technology are reviewed with particular reference to Shell Chemical’s acclaimed breakthrough technology for use where the beer is to be pasteurised in situ. The new resin, Hipertuf 89010, contains a small amount of PEN, but incorporates an extra ring of benzene to improve barrier properties. The company, in addition, has shown that PEN can be made using continuous as well as batch production, which, in the long term, could significantly reduce the price difference between it and PETP, it is claimed.
SHELL CHEMICAL CO.
WORLD
Accession no.709918

Item 290
Kunststoffe Plast Europe
85, No.9, Sept.1995, p.37-40
HOT FILLABLE PET BOTTLES
Koch M; Jaksztat W
Krupp Coroplant Maschinenbau GmbH
Basic mechanical and process engineering principles are discussed for hot fillable PETP bottles. Details are given of filling conditions, bottle design and raw material, basic process principles, and machine engineering with respect to heat stabilisation.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.709850

Item 291
Packaging Technology & Science
ELECTRON MICROSCOPIC STUDY OF THE PVC BOTTLE WALL: FOOD-PLASTIC INTERACTION
Choudhry M S; Lox F; Buekens A; Decroly P
Brussels,Free University; Solvay SA
Samples of PVC bottle walls prepared under different treatment conditions, i.e. without air-blowing, with air-blowing and with air-blowing in contact with water, were investigated. ESCA results for the PVC bottle wall indicated that the surface composition was almost the same in both air-blowed and non-air-blowed samples. In the case of air-blowed samples filled with water, the ratio of O/C and Cl/C increased significantly. The aim of the study was to simulate transport vibrations and to develop a technique for evaluation of the effects of vibration on migration. Solvent extraction of the water in contact with PVC bottles was carried out and subsequent gas chromatographic analysis was used to quantify the migrant 2-ethylhexanoic acid. The results confirmed that migration was strongly induced by mechanical stresses. 18 refs.
BELGIUM; EUROPEAN COMMUNITY; EUROPEAN UNION; WESTERN EUROPE
Accession no.709674

Item 292
Packaging Magazine
1, No.25, 17th Dec.1998, p.18-9
TURNING UP THE HEAT
Ayshford H
A review is presented of UK packaging developments and innovations over the last year. It takes the form of a product review including developments in can designs, self-heating containers, PETP drinks containers, barrier packaging developments, and food packaging designs.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.708070
TRENDS IN ASEPTIC PACKAGING AND BULK STORAGE
Floros J; Ozdemir M; Nelson P
Purdue University

This article discusses ongoing technology developments together with some future trends in aseptic food packaging and bulk food storage. It looks at the advantages of aseptic packaging, the historical perspective, technical aspects, mobility, and finally, pouches and bag-in-box systems.

6 refs.

SPI; POLYSTYRENE PACKAGING COUNCIL
USA
Accession no.705948

OXYGEN INGRESS IN PLASTIC RETORTABLE PACKAGES DURING THERMAL PROCESSING AND STORAGE
Zhang Z; Britt I J; Tung M A
Guelph, University

The influence of thermal processing and storage conditions on oxygen ingress in CPETP and EVOH-containing PP retortable trays is investigated. Oxygen ingress during retorting is negligible in CPETP trays, but increases in PP/EVOH/PP trays at higher retort temperatures, longer process times and higher oxygen partial pressures. Hydration of EVOH-containing trays does not influence oxygen permeability during thermal processing, but is correlated to oxygen ingress during storage. Oxygen ingress in PP/EVOH/PP trays is minimal during one year of storage at 21.1 deg.C, 60% RH, but increases substantially after 100 days storage at 32.2 deg.C, 75% RH. Oxygen ingress in CPETP trays is greater than that of EVOH-containing trays during storage under both conditions studied. 35 refs.

CANADA
Accession no.705825

MILLIKEN CATCHES THE PIGEON
Korean manufacturer of household cleaners, detergents and fabric softeners - Pigeon of Seoul - has launched an extrusion blow moulded spray bottle made with PP clarified with Milliken's Millad 3988 agent. The spray bottle is among several new Pigeon designs with complicated shapes that have been difficult to produce economically. One of the most complicated is its Dalio spray starch bottle. By using parison programming technology in combination with clarified PP, Pigeon found it could obtain the physical properties needed while also reducing product weight.

© Copyright 2002 Rapra Technology Limited
parison is controlled by computer, making it possible to adjust extrusion speed and parison thickness. Clarity and impact toughness can be adjusted at different points on a bottle, enabling Pigeon to make complex shapes without compromising bottle integrity. Elsewhere in Korea, Milliken has been active in helping LG-Caltex Oil, a leading maker of PP resin used to produce consumer packaging, find a cost-effective alternative to PETP for everything from water to rice wine bottles to personal care product bottles. Details are given.

PIGEON CO.; MILLIKEN CHEMICAL CO.
KOREA; USA
Accession no.704714

Cryogenic cooling promises huge benefits to PETP bottle producers. Meanwhile, there is a mixed reception of this new technology. Plastic Solutions has developed a production technique which uses cryogenic temperatures to cool the interiors of PETP bottles during moulding. This is a one-step process eliminating the costly and time consuming post-processing technique of heat setting. Developments made by BOC Gases, PET Power, Trevira and Twinpak are also described.

BOC GASES; PLASTIC SOLUTIONS INTERNATIONAL; PET POWER; TREVIRA CORP.; TWINPAK INC.
ASIA; USA; WORLD
Accession no.704443

This presenter explains the importance of packaging in our everyday lives, and then focuses on industrial bulk packaging. It considers in detail: steel drums, fibre drums, plastic drums, and rigid intermediate bulk containers. For each, it looks at positive and negative perceptions, and trends to come.

USA
Accession no.703515

Dispense systems for healthcare and pharmaceutical products

The pharmaceutical industry has long faced the challenge of using containers and closures that are not only attractive to customers, but which will also meet with stringent requirements for product integrity, tamper evidence and resistance to the ingress of moisture and air. This comprehensive article reviews a variety of innovative designs, developed and currently available from a number of British companies which meet these requirements.

ENERCON INDUSTRIES LTD.; RPC HEALTHCARE PACKAGING; ABLE INDUSTRIES LTD.; WIKO (UK) LTD.; PET TECHNOLOGIES LTD.; ENGGLASS DISPENSING AND PACKAGING SYSTEMS; BEMAS INTERNATIONAL PACKAGING LTD.; ALPHA PACKAGING & DESIGN LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.701645

The use of blisterpacks for pharmaceutical packaging is examined, with reference to materials used, testing and trends. Despite the fact that the blisterpack has been used for pharmaceutical unit dose packaging for many years, a growth rate of 5-10% is forecast per year over the next five years. This is said to be due to the increasing elderly population, and age group which is prescribed around 2-3 times the amount of medication prescribed to other age groups with the exception of under fives. The role of the blisterpack is discussed, with respect to its many functions such as providing a moisture barrier and also displaying product information. Typical material combinations are compared.

REXAM MEDICAL PACKAGING
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.701421

For carbonated drinks, Shell Chemicals has introduced two new Cleartuf “fast heat-up” PETP grades with high infrared absorption. The company’s other grades for mineral water bottles offer low gas permeability, low weight, high strength, optical clarity and sparkle. Most importantly, they have low acetaldehyde formation. Three
grades of Lighter C PETP from INCA International are said to process at reduced injection moulding temperatures, as well as also having lower acetaldehyde formation.

INCA INTERNATIONAL SPA; SHELL CHEMICALS EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; UK; WESTERN EUROPE
Accession no.700606

Item 303

Modern Plastics International
28, No.11, Nov.1998, p.44/6
LONG-STROKE SYSTEMS TACKLE CONTAINER GOAL OF 20 MILLION/YR
Gabriele M C

At K’98, several machine builders unveiled bigger versions of their long-stroke extrusion blow moulding systems. The aim is to achieve output rates of 20 million units/year by incorporating more extrusion heads and larger platens to accommodate higher mould cavitation. The latest system designs put emphasis on incorporating an automated in-mould labelling system to enhance productivity. Calibrated neck finish, approaching injection moulding tolerances, is another advantage for long-stroke systems compared with wheel machines.

WORLD
Accession no.700600

Item 304

Food Additives and Contaminants
15, No.3, 1st April 1998, p.336-45
EVALUATION OF RECYCLED HDPE MILK BOTTLES FOR FOOD APPLICATIONS
Devlieghere F; De Meulenaer B; Demyttenaere J; Huygherbaert A
Ghent,University

The recycling of milk-contaminated HDPE was investigated. Bottles were blown from untreated, caustic-washed and caustic-washed/steam-stripped/air-dried recycled material. The migration characteristics of the different bottles were compared using various food simulants, as well as their sensorial and mechanical properties. It was shown that the untreated and caustic-washed recycled material could not be considered as a food packaging material. A high number of compounds which were able to migrate were detected, causing an off-flavour which could easily be recognised. The steam-stripped recycled material, however, seemed to perform almost as well as its corresponding virgin material. Only low amounts of compounds able to migrate could be detected, resulting in a packaging material characterised by good sensorial properties which could not be distinguished from its virgin material. Furthermore, it was proved that the mechanical properties of the recycled material did not change during the recycling process. 17 refs.

BELGIUM; EUROPEAN COMMUNITY; EUROPEAN UNION; WESTERN EUROPE
Accession no.698955

Item 306

Packaging Review South Africa
24, No.7, July 1998, p.23
THE STUFF OF WHICH REAL BOTTLES ARE MADE

This article describes and assesses the advantages and continued growth of PETP as a packaging material worldwide. Low-weight and stability are two main advantages, the weight saving also correspondingly means energy saving and lower transportation costs. The article includes information on the growing world markets and market share of PETP.

SHELL CHEMICAL WORLD
Accession no.696252

Item 307

Food Additives and Contaminants
15, No.5, 1st July 1998, p.592-9
PS CUPS AND CONTAINERS: STYRENE MIGRATION
Tawfik M S; Huygherbaert A
Ghent,University

The level of styrene migration from PS cups was monitored in different food systems. The effect of different parameters including fat content, temperature and time on migration level was examined. 18 refs.

BELGIUM; EUROPEAN COMMUNITY; EUROPEAN UNION; WESTERN EUROPE
Accession no.695970
Item 308
Packaging Digest
35, No.8, July 1998, p.46/50
PETP TRI-FOLD DISTINGUISHES PREMIUM EGGS
Lingle R

Egg Innovations has repackaged its premium eggs in a tri-fold carton, thermoformed by Interplast using PETP sheet made from recycled materials, specifically Klockner’s KPET. The design allows viewing of eggs, no-glue paper labels and provides enhanced damage protection versus clamshells.

EGG INNOVATIONS
USA
Accession no.695099

Item 309
Additives for Polymers
Sept.1998, p.8-9
NUCLEATED PP CHALLENGES PETP IN ASIA BOTTLES MARKET

Clarified (nucleated) PP is being promoted in Asia by LG Caltex as an alternative to PETP for clear blow moulded packaging. Containers ranging from bottles for water and rice wine to soap, detergent and personal care products are offering useful cost savings, with high quality protection and presentation.

LG-CALTEX OIL
ASIA
Accession no.695079

Item 310
Chicago, Il., 5th-7th Nov.1997, p.233-46. 8(13)
HDPE RECYCLED CONTENT IN BUCKET MANUFACTURING: REGULATORY AND TRANSPORTATION ISSUES
Holser B
Letica Corp.
(SPE, Plastics Recycling Div.)

An overview of the Letica Pail Recycling Program, together with appropriate recycling legislation, is presented. Aspects covered include the reasons for considering bucket recycling, optimum and realistic Letica recycling loops, manufacturing issues/challenges, Letica’s EcoPail and RegPail, Letica’s quality control SPC programme.

USA
Accession no.694537

Item 311
Atlanta, Ga., 26th-30th April 1998, p.3338-9. 012

EFFECTS OF PINCH-OFF GEOMETRY ON THE STRENGTH OF THE WELD LINE IN BLOW MOULDED BOTTLES
Mika J; Hieber F
Behrend College
(SPE)

Extrusion blow moulding has often relied upon trial and error experience and old rules of thumb to design a pinch-off. Reliable pinch-off design guidelines require the collection and quantification of design factors and respective pinch-off performance data. A good method of quantifying pinch-off design performance is necessary to develop data that is useful in reducing guesswork and ultimately making robust pinch-off designs the first time. A two level design of experiment is used in the collection and analysis of data. An insertable pinch-off mould plate is designed and constructed along with inserts for the varying design factors such as land width, flash pocket depth, primary and secondary land angles, and depth to transition. Tensile strength and impact strength at the weld are tested.

USA
Accession no.693683

Item 312
Plastics Technology
COMPRESSION STRETCH BLOW MOULDING
Knights M

Details are given of a new process in development for making oriented PETP bottles and cans. It does not use injection moulded preforms; instead, it starts with a blank or ‘puck’ that is cut from extruded sheet and compression moulded into a concave shape before being stretch blow moulded. Compression stretch blow moulding is said to offer the advantages of processing at lower temperatures, lower pressure and lower shear stresses than are encountered in injection moulding.

LOWELL, MASSACHUSETTS UNIVERSITY
USA
Accession no.692597

Item 313
Modern Plastics International
28, No.5, May 1998, p.48
ALLOYS PUMP UP AIR-POWERED SPRAY DEVICE FOR REFILLABLE CONTAINERS
Graff G

It is reported that some manufacturers of refillable, air-powered spray containers (capable of producing a continuous spray) have started making them from polyamide/polyolefin alloys instead of PP. The alloys are tradenamed Orgalloy and are produced by Elf Atochem of France. Full details are given.

ELF ATOCHEM SA; CANYON CORP.
BLOW MOULDING: A COMPARISON OF MATERIALS AND TECHNOLOGIES
Bettucchi M; Sarti S
Automa SpA

Procedures for analysing the costs of manufacturing bottles using different plastics and blow moulding techniques are described. The examples presented relate to a 500 ml bottle made by continuous extrusion blow moulding of PETG or by injection stretch blow moulding of PETP, and a 300 ml bottle produced by the same techniques from PVC and PETP, respectively.

CONTINUED EVOLUTION OF PHARMACEUTICAL PACKAGING
Gailliez E

A survey is made of trends in the use of plastics in packaging for pharmaceuticals, including blister packs, multi-layer containers and multi-layer, multi-compartment pouches.

COMPRESSION-STRETCH PREFORM SYSTEM TAKES ON PETP BOTTLES
Gabriele M C

The Valyi Institute for Plastic Forming is developing a novel system for compression stretch blow moulding of PETP containers. The approach would allow wide-mouth jars capable of containing hot-fill foods to be made in PETP. The technology compression moulds the preforms for the stretch blow moulding process. It is claimed that in terms of capital investment, compression stretch blow moulding would cost 50% less than a comparable system employing injection moulded preforms.

CONSIDER PLASTIC DRUMS FOR CHEMICAL TRANSPORT
Malloy J
SPI

The benefits of using plastics drums for the transport of chemicals include low cost, resistance to physical damage and good corrosion resistance. Additionally, multiple-time use is common, and drums can be recycled eliminating waste-disposal problems. They are only one type of industrial shipping container on the market today. The others include steel, intermediate bulk containers (IBCs) and fibre drums. IBCs are all steel, all plastic, or plastic in a steel cage. Plastic drums are commonly available in 5-55 gal. capacities, with 55 gal. being the most widely-used size; they offer several benefits over other forms of industrial containers, including chemical and corrosion resistance that allow for greater storage possibilities in most types of weather conditions. These drums are lightweight, have a seamless internal design that reduces the possibility of contamination, and are durable and reusable. Details are given. 4 refs.
POLYSTYRENE IN THE PACKAGING MARKET
Honvari K

Applications of PS in packaging are described, with reference to food packaging, audio and video cassettes and boxes for these, impact-protecting packaging, and cartons and boxes. Development trends are discussed, including reduction in quantity of packaging materials and improvement in their functional efficiency, form-fill-seal (FFS) technology, and blends. Tabulated data are presented on consumption of PS in Western Europe (1996), consumption of foamable PS in Western Europe (1996), consumption of PS in packaging in Central and Eastern Europe (1996), packaging materials market in Western Europe (1994) and use of FFS technology in Western Europe (1994), 4 refs. (Full translation of Muanyag es Gumi, No.12, 1997, p.372)

EASTERN EUROPE; EUROPE-GENERAL; HUNGARY

Accession no.687734

COMPOSTABLE YOGHURT TUBS
Schlicht R

Recently, Danone has been packaging a yoghurt product in a degradable package made of the renewable raw material polylactic acid (PLA). Apart from the development aspects of the tubs themselves, the company has had to devise a disposal strategy and make preparations for a life-cycle analysis. Aspects covered include the fresh milk sector, technical development and disposal strategy.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.687630

PACKAGING WATER EASILY
Gebauer P; Krieter M; Ohst S

The use of high-quality engineering plastics in packaging is unusual. One of the few exceptions is the returnable 5-gallon water bottle. On account of complex requirements, it is produced all around the world, almost without exception, in polycarbonate. There are essentially two application areas for the five-gallon polycarbonate water bottle. First, it acts as the drinking water supply for households in developing and newly industrialised countries, and extremely sparsely settled areas and, second, it serves as a water dispenser or so-called cooler. Aspects covered include material properties for extremes, one material for two production methods, the optimisation of dies to reduce cycle time and recycling.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.687617

INNOVATIVE PETP TECHNOLOGY
Hartwig K

Stretch blow moulding is used for high-quality PETP bottles with outstanding mechanical, optical and barrier properties and low weight. Ongoing developments in machine and process technology and raw materials are continually opening up new applications. The continuing replacement of metal and glass packaging by stretch blow-moulded PETP bottles has in recent years led to annual growth rates of 16%. Growth is expected to be even higher in coming years. Rapid developments in machine and process technology as well as raw materials are continually opening up new applications for stretch blow moulded PETP bottles. Thus, not only carbonated soft drinks, but also fruit and vegetable juices, teas, isotonics, dairy products, and even mineral water and beer are now sold in PETP bottles. The requirements made on the bottle properties depend on the particular contents. Fruit and vegetable juices, teas, isotonics and dairy products are filled in a hot, sterile state. Filling temperatures in this case may reach 95 deg.C. To protect the contents, the PETP bottle is also expected to have high barrier properties.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.687617
PETP PREFORMS WITH PA BARRIER LAYER  
Bichler M; Issel D  
Demag Ergotech GmbH  

A new coinjection process is reported to introduce thin layers of polyamide into preforms for PETP bottles. They are used as a barrier layer against oxygen, carbon dioxide, and aroma substances and extend the field of application of transparent plastics bottles to demanding products such as beer and milk beverages. Stretch blow moulded bottles of PETP are already widely used for packaging carbonated soft drinks and are to be introduced for mineral waters. Unlike soft drinks, beer- and milk-based beverages require PETP bottles with a higher barrier effect against the escape of carbon dioxide or permeation of oxygen. The barrier properties of PETP bottles can be improved by various processes and barrier polymers. The coinjection process from Demag Ergotech introduces thin barrier layers of transparent polyamide into PETP preforms for non-returnable bottles. The combination of PETP and polyamide is technically demanding but the process is stable and reproducible, and the necessary barrier properties are ensured.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE  
Accession no.687616

Item 325  
Revue Generale des Caoutchoucs et Plastiques  
No.759, May 1997, p.34-7  
French

INDUSTRIAL PACKAGING: PLASTICS IN POOL POSITION  
Lavabre S  

Developments in the use of returnable plastics containers for the transportation of industrial goods are examined. The activities of a number of companies in the recycling of packaging waste and the manufacture of pallets from reclaimed plastics are reviewed.

PEUGEOT SA; RENAULT SA; PSA; GEFCO; SCHUTZ; POOL MANAGEMENT FRANCE; PERIFEM; IFCO; MDM; STECO-ALLIBERT; PERSTORP PLASTICS SYSTEMS; CHEP; OTTO MELOG; ST.ETIENNE,UNIVERSITY; PLASTIC OMNIUM SA; RECYPLAST; ECOFUT  
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; GERMANY; LUXEMBOURG; SCANDINAVIA; SWEDEN; UK; WESTERN EUROPE  
Accession no.686296

Item 326  
Packaging Technology & Science  
11, No.3, May-June 1998, p.91-117

LATERAL DEFORMATION OF PLASTIC BOTTLES: EXPERIMENTS, SIMULATIONS AND PREVENTION

van Dijk R; Sterk J C; Sgorbani D; van Keulen F  
Delft,University; Unilever Research Laboratory  

Details are given of the lateral deformation of a PETP and a PVC bottle due to an internal vacuum. Data are given for top load, vacuum and impact resistance. 23 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; NETHERLANDS; WESTERN EUROPE  
Accession no.684953

Item 327  
Atlanta, Ga., 26th-30th April 1998, p.821-5. 012

MODELLING AND OPTIMISATION OF BARRIER PROPERTIES FOR STRETCH BLOW MOULDED BOTTLES  
Hartwig K  
Krupp Corpoplast Maschinenbau GmbH (SPE)

In the stretch blow moulding process, hollow articles with excellent qualities due to biaxial deformation are produced. The shelf life of the packed beverages depends mainly on the barrier properties of the bottles. The influencing factors on the barrier properties of packaging are summarised, and methods to optimise these are presented. A theoretical model to predict barrier properties is included, as are practical results on blown bottles. The investigations are performed for different materials and material combinations. 4 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE  
Accession no.684628

Item 328  
Atlanta, Ga., 26th-30th April 1998, p.810-5. 012

FUNDAMENTALS OF PETP STRETCH BLOW MOULDED CONTAINERS  
Caldicott R J  
DevTech Labs Inc. (SPE)

For centuries there has been a need for inexpensive, high performance resealable containers to package food, personal care and other products. Limitations associated with natural materials have led to the exploration and application of synthetics to make containers. Many bottle grade plastic homopolymers, copolymers and blends have surfaced from these efforts. Among others are PP, PE, PS, PVC, PAN, PETP and PEN based polymers. In particular, biaxially oriented PETP has won great acceptance from consumers. More than two decades since the first stretch blow moulded PETP container was made, there is a far better understanding of the particulars involved in successful production of high quality PETP containers. 5 refs.

USA  
Accession no.684626
EFFECT OF STRETCH AND HEAT TRANSFER ON THE THERMOMECHANICAL PROPERTIES OF PETP BOTTLES
Silberman A; Omer M; Ophir A; Kenig S
Israel Plastics & Rubber Center (SPE)

Thin (0.2 mm) and thick (1 mm) injection stretch blow moulded (ISBM) PETP based bottles are analysed with respect to the effect of stretch ratio (SR) on the strain induced crystallisation in addition to the thermal history and its effect on crystallisation level. Dynamic mechanical analysis and differential scanning calorimetry are used to determine the structure and degree of crystallinity of the thin and thick walls of the bottles, respectively. For rigorous analysis of the ISBM bottles, both heat transfer analysis to determine temperature profiles and simulation of the process to establish the SR are carried out. Results indicate that, due to large temperature gradient, the thick bottles consist of three sublayers having a variable crystallinity level as function of SR. The prediction of crystallinity distribution and relationship to modulus as function of thickness and location in the moulded bottle is highly significant for stiffness and strength development in the ISBM bottles, which determines the load carrying ability of the ISBM part. 7 refs.

FLAT DIE EXTRUSION OF EXPANDED PP SHEET FOR THERMOFORMING OF FOOD CONTAINERS
Menghi G
Omam SpA
(Schotland Business Research Inc.)

Foamed PP (EPP, expanded PP) is a new alternative material for processors of PP or PS thermoformed items for packaging applications. It is ecological, has insulating, mechanical and physical properties similar to those of rigid PP, is easily thermoformed and is cheaper. EPP has already been considered by major companies worldwide as an attractive future development for their range of products. The joint research and development programme Flat-Die EPP, developed by Italproducts, Reedy International and Omam has made it possible for the packaging industry to install and run an extrusion and thermoforming line capable of producing medium density EPP items and, at the same time, more traditional PP, PS and APETP. Details are given.

Coralfoam has developed a new injection moulding technology that will enable selectively-foamed thin wall packaging items to be produced at lower part weights and tighter dimensional tolerances than achievable with thermoformed products without sacrificing cycle time. InjectForm II is built around a novel injection mould design which enables moulding and forming to be carried out in one production step. The component currently under development is a 500g PP container.

Coralfoam has developed a technology package for imparting unprecedented high gloss levels into blown HDPE bottles. Sclair 58G is a homopolymer HDPE that can be blown into bottles with surface gloss values of 60-70%. Processing ease and relatively low cost makes HDPE a potential replacement for PVC and PP resins designed for high-gloss bottles required in cosmetic, pharmaceutical, personal care and home care markets. Property data are presented.

Nova Chemicals has developed a technology package for imparting unprecedented high gloss levels into blown HDPE bottles. Sclair 58G is a homopolymer HDPE that can be blown into bottles with surface gloss values of 60-70%. Processing ease and relatively low cost makes HDPE a potential replacement for PVC and PP resins designed for high-gloss bottles required in cosmetic, pharmaceutical, personal care and home care markets. Property data are presented.

© Copyright 2002 Rapra Technology Limited
EFFECT OF MOULDED-IN STRESSES ON ESCR INDUSTRIAL DRUM APPLICATIONS

Constant D R
Paxon Polymer Co.
(SPE; Canada,National Research Council)

Environmental stress crack resistance (ESCR) is a major performance issue for industrial drums produced with high molecular weight HDPE. Some of the primary factors affecting ESCR in this application, as in others, include resin density, drum design, die design, mould design, processing conditions and chemicals packaged in the drum. Any of the factors alone, or combined, can make a typically ‘good’ resin perform badly, causing premature ESCR failure. Emphasis is placed on blow moulding processing conditions, i.e. effects on morphology, density and ESCR, using a known high ESCR HDPE. Early results show no relationship between drop time and retained orientation, as measured by optical microscopy birefringence and transmission electron microscopy techniques. ESCR is not affected at various drop times. Density variations are measured within the same part, however, which are attributed to different cooling rates on thick pinch-off areas vs. thin sidewalls. ESCR failures are consistently noted in one of the thicker areas. 7 refs.

NEW TRENDS IN POLYESTER PACKAGING TECHNOLOGY FOR HIGH PERFORMANCE PACKAGING APPLICATIONS

Barger M
Dow Plastics
(SPE; Canada,National Research Council)

Polyesters have been commercially significant materials for many decades in fibre and film markets, but they are relatively new to rigid packaging. PETP-based bottles, containers and jars are produced by one of three basic types of injection blow moulding processes. These processes, particularly those that employ stretch blow moulding, capitalise on the ability of PETP to strain induce crystallise, which allows for high speed production of transparent, oriented bottles of uniform wall thickness. Injection blow moulded PETP containers exhibit excellent performance attributes (gas barrier, creep resistance, toughness) for a number of rigid packaging applications, the most notable one being carbonated soft drinks. Several emerging technologies aimed at improving the performance of PETP to enable expansion of the performance envelope and capture of applications that are traditionally based in glass are described. Some specific technologies are summarised. 8 refs.

EXTRUSION BLOW MOULDING OF LCP MULTI-LAYER BOTTLES

Lusignea R
Superex Polymer Inc.
(SPE; Canada,National Research Council)

Liquid crystal polymers (LCPs) have been commercially available for over ten years, and although they have many attractive properties, their use is limited almost entirely to injection moulded parts. LCPs are not blow moulded into containers for two reasons: the strong, influence of shear to orient the polymer in the direction of flow, combined with very long relaxation time which prevents the induced orientation from randomising after melt extrusion, and their relatively high cost compared with materials such as PETP and PE. It is explained how transverse shear can be used effectively to orient LCP layers. 22 refs.
Item 338
New Plastics '98. Conference proceedings.
London, 21st-22nd Jan.1998, paper 4. 6
PEN: REAL BENEFITS IN REAL APPLICATIONS
Swift D
Shell Chemicals Europe Ltd.
(European Plastics News)
The advent of the polyester packaging market in 1976 brought significant growth for a huge value chain, including the major food and beverage companies who have found new market segments based upon clarity, shatter resistance and superior container performance over traditional materials such as glass and metals. However, analysis of the container performance based on traditional PETP leads to the very rapid conclusion that in the developed markets traditional PETP is becoming saturated and growth will begin to taper off. Better performing containers are needed to penetrate the new markets. Shell’s direction is outlined and the analysis used in deciding upon the approach now being followed is reviewed.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.679258

Item 339
Plasticulture
No.112, 1996, p.46-50
English; French
HORTICULTURAL POTS MADE FROM BIODEGRADABLE MATERIALS
Groot L
Institut fuer Technik in Gartenbau und Landwirtschaft
The use of biodegradable materials, particularly paper, in plant pots and other horticultural containers is examined, and properties of plastics, paper and starch pots are compared. Results are presented of trials which showed the increased energy requirements arising from higher water consumption by paper pots, and the possibility of reducing evaporation rates by coating the pots with various biodegradable materials including latex and natural resins is discussed. 3 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.679258

Item 340
AMOSORB OXYGEN SCAVENGING CONCENTRATES FOR RIGID CONTAINERS, FLEXIBLE FILMS AND CLOSURE LINERS
Cernak M G; Chiang W L
Amoco Chemicals
(TAPPI)
The use of Amosorb oxygen scavenging concentrates (Amoco Chemicals) for oxygen absorption in plastics food and beverage packages is examined. The concentrates are incorporated in an inner layer of a multi-layer package during its manufacture, resulting in a structure which absorbs the oxygen initially present in the headspace and trapped in the food or beverage and also any oxygen which permeates into the package over time. Applications in flexible films, closure liners and sidewalls and lids of rigid containers are described.
CADILLAC PRODUCTS INC.
CANADA; USA
Accession no.679009

Item 341
Modern Plastics International
28, No.3, March 1998, p.30-1
FOAM BLOW MOLдинG MAKES ITS DEBUT WITH HDPE SHAMPOO BOTTLE
Schut J; Colvin R
Wella AG has introduced a blow moulded HDPE shampoo bottle which experts believe is the first foamed blow moulded product made commercially. The foamed bottles have a density range of 0.78 to 0.810g/cc and are about 25% lighter than equivalent ones made in HDPE homopolymer. A special version of Boehringer Ingelheim’s endothermic, nucelated foaming agent is used. Alpla Technik has developed a proprietary, multi-cavity, long-stroke extrusion blow moulding machine for foaming the bottles.
WELLA AG
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.672996

Item 342
Plast’21
No.55, Oct.1996, p.135-6
Spanish
PLASTICS, PROTECTORS OF TASTE
Guevara I
Results are presented of a study undertaken by Polysultants of the loss of taste from foods and drinks through absorption by containers made of various types of plastics. Loss of taste is examined as a function of oxygen permeability, and methods for controlling the phenomenon are discussed.
POLYSULTANTS CO.
USA
Accession no.670872

Item 343
European Plastics News
25, No.3, March 1998, p.54
POSSIBILITIES IN PEN
Lee M
Sipa has recently been devoting a good deal of attention to the blow moulding of PEN bottles. The company claims it was the first to develop a PEN beer bottle with a useful shelf life. Sipa is using its ECS one-stage process for blowing its experimental PEN bottles, that is the preforms are injected and then blown on the same machine. Using a one-stage process enables the machine to make use of the residual heat of the preform and so makes substantial energy savings.

**SIPA SPA**
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE

Authorization no.669659

---

**Item 344**

**Packaging Technology & Science**

‘ACTIVE’ PACKAGE FOR THERMAL PROTECTION OF FOOD PRODUCTS
Espeau P; Mondieg D; Haget Y; Cuevas-Diarte M A Bordeaux,University; Barcelona,University

Double walled containers using molecular alloy phase change materials, (MAPCMs) are proposed as packages for thermal protection of liquid food products. Results are presented concerning a phenomenological approach to four types of container. The work leads to a commercial ‘active’ package which is shown to be effective for more than three hours in an external environment of about 25 degrees C. In addition, these ‘active’ packages are able to cool down a drink. 7 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; SPAIN; WESTERN EUROPE

Authorization no.668758

---

**Item 345**

**Plast’ 21**
No.52, May 1996, p.51-2

Spanish

EVOLUTION OF PACKAGING FOR TRANSPORTATION IN THE SOFT DRINKS MARKET
Verstraeten J
Spadel NV

An examination is made of applications of disposable and returnable packaging, particularly pallets, in the transportation and storage of mineral water and other soft drinks in glass and PETP bottles.

BELGIUM; EUROPEAN COMMUNITY; EUROPEAN UNION; WESTERN EUROPE

Authorization no.6668758

---

**Item 346**

**Reinforced Plastics**
42, No.1, Jan.1998, p.44-8

SMC CRATES SATISFY FIRE TESTS

Eckel A; Horbach A
BASF AG; DSM-BASF Structural Resins

Storage crates using new SMC formulations can meet the severest requirements for fire safety in warehouses and yet maintain the properties of conventional plastic crates. The new SMC formulation is based on an unsaturated polyester, Palapreg from DMS-BASF Structural Resins.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Authorization no.664849

---

**Item 347**

**Journal of Applied Polymer Science**

BARRIER, IMPACT, MORPHOLOGY, AND RHEOLOGICAL PROPERTIES OF MODIFIED POLYAMIDES AND THEIR CORRESPONDING POLYETHYLENE-MODIFIED POLYAMIDE BLENDS
Yeh J T; Fan-Chiang C C
Taiwan,National University of Science & Technology

A systematic investigation of the effects of melt indices of polyamides on the morphology, barrier and impact properties of blow moulded PE-polyamide and PE-modified polyamide containers is reported. An appropriate alkyl carboxyl-substituted polyolefin was chosen as a compatibiliser precursor to modify polyamides of varying melt indices in a twin-screw extruder by the ‘reactive extrusion’ process. 17 refs.

CHINA

Authorization no.664049

---

**Item 348**

**Revista de Plásticos Modernos**
70, No.472, Oct.1995, p.369-72

Spanish

IML (IN-MOULD LABELLING): IN-MOULD DECORATION OF INJECTION MOULDED PLASTICS PRODUCTS

In-mould labelling is examined as a method for decorating injection moulded plastics containers, and the efficiency and costs of the process are compared to those of traditional decoration techniques.

NETSTAL AG
SWITZERLAND; WESTERN EUROPE

Authorization no.663462

---

**Item 349**

**Packaging Week**
13, No.25, 11th-18th Dec. 1997, p.1

PLASTIC BEER BOTTLE LAUNCH FROM BASS
Pidgeon R

Bass Brewers is to test market sales of its Carling Black Label lager and Hoopers Hooch alcopops in plastic
bottles. The bottles are three-layer PETP/EVOH/PETP barrier bottles with crown closures which will carry a 12 week best before date. Laboratory tests have shown that the bottles can offer a longer shelf life without chilled distribution. The process technology and bottle design were developed by American National Can, a Pechiney subsidiary, using preforms moulded using a proprietary co-injection process. Pechiney; Bass Brewers; American National Can; European Community; European Union; UK; Western Europe

Item 350
Packaging Digest
34, No.12, Nov. 1997, p.66/70
KRAFT PROMOTES CEREALS IN SLEEVED PLASTIC BOXES
Lingle R

In an effort to provide added value to its packaged cereals, and increase sales of cereal volumes, Kraft Canada has launched a promotional range of PVC shrink-sleeved PP reusable containers which have a custom-coloured LLDPE reclosable lid. Details are given of the production of the packaging. Kraft Canada Inc.; Canada

Item 351
Modern Plastics International
27, No.11, Nov. 1997, p.60/3
HUNGER FOR ‘READY’ FOOD STIMULATES NEW OPTIONS IN BARRIER PACKAGING
Leaversuch R D

Change is occurring in the thermoforming of rigid barrier dishes, trays and lidstock used in the packaging of fresh prepared foods. In North America, the most pressing demand involves meeting the barrier needs of the emergent home-meal replacement (HMR) sector. In Europe, similar interest is focused on the comparable almost-ready sector, a segment that is seeing accelerated growth. In both these markets, the intent is a fresh, high-quality prepared dish that is easy and quick to use at home. Requirements of the still-infant HMR market in the USA were addressed recently at the Future-Pak ’97 exhibition. Sponsor George O. Schroeder Associates says that fresh, refrigerated, ready-to-serve dishes typically call for structures that provide sufficient oxygen and moisture barrier to keep food fresh and limit spoilage, major issues for retailers. The company adds that because packaging must ensure excellent flavour and bacteria control, compatibility with modified atmosphere (MAP) design is often critical. Appearance is also important to spur sales. In current barrier markets, a one-year shelf life is standard, so EVOH, PvdC and nylon are typically used in multilayer coextrusions with appropriate structural and tie layers. Recent developments are reviewed. Eastman Chemical Co.; Phillips 66 Co.; BP Chemicals Ltd.; European Community; European Union; UK; USA; Western Europe

Accession no.662158

Item 352
Modern Plastics International
27, No.12, Dec. 1997, p.48-51
THERMOFORMING GETS IN-LINE FOR PP PACKAGING APPLICATIONS
Gabriele M C

It is claimed that, as a process technology, in-line thermoforming for food packaging applications can now match injection moulding in terms of part quality, barrier properties and per-part cost. In-line thermoforming is well suited to the large volumes associated with the North American market. PP resin suppliers have recently developed homopolymer grades specially tailored for melt strength and clarity to complement in-line thermoforming. World

Accession no.661637

Item 353
Modern Plastics International
27, No.12, Dec. 1997, p.35-6
PIGMENTED WHITE JUG AIMS TO SWEETEN US MILK SALES
Schut J H

Two major US dairies introduced pigmented white milk bottles in October made out of HDPE. Almost simultaneously, a second brace of dairies launched pint milk bottles in clear PETP. Opaque HDPE jugs are said to better preserve milk’s flavour and vitamin content. Contents of translucent HDPE jugs may be degraded by oxidation tied to in-store fluorescent lighting. USA

Accession no.661635

Item 354
Injection Moulding International
2, No.4, Sept./Oct.1997, p.32
CLARIFIED POLYPROPYLENE MATERIAL OF CHOICE IN PACKAGING

This article explains the material selection process of Schneider & Klein for transparent consumer hardware packaging. The company chose clarified polypropylene for its new boxes. The plastics desirable properties are explained. Schneider & Klein; European Community; European Union; Germany; USA; Western Europe

Accession no.661025
Item 355
Paper, Film & Foil Converter
71, No.11, Nov. 1997, p.24
VALUE-ADDED PACKAGING IS HOT (AND COLD) STUFF
Sacharow S
Packaging Group Inc.
Developments in self-heating and self-chilling packaging using exothermic and endothermic reactions, for food and drinks are reviewed. Included are details of Heater Meals’ complete meal systems which involves the use of a magnesium mixture which is activated by salt water to heat the meal by contact with the hot water in a polystyrene tray, and a self-chilling can by Joseph Co. which uses a refrigerant gas to cool beverages to 45 degrees F in 90 seconds. The latter, however, raises questions regarding the use of HFC-134a. Other products are also described.
HEATER MEALS CO.; DAINIPPON; JOSEPH CO.
JAPAN; USA
Accession no.660571

Item 356
Packaging
No.5, 1997, p.15
SALAD DAYS FOR TENNECO PACKS
Design details are given of a salad packaging container for Sainsbury’s new range of value-added salads which was designed by Tenneco Packaging. It consists of a salad bowl shaped container which is made to look like a hand-painted porcelain bowl. It incorporates a lettuce leaf design which is sandwich printed on a high gloss white base material using food approved inks. The thermoformed container is resealable.
SAINSBURY J., PLC; TENNECO PACKAGING, PLASTICS DIV.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; USA; WESTERN EUROPE
Accession no.660585

Item 357
Packaging
RIGHT APPROACH TO A FUTURE IN PLASTICS
The potential market for PEN/PETB blends in hot filling packaging applications is discussed. The advantages of PETP in packaging applications are reviewed, and in particular, its success in sectors previously dominated by glass. However, caution is suggested regarding the exaggeration of the immediate possibilities regarding the use of PEN in high temperature filling applications, since a question mark is raised over its consistency and some technical and cost implications which would require some redesigning of original containers.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.660572

Item 358
Plastiques Modernes et Elastomeres
49, No.2, March 1997, p.69-71
French
DEVELOPMENTS IN THERMOFORMED PP
Topuz B
Applications of PP in thermoformed food packaging are examined, and developments in thermoforming machinery and polymers with enhanced thermoformability are reviewed.
APPRYL; BOREALIS; BASF AG; ILLIG MASCHINENBAU; KIEFEL GMBH; CANNON GROUP; POLARCUP
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; GERMANY; ITALY; NORWAY; SCANDINAVIA; WESTERN EUROPE; WESTERN EUROPE-GENERAL
Accession no.658238

Item 359
British Plastics and Rubber
Oct.1997, p.45
BLOW MOULDING NOW POSSIBLE IN PP FOAM
Krupp Kautex, in association with Borealis, is extending the range of the blow moulded foam process with the addition of PP compounds. Potential is seen in the combination of foamed core blow mouldings with skins using Kautex’s long glass fibre-reinforced PP technology to produce mouldings with high strength and rigidity combined with reduced weight and material content. Kautex has also emphasised the growing potential for bottom calibration as a way to produce an increasingly demanding range of industrial containers.
KRUPP KADEX MASCHINENBAU GMBH; BOREALIS
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.654713

Item 360
Plastics Southern Africa
27, No.2, July 1997, p.20
BOTTLING BREAKTHROUGH
Log Plastic Products of Israel has developed a process to produce bottles for hot-filling of drinks up to 93 deg.C, which is usually carried out in glass containers. The Glastic process makes it possible for numerous hot-fill products to be packaged in plastic. Key parameters are the process itself, the material and a special bottle design. The process is patent pending and the engineering is registered design pending. Hot-filling is a
References and Abstracts

decontamination process involving temperatures between 75 and 95 deg.C. The container is exposed to the high filling temperatures - in the process killing spoiling bacteria and germs - and cooled immediately; the container is usually exposed to the elevated temperature for a period of less than one minute. As mentioned, this requirement has up until now restricted the process to the use of glass containers. Log is using Shell's Hipertuf 89010 polyester and, working closely with Shell, has enhanced and maximised the material's performance to create the Glastic grade. One major advantage of the plastic over glass is that the filling process is simplified: no cascade system for thermal pretreatment of the empty bottles is needed at all, as required for glass to prevent thermal shock failure breakage. This may result in considerable financial savings. Details are given.

LOG PLASTIC PRODUCTS
ISRAEL
Accession no.654499

Item 361
Packaging Week
MADE FOR MEASURE
Braithwaite P

The issues of user friendliness, consumer safety and source reduction are reported to have resulted in a number of developments in dispensing systems and closures. These concerns have been reflected in the futuristic design of the Conoco (Jet) oil can incorporating a handle and a twist-to-open spout with an air hole to make pouring simpler and cleaner. A transparent strip down the front of the can to show how much oil has been used adds an extra dimension to pack design. Minimisation is forecast to be the next trend: for the oil can, as long as there is a strong handle and dispensing device, the rest of the pack could, for example, be similar to a pouch. Through the use of integrated valves, a pouch might also contain compressed air chambers within the structure to give it handleability to the last drop of product. Details of products recently made available by PI Design, Plysu, Bemas International and Courtin, are given
PI DESIGN; PLYSU PLC; BEMAS INTERNATIONAL; COURTIN
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.654482

Item 362
Plastiques Modernes et Elastomeres
49, No.1, Jan./Feb.1997, p.48-9
French
TRENDS IN FOOD PACKAGING
Gailliez E

Developments in multi-layer films, modified and controlled atmosphere packages and reclosable containers for foods are examined. European Union legislation relating to the use of plastics in food packaging is briefly reviewed, and the possibility of using recycled materials in food packages is discussed.
SOPLARIL; CRYOVAC; DU PONT DE NEMOURS E.I.,& CO.INC.
EU; EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; USA; WESTERN EUROPE; WESTERN EUROPE-GENERAL
Accession no.653047

Item 363
Modern Plastics International
27, No. 9, Sept. 1997, p.106/11
COINJECTION BOOSTS BARRIER PROPERTIES OF PET BOTTLES
Gabriele M C

The demand for containers with higher barrier properties is claimed to be driving a shift towards preform coinjection moulding. Advantages of the latest technology are discussed and compared with monolayer PETP bottles. Coinjection is claimed to achieve a 10% improvement in retaining carbon dioxide, and a 200-400% improvement in oxygen permeation. Details are given of ways in which processors and tool designers are using the technique to extend the shelf life of single serve food and beverage containers.
WORLD
Accession no.649429

Item 364
Modern Plastics International
27, No. 9, Sept. 1997, p.36/8
LATEST BARRIER OPTION IS A ‘REMOVABLE’ COATING
O’Neill M

PPG has developed a gas barrier coating for PETP which can be removed during the recycling process. It is offered for use in the packaging of oxygen-sensitive foods, fruit juices, tomato-based products and beers. The coating is a two-component epoxy-amine, characterised by toughness and humidity resistance. Some controversy surrounds claims made by the manufacturers as to oxygen ingress, and its superiority over PEN homopolymer, blends of PVdC and PET, and these are addressed.
PPG INDUSTRIES INC.;
USA
Accession no.649400

Item 365
Packaging
No.3, 1997, p.14
PALLETS, PALLETS AND MORE PALLETS

Plastic pallets are available in a number of formats to suit a variety of intended uses. The pallet deck can be either solid or ventilated, equipped with or without a retaining
collar. The base is fitted with either runners or feet. Ventilated pallets are ideal for use in cold rooms or freezers, where good air circulation is important. Pallets with runners are intended for use in racking or for block stacking. Many models will feet nest when not in use, saving space in storage or on return transport. Sommer Allibert (UK) produces a range of plastic pallets, from the steel-cored Jumbopal for the heaviest duty applications to specialist pallets for distribution, food handling and other industrial sectors. Details are given.

**SOMMER ALLIBERT**
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

**Accession no.642086**

**Item 366**

**Polymer Recycling**
2, No.3, April 1996, p.183-99

**ECOLOGICAL LIFE CYCLE ANALYSIS: MODULAR APPROACH ILLUSTRATED IN INSTANCE OF YOGHURT RETAIL PACKAGING**
Thalmann W R; Schmid M
TS Oeko-Engineering AG

A global approach to ecobalance/ecoprofile compilations for different yoghurt retail containers is developed by TS Oeko-Engineering for a client. The life cycle analysis (LCA) includes all stages of product life from raw materials production to elimination/recycling. It is probably the first broad, integrating analysis for yoghurt containers to-date. It includes, among other items, the production of packaging materials and their processing to the retail containers, the filling operations, impacts of transport and distribution (at different points of the life cycle), as well as the different scenarios for round-trip containers, materials recycling and elimination. A rational, computer-based integration can be performed because of the modular approach to individual life cycle aspects. The possibilities of an aggregated analysis of optimised packaging systems going further than Thalmann’s basic environmental considerations are outlined in conclusion as a perspective. 6 refs.

SWITZERLAND; WESTERN EUROPE

**Accession no.642082**

**Item 367**

**Injection Molding**
5, No.5, May 1997, p.39-40

**JEWEL BOX PACKAGING DURABILITY ISSUES ADDRESSED AT ITA**
Goldsberry C

Problems associated with the jewel box packaging of compact discs are addressed. The need for improved profitability has encouraged moulders to use less resin in the design of the jewel box, but thinner walls have led to cracks. Details are given of product innovations which claim to have solved the problems of quality and profitability.

USA

**Accession no.637458**

**Item 368**

Antee 97. Volume I. Conference proceedings.
Toronto, 27th April-2nd May 1997, p.850-6. 012

**PROCESS OPTIMISATION OF STRETCH BLOW MOULDING FOR MECHANICAL, CLARITY AND BARRIER PERFORMANCE**
DiRaddo R W; Laroche D; Aubert R; Gao D M; Doordan M; Jobin G
Canada, National Research Council; Montell (SPE)

The critical performance characteristics of a stretch blow moulded container are the mechanical behaviour, barrier performance and clarity. These characteristics are dependent on the resulting material, crystallinity and orientation distribution in the part, which in turn are affected by the processing conditions and the material characteristics of the polymer. The effects of the processing conditions and the resulting container geometry and microstructure on the final part performance characteristics are discussed. Numerical approaches are described in an attempt to obtain a better understanding of the process fundamentals and as a tool for process optimisation in the determination of the output/input relationships of process parameters. 7 refs.

USA

**Accession no.637329**

**Item 369**

Antee 97. Volume I. Conference proceedings.
Toronto, 27th April-2nd May 1997, p.839-43. 012

**RECOGNISING INTERACTIVE NATURE OF PETP CONTAINER MANUFACTURING PROCESS IS KEY TO DESIGNING, CONTROLLING AND IMPROVING THEM**
Zagarola S W
Terra Firma International Ltd. (SPE)

PETP bottle manufacturers are often puzzled by ‘illogical’ results when changing process settings. Process interactions often account for these counter-intuitive results. Identifying interactions allows an explanation of the counter-intuitive response and offers opportunities to design processes virtually immune to process variables which are difficult to control. PETP bottle manufacturing case studies are presented, which demonstrate process interaction and how to use it to advantage.

USA

**Accession no.637327**
References and Abstracts

Item 370
Toronto, 27th April-2nd May 1997, p.706-12. 012

THERMOFORMED CONTAINERS FOR ELECTROSTATIC SENSITIVE DEVICES
Gately W E
Ex-Tech Plastics Inc.
(SPE)

Since the 1960s the protective packaging for electrostatic sensitive devices has consisted almost exclusively of specially-treated plastic bags. A series of events in the mid-1980s has provided a market opportunity for the introduction of thermoformed containers made from newly-developed static dissipative plastic materials. Within the last ten years, the market has grown from essentially zero to an estimated 35 million US dollars/year. Continuing changes in electronic technology strongly favour the increased usage of thermoformed clamshell containers and trays for sensitive circuit boards, integrated circuits and disc-drive assemblies. 12 refs.

USA
Accession no.637306

Item 371
Plastics News(USA)
9, No.6, 7th April 1997, p.10

CARBON FILM EXTENDS LIFE OF PETP BEER BOTTLE
MacDermott M

Japan’s Kirin Brewery is reported to have developed new carbon coating technology for PETP bottles that extends their shelf life and allows multiple washings and refillings. Although PETP is becoming an increasingly popular liquid packaging material because of its light weight and durability, its inferior gas- and flavour-barrier properties, compared to glass, limit shelf life and restrict reuse. Tests have shown that by applying the hydrocarbon film to the inside wall of a PETP bottle, its barrier property for oxygen is more than 50 times better than conventional PETP and its barrier property for carbon dioxide as much as 100 times better. The coated bottles also can withstand as many as 30 washings at 158 deg.F. Although Kirin Brewery now packages its beer in glass, it has been investigating alternatives for several years. The brewery developed and tested the hydrocarbon film in conjunction with a university in Kyushu, Japan. The brewery has no immediate plans to commercialise the technology, because it needs to do more testing on whether Japanese consumers would accept beer packaged in PETP; details are given.

KIRIN BREWERY CO.LTD.
JAPAN
Accession no.635699

Item 372
Modern Plastics International
27, No.5, May 1997, p.26

POLYOLEFINs TAILORED FOR FOOD CONTAINERS AND LIDS
Leaversuch R D

Trends in food containers and lid production in North America and Europe are discussed, with reference to the use of polyolefins in thin-walled containers. In North America, injection moulded PE containers dominate in dairy and deli packaging, ice cream containers and drink cups and lids, but this is reported to be being challenged by PP moulding, where growth in yoghurt pots is reported. To meet demands, companies are introducing tailored high-flow grades of HDPE and LLDPE to elevate their toughness/stiffness balance. In Europe, however, thermoformed polystyrene and PP dominate the food packaging industry, where the smaller moulding sector has an equipment base which encourages the use of relatively slower-flowing (20-40 melt index) HDPE or PP.

EUROPE-GENERAL; USA
Accession no.635032

Item 373
Journal of Vinyl and Additive Technology
3, No.1, March 1997, p.12-16

TOTAL QUALITY: OUT OF REACH OR WITHIN REACH?
Prasad S
Novatec Plastics & Chemicals Co.Inc.

The development of total quality programmes for PVC compounding and bottle blow moulding set-ups is described, the key factors being presented in a general format to show the merit and applicability to other manufacturing industries. Introductions to some major concepts and tools in quality control, including variables, attributes, sampling plans, cause-effect diagrams, quality function deployment, statistical process control and quality auditing, are presented to measure the efficacy of the quality programme to achieve total quality. 4 refs.

USA
Accession no.634629

Item 374
Packaging Review South Africa
23, No.3, March 1997, p.15/8

RIGID PLASTICS PACKAGING
Hannay F

At the 1996 Plastics in Packaging 21 conference, Nampak R&D discussed the prospects for future innovation in the plastics packaging sector. The big challenge of the 1980s was to replace metal cans and glass bottles with lighter, more convenient and safer plastic alternatives. Coextrusion, multi-layers and barrier polymers were the subject of most plastics packaging discussions; and a great future was seen for high performance plastic containers. Moving into the 1990s, led by the microwave revolution, many new packs were launched around the world, some
successfully, but others less so - examples were the Petainer (affected by environmental lobbying), the Stepcan (appealing to consumers but too expensive), and Lunch Buckets and other high-tech coextruded containers for processed food (which disappeared for no apparent reason). Other promising packages were launched with much fanfare but didn’t meet expectations. Barrier sauce bottles seem to have settled into niche applications but others like dual-ovenable trays just disappeared. An overview of the industry is presented, including a review of some new developments.

PLASTICS INSTITUTE OF SOUTH AFRICA; SOUTH AFRICA, INSTITUTE OF PACKAGING SOUTH AFRICA

Accession no.634311

Item 375

Modern Plastics Encyclopedia

NEW TECHNOLOGY PROVIDES CRITICAL TOLERANCE CONTROL FOR CONTAINERS
Rost B
Illig A., Maschinenbau GmbH & Co.

Opportunities for new product applications in thermoforming have been increasing, especially in the food industry. Major trends here include the increasing use of PP and reduced wall thickness. Precisely shaped packs are required when high-performance machines do the filling. This accuracy can only be achieved for PP on thermoforming lines when the packs are formed and punched at the same station. Higher-end machine technology includes cam-controlled forming table drives allowing both forming and punching to occur in one cycle.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.632256

Item 376

Plastics Technology
43, No.3, March 1997, p.21

COEX PROCESS FOR PET BOTTLES TIGHTENS LAYER CONTROL, CUTS TOOL COST
De Gaspari J

A novel extrusion-based approach to blowing multi-layer PETP containers is offered as an alternative to coinjection moulding. The process, developed by Sabel Plastechs Inc. is said to offer superior layer thickness control and inexpensive tooling. Details are given of the machine which is currently being applied to making small unorientated bottles.

SABEL PLASTECHS INC.
USA

Accession no.631822

Item 377

Packaging & Bottling International
No.2, April 1997, p.38-42

A STAR IN PEN TWINKLES ON THE HORIZON
Bornioli Metalplast; Aoki Technical Laboratory Inc.; Shell Chemical Co.

Characteristics of polyethylene naphthalate (PEN), are described, and its advantages in hot filling packaging applications are discussed. Aoki Technical Laboratory has developed a method of producing low cost hot fill PEN/PETP bottles using the same moulding process as that for PETP. By using the proper combination of PEN/PETP blend, a high Tg point and crystallinity can be achieved.

EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; USA; WESTERN EUROPE

Accession no.631710

Item 378

Packaging Technology & Science
9, No.6, Nov.-Dec.1996, p.313-26

THINNING OF BARRIER LAYERS IN MULTIWALL THERMOFORMED PACKAGES
Piergiovanni L; Rho V; Bernig W
Milan, University; Dixie-Union-Verpakungen GmbH

The stretching of the sides, edges and the bottom of some thermoformed containers were studied, with particular reference to the thickness reduction of an aromatic polyamide barrier layer. The total thickness along the sides, at the edges and on the bottom of the containers thinned according to different models, but it was always possible to estimate approximately the extent of stretching by simple equations which linked the thickness to the drawing depth of the containers. The thickness measurements of the barrier layer at the edges, before and after the thermoforming step led to a definition of ‘degree of barrier stretching’ and it was possible to correlate these figures with the depth of drawing. Furthermore, it was also possible to correlate the residual barrier layer with absorption measurements made at 294.2 nm of the composite structure along the sides of the thermoformed containers, obtaining simple relationships which could be useful tools in packaging design as well as in shelf-life studies. 7 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; ITALY; WESTERN EUROPE

Accession no.631674

Item 379

Plastics Southern Africa
26, No.7, Jan.1997, p.12/8

RIGID PLASTICS PACKAGING: IS THERE STILL ROOM FOR INNOVATION
Hannay F
Nampak Group

Some of the factors in raw materials and process developments that will be around to help create innovative
plastics containers as the turn of the century approaches are reviewed. To choose the successful ones, it is necessary to keep close to the market place, to discern the real needs and link efforts to partners who can cover all aspects of the supply chain.

Accession no.630914

Item 380

Plastics News(USA)
8, No.50, 10th Feb.1997, p.3/31

AUSSIE GROCER DROPS EPS FOAM
Tilley K

Woolworths Ltd. has banned the use of expanded polystyrene boxes for the packaging of fruit and vegetables from its Australian stores. The company, which has over 500 supermarkets throughout Australia stopped buying fresh produce in EPS boxes on Jan. 1, with the exception of brussels sprouts, sweet corn and beans where no alternative is available. The ban is said to be based on concerns regarding the high disposal costs. The effect of the ban on Australia’s EPS box industry is reported.

WOOLWORTHS LTD.
AUSTRALIA

Accession no.629618

Item 381

Polymer Engineering and Science
37, No.1, Jan.1997, p.178-82

WALL THICKNESS DISTRIBUTION IN PLUG-ASSIST VACUUM FORMED STRAWBERRY CONTAINERS
Aroujalian A; Ngadi M O; Emond J P
Laval,University

A study was made of the influence of film temperature (118-165°C), plug velocity (0.15-0.27 m/s) and plug temperature (25-135°C) on the wall thickness distribution of high-impact PS strawberry containers produced by plug-assist vacuum thermoforming. Increasing the plug velocity resulted in improved thickness distribution due to elastic deformation of the sheet during forming. Decreasing the stretching time and the temperature difference between film and plug was important for good thickness distribution. Better wall thickness was obtained with a plug velocity of 0.27 m/s and a plug temperature of 123°C. 15 refs.

CANADA

Accession no.629160

Item 382

Injection Moulding International
2, No.1, Jan./Feb.1997, p.68-9

SINGLE-PURPOSE BOTTLE CRATE MACHINE
Luling M

Schoeller produces PP and HPDE bottle crates which are used all over the world. The variety of colours and shapes of bottle crates has increased steadily in recent years, so small runs must be produced economically. Schoeller, in cooperation with Krauss-Maffei, has optimised the C-Series standard injection moulding machine for the production of bottle crates. Cycle time has been reduced from about 45 to 35 seconds.

KRAUSS-MAFFEI KUNSTSTOFFTECHNIK GMBH;
SCHOELLER PLAST INDUSTRIES
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY;
WESTERN EUROPE

Accession no.624857

Item 383

European Plastics News
24, No.3, March 1997, p.23-4

BATTLE OF THE BOTTLE
Marshall D

Finding a plastic that effectively contains beer in prime condition has proved difficult. PETP in its pure form is unsuitable for all but the briefest storage periods. This is due, primarily, to the beer’s high susceptibility to the deteriorating effects of oxygen which has little trouble permeating the PETP walls. Polyethylene naphthalate has superior gas barrier properties essential for beer storage. Beer contained in a PEN homopolymer bottle has a shelf life some five times longer that of beer contained in PETP. A blend of the two, containing 8% PEN, offers a shelf life 2-3 times greater, with no attendant recycling problems.

WORLD

Accession no.624474

Item 384

Revista de Plasticos Modernos
70, No.473, Nov.1995, p.474-9

Spanish

NEW TRENDS IN PRODUCTION AND MACHINERY IN THE EUROPEAN BLOW MOULDING INDUSTRY
Wilke U
Battenfeld Fischer Blasformtechnik GmbH

A survey is made of trends in extrusion and coextrusion blow moulding machinery on the European market arising from changing requirements by manufacturers of plastics bottles and other containers.

ALPLA WERKE ALWIN LEHNER KG
EUROPE-GENERAL; EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.624375

Item 385

Plastics News(USA)
8, No.37, 11th Nov.1996, p.50

EPA ENDORSES RECYCLED-CONTENT PALLET

King R
The EPA has recommended that plastic shipping pallets containing recycled content be purchased by federal government agencies as part of the government’s list of 12 other products proposed for addition to its buy-recycled programme mandated by the Resource Conservation and Recovery Act. The amount of recycled content can be between 25-100%. Problems relating to lack of specifications on such products are discussed, and the effect on the US Postal Service, which currently has 3 million high molecular weight PE cargo pallets, is examined.

US, ENVIRONMENTAL PROTECTION AGENCY
USA
Accession no.618891

Item 386
Plastics Engineering
MODIFYING PETP CRYSTALLISATION TO IMPROVE CONTAINER PROCESSING
Sakellarides S L
Amoco Chemical Co.

Three commonly used comonomer modifiers are compared as to their effectiveness in slowing PETP’s rate of thermal crystallisation in order to improve container clarity and reduce acetaldehyde formation. A comparison of the three modifiers - isophthalic acid, diethylene glycol and cyclohexanedimethanol - find that the first two cause a real decrease in PETP’s crystallisation rate, manifested by all three of the above effects.

USA
Accession no.618628

Item 387
Plast’21
Spanish
NEW TRENDS IN PRODUCTION AND EQUIPMENT IN THE BLOW MouldING INDUSTRY
Wilke U
Battenfeld Fischer Blasformtechnik GmbH

A survey is made of trends in extrusion and coextrusion blow moulding machinery for the manufacture of bottles and other plastics containers.

ALPLA WERKE ALWIN LEHNER KG
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.616952

Item 388
Modern Plastics International
26, No.12, Dec.1996, p.54-7
HOUSEWARE MOULDERS SEEK OUT NEW PP TECHNOLOGIES
Leaversuch R D

New high-flowing PP random and impact copolymers developed by Montell and other PP suppliers make oversized housewares feasible and cost-effective. Today’s large housewares include 190-L storage boxes, 9.5-L food containers and closet clothing bins. Higher-flowing PPs fill existing moulds at about 38°C lower process temperatures than before, so cooling times decline and cycles are shorter. BASF has developed a PP random block copolymer which combines the low-temperature impact strength of a block copolymer with the transparency of a random.

USA; WESTERN EUROPE-GENERAL
Accession no.615876

Item 389
Boston, Ma., 4th-7th Sept.1990, p.735-50. 6A
THERMOFORMING MICROWAVEABLE CONTAINERS
Kent W F

This paper describes in some detail methods for thermoforming of PP and crystallised PETP microwaveable packaging containers. Information is presented on processing parameters, equipment and material requirements. 3 refs.

USA
Accession no.614951

Item 390
Plastics News (USA)
8, No.33, 14th Oct.1996, p.7
HOOSIER FIBERGLASS MARKETING LIGHTWEIGHT, CHEAPER CD HOLDER
Goldsberry C

This article highlights the CD Muffin, a new type of CD packaging that promises a lower-cost, lightweight alternative to the jewel box. The CD Muffin, a pressure formed, one-sided PP holder that incorporates an air pocket to protect the laser tracks, is manufactured by Hoosier Fiberglass Inc. of the USA. Details of the Muffin’s production are given.

HOOSIER FIBERGLASS INC.
USA
Accession no.611978

Item 391
Medical Design & Manufacturing West 1994.
Conference proceedings.
Anaheim, Ca., 1st-3rd Feb.1994, p.103.2-103.9. 6S
CASE STUDY IN MEDICAL PACKAGING DESIGN AND MATERIAL SELECTION
Frambach D
Creative Forming Inc.
(Canon Communications Inc.; Medical Device & Diagnostic Industry Magazine)

Among the Environmental Protection Agency’s preferred options for solid-waste management - the familiar Reduce, Reuse, Recycle credo - its top priority is source reduction. Source reduction in packaging results in the introduction of less materials into the solid waste stream. The positive effects of source reduction are not dependent on the development of a recycling infrastructure, or on the availability of any particular disposal method. A source-reduction case history is outlined. An overview is presented of a collaborative effort between Baxter Healthcare, Conceptual Design Industries and Creative Forming is presented, which resulted in the development of a thermoformed plastic medical shipper tray reducing by more than 100 tons annually the amount of medical waste introduced to landfills. The redesigned package, made of recyclable PETG, met Baxter’s initial source reduction mandate while at the same time improving the packaging system.

USA
Accession no.611210

Item 392
Antec ’96. Volume III. Conference proceedings.
Indianapolis, 5th-10th May 1996, p.3422-6
TOTAL QUALITY: OUT OF REACH OR WITHIN REACH?
Prasad S
Novatec Plastics & Chemicals Co.Inc.
(SPE)

Until recently, quality has gained increasing importance in the manufacturing sector on a global scale. Quality standards such as the ISO 9000 series, QS 9000 series and the Malcolm Baldrige National Quality Award have brought on a movement which seems to be gaining momentum by the day. Development of a total quality programme for any manufacturing facility must take some key factors into consideration for the programme to work. The key factors that need to be considered in a PVC compounding or bottle blow moulding set-up are presented in a generic format to show the merit and applicability to other manufacturing industries. Introductions to some major concepts and tools in quality control including variables, attributes, sampling plans, cause-effect diagrams, quality function deployment, statistical process control and quality auditing are presented to measure the efficacy of the quality programme to achieve total quality. 4 refs.
USA
Accession no.608759

Item 393
Polymer Plastics Technology and Engineering

EFFECT OF RESIN TYPES AND ANTIOXIDANTS ON RELEASE OF OFF-FLAVOUR FROM HDPE BOTTLES
Yam K L; Ho Y C; Young S S; Zambetti P F
Rutgers,University; Hoffmann-La Roche Inc.

The effects of three types of HDPE resins and three antioxidants (vitamin E, Irganox 1010 and BHT) on the release of off-flavour (including off-odour and off-taste) from blow-moulded HDPE bottles were investigated using sensory analysis and gas chromatography/mass spectrometry analysis. Overall the sensory study showed that off-flavour intensity was affected by both resin type and antioxidant. The GC/MS study identified more than 60 volatile compounds released from the bottles, ranging from C5 to C20, belonging to the groups of n-alkane, 1-alkene, aldehyde, ketone, phenolic, olefin and paraffin. 20 refs.
USA
Accession no.608520

Item 394
Kunststoffe Plast Europe
86, No.8, Aug.1996, p.17-9
HIGH-PERFORMANCE PP FOR THERMOFORMING
Folland R; Karlsson H
Borealis

Controlled crystallinity polypropylene and high stiffness polypropylene is examined for use in thermoformed thin-wall rigid packaging containers. Its advantages are described, and the material is suggested as an alternative to traditional thermoforming materials such as polystyrene and PVC in packaging applications. Details are given of process developments, the morphological properties of PP, and the reactor nucleation of polypropylene.
DENMARK; EUROPEAN COMMUNITY; EUROPEAN UNION; SCANDINAVIA; WESTERN EUROPE
Accession no.607138

Item 395
Paper, Film & Foil Converter
70, No.9, Sept.1996, p.22
NEW POSSIBILITIES FOR BEER PACKAGING IN PEN AND LCP
Sacharow S
Packaging Group Inc.

Commercialisation of PEN and LCP bottles for beer is discussed with reference to the advantages offered by both materials in terms of oxygen barrier. Problems associated with bottling beers are examined, which can lead to flavour and colour deterioration. The approval of PEN homopolymers by the FDA is claimed will enable at least one major US beer bottler to have a PEN bottle on stream by 1997. Research being carried out at North Carolina State University into the use of LCP bottles is also discussed.
USA
Accession no.606983
Item 396
Indianapolis, 5th-10th May 1996, p.958-62. 012
BASIC STUDIES OF BLOW MOULDING OF
TALC- THERMOPLASTIC COMPOUNDS
Suh C H; White J L
Akron,University,Inst.of Polym.Engineering
(SPE)
The extrusion blow moulding of talc filled HDPE and PP
compounds was studied. These compounds did not exhibit
zero shear viscosity, but exhibited yield stresses below
which there was no flow. Annular swell was greatly
reduced compared to the neat polymers, but extrusion sag
was minimised. Blow moulded bottles had much greater
thickness uniformity than bottles blow moulded from the
meat polymers. X-ray diffraction studies showed that the
talc particles were oriented with the flake surfaces parallel
to the mould surface, or equivalently to the bottle surface.
8 refs.
USA
Accession no.606643

Item 397
Indianapolis, 5th-10th May 1996, p.870-7. 012
HIGH NITRILE POLYMERS:
THERMOFORMING PAR EXCELLENCE
Young G; Lund P R
American Mirrex Corp.; BP Chemicals Inc.
(SPE)
Applications of high nitrile resins based on acrylonitrile-
methacrylate copolymers in thermoformed packaging are
examined. Their properties and thermoforming
characteristics are discussed and compared with those of
PVC. The environmental advantages of these resins are
also reviewed. 5 refs.
USA
Accession no.604786

Item 398
Indianapolis, 5th-10th May 1996, p.848-53. 012
THERMOFORMING DISPOSABLES:
OPPORTUNITIES AND ISSUES: MARKETS,
MATERIALS AND MACHINERY, THE
COMPETITIVE INTERFACE
Hoover L
Harborside Research Group Inc.
(SPE)
The market for disposable thermoformed plastics products
in the food packaging and medical sectors is examined,
and aspects of machinery and materials selection affecting
competitiveness in this market are discussed.
USA
Accession no.604457

Item 399
Packaging Digest
33, No.11, Aug.1996, p.33/6
THERMOFORM REELS IN SURGICAL
BENEFITS
Indigo Medical has introduced a new two-piece
thermoform for optical fibre devices used in prostate
surgery which is described as protective, dimensionally
stable, rigid and aesthetically pleasing. The packaging
now gives substantially more control over what had been
difficult medical device to handle. In development about
three months, the new package is the result of an upgrade
made late last year for the line of optical fibres used for
laser surgery. Performed internally, the surgery requires
that the tip end of each device must be kept absolutely
sterile until entering the body. Merrill’s Packaging
produces the thermoformed tray in a meticulous
cleanroom environment using Kloeckner Pentaplast’s 25
mm blue tinted, rigid Pentamed PETG film, extruded from
Eastman’s PETG copolyester resin. The forming film’s
flexibility and machinability are critical to the tray’s
design. A centre cavity is shaped like a circular reel; square
corners with 1 in.-deep pockets lock the device’s diffuser
or connector end and pointed tip neatly into place. The
two-piece container can hold several styles of optical fibre
cable that coils up and nests within the 9.5 in.-diameter
centre cavity. Details are given.
INDIGO MEDICAL; MERRILL’S PACKAGING
INC.; EASTMAN CHEMICAL CO.
USA
Accession no.604457

Item 400
Packaging Digest
33, No.10, July 1996, p.32/6
CLAMSHELL TURNS ON A BRIGHT 3-WAY
IDEA
The article supplies details of the thermoform clamshell
packaging designed to enhance and protect new 3-way
fluorescent components from US company Solium. The
polystyrene chloride clamshell secured packaging,
manufactured by Walter Drake Inc., was designed and
produced, without benefit of the traditional prototype,
within four weeks.
SOLIUM; BRANDEQUITY INTERNATIONAL;
DRAKE W.,INC.; CHARLES RIVER
LITHOGRAPHY
USA
Accession no.604457

Item 401
Modern Plastics International
26, No.9, Sept.1996, p.44
FORMING SYSTEM CUTS SCRAP FROM 50%
TO 15%
Gabriele M C
QuesTech Packaging has introduced a thermoforming process for deep-draw barrier containers for use in food, medical and pharmaceutical applications. The company plans to license the process, in which pre-cut blanks are formed in a near melt-phase, but semi-solid state, rather than heated and stretched as occurs in cut-sheet thermoforming. It is claimed the system offers advantages in scrap reduction and technical capability versus existing thermoforming methods for manufacturing specialty containers.

QUESTECH PACKAGING INC.
USA
Accession no.604044

Item 402
Plastics News(USA)
8, No.16, 17th June 1996, p.9
ENTERTAINMENT BUSINESS DRESSES UP FOR SHOW
Goldsberry C

Manufacturers in the compact disc, video and audio tape packaging industry are reported to have introduced new products at the recent Replitech International 1996 exhibition that have improved consumer eye appeal, and greater durability and functionality. Alpha Enterprises has launched two new videocassette cases at the San Jose show. DuraCase, targeted for the video sellthrough market, is the same size as the standard vinyl vacuum formed clamshell, but is injection moulded in one piece from polypropylene. Details of other products are included.

ALPHA ENTERPRISES INC.
USA
Accession no.603597

Item 403
Advances in Polymer Technology
15, No.3, Fall 1996, p.191-204
EXTRUSION BLOW MOULDING OF HDPE-PETP BLENDS
Kumaravel G; Jabarin S A
Toledo,University

The suitability of blends of HDPE/PETP/compatibiliser for blow moulding was investigated. The rheology of the blends was studied in the context of extrusion blow moulding. Bottles were blown from the blends and tested for mechanical properties. 15 refs.

USA
Accession no.602166

Item 404
Polymers for Advanced Technologies
7, Nos.5/6, May/June 1996, p.365-73
NEW POLYMERIC MATERIALS FOR CONTAINERS MANUFACTURE BASED ON PETP/PEN (ETHYLENE NAPHTHALENEDICARBOXYLATE)

NAPHTHALENEDICARBOXYLATE) COPOLYESTERS AND BLENDS
Po R; Occhiello E; Giannotta G; Pelosini L; Abis L
EniChem SpA

Copolyesters of terephthalic acid, 2,6-naphthalenedicarboxylic acid and ethylene glycol, prepared by either melt polycondensation or blending, were shown to be promising materials for the manufacture of hot-fillable, re-fillable, high oxygen barrier and high UV barrier containers. The properties of these materials were dependent on their composition and microstructure, which could be tailored by controlling the experimental parameters during their preparation. In particular, the effect on crystallisation rate, which played a key role in the bottle manufacturing cycle (comprising melt polymerisation, solid-state polymerisation, drying, moulding and blowing), was studied. 26 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.599384

Item 405
Packaging Week
12, No.11, 25th July 1996, p.1
PEN/PETP BOTTLES OFFER COST SAVINGS
Pidgeon R

It is reported that a new beer, juice and mineral water bottle made of blended polyethylene naphthalate and PETP could lead to big costs savings for fillers. CA Greiner of Kremsmuenster says that the 50cl prototype bottle, weighing just 45g, has attracted interest from around the world since it was unveiled at the Interpack exhibition in May 1996. Claimed to be made of 90% polyethylene naphthalate, the bottle can be washed at up to 90 deg.C and is refillable for between 25-50 trips. The company claims that the lightweight PEN/PETP bottle can save up to 6.5 tons on each delivery truck, compared with using glass bottles, leading to logistics cost savings of about 10-15%.

GREINER C.A.,& SOHNE GMBH
AUSTRIA; WESTERN EUROPE
Accession no.599309

Item 406
Plastics Engineering
52, No.7, July 1996, p.33-4
THERMOFORMING OF POLYPROPYLENE
Macaulay N; Harkin-Jones E
Belfast,Queen’s University

A considerable area of plastics processing is concerned with the thermoforming of food packaging from extruded thermoplastic sheet, of which thin-gauge containers for dairy products represent a large market. The chief materials employed in this area are PP and high-impact PS (HIPS). PP’s versatility in thermoforming applications arises from its excellent combination of physical, thermal,
and chemical properties. However, despite these advantages, HIPS has been the resin of choice until quite recently because of difficulties encountered in the extrusion and thermoforming of PP. The optimum thermoforming conditions for thin-gauge PP sheet are determined, and the processing characteristics of a nucleated and an unnucleated grade are compared. 5 refs.

USA
Accession no.599268

Item 407
Packaging Technology & Science
9, No.4, July/Aug.1996, p.175-85
ACETALDEHYDE IN MINERAL WATER STORED IN PETP BOTTLES: ODOR THRESHOLD AND QUANTIFICATION
Nijssen B; Kamperman T; Jetten J
TNO Nutrition & Food Research Institute
A method is described for determining the concentration of acetaldehyde in water during storage in PETP bottles. Comparisons between still water and carbonated water are discussed using model experiments. 16 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; NETHERLANDS; WESTERN EUROPE
Accession no.599138

Item 408
Packaging Review South Africa
22, No.5, May 1996, p.51
ROSY FUTURE FOR PVC PACKAGING
Loubser G
Adriaplast of Italy revealed recently that South Africa represents its third largest export market for rigid PVC packaging materials. The company is a major producer of rigid PVC; and local agent Interchem imports some 500 tpa for use by the South African packaging industry. Fast-growing markets are the pharmaceutical and confectionery sectors (especially for blister packaging). Another significant market is for bottle capsules. Adriaplast’s factory at Monfalcone in Italy specialises in the production of a comprehensive range of rigid PVC for packaging; and recent developments include multilayer rigid sheet offering improved oxygen and moisture barrier properties, as well as oriented PVC to meet the needs of the shrink label market. Details are given.
ADRIAPLAST SPA; INTERCHEM INTERNATIONAL SA
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; SOUTH AFRICA; WESTERN EUROPE
Accession no.597506

Item 409
Plastics News International
July 1996, p.22-3
PEN FOR REPLACEMENT OF GLASS CONTAINERS
The development work carried out in recent years by Shell Chemical into polyethylene naphthalate (PEN) has looked at opportunities to improve on the established attributes of PET as packaging material. The opportunities are seen as high fill temperatures, improved chemical and temperature resistance, autoclaving and improved barrier performance. Applications requiring these properties include some potentially large markets - pharmaceutical containers, hot fill products such as sauces, jams and juices, and returnable/refillable containers for wine, beer and water.
SHELL CHEMICALS CO.
AUSTRALIA
Accession no.595960

Item 410
Plastics and Rubber Asia
11, No.64, June 1996, p.76/8
GLOBAL ALTERNATIVE TO WOOD
Hunerberg E
Johnson Controls Inc.
It is reported that while it is gaining in popularity in North America and Europe, the use of structural foam pallets as an alternative to wood is also being promoted for the Asia Pacific. In terms of advantages, they are environmentally safe, recyclable and nail and splinter free. They are more durable, lightweight and have utility advantages such as their stacking quality, and moulded-in performance features. Details are given.
ASIA-PACIFIC; USA
Accession no.593477

Item 411
Polymer Engineering and Science
36, No.9, Mid-May 1996, p.1266-71
EFFECT OF PROCESSING VARIABLES ON THE ENVIRONMENTAL STRESS CRACK RESISTANCE OF BLOW MOLDED POLYETHYLENE BOTTLES
Strebel J J; Benson M
Quantum Chemical Co.
Experimental design was used to test the effect of die temperature, mould temperature, moulding time, and drop time. Bottles blown at each condition were tested using the internal pressure ESCR test. Using regression analysis, the effect of each variable was quantified. 10 refs.
USA
Accession no.593342

Item 412
Packaging
66, No.710, Iss.2, 1996, p.22-3
PUTTING A GLOSS ON PLASTIC
Meyrick N
RPC Containers Ltd.
Blow moulded bottles and jars for sauces, relishes and mayonnaise products have provided PP with its greatest success in the packaging market. Such bottles are usually coextruded, combining PP with an EVOH oxygen barrier, typically in a five or seven layer structure. Penetration of these bottles in the UK ketchup market is nearly 30% of retail volume and in the US the share is in excess of 50%. At RPC Containers the development of a special high gloss finish has been the most significant advance in this area for multilayer PP. The combination of materials provides a visually-appealing, contact-clear bottle or jar which maintains a quality image.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.592540

Item 413
Kunststoffe Plast Europe
86, No.5, May 1996, p.27-8
RETURNABLE BOTTLES OF POLYCARBONATE
Ohst S; Gotzmann G
Bayer AG

The advantages are described of the use of polycarbonate in returnable milk bottles. The lightweight bottle offers safety and is virtually unbreakable, and in addition, its transportation uses less fuel. Its ease of processing is emphasised, and its ability to withstand repeated sterilisation. Polycarbonate has a light transmission of almost 90%, permitting optimum control of cleanliness during packaging and filling. 3 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.592359

Item 414
Kunststoffe Plast Europe
86, No.5, May 1996, p.17-9
PACKAGING MADE OF METALLOCENE-PP
Kunzer R; Wieners G
Hoechst AG

Comparisons are made between conventional PP and metallocene PP with respect to properties and processing behaviour. Their use in thin-walled injection moulding of packaging containers is discussed, where the application calls for transparent, rigid, odour-free packaging.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.592354

Item 415
Kunststoffe Plast Europe
86, No.5, May 1996, p.13-4
BARRIER PROPERTIES OF PET AND PEN BOTTLES

Appel O
Krupp Corpoplast Maschinenbau GmbH

Barrier properties of PETP and PEN bottles are examined and factors influencing such properties such as orientation, crystallinity and bottle designs are examined. Polyethylene naphthalate and its copolymers are shown to offer better properties than PETP in terms of carbon dioxide permeability, with the higher the PEN content of the material, the better the property profile of the blow moulded bottle. Machine and process technologies to be adjusted to the various bottle materials are discussed with respect to a ten-stage blow moulding machine.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.592351

Item 416
ALPHA-TOCOPHEROL (VITAMIN E) AS AN ANTIOXIDANT FOR EXTRUSION COATING POLYMERS
Zambetti P; Baker S; Kelley D
Hoffmann-La Roche Inc.; Dow Chemical Co. (TAPPI)

Alpha-tocopherol (vitamin E) was used as an antioxidant in an extrusion coating grade of LDPE, and its effects on taste and odour reduction and on adhesion and heat seal performance of coated substrates were investigated. The effectiveness of this antioxidant in reducing taste and odour in blow moulded HDPE bottles was also studied. 9 refs.

USA
Accession no.592166

Item 417
Montreal, 5th-8th May 1996, paper 22, pp.20. 012
MATERIAL SOLUTION OPTIONS - TOTAL PACKAGE
Dean P R
Harwick Chemical Corp. (ACS,Rubber Div.)

A broad overview is presented of functional options available in chemical packaging. The options which are described include pre-dispersed forms, pre-blended systems, preweighed systems and protective packaging. Individual and option combinations are also discussed. A description of the benefits of these options is included to aid the consumer in product selection for specific requirements. 2 refs.

USA
Accession no.591663
**Item 418**

**USING POST CONSUMER PLASTIC TO PRODUCE SLIP TRAYS THAT WILL REPLACE WOOD, PLASTIC AND METAL PALLETS**
Trickett H J
Enviropak Inc.
(ACS, Rubber Div.)

The challenges solved by this project are the elimination of plastic materials currently going into landfills and their reuse to create a new product that will replace a wood, plastic or metal pallet. More than 500 million wood pallets are used each year in the USA. 415 million, or more than 83%, eventually end up in landfills. Approximately 16% are recycled. Because of inherent problems the present plastic slip sheet has made only a minimal 04% penetration of the pallet market. Slip sheets overall comprise less than 10% of the palletised unit market. Enviropak has developed a Slip Tray design that has an enhanced lip and four sides. Tests of this design have proven that this lip is much stronger and much easier to grasp. This design also makes it easier to chisel under the unit with the platens. Details of the HDPE slip tray are given.

**WESTERN EUROPE-GENERAL; WESTERN EUROPE**
Accession no. 591207

**Item 419**

**Packaging Digest**
33, No. 6, May 1996, p.84/6

**LIGHTWEIGHTING BIAx-BOTTLES VIA PREFERENTIAL HEATING**
Abrams B

This comprehensive article supplies details of a new stretch blow moulding technique to produce biaxially oriented PETP bottles, being used by three companies in the USA, for salad dressings. The bottles are very lightweight, achieving a 15% saving in materials. The article describes the process and production organisation at the three companies.

MARTIN GILLET CO.; TOPCO ASSOCIATES; POCONO P.E.T. INC.

**USA**
Accession no. 591649

**Item 420**

**European Plastics News**
23, No. 6, June 1996, p. 22-3

**PRESSING AHEAD WITH PP**
Anscombe N

PP’s many desirable properties have meant an increasing demand for the material from the thermoforming industry. PP’s semi-crystalline structure makes it more difficult to form than its amorphous counterparts. Solvay has a variety of grades of PP specifically developed for thermoforming. These include the Eltex P HL range for high speed extrusion thermoforming. Fina foresees a huge market for the microwave, hot-fill and dairy packaging industries for its Finapro grades. Montell has developed a family of high melt strength PPs for large part thermoforming. Illig has developed thermoforming machines which can process standard grades of PP. These use the solid phase forming technique. Rigo has a pre-heat calender between the unwinding and forming station which discourages sheet sag and reduces heat consumption.

**USA**
Accession no. 591641

**Item 421**


**FUNDAMENTAL STUDY OF STRETCH-BLOW MOULDING NAPHTHALATE POLYESTERS**
Tibbitt J; Schmidt G; Bauer C
Amoco Chemical Co.
(SPE, European Sections)

This paper presents a detailed study of the injection stretch-blow moulding (ISBM) of naphthalate polyesters including polyethylene naphthalate (PEN), copolymers with high and low levels of naphthalate, and low naphthalate content blends. In an experiment, ISBM was simulated using the process of freeblowing of injection moulded preforms and the naphthalate polyester compositions were tested and compared to PETP. Development of strain hardening and crystallinity was studied. The data generated from this work is said to be intended for use in the design of naphthalate polyester preforms and containers.

**USA**
Accession no. 590911

**Item 422**

**Plastics and Rubber Weekly**
No. 1638, 31st May 1996, p. 9

**FOAM PROCESS ON SHOW**
Smith C

The patent-protected Coralfoam injection moulding technique uses a combination of blowing agent technology and tool design features to place discrete areas of foam at key points in plastics parts within the moulding cycle. It is claimed it is possible to vary and tightly control the density of the foamed regions of the part and to use thick wall features without extending the cycle. At the heart of the Coralfoam process is an endothermic chemical foaming and nucleating agent developed by Reedy International. The Safoam additive generates carbon dioxide. The Coralfoam process uses a controlled temperature difference across the mould halves. Development trials have proved the Coralfoam technique
with the polyolefin and styrenic materials used by the packaging industry.

CORALFOAM
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no. 590527

Item 423
British Plastics and Rubber
April 1996, p. 10-1
BLOW MOULDING

A recent seminar hosted by Trendpam Machinery discussed the use of amorphous PETP as a cost-saving alternative to crystallised material. Aoki’s injection stretch blow machine is able to process A-PETP directly through a vented barrel under vacuum, removing the moisture in the processing machine. PEN has been heralded as offering hot fill capabilities over those of PETP, better oxygen and carbon dioxide barrier, and reduced UV permeation. However, the question is whether the improved performance is sufficient to replace glass at a cost-effective price.

TRENDPAM MACHINERY LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no. 588622

Item 424
British Plastics and Rubber
April 1996, p. 4-6
DOWN SIDE OF DIY

Enderby R
Blow Moulding Controls Ltd.

As a bottle user, it may seem attractive to cut out the middle man and blow mould the bottles in-house. However, going in-house can be more complex than many people anticipate. This article discusses the pitfalls of this strategy. Considerations include the investment in machinery and technical skills required, support from the machine supplier, market shifts, printing and capping, raw material supplies, product liability, mould trials and technical support.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no. 588617

Item 425
Food Additives and Contaminants
13, No. 3, April 1996, p. 307-14
OLIGOMERS IN PLASTICS PACKAGING. I. MIGRATION TESTS FOR VINYL CHLORIDE TETRAMER

Castle L; Price D; Dawkins J V
UK, Min. of Agriculture, Fisheries & Food; Loughborough, University of Technology

Vinyl chloride tetramer was studied as a representative oligomer that had the potential for migration from plastics packaging. PVC bottles for retail beverages were analysed by a process of dissolution followed by gas chromatography. Tetramer levels ranged from 70 to 190 mg/kg in the plastic. When these bottles were tested for migration into the simulants distilled water, 3% acetic acid, 15% ethanol and olive oil, no tetramer migration was detected at a limit of 5-10 microg/kg. As, of the low molec. wt. oligomers, the tetramer had the highest concentration in the PVC plastics, it was concluded that the other vinyl chloride oligomers of higher molec. wt. would not migrate above this limit of detection either.

18 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no. 587979

Item 426
Polymer Engineering and Science
STRUCTURE AND PROPERTIES OF BIAXIALLY STRETCHED POLY(ETHYLENE TEREPHTHALATE) SHEETS

Maruhashi Y; Asada T
Kyoto, University

This study examines how PETP sheet stretching affects the PETP heat-shrinkage behaviour at 85°C, which is the hot-filling temperature in the manufacture of stretch blow moulded PETP bottles.

20 refs.
JAPAN
Accession no. 587369

Item 427
Polymer Engineering and Science
36, No. 3, Mid-Feb. 1996, p. 378-86
EXTRUSION BLOW MOULDING OF MICROCOSMITE BASED ON THERMOTROPIC LIQUID CRYSTALLINE POLYMERS AND PP

Handlos A A; Baird D G
Virginia, Polytechnic Institute

Details are given of the extrusion blow moulding of bottles from pellets of PP containing pregenerated microfibrils of thermotropic liquid crystal polymers. Factors considered include the effect of thermotropic liquid crystal polymer concentration and in situ composite strand properties on the mechanical properties and anisotropy of bottles.

42 refs.
USA
Accession no. 585921

Item 428
Packaging Review South Africa
PACKAGING MOTOR OIL
Loubster G
Trends in the way in which motor oil and other lubricants are bought has in turn brought about changes in packaging, with growth in plastic containers seen in South Africa. The move to garage chain stores and self-service garages, and the ability to buy such items in supermarkets for the purchaser to do his own oil changes and topping up, has provided a forum for competitive marketing of lubricants, and plastics containers, with their printability and eye-catching lightweight designs. Features such as anti-glug pouring mechanisms, corrosion resistance and less denting of containers have been achieved through the use of plastic materials.

SOUTH AFRICA
Accession no.585419

Item 429
*Kunststoffe Plast Europe*
84, No.5, May 1994, p.6-7
German; English
INJECTION STRETCH BLOW MOULDING OF PP BOTTLES
Neumann E H
Nissei ASB GmbH

The technique of injection stretch blow moulding PP bottles is described, and the advantages it affords in terms of better mechanical properties and improved transparency are discussed. Improvements in the process technology, especially in preform conditioning, ensure that the process can be run at a high level of safety in production.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.585081

Item 430
*Packaging Week*
11, No.38, 14th March 1996, p.24-5

TURNING UP THE HEAT
Goddard R

The prospect for the development of a truly hot-fillable plastic material, with enhanced gas barrier and UV barrier properties, has attracted a lot of attention in recent years. The main plastic contenders are HDPE, PP, PVC and PETP. PVC and PETP can both be modified to give temperature tolerance of up to 85°C. Blends of PETP/PEN which have appeared in evaluation quantities over the last two years are seen by many as the way forward. Blends of PETP and LCP have also shown promise in development programmes. Carters Packaging has shown minimum-processed orange juice in bottles blown using Shell HiPertuf resin and hot filled at 95°C.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.584456

Item 431
*Revue Generale des Caoutchoucs et Plastiques*
French
NEW DEVELOPMENTS IN NUCLEATED POLYPROPYLENES
Detaeye J
Fina Chemicals

The properties of Fina Chemicals’ Finapro range of nucleated PP resins are examined, and applications in the thermoforming of packaging containers are described.

BELGIUM; EUROPEAN COMMUNITY; EUROPEAN UNION; WESTERN EUROPE
Accession no.583132

Item 432
*Plastics Technology*
42, No.1, Jan.1996, p.80

FLEXIBLE CUP BOTTOM ‘BREATHES’ AS AIR PRESSURE CHANGES

The solution to a design problem relating to yoghurt pots which were subject to differing air pressures, is described. The pots are thermoformed by Multidimensionales SA of Bogota, Columbia, who found that the containers deformed when transported from high altitude locations to a lower altitude. The technique used involved the manufacture of containers formed from coextruded HIPS and g-p polystyrene sheet, and which incorporate a false bottom with a flexible diaphragm that moves in or out depending on the atmospheric pressures.

MULTIDIMENSIONALES SA
SOUTH AMERICA
Accession no.580883

Item 433
*Analyst*

USE OF POLYETHYLENE TEREPTHALATE PLASTIC BOTTLES FOR THE SAMPLING, TRANSPORTATION AND STORAGE OF POTABLE WATER PRIOR TO MERCURY DETERMINATION

Copeland D D; Facer M; Newton R; Walker P J
Thames Water Utilities Ltd.

Comparisons were made between the use of PETP bottles and clear glass bottles for the storage of potable water samples for up to 10 days, prior to mercury determination. The PETP bottles were found to be as suitable as glass bottles for this purpose, while also offering significant cost saving and safety advantages. Two chemical preservatives were also compared. The recovery of mercury was significantly enhanced for both bottle types by the pre-addition of either hydrochloric acid or an acid dichromate preservative solution. The latter was preferred on safety grounds owing to its obvious colour. 10 refs.
REFERENCES AND ABSTRACTS

Item 434

Packaging Review South Africa
21, No.11, Nov.1995, p.13/5
FRESH PRODUCE PACKAGING. DOES PLASTIC THREATEN CORRUGATED?

A recent survey on European packaging markets for fresh produce, reveals that only a limited threat to South Africa's corrugated industry is presented by the use of reusable plastic crates for fruit packaging. Information on the European packaging markets was presented to fruit producers, packaging converters and corrugated material manufacturers at a workshop hosted by Unifruco, following the launch of a collapsible and reusable plastic packaging system by International Fruit Container Organisation, (IFCO). The biggest threat from the IFCO system comes from the temperature-controlled product range. The need for consistency and a pan-European standard for reusable packaging is stressed.

MARKETPOWER; INTERNATIONAL FRUIT CONTAINER; MONDI KRAFT
SOUTH AFRICA
Accession no.579455

Item 435

McGee T M; Jones A S Eastman Chemical Co. (SPE,Cleveland Section; SPE,Blow Molding Div.)

The effects of transesterification on ultimate blend properties such as planar stretch ratio, oxygen permeability, and crystallinity were investigated. Transesterification rates and levels and selected physical properties of blends made from both PETP/poly(ethylene 2,6-naphthalene dicarboxylate) and PETP/N-T copolymer systems. The blend properties were then compared with those of the corresponding neat N-T copolymers. 10 refs.

USA
Accession no.578856

Item 436


Johnson K C
Lowell,Massachusetts University (SPE)

HDPE is one of the most commonly used materials for the production of bottles and containers. In recent years, many communities have set up programmes to collect these bottles for the purpose of recycling. Unfortunately it is difficult to completely eliminate contaminants, such as PP, from the waste stream, due to the latter’s similar density and physical properties. The effects that different grades and concentrations of PP contaminants have on the low temperature impact properties and processing of the recycled HDPE bottles are examined. 3 refs.

USA
Accession no.577868

Item 437

Asian Plastics News
March/April 1995, p.13-4
PET BOTTLES TAKE THE HEAT
Reade L

The Asian market for hot fill PETP bottles is examined, with reference to trends in the industry and technological developments in blow moulding methods and machinery. Particular attention is paid to the processes used to produce crystallinity of the PETP using integrated single blow, two-step single blow, integrated double blow, and two-step double blow processes.

ASIA
Accession no.572745

Item 438

Modern Plastics International
25, No.11, Nov.1995, p.60-3
INNOVATIONS ADVANCE CUSTOM BOTTLE-MAKING
O’Neill M

Demand is increasing for custom bottles. Machinery manufacturers are increasing the diversity and production rates of their machines. Krupp Corpoplast has launched its B111 machine which can produce PETP beverage bottles of capacity 0.2 to 3L at a rate of 12,000/h. Smaller machines have recently become a focus for processors, for example, when lower outputs are required for developing and emerging markets. Some machines, such as those from Aoki, have the capability to produce bottles from amorphous PETP. Frontier has a machine for injection stretch blow moulding bottles from highly clarified PP. Lightening of containers has become a priority for both equipment suppliers and their customers. An outline of flow analysis software to aid manufacturing is given.

WORLD
Accession no.570895
Item 439

Modern Plastics International
25, No.11, Nov.1995, p.19-21
PEN BOTTLE COMMERCIALISATION DELAYS APPEAR SHORT-TERM
Leaversuch R D

Hopes remain high that polyethylene naphthalate is poised to replace glass in hotfill, refillable-returnable, beer and other food container markets. It is claimed that PEN, versus PETP, offers superior oxygen and carbon barrier, thermal resistance and stiffness. Amoco Chemical and partners are finding ways to use the polyester variant more cost-effectively, notably PEN/PETP copolymers, PETP/PEN copolymer blends and adaptations of existing injection stretch blow moulding equipment to optimise PEN use. The immediate delay on PEN commercialisation is the postponed startup of Amoco’s 27,000 tonne NDC facility in Decatur, scheduled for last summer.

AMOCO CHEMICAL CO.
USA
Accession no.570888

Item 440

Plastics News(USA)
NEW MATERIAL KEEPS OXYGEN OUT OF PACKAGES
Ford T

It is reported that one of the largest problems facing package designers and food processors is how to keep oxygen out of packaged goods in order to increase shelf life and decrease the chance of contamination. Toyo Seikan Keisha claims to have developed a packaging material that removes oxygen from inside the package and increases the oxygen barrier to the outside. Details are given.

TOYO SEIKAN KAISHA LTD.
JAPAN; USA
Accession no.569248

Item 441

Coex ’87.Proceedings of the 8th International Coextrusion Conference.
Teaneck,NJ,14-16th Oct.1987,p.269-308. 82
CASE HISTORIES OF DIAL LUNCH BUCKET AND CAMPBELL’S MICROWAVE CHUNKY SOUP COEX HIGH-BARRIER CONTAINERS
Miller R W
DRG PLASTICS
(Schotland Business Research Inc.)

A dial lunch bucket was thermoformed from coextruded PP/regrind/adhesive and EVOH. Considerable attention was given to the container lip design. The Campbell’s Microwave Chunky Soup container is a low profile rectangular tray produced from a seven layer structure including similar materials and sealed with a peelable foil lid. A rotary thermoforming process unique to DRG is used to produce the containers. The process is well suited to polyolefin including the newest EVOH high barrier materials.

USA
Accession no.388394
Subject Index

A
ABRASION RESISTANT, 100 119
ABSORPTION, 21 39 216 284 340 342
ACCELERATED TEST, 148 171 220
ACCUMULATOR HEAD, 73 108 174 384 387
ACETALDEHYDE, 24 36 101 111 243 407
ACETIC ACID, 245 425
ACETONE, 63
ACRYLIC, 2 15 274
ACRYLIC POLYMER, 30 67
ACRYLONITRILE-BUTADIENE-STYRENE, 15 67 74 136 186 263 278 294
ACRYLONITRILE COPOLYMER, 43 248 397
ACTIVE FILM, 157
ADDITION, 24 42 44 51 68 74 82 86 97 109 112 119 122 164 202 221 230 243 245 291 294 295 297 315 332 340 358 384 386 387 393 396 397 398 416 417 431
ADHESION, 11 67 119 186 195 245 340 397 416
ADHESIVE, 109 112 119 141 144 181 186 195 205 214 299
AESTHETIC, 24 67 68 74 82 94 112 164 187 294 348
AGEING, 27 60 148 216 416
AGRICULTURAL APPLICATION, 9 14 42 51 102 217 224 320 339 398 413
AIR, 95 291 304
AIR BARRIER, 24 30 43 44 65 66 67 82 104 109 111 118 120 133 190 195 199 201 204 206 212 248 269 275 289 364
AIR BUBBLE, 74
AIR-TIGHT, 395
ALCOHOL, 25 342
ALCOHOLIC BEVERAGE BOTTLE, 110 222 247 263 305 371
ALDEHYDE, 111 133 190 393 416
ALPHA-TOCOPHEROL, 416
ALUMINIUM, 30 32 44 75 189 301
ALUMINIUM FOIL, 49 67
AMORPHOUS, 19 66 111 133 159
342 423 431 435 438
AMPOULE, 146 315
ANALYSIS, 43 54 100 112 211 271 284 326 340 386 396 411 416 425
ANCILLARY EQUIPMENT, 36 38 375
ANNEALING, 63 309
ANNULAR DIE, 396
ANTIOXIDANT, 39 271 393 416
ANTISTATIC, 74 82 155 332 370 394
APPEARANCE, 15 39 40 130 131 178 180 183 194 202 261
AROMA, 24 43 44 66 67 82 305
ASPIRIN, 32 36 52 57 66 68 74 82
AUXILIARY DISC, 367
AUTOMATION, 32 36 52 77 78 88 93 95 102 108 114 170 183 214 264 303 348 384 387 398
AUTOMOTIVE APPLICATION, 11 195 205 233 248 263 276 325 358
AWARD, 150 181 253 278
440
BARRIER RESIN, 30 43 44 63 66 82
BEER, 24 64 66 96 109 111 133 147 167 246 263 305 343 349 363 364 383 395
BEER BOTTLE, 24 30 37 41 56 57 58 59 66 67 98 103 104 109 111 115 118 122 123 124 130 133 138 140 145 158 167 173 179 184 190 200 205 212 213 215 219 225 231 239 249 250 255 263 269 275 280 289 292
BEVERAGE, 1 16 18 23 24 33 39 41 57 75 91 95 98 102 103 113 131 132 137 140 151 152 167 173 179 180 186 192 195 196 197 198 212 239 250 251 263 266 275 288 292 305 340 345 355 363 415 425
BIAxIAL ORIENTATION, 53 88 101 193 248 283 376 396 419 429 437
BIAxIAL STRETCHING, 269 426
BINDER, 173 186 263
BIOCIDE, 241
BIODEGRADABLE, 3 34 42 51 87 186 248 320 339
BIODETERIORATION, 3 34 42 51 87 186 248 320 339
BIOLOGICAL ATTACK, 95 284
BIOPOLYMER, 34 87
BISPHERON A, 189
BLEND, 2 8 15 22 25 29 39 42 48 60 61 63 64 68 76 116 120 122 133 173 182 204 210 216 227 229 234 248 259 256 276 281 263 269 275 279 296 319 347 357 363 364 377 383 403 404 415 421 423 430 432 435 439
BLENDING, 63 372 417
BLISTER PACKAGING, 81 134 173 200 202 301 315 397
BLOW-FILL-SEAL, 315
BLOW MOULD, 45 55 108 110 264 280 314 384 387 396 403 416 427
BLOW MOULDED, 49 120 167 263 347 393 411
BLOW MOULDING MACHINE, 2 16 20 31 33 47 57 58 69 77 120 124 125 131 140 164 173
Subject Index

Subject Index

116 © Copyright 2002 Rapra Technology Limited
Subject Index

Crack Resistance, 54 119
128 411
Cracking, 54 85 128 263 367
Crater, 6 86 90 100 114 154 162
235 240 325 345 346 382 434
Creeper, 100 397
Cryogenic, 208 219 251 277
298
Crystalinity, 27 36 41 43 44
66 70 82 86 100 101 110 112
121 142 159 208 234 251 283
298 327 329 342 347 358 368
377 394 415 421 426 431 435
437
Crystallisation, 43 86 94
100 101 110 144 159 238 290
358 386 394 404 430 435
Dairy application, 14 102
217 224 320 398 413
Damage, 155 183
Damage Tolerance, 126 308
Decomposition, 3 111
Decoration, 52 74 82 132 170
181 183 184 294 305 348 356
397
Deep Drawing, 144 397 401
Defect, 36 108
Deflashing, 303
Deformation, 27 72 100 110
211 326 369 381 388 397 398
432
Degradable, 3 34 42 51 87
186 339
Degradation, 27 42 60 86 138
148 177 202 216 217 223 247
284
Degradation Resistance, 217
Direct application, 14 102
127 224 320 398 413
Diameter, 45 46 20 93 110
123 136 140 207 208 390 396
420
Die, 32 52 155 264 375 390 396
416
Die Cutting, 401
Die Swell, 17 403
Die Temperature, 396 411
Differential Scanning Calorimetry, 60 257 386
Differential Thermal Analysis, 112 121 257 386
Diffusion, 44 157 248 268 269
342
Digital Versatile Disc, 262 367
Dimension, 9 45 52 110 396
Dimensional Stability, 36 100 158 346 397 398 431
Dimensional Tolerance, 333
Direct application, 14 102
127 224 320 398 413
Disc, 262 367 390
Discolouration, 101
Disinfection, 91
Dispenser, 10 183 300
Dispensing, 81
Disposable, 9 14 134 249 345
384 387 398
Domestic Appliance, 13 131
276 388
Double Walled, 344
Draw Ratio, 101 381 397 426
© Copyright 2002 Rapra Technology Limited
E

EASY-OPEN, 49 67 245 263 305 315 362 388
ECOBALANCE, 288 366
EGG BOX, 308 358
EJECTOR, 36 45
ELASTOMER, 15 29 40 48 74 294 339 397 417
ELECTRIC MOTOR, 55 69 108 264
ELECTRIC MOULDING TECHNOLOGY, 55
ELECTRON BEAM RADIATION, 31
ELECTRONIC APPLICATION, 92 155 276 370
ELECTROSTATIC, 38
ELECTROSTATIC SPRAYING, 2 119
ELONGATION, 15 119 331 397 414
ELONGATION AT BREAK, 29 48 60 112 148 346 397
EMBOSSING, 116
EMBRITTLEMENT, 86
EMISSION, 197 276
EMISSION CONTROL, 151
ENCAPSULATION, 11 42
ENERGY CONSUMPTION, 16 36 55 77 108 166 287 302 314 339 358 382
ENGINE OIL, 428
ENGINEERING APPLICATION, 55 67 294 422
ENGRAVING, 348
ENVIRONMENT, 9 42 47 71 100 104 202 203 226 274 279 325 339 345 366 387 398 409 410
ENVIRONMENTAL IMPACT, 3 9 48 130 179
ENVIRONMENTAL LEGISLATION, 9 11 87 288 385
ENVIRONMENTAL STRESS CRACKING, 17 263 331 334 411
ENVIRONMENTALLY FRIENDLY, 13 155 166 198 422
EPOXY RESIN, 67 109 119 133 173 186 192 195
EPOXY-AMINE RESIN, 2 153 250 364
EQUIPMENT, 15 32 36 38 45 95 178 182 191 243 275 314 419
ETHANOL, 63 245 425
ETHYLENE ACRYLIC ACID COPOLYMER, 25
ETHYLENE GLYCOL, 214
ETHYLENE OXIDE, 45 274
ETHYLENE-PROPYLENE COPOLYMER, 112
ETHYLENE TEREPTHALATE COPOLYMER, 27 101 133 257 404 439
ETHYLENE-VINYL ACETATE COPOLYMER, 41 43 44 103 115 126 156 263 269 440
ETHYLENE-VINYL ALCOHOL COPOLYMER, 30 41 43 44 64 65 67 74 82 103 112 115 119 120 122 133 138 144 181 184 205 213 229 245 248 249 260 264 268 269 275 276 280 289 296 305 315 317 332 342 349 352 363 384 412 441
EVAPORATION, 42 339
EXPANDED, 21 181 380
EXTRACTABILITY, 169
EXTRACTION, 271 291
EXTRUSION, 8 16 17 18 19 24 28 39 44 48 52 60 67 68 69 73 74 76 77 84 96 101 108 131 143 160 166 168 170 180 189 240 241 243 245 259 264 273 279 285 294 297 302 303 311 314 322 325 330 332 336 341 358 376 384 387 396 397 398 400 403 416 427 435
EXTRUSION BLOW MOULD, 264 396 416
EXTRUSION BLOW MOULDING, 8 17 18 28 68 69 73 74 77 84 96 108 168 170 259 264 285 297 303 311 314 322 336 341 376 384 387 398 400 403 416 427 435
EXTRUSION CoATING, 209 292 340 416
EXTRUSION COMPOUNDING, 396 416
EXTRUSION RATE, 52 396 398

F

FABRICATION, 171
FAILURE, 121 411
FAT RESISTANCE, 284 431
FEEDING, 32 110 205 264 348
FEEDSTOCK, 15 166
FERTILISER, 42 87
FIBRE, 3 24 51 143 214 339 359
FILAMENT WOUND, 96
FILLED, 263 294
FILLER, 44 51 61 74 112 119 230 346 396 405
FILLER DISTRIBUTION, 396
FILLING, 16 32 39 72 77 91 95 102 111 114 121 124 138 146 167 170 178 180 197 198
FILM, 11 15 30 32 34 39 41 43 44 47 51 52 61 67 81 82 90 95 115 126 138 156 157 166 173 178 183 209 234 245 248 269 273 279 294 315 325 340 342 345 348 350 362 381 416 435 441
FILTER, 38 45 78
FINISHING, 93 261 264
FISH, 30 82
FIVE-LAYER, 74 133 289 292
FLAME IONISATION, 284
FLAMMABILITY, 346
FLASH, 93
FLASH REMOVAL, 187 264
FLAVOUR, 123 231 284 304 393 416
FLEXIBILITY, 32 44 93 119 195 355
FLEXURAL PROPERTIES, 6 15 17 41 48 68 82 97 100 117 160 166 251 279 331 332 341 346 354 358 372 388 394 397 403 429 431 439
Subject Index

FLOUR, 339
FLOW, 6 36 53 100 205 256 258
287 372 384 388 396 397 398
427
FLOWERPOT, 333
FLUORINATION, 84 187 248 268
342
FLUOROPOLYMER, 342
FOAM, 21 30 60 67 82 90 105 109
112 126 132 144 155 161 181
195 205 263 265 270 272 294
308 319 322 325 330 332 333
341 358 359 380 410 422
FOAMING AGENT, 112 341 359
FOIL, 32 183 301
FOLDABLE, 325 345 387
FOOD SIMULANT, 245 284
FORECAST, 4 105 179 193 262
275 286 379 394
FORM-FILL-SEAL, 81 82 112 144
200 319 377 416
FORMABILITY, 397 398 419 420
FORMING, 32 94 127 253 330 332
333 351 370 378 381 385 391
399 406 441
FORMULATION, 11 178 180 210
214 436
FRAC TURE MORPHOLOGY, 25
63 76 119 251 298 347
FROZEN, 126 211
FRUIT JUICE, 75 108 109 137 199
205 206 245 263
FRUIT PACKAGING, 9 82 325
380 381 434
FUEL CONTAINER, 187
FUEL RESISTANCE, 76 210
FUEL TANK, 77 248 263 276 384
387
FUNGUS, 339

G

GAS ABSORPTION, 340
GAS BARRIER, 24 30 43 82 109
111 115 123 137 163 184 190
201 239 246 248 250 255 342
364 377 383 423 430
GAS CHROMATOGRAPHY, 141
185 268 271 284 291 393 416
425
GAS EXCHANGE, 167
GAS FLUSHING, 127 340
GAS PERMEABILITY, 24 30 35
43 44 55 64 66 67 75 82 96 98
101 107 109 111 112 133 159
205 245 248 256 279 294 302
305 315 340 342 362 397
GAS PLASMA, 111
GAS SOLUBILITY, 66 248
GAS STERILISATION, 45
GAS TRANSMISSION, 41
GASOLINE, 63
GELATIN, 42
GLASS, 24 41 55 130 131 179 180
203 249 260 263 305 345 357
363
GLASS FIBRE-REINFORCED
PLASTIC, 71 96 122 189 359
GLASS TRANSITION
TEMPERATURE, 27 101 112
119 182 248 343 344 377 386
415 423
GLOBALISATION, 161
GLOSS, 8 15 17 52 94 116 119 166
238 279 294 331 332 348 397
412 431
GROWTH RATE, 18 19 56 65 73
77 92 105 115 125 132 144 167
173 174 193 200 249 254 301
332 353 358 388 394 437
H

HAIR DRESSING
APPLICATION, 106 170
HANDLE, 108 110 207 244 359
384 387 388
HANDLING, 15 32 46 102 114
118 138 162 211 275 345 348
375 417
HARDNESS, 15 119 279 394 414
431
HAZARDOUS MATERIAL, 176
189 198
HAZE, 68 94 101 184 388 435
HEAD SPACE ANALYSIS, 70
HEALTH HAZARD, 42 67 274 346
HEALTHCARE APPLICATION,
93 169 178 261 300 398
HEAT CONDITIONING, 108
HEAT DEGRADATION, 27 86
101 284
HEAT DISTORTION
TEMPERATURE, 388 413 414
430
HEAT INSULATION, 126 181 189
270 272 344
HEAT RESISTANCE, 19 24 43 48
67 82 86 94 98 100 101 110 116
133 158 159 213 231 245 248
274 279 290 332 340 343 358
377 383 388 412 420 423 430
431 439
HEAT RETENTION, 398
HEAT SEAL, 44 45 67 82 90 177
200 245 356 362 416
HEAT SETTING, 1 18 110 158
175 251 283 302 430
HEAT STABILISER, 86
HEAT TRANSFER, 120 270 329
358 381 398
HEAT TREATMENT, 43 159 290
HEATING, 18 32 66 101 108 110
120 121 149 152 159 245 292
317 339 352 355 358 381 389
397 398 420 438
HIGH DENSITY
POLYETHYLENE, 8 14 16 17
18 24 43 47 49 52 55 57 67 69
70 78 80 82 84 86 89 93 96 97
100 102 106 127 131 132 141
149 154 168 170 174 177 187
191 194 200 233 240 248 261
263 268 273 274 279 294 303
304 310 325 331 334 341 342
353 359 372 382 384 387 393
396 403 416 418 428 430 436
HIGH IMPACT
POLYPROPYLENE, 100 431
HIGH IMPACT POLYSTYRENE,
52 67 82 116 279 294 367 381
406 432
HIGH SPEED EXTRUSION, 52
420
HIGH SPEED MOULDING, 36 55
108 205 415
HIGH TEMPERATURE, 340 342
HIGH VOLUME PRODUCTION,
163
HINGE, 79 82 263
HOLLOW ARTICLE, 24 36 45 55
66 108 133 264 290 384 387
HOOP STRENGTH, 53
HORIZONTAL MACHINE, 69
384 387
HORTICULTURAL
APPLICATION, 333 339
HOT FILLING, 1 18 24 28 41 44
57 65 82 93 110 158 159 206
207 208 245 248 251 256 257
266 275 290 317 357 360 363
377 404 414 420 423 426 430
431 437 439
HOT RUNNER, 36 46 101 175 205
212 263 280 429
HOUSEHOLD CHEMICALS, 150
HOUSEWARE, 388
HUMIDITY, 30 43 44 248 340
HYDROLYSIS, 101 271
HYDROLYSIS RESISTANCE,
423
HYDROPHILIC, 42
HYDROPHOBIC, 284
HYGIENE, 16 51 91 281
<table>
<thead>
<tr>
<th>Subject Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>174 180 181 191 196 198 205</td>
</tr>
<tr>
<td>218 244 245 249 250 263 264</td>
</tr>
<tr>
<td>275 280 285 286 287 298 303</td>
</tr>
<tr>
<td>305 314 330 332 337 341 348</td>
</tr>
<tr>
<td>352 358 359 363 375 381 382</td>
</tr>
<tr>
<td>384 387 389 396 397 398 416</td>
</tr>
<tr>
<td>420 422 423 424 438 439</td>
</tr>
<tr>
<td>MARBLISING, 205</td>
</tr>
<tr>
<td>MARKET, 15 16 93 130 140 179</td>
</tr>
<tr>
<td>180 262 273 278 299 305 306</td>
</tr>
<tr>
<td>339 358 390 398 434</td>
</tr>
<tr>
<td>MARKET GROWTH, 15 16 93</td>
</tr>
<tr>
<td>105 194 202 262 299 313</td>
</tr>
<tr>
<td>MARKET SHARE, 41 46 47 50 51</td>
</tr>
<tr>
<td>65 77 89 91 105 131 145 150</td>
</tr>
<tr>
<td>173 183 203 214 231 239 246</td>
</tr>
<tr>
<td>249 254 260 261 274 276 280</td>
</tr>
<tr>
<td>288 306 332 383 398 412</td>
</tr>
<tr>
<td>MARKET SIZE, 200 275 377 380</td>
</tr>
<tr>
<td>437</td>
</tr>
<tr>
<td>MARKET SURVEY, 105 252</td>
</tr>
<tr>
<td>MARKET TREND, 69 217 273</td>
</tr>
<tr>
<td>MATERIAL REPLACEMENT, 7</td>
</tr>
<tr>
<td>15 16 24 30 31 33 37 41 55 59</td>
</tr>
<tr>
<td>60 67 69 80 82 84 97 100 105</td>
</tr>
<tr>
<td>132 179 193 200 215 216 220</td>
</tr>
<tr>
<td>222 235 260 263 305 308 309</td>
</tr>
<tr>
<td>313 315 322 325 330 331 335</td>
</tr>
<tr>
<td>338 357 363 365 370 371 372</td>
</tr>
<tr>
<td>374 377 387 394 398 405 409</td>
</tr>
<tr>
<td>410 414 415 433 434</td>
</tr>
<tr>
<td>MATERIALS HANDLING, 106</td>
</tr>
<tr>
<td>135 155</td>
</tr>
<tr>
<td>MATERIALS SELECTION, 12 32</td>
</tr>
<tr>
<td>41 129 130 138 179 194 211</td>
</tr>
<tr>
<td>274 351 354 379 391 398 424</td>
</tr>
<tr>
<td>MATT FINISH, 74 263 294</td>
</tr>
<tr>
<td>MEAT PACKAGING, 30 67 82</td>
</tr>
<tr>
<td>245</td>
</tr>
<tr>
<td>MEAT TRAY, 30 82 362</td>
</tr>
<tr>
<td>MECHANICAL RECYCLING, 130 284 325</td>
</tr>
<tr>
<td>MEDICAL APPLICATION, 15 32</td>
</tr>
<tr>
<td>38 173 253 273 274 391 398</td>
</tr>
<tr>
<td>399 401 440</td>
</tr>
<tr>
<td>MEDIUM DENSITY</td>
</tr>
<tr>
<td>POLYETHYLENE, 82</td>
</tr>
<tr>
<td>MELT FLOW, 36 86 116 117 205</td>
</tr>
<tr>
<td>210 256 258 384 396 398 422</td>
</tr>
<tr>
<td>MELT FLOW INDEX, 53 82 100</td>
</tr>
<tr>
<td>279 331 347 394</td>
</tr>
<tr>
<td>MELT FLOW RATE, 160 186 332</td>
</tr>
<tr>
<td>340 388 414</td>
</tr>
<tr>
<td>MELT STRENGTH, 17 332 352</td>
</tr>
<tr>
<td>397 420</td>
</tr>
<tr>
<td>MELT TEMPERATURE, 36 101</td>
</tr>
<tr>
<td>116 205 344 396 414 416</td>
</tr>
<tr>
<td>MELT VISCOSITY INDEX, 36 82</td>
</tr>
<tr>
<td>100 279 331 396</td>
</tr>
<tr>
<td>MELTING POINT, 43 101 112 159</td>
</tr>
<tr>
<td>238 270 377 414 431 435</td>
</tr>
<tr>
<td>METAL, 5 30 44 55 263 305</td>
</tr>
<tr>
<td>METAL FOIL, 270</td>
</tr>
<tr>
<td>METAL REPLACEMENT, 5 30 84</td>
</tr>
<tr>
<td>96 263 428</td>
</tr>
<tr>
<td>METALLISED FILM, 44 269 279</td>
</tr>
<tr>
<td>METALLISING, 44 74 263 279</td>
</tr>
<tr>
<td>294</td>
</tr>
<tr>
<td>METALLOECNE, 8 15 262 374</td>
</tr>
<tr>
<td>414</td>
</tr>
<tr>
<td>METHACRYLATE</td>
</tr>
<tr>
<td>COPOLYMER, 248 397</td>
</tr>
<tr>
<td>MICROBIOLOGICAL ATTACK, 95 284</td>
</tr>
<tr>
<td>MICROORGANISM, 38</td>
</tr>
<tr>
<td>MICROWAVE, 67 94 116 144 173 185 190 216</td>
</tr>
<tr>
<td>245 250 269 271 284 291 295</td>
</tr>
<tr>
<td>304 307 362 425</td>
</tr>
<tr>
<td>MILK, 14 24 70 82 203 245 305</td>
</tr>
<tr>
<td>353 358 413 431</td>
</tr>
<tr>
<td>MILK BOTTLE, 16 24 47 49 89</td>
</tr>
<tr>
<td>102 108 113 131 168 200 263</td>
</tr>
<tr>
<td>304</td>
</tr>
<tr>
<td>MINERAL WATER, 42 67 108 141</td>
</tr>
<tr>
<td>159 243 245 288 305 345</td>
</tr>
<tr>
<td>MIXING, 52 180 287 331 392 396</td>
</tr>
<tr>
<td>416</td>
</tr>
<tr>
<td>MODIFICATION, 15 32 182 248</td>
</tr>
<tr>
<td>333 342 347 351 372 386</td>
</tr>
<tr>
<td>MODIFIED, 39 144 173 347</td>
</tr>
<tr>
<td>MODIFIED ATMOSPHERE, 30 82</td>
</tr>
<tr>
<td>245 248 269 351 362</td>
</tr>
<tr>
<td>MODULAR, 13 20 38 108 266 345</td>
</tr>
<tr>
<td>375 438</td>
</tr>
<tr>
<td>MOISTURE, 38 43 340 342</td>
</tr>
<tr>
<td>MOISTURE ABSORPTION, 101</td>
</tr>
<tr>
<td>159 248</td>
</tr>
<tr>
<td>MOISTURE BARRIER, 30 67 82</td>
</tr>
<tr>
<td>301 362</td>
</tr>
<tr>
<td>MOISTURE CONTENT, 101 316</td>
</tr>
<tr>
<td>MOISTURE CONTROL, 38</td>
</tr>
<tr>
<td>MOISTURE RESISTANCE, 43</td>
</tr>
<tr>
<td>237 250</td>
</tr>
<tr>
<td>MOLECULAR ORIENTATION, 142 244</td>
</tr>
<tr>
<td>MOLECULAR STRUCTURE, 44</td>
</tr>
<tr>
<td>76 101 159 248 358 377 395</td>
</tr>
<tr>
<td>414 426 431</td>
</tr>
<tr>
<td>MOLECULAR WEIGHT, 24 100</td>
</tr>
<tr>
<td>121</td>
</tr>
</tbody>
</table>

© Copyright 2002 Rapra Technology Limited
MULTISHOT MOULDING, 12 40
MULTIWALL, 378

N
NANOCOMPOSITE, 62 184 192
230 260 269
NANOFOIL, 61 62
NAPHTHALENE COPOLYMER, 421
NATURAL FIBRE, 339
NATURAL POLYMER, 42 87 166 339
NECK, 20 46 49 73 207 208 303
NECKING, 397 416
NITROGEN, 35 43 66 95 107 245 362
NUCLEATED, 388 414 420 431
NUCLETING AGENT, 112 144 238 309 315 332 358 406 422 431
NUCLEATION, 82 94 100 112 258 358 394 431
NYLON, 2 25 39 41 43 44 55 61 62 63 64 67 76 119 122 133 138 144 149 179 184 205 248 260 263 264 268 269 273 280 294 301 313 342 363 378 384
NYLON-6, 15 25 43 61 63 67 204 269 342
NYLON-6,6, 43 204
O
ODOUR, 42 43 44 67 216 269 284 340 362 393 407 416
ODOUR BARRIER, 388
OFFSET PRINTING, 52 74 348 358
OIL CAN, 361
OLIVE OIL, 425
OPACITY, 26 55 160 245 294 353
OPTICAL DISC, 262 367 390
OPTICAL PROPERTIES, 24 29 39 41 43 44 52 55 67 68 74 82 94 95 101 109 133 159 178 205 221 238 245 263 264 269 279 294 315 329 340 348 354 358 362 372 384 388 397 398 431
ORGANOELPTIC PROPERTIES, 24 36 43 44 66 82 94 109 111 133 245 305 340 342 362 388 416
ORIENTATION, 44 52 53 88 101 110 193 208 234 248 279 283 287 336 368 376 396 415 435
ORIENTED, 15 57 70 156 166 180 269 301
PACKAGING FILM, 30 34 39 43 44 52 67 81 82 209 234 245 248 269 294 315 325 340 345 362 416
PACKAGING OF CHEMICALS, 110 176 177 263 264 314 318 334 384 387 417
PACKAGING TUBE, 43 82 205 294 315
PACKAGING WASTE, 9 24 109 155 245 279 325 345 384 387 397
PAIL, 6 53
PAINT, 11 25 233
PAINT CAN, 72 83
PALLET, 7 9 13 45 53 97 100 105 122 135 235 325 345 358 359 365 385 410 418
PALLETSING, 102 345 269 301
PACKAGING FILM, 30 34 39 43
44 52 67 81 82 209 234 245 248 269 294 315 325 340 345 362 416
PACKAGING OF CHEMICALS, 110 176 177 263 264 314 318 334 384 387 417
PACKAGING TUBE, 43 82 205 294 315
PACKAGING WASTE, 9 24 109 155 245 279 325 345 384 387 397
PAIL, 6 53
PAINT, 11 25 233
PAINT CAN, 72 83
PALLET, 7 9 13 45 53 97 100 105 122 135 235 325 345 358 359 365 385 410 418
PALLETSING, 102 345
PANEL, 1 41
PAPER, 32 171 292 305 339 340 348
PAPERBOARD, 252 340
PARISON, 108 120 129 143 168 259 264 314 384 387 396 415
PART REMOVAL, 38 46
PART WEIGHT, 17 46 96 97 127 175 333 353 388
PASTEURISATION, 24 41 64 102 110 133 158 159 208 213 231 251 266 289 383
PATENT, 10 39 49 120 122 140 152 156 167 183 186 242 244 251 317 333 341 382 422
PATENT INFRINGEMENT, 280
PEARLESCENCE, 294
PEARLISED, 74
PEEL STRENGTH, 119 416
PEELABLE, 82 315 332 362
PERFUME, 74 263 294
PERMEABILITY, 24 25 30 35 41 42 43 44 55 61 62 63 64 66 67 71 75 76 82 96 98 101 104 107 109 111 112 133 157 159 184 204 205 210 215 216 219 231 245 246 248 256 268 296 307 327 347 395 415 429
PERMEABILITY COEFFICIENT, 115 248
PERMEATION, 25 44 62 63 248 268 275 340 342
PERSONAL CARE PRODUCT, 150 164 170 205 281
PESTICIDE, 42
PETALOID, 54
PETRI DISH, 31
PETROL CAN, 263
PHARMACEUTICAL
APPLICATION, 15 33 38 45 78 80 81 125 126 146 150 169 173 183 202 205 263 264 292 300 301 315 325 398 401
PHENOLIC RESIN, 263
PHENOXY RESIN, 248
PHOTOCHMICAL DEGRADATION, 42
PHTHALATE, 42
PHYSICAL PROPERTIES, 85 101 112 166 238 283 377 414 421 429 435
PICK-AND-PLACE, 108
PIGMENT, 74 83 86 112 116 154 180 233 240 294 331 341 384
PINCH-OFF, 311
PINHOLING, 353
PLANT POT, 339 420
PLASMA COATING, 2 18 115 138
<table>
<thead>
<tr>
<th>Subject Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>VENTING, 28 32 156 187 438</td>
</tr>
<tr>
<td>VERTICAL MACHINE, 52 69 108 384 387</td>
</tr>
<tr>
<td>VIAL, 146</td>
</tr>
<tr>
<td>VIDEO CASSETTE, 402</td>
</tr>
<tr>
<td>VINYL ALCOHOL COPOLYMER, 60 75</td>
</tr>
<tr>
<td>VINYL CHLORIDE, 425</td>
</tr>
<tr>
<td>VINYL CHLORIDE COPOLYMER, 44</td>
</tr>
<tr>
<td>VINYLIDENE CHLORIDE COPOLYMER, 44</td>
</tr>
<tr>
<td>VISCOSITY, 30 36 52 74 76 101 112 182 198 210 251 302 317 396 397 430 431</td>
</tr>
<tr>
<td>VITAMIN, 81 169 353</td>
</tr>
<tr>
<td>VITAMIN E, 393 416</td>
</tr>
<tr>
<td>WEAR RESISTANCE, 100 119</td>
</tr>
<tr>
<td>WEIGHT, 1 24 45 66 67 73 112 137 211 314 398</td>
</tr>
<tr>
<td>WEIGHT REDUCTION, 24 35 37 49 55 65 67 84 100 127 144 160 181 287 288 297 298 322 325 333 341 352 359 372 384 394 397 398 405 438</td>
</tr>
<tr>
<td>WELD LINE, 53 193 311</td>
</tr>
<tr>
<td>WELDING, 32 49 92 120</td>
</tr>
<tr>
<td>WHITE SPIRIT, 25</td>
</tr>
<tr>
<td>WIDE-MOUTH, 108 110 340</td>
</tr>
<tr>
<td>WIDGET, 167</td>
</tr>
<tr>
<td>WINDING, 32 52</td>
</tr>
<tr>
<td>WINE, 263 305</td>
</tr>
<tr>
<td>WOOD, 7 105 305 339</td>
</tr>
<tr>
<td>WOOD REPLACEMENT, 7 97</td>
</tr>
<tr>
<td>WAFER, 92</td>
</tr>
<tr>
<td>WALL THICKNESS, 23 27 29 35 36 48 53 67 74 90 100 101 108 110 120 121 122 127 129 188 205 208 211 232 251 264 270 279 283 314 333 353 359 369 381 382 384 387 396 398 401 415 420 422 432 438</td>
</tr>
<tr>
<td>WARPAGE, 388 420</td>
</tr>
<tr>
<td>WASHING, 9 45 159 250 271 284 304 325</td>
</tr>
<tr>
<td>WASTE, 9 24 100 109 155 245 279 325 339 345 384 387 397 398 431</td>
</tr>
<tr>
<td>WASTE DISPOSAL, 9 31 87 104 155 202 279 299 320 339 380 397 431 436</td>
</tr>
<tr>
<td>WASTE MANAGEMENT, 9 104 166 284</td>
</tr>
<tr>
<td>WASTE RECOVERY, 325</td>
</tr>
<tr>
<td>WASTE REDUCTION, 9 100 155 162 345</td>
</tr>
<tr>
<td>WASTE SORTING, 26 34 151 197 325</td>
</tr>
<tr>
<td>WATER, 15 16 42 95 120 193 245 291 342 355 407 413 416</td>
</tr>
<tr>
<td>WATER ABSORPTION, 44 159 272 279 429</td>
</tr>
<tr>
<td>WATER BARRIER, 395</td>
</tr>
<tr>
<td>WATER CONTENT, 101</td>
</tr>
<tr>
<td>WATER RESISTANCE, 412</td>
</tr>
<tr>
<td>WATER SOLUBILITY, 30 42 51</td>
</tr>
<tr>
<td>WATER VAPOUR PERMEABILITY, 30 44 67 82 248 269 294 315 358 362 431</td>
</tr>
<tr>
<td>WATER VAPOUR TRANSMISSION, 44 272 279 395</td>
</tr>
<tr>
<td>Y</td>
</tr>
<tr>
<td>YOGHURT POT, 48 160 358 372 432</td>
</tr>
</tbody>
</table>
The Polymer Library (www.polymerlibrary.com) is the world's most comprehensive collection of information on
the rubber, plastics, composites and adhesives industries. The fully searchable database covers approximately 500
regular journals as well as conference proceedings, reports, books, company brochures and data sheets.

Almost all the articles selected for the database can be ordered in full text through our document delivery department.
Non-patent requests are usually despatched within 24 hours of receipt (Monday to Friday).

- We have a large collection of literature directly related to the industries we serve and can offer a personal
  service with minimal bureaucracy, based on detailed knowledge of our stock.

- Many of the documents held at Rapra are not available via other services. This is particularly the case for our
  extensive and unique collection of company literature and data sheets.

- We offer a fast turnaround service (within one working day) combined with a range of delivery options. Some
  full text documents are available as PDF files which can be downloaded immediately

**SPEED OF DELIVERY**

Non-patent documents are despatched from Rapra within 24 hours of receipt (Monday - Friday) of request using
first class mail within the UK, and airmail for the rest of the world. If you request e-mail or fax service, delivery will
be within hours anywhere in the world.

**HOW TO ORDER**

Orders can be made by post, fax, telephone, e-mail, on-line via the website database (http://www.polymerlibrary.com),
or through an online host.

When ordering please include your full company details and which documents you require, quoting one of the following:

1. Accession Number or Copyquest number or,
2. Full Bibliographic Details

Please include which payment method you wish to use and how you wish to receive the article (i.e. e-mail, post, fax, etc.)

Documents can be ordered from Rapra online using the appropriate command of your online host. In this case we
will issue you with an invoice and statement every three months.

For further information, please see www.rapra.net/absdocs/copyquest.htm or contact Sheila Cheese or Jackie
McCarthy on +44 (0)1939 250383 or e-mail documents@rapra.net.

**PLEASE TURN OVER FOR PAYMENT METHOD OPTIONS AND ORDER FORM**
CREDIT CARD PAYMENTS

This is preferable for people who only intend to use our service occasionally. The prices are per copy inclusive of postage and packaging if appropriate. Pre-payment is required by Credit Card payment.

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail, Ariel, Fax, First Class / Airmail Post</td>
<td>£10 / Approx. US$15 or €17 (UK &amp; Overseas) + VAT</td>
</tr>
<tr>
<td>PDF files</td>
<td>Prices – Please refer to online order form for details (these may vary – each publisher sets price)</td>
</tr>
</tbody>
</table>

ANNUAL DEPOSIT ACCOUNTS

A more cost effective way to use our service is to open an annual deposit account. (Web subscribers can use their web subscription for both web access and document delivery)

The minimum amount required to open an account is £200 / Approx. US$290 or €330 (UK & Overseas)

<table>
<thead>
<tr>
<th>Delivery Method</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail, Ariel, Fax, First Class / Airmail Post</td>
<td>Documents are only priced at £7 / Approx. US$10 or €12 per item</td>
</tr>
<tr>
<td>PDF files</td>
<td>Prices – Please refer to online order form for details (these may vary – each publisher sets price)</td>
</tr>
</tbody>
</table>

Please Note: Any money remaining in an annual deposit account after 12 months is void.

Patents are charged at a standard price of £10 / Approx. US$15 or €17.

ORDER FORM

- I would like to open/renew a deposit account for the following amount ___________________________________
- I would like to order the following documents _______________________________________________________

PAYMENT

Name: ____________________________________________________
Company: _________________________________________________
Address: __________________________________________________
 PhoneNumber: _____________________ Fax: ______________________

Rapra Technology Limited
Shawbury, Shrewsbury, Shropshire SY4 4NR, United Kingdom
Tel. +44 (0)1939 250383 Fax: +44 (0)1939 251118
E-mail: documents@rapra.net

- Remittance enclosed (use only for opening or renewing annual deposit accounts)
  (If paying by cheque, please make payable to Rapra Technology Ltd. in £ Sterling/US$/Euros via UK banks only or make payment direct to
  Account No: 05625025, Sortcode: 55-50-05, National Westminster Bank Plc,
  8 Mardol Head, Shrewsbury, Shropshire, SY1 1HE, UK)
- Please invoice my company (use only for opening or renewing annual deposit accounts)
- Please deduct from my annual deposit account (use this option when ordering documents if you already have a deposit account)
  Account Number _______________________________________
- Please charge my credit card
  American Express / Visa / Mastercard (delete as appropriate)
  Card Number:
  Signature: ______________________ Exp. date: ______________

IMPORTANT - Value Added Tax (VAT)
The above prices do not include VAT. Customers in EU member countries may be liable to pay VAT if their Registration Number is not supplied. Please enter your EU Registration Number (VAT - BFV - IVA - TVA - MWST - MOMS - FPA) below:

VAT Number: ____________________________