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**Title**

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

Pil Joong Yoon; Chang Dae Han

Akron, University

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.

**Authors and affiliation**

Pil Joong Yoon; Chang Dae Han

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Troubleshooting Injection Moulding

Vannessa Goodship

(Warwick Manufacturing Group)

ISBN 1-85957-470-X
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1 Introduction

Sometimes, problems occur in injection moulding parts of the desired quality. In most cases, the surface quality is the main criterion. Due to the complex interrelationship between the moulded part and the mould, the moulding compound and the processing, it is often very hard to recognise the origin of problems and thus to take immediate action. The guide that follows aims to help with the practical work and to consider factors affecting the quality of injection moulding parts such as the process, the machinery and the mould.

1.1 Optimising the Moulding Part

Machine specifications and injection moulding parameters are critical in determining the quality of moulded parts.

This troubleshooting guide is designed to help analyse surface defects in the injection moulding and to provide hints on avoiding and/or reducing defects. The core of this review was written during a three-year team project, which involved intensive work by 30 companies. It consists of descriptions, pictures and notes about the different defects, which helps to classify the problem. It provides a short explanation of possible physical causes for the defect. Flow diagrams are also included containing hints on avoiding or reducing defects. Remedy and hints are given, concerning the process, the moulded part, the mould design and the moulding compound.

2 Detection, Classification and Troubleshooting Defects

2.1 Classification

Moulding defects are classified into seventeen types:

1. Sink marks (Section 2.3)
2. Streaks (Section 2.4)
   - Burnt streaks
   - Moisture streaks
   - Colour streaks
   - Air streaks/air hooks
   - Glass fibre streaks
3. Gloss/gloss differences (Section 2.5)
4. Weld line (Section 2.6)
5. Jetting (Section 2.7)
6. Diesel effect (burns) (Section 2.8)
7. Record grooves effect (Section 2.9)
8. Stress-whitening/stress cracks (Section 2.10)
9. Incompletely filled parts (Section 2.11)
10. Oversprayed parts (flashes) (Section 2.12)
11. Visible ejector marks (Section 2.13)
12. Deformation during demoulding (Section 2.14)
13. Flaking of the surface layer (Section 2.15)
14. Cold slugs/cold flow lines (Section 2.16)
15. Entrapped air (blister formation) (Section 2.17)
16. Dark spots (Section 2.18)
17. Dull spots near the sprue (Section 2.19)

In order to eliminate surface defects, knowledge about the causes of the defects is essential. This section gives some important notes on economical and quick optimisation of the moulding process and on avoiding defects.

2.2 Flow Charts for Troubleshooting

Getting rid of surface defects can be a hard task, due to the different physical causes. In order to help the processor, this section contains flow charts which systematically show how to eliminate the defect. The aim is to reach the desired quality by varying the process parameters.

For each defect, the diagram slides into different branches, according to the questions. Only one parameter should be changed at a time, in order to avoid mutual influence. Afterwards several cycles should be completed to ensure stable working conditions. In some cases various solutions are possible, but tendencies (+) or (-) are given. Should one parameter variation fail, go through the questions again and apply, if possible, one remedy after another.

These diagrams only offer suggestions and cannot consider all eventualities. The diagram helps to decide whether the defect can be eliminated by changing the machine settings, or whether the mould or the part has to be changed.
2.3 Sink Marks

2.3.1 Physical Cause

Sink marks occur during the cooling process, if the thermal contraction (shrinkage) of the plastic cannot be compensated in certain areas. If the outside walls of the moulded part are not stable enough, due to insufficient cooling, the outer layer is drawn inside by cooling stresses as shown in Figure 1.

There are three fundamental cases:

- solidification too slow
- effective holding pressure time too short
- not enough holding pressure transfer, because flow resistances in the mould are too high.

For optimum holding pressure transfer the moulded part should be gated to the largest cross-section. In order to avoid premature solidification of the sprue and gate system, sufficient dimensioning is necessary.

Sink marks appear for example near material accumulations as depressions on the surface of the moulded part, if the thermal contraction (shrinkage) cannot be compensated as illustrated by Figure 2 and Figure 3.

2.3.2 Correcting Sink Marks

Check and/or change machine settings. Change mould or moulding compound. Start new cycle and work through Flow Chart 1.

2.4 Streaks

Streaks caused by burning moisture or air can look very similar making classification difficult if not impossible. The signs listed here do not have to appear, they only give reason to suspect a certain type of streak.
Troubleshooting Injection Moulding

Flow Chart 1
Correcting sink marks

* Important! Check if there are voids in the moulded part after removing sink marks
** Residual melt cushion should be at least 2-5 mm

**Inquiry**

**Residual melt cushion too small?**
- Yes → (1) increase metering stroke
  (2) check non-return valve
- No

**Sink marks near the gate or thick-wall areas?**
- Yes → (1) optimise holding pressure time
  (2) increase holding pressure
  (maybe short overpacking)
  (3) change mould wall temperature (-)
  (4) change melt temperature (-)
  (5) change injection rate (-)
- No

**Sink marks away from the gate or in thin-wall area?**
- Yes → (1) optimise holding pressure time
  (2) increase holding pressure
  (maybe short overpacking)
  (3) change injection rate (+)
  (4) change melt temperature (+)
  (5) change mould wall temperature (+)
- No

**Sink marks directly after demoulding?**
- Yes → (1) check ventilation
  (2) check sprue and gate dimensions
  (3) check granules condition
  (4) adapt mould temperature control
  (5) remove material accumulations
  (6) consider wall thickness/rib ratio
  (7) add blowing agent
  (8) use plastic with low shrinkage
- No → (1) increase cooling time
2.4.1 Burnt Streaks (Brown or Silver)

2.4.1.1 Signs for Burnt Streaks

- the streak appears periodically
- the streak appears behind narrow cross-sections (shear points) or sharp edges in the mould
- the melt temperature is near the upper processing limit
- lowering the screw advance speed has a positive impact on the defect
- lowering the melt temperature has a positive impact on the defect
- long residence time in the plasticising unit or the space in front of the screw (due to e.g., cycle breaks or low shot volumes)
- high reclaim content, or a part of the material has already been melted several times before
- the mould is equipped with a hot runner
- the mould is equipped with a shut-off nozzle.

Examples of mouldings with burnt streaks are shown in Figure 4.

2.4.1.2 Physical Cause

Burnt streaks are caused by thermal damage to the melt. The result can be a decrease of the length of the molecule chain (silvery discoloration) or a change of the macromolecules (brownish discoloration).

Possible causes of thermal damage:

- temperature too high or residence time too long during predrying
- melt temperature too high

Figure 4

Examples of burnt streaks
Top left: Burnt streaks due to excessive residence time in the plasticising cylinder
Top right: Burnt streaks due to high shearing heat in the gate;
Bottom left: Burnt streaks due to excessive residence time in the plasticising cylinder
**Troubleshooting Injection Moulding**

**Inquiry**

Melt temperature above the processing range?  
Yes → reduce melt temperature  
(1) vary cylinder temperature (-)  
(2) vary screw speed (-)  
(3) reduce back pressure

No

Is the melt residence time within the critical range?  
Yes →  
(1) reduce cycle time  
(2) increase plasticising time delay  
(3) use the machine to higher capacity: increase screw stroke  
(4) reduce reclaim

No

Burnt streaks appearing periodically or visible after injecting 'into the air'?  
Yes →  
(1) avoid dead spots and flow impeding areas in the gate system and in the plasticising unit  
(2) check plasticising unit for wear  
(3) check granules condition and feed

No

Burnt streaks near the gate?  
Yes →  
(1) lower injection rate (injection profile slow-fast)  
(2) check hot runner  
(3) avoid sharp edges in the gate system

No

(1) lower injection rate  
(2) avoid sharp edges  
(3) avoid small runners*  
(4) check sprue and gate system*  
(5) check nozzle cross-section  
(6) check functioning of shut-off nozzle  
(7) check pre-drying of material**  
(8) reduce reclaim part  
(9) use moulding compound or colouring agents with higher thermal stability

* use rheological mould design  
** thermal damage possible due to excessively long or hot drying process

**Flow Chart 2**

Correcting burnt streaks
• shearing in the plasticising unit too high (e.g., screw speed too high)

• residence time in the plasticising unit too long

• shearing in the mould too high (e.g., injection rate too high).

In order to check the melt temperature inject ‘into the air’. Measure temperature with a needle thermometer.

Thermal degradation of the plastic has a negative impact on its mechanical properties, even if no damage is visible on the surface.

2.4.1.3 Correcting Burnt Streaks (Brown or Silver)

Check and/or change machine settings, change mould or moulding compound, start new cycle and work through Flow Chart 2 again reducing melt temperature.

2.4.2 Moisture Streaks

2.4.2.1 Signs for Moisture Streaks

• the material tends to absorb moisture (e.g., polyamide (PA), acrylonitrile-butadiene-styrene (ABS), cellulose acetate (CA), polybutylene terephthalate (PBTB), polycarbonate (PC), polymethyl methacrylate (PMMA), styrene-acrylonitrile (SAN))

• when slowly injecting the melt into the air, the melt shows blisters and/or is steaming

• the solidified flow front of a partial filling shows crater-like structures

• the moisture content of the material before the processing is very high.

2.4.2.2 Physical Cause

During storage or processing, moisture is absorbed by the granules, forming water vapour in the melt (Figure 5). Due to the velocity profile at the flow front, gas blisters are pushed to the surface of the melt as shown in Figure 6. As the pressure changes, the blisters are deformed by the moving flow front and burst and freeze at the mould wall.

Possible causes for moisture streaks:

(1) Moisture on the mould surface

• leaky mould temperature control system

• condensation water on the mould walls.

(2) Moisture in/on the granules

• insufficient pre-drying of the material

• wrong storage of the material.

2.4.2.3 Correcting Moisture Streaks

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 3.

Figure 5

Examples of moisture streaks
Left: Streaks due to moisture granules; Right: Streaks due to moisture on the mould surface
2.4.3 Colour Streaks

2.4.3.1 Physical Cause

During pigmentation, pigment agglomerations can lead to differences in the concentration. To some extent this can be mitigated by an increase in shearing as shown in Figure 7 and increases in back pressure can be applied during the plastication stage to increase mixing. This kind of poor distribution can be caused by the plastic, the processing parameters, adhesives and other additives. With in-plant colouring using dyes, the defect can occur due to uncompleted solution of the dye particles in the melt.

Similar to thermoplastics, pigments and dyes are sensitive to excessive processing temperature and residence times. If thermal damage is the reason for colour streaks, they should be considered as burnt streaks.

Extensive stress or warpage can also cause colour differences. The deformed areas break the light in a different manner than other areas.

If using masterbatches for colouring, make sure the substrate is compatible with the plastic to be coloured. The effect of the use of an incompatible masterbatch is shown in Figure 8.
2.4.3.2 Correcting Colour Streaks

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 4.

2.4.4 Air Streaks/Air Hooks

2.4.4.1 Signs for Air Streaks

- the moisture content in the environment is very high (especially in combination with cold moulds and cold granules)
- the defect becomes smaller with lower decompression
- the defect becomes smaller with lower screw advance speed
- blisters are visible in the injected material
- the solidified front flow of a partial filling shows crater-like structures.

2.4.4.2 Physical Cause

Air which cannot escape in time during mould filling, is drawn to the surface and stretched in the direction of the flow. Especially near writing, ribs, domes and depressions, the air can be rolled over and thus entrapped by the melt as shown in Figure 9. The result is the formation of air streaks or air hooks.

If air is sucked into the area in front of the screw during decompression, air streaks will appear near the gate. Here, air is transported into the cavity during the injection, and is then pushed towards the mould wall where it freezes.

2.4.4.3 Correcting Air Streaks/Air Hooks

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 5.
Troubleshooting Injection Moulding

Inquiry

Does the processing range of the material allow higher shearing (danger of thermal damage)?

- Yes
  - Improve mechanical melt homogeneity:
    1. increase back pressure and adapt screw speed*
    2. increase injection rate
    3. use smaller gate

- No

Are modifications of the colouring process possible?

- Yes
  - Pigmentation:
    1. use smaller pigments
    2. use pigment paste or masterbatches**
  - Colouring with dye:
    1. use smaller particles
    2. check solubility of the dye

- No

Can other granules be used?

- Yes
  - (1) use smaller granules

- No

Changing the machine or the plasticising unit***:
  1. increasing the L/D ratio
  2. use shearing and blending devices
  3. use non-return valves with intensive mixers

* pay attention to processing instructions by the raw material and machine producers
** MFI-value of the substrate must be the same as that of the plastic
*** when choosing plasticising unit make sure melt homogeneity is sufficient (shear and blend devices must not damage plastic and dye)

Flow Chart 4
Correcting colour streaks

Flow front

Figure 9
Formation of an air streak behind an engraving
**Inquiry**

Are there air hooks?

- Yes
  - (1) adapt injection rate (-)
  - (2) avoid sharp edges on transitions
  - (3) reduce depth of engraving
- No

Air streaks near the gate?

- Yes
  - (1) reduce screw return speed during decompression
  - (2) reduce decompression
  - (3) use shut-off nozzle
- No

(1) adapt injection rate (-)
(2) increase back pressure
(3) avoid sharp edged transitions
(4) check nozzle sealing
(5) move gate

**Flow Chart 5**
Correcting air streaks/air hooks

**Figure 10**
Air streaks/air hooks
Top left: Air streak behind a wall thickness variation; Top right: Air streak (near the sprue) due to sucked in air during decompression; Bottom: Air streak due to entrained and stretched air near rib
2.4.5 Glass Fibre Streaks

2.4.5.1 Physical Cause

Due to their length, glass fibres orientate themselves in the direction of flow during injection. If the melt suddenly freezes when touching the mould wall, the glass fibres may not yet be sufficiently surrounded with melt. In addition to that, the surface can turn rough because of the big differences in shrinkage (glass fibre: plastic = 1:200). The glass fibres impede shrinkage of the cooling plastic, especially in the longitudinal direction of the fibre, thus producing an uneven surface as shown in Figure 11. Figure 12 illustrates the effects that fibre orientation can have on moulded parts.

Figure 11
Formation of a rough surface due to different shrinkages

Figure 12
Glass fibre streaks
Top left: Glass fibre streaks: clearly visible weld line; Top right: Moulded part with rough silvery surface; Bottom: Glass fibre streak due to orientation near sprue
2.4.5.2 Correcting Glass Fibre Streaks

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 6.

2.5 Gloss/Gloss Differences

2.5.1 Physical Cause

The gloss of a moulded part is the appearance of its surface when exposed to light. If a ray of light hits the surface, its direction will change (refraction of light). While one part of the light will be reflected on the surface, another part will reflect inside the part or penetrate it with different intensities. The impression of gloss is at an optimum, the lower the surface roughness. To achieve this, a polished mould wall should be as good as possible, a textured mould wall would not be effective. This is illustrated in Figure 13.

Gloss differences are caused by different projection behaviours of the plastic at the mould wall, due to different cooling conditions and shrinkage differences.
Stretching of already cooled areas (e.g., due to warpage) can be another reason for gloss differences. Various examples of gloss related defects are shown in Figure 14.

2.5.2 Correcting Gloss/Gloss Differences

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Charts 7 and 8.
2.6 Weld Line (Visible Notch or Colour Change)

2.6.1 Physical Cause

Weld lines are created when two or more melt flows meet. The rounded flow fronts of the melt streams are flattened and bonded when touching each other. This is shown in Figure 15 and Figure 16. This process requires stretching of the already highly viscous flow fronts. If temperature and pressure are not high enough, the corners of the flow fronts will not completely develop, creating a notch. Furthermore, the flow fronts no longer melt together homogeneously, possibly producing an optical and mechanical weak spot as shown in Figure 17. If moulding compounds containing additives (e.g., colour pigments) are used, strong orientations of these additives near the weld line are possible. This can lead to colour changes near the weld line. Notches are particularly visible on dark or transparent parts with smooth, highly polished surfaces. Colour changes are particularly visible on parts with metallic pigments (161). Significant improvements can only be reached by high mould wall temperatures.

Increasing the mould wall temperature increases the cycle time by approximately 2% per °C.

2.6.2 Improving a Weld Line (Visible Notch or Colour Change)

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 9.

2.7 Jetting

2.7.1 Physical Cause

Jetting is caused by an undeveloped frontal flow of melt in the cavity. A melt strand is developed which, starting at the gate, enters the cavity with uncontrolled movements. During this phase the melt strand has cooled down to such a degree that it cannot be fused homogeneously with the rest of the moulding.
Troubleshooting Injection Moulding

Inquiry

Gloss differences at ejectors or slides? Yes

No

Gloss differences at perforations? Yes

(1) adapt geometry of perforation
(2) move gate

No

Gloss differences at weld lines? Yes

(1) increase mould wall temperature
(2) increase injection rate
(3) move gate

No

Gloss differences at corners of the moulded part? Yes

Even temperature at corners of the moulded part
(1) reduce temperature of moving half of the mould
(2) change geometry of corners (e.g., round off corners)
(3) change thermal mould design

No

Gloss differences at ribs? Yes

(1) optimise holding pressure time
(2) increase holding pressure
(3) change geometry of the moulded part
(4) change thermal mould design

No

Gloss differences at wall thickness variations? Yes

(1) optimise holding pressure time
(2) increase holding pressure
(3) adapt injection profile to geometry
(4) try to attain continuous wall thickness variations

No

(1) change colour of material
(2) reduce glass fibre content
(3) reduce filler material content

Flow Chart 8
Correcting gloss/gloss differences (2)
**Troubleshooting Injection Moulding**

**Figure 15**
Flow fronts before touching each other

**Figure 16**
Stretching of the rounded flow fronts

**Figure 17**
Visible notch on the top and bottom side of a transparent part

---

**Inquiry**

```
Colour change near weld line?  Yes  (1) use smaller pigments
                          No                         (2) use spherical pigments
                                          (3) use lighter material

(1) increase mould wall temperature*
(2) increase injection rate
(3) increase melt temperature
(4) increase holding pressure
(5) check ventilation
(6) use mould wall with higher roughness
(7) move gate (move weld line to invisible area)
```

* High mould wall temperatures can significantly reduce the defect, but need a much longer cycle time (approximately 2% per °C). Changing points (2) - (4) only have little influence.

---

**Flow Chart 9**
Improving a weld line
compound. This often happens with discontinuously increasing cross-sections of the moulding part in conjunction with high injection speeds. Jetting is illustrated in Figures 18 and 19. Often jetting causes differences in colour and gloss. In some cases there are similarities to the record grooves effect. Jetting can also be influenced by the position of the mould. In order to avoid defects, the cavity should not be filled from top to bottom.

### 2.7.2 Correcting Jetting

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 10.

### 2.8 Diesel Effect (Burns)

#### 2.8.1 Physical Cause

The diesel effect is a pure venting problem. It can occur near blind holes, fillets, the end of flow paths and near points where several flow fronts fuse. It happens whenever the air cannot escape or not quick enough via commissures, venting channels or ejector fits. Towards the end of the injection process, the air is compressed and thus heated to a high degree. The result is very high temperatures which can cause burn marks on the plastic as shown in Figures 20 and 21. Due to the burning of the plastic, aggressive decomposition products may be created, which often attack the mould surface.
**Troubleshooting Injection Moulding**

**Flow Chart 10**
Correcting jetting

**Inquiry**

- Can injection speed be reduced?
  - Yes: (1) reduce injection speed or injection profile (slow-fast)
  - No

- Can the melt temperature be changed?
  - Yes: (1) change melt temperature (+)
  - No

  (1) check position of mould
  (2) round off transition gate-moulded part
  (3) increase gate diameter
  (4) move gate (create flow resistance)
  (5) use impact die

**Figure 20**
Sheet with diesel effect (filling pattern)
(s indicates the flow fronts)

**Figure 21**
Diesel effect (burns) due to merging of several flow fronts
2.8.2 Correcting Diesel Effect (Burns)

Check and/or change machine settings. Change mould or moulding compound, start new cycle and go through Flow Chart 11.

2.9 Record Grooves Effect

In this effect very fine grooves show up on the moulded part, which are very similar to those of records. Concentric rings appear near pin-point gates, while markings are parallel towards the end of the flowpath and/or behind the gate. This is shown in Figure 22.

2.9.1 Physical Cause

- high cooling velocity
- melt temperature too low
- injection speed too low
- mould wall temperature too low.

When injecting the moulding compound into a cold mould, a solidified peripheral layer will be formed behind the flow front due to the high cooling rate. The cooling of the peripheral layer also causes cooling of flow front areas near the mould wall. If this cooling is very high (especially with low injection speeds) these very high viscosity or frozen flow front areas can impede the direct frontal flow of the melt to the wall.
Thus the following hot melt will not be pushed towards the wall as usual, but it will cause an elongation of the flow front in the middle. From a certain pressure the flow front will again touch the wall. The cooled down peripheral areas of the flow front have no contact with the wall (see Figures 23-25).

2.9.2 Correcting Record Grooves Effect

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 12.

Inquiry

Can injection speed be increased?

Yes → (1) increase injection speed

No

Is the maximum injection pressure reached?

Yes → (1) increase maximum injection pressure

No

(1) increase melt temperature
(2) increase mould wall temperature
(3) avoid small runners

Flow Chart 12

Correcting record grooves effect
2.10 Stress Whitening/Stress Cracks

2.10.1 Physical Cause

Stress whitening or stress cracks occur when exceeding the maximum deformation (e.g., due to external stress or warpage). The maximum deformation depends on the type of material used, the molecular structure, the processing and the surrounding climate of the moulded part.

The strength against external and internal stresses can be drastically reduced through physical processes depending on time and temperature. In this case, the linkage forces of the molecules are reduced through wetting, diffusion and swelling processes. This may especially favour stress cracks. Besides internal cooling stresses and stresses due to flow, internal stresses due to expansion are another main reason for internal stresses. External expansion stress is created by demoulding under residual pressure, when the moulded part suddenly shifts from residual pressure to atmospheric pressure. Thus the inner layers of the moulded part put stress on the outer layers. The main reasons for demoulding under residual pressure are insufficiently dimensioned moulds and/or high cavity pressures. The formation of stress is shown in Figure 26 and the physical manifestations on the moulding in Figure 27. If aggressive substances are used (e.g., alkali solutions, grease, etc.) stress whitening and stress cracks often appear after a very long time of operation.

![Figure 26](image)

(a) unstressed, felted molecule structure; (b) orientation of molecules due to force; (c) destroyed molecules due to additional force

![Figure 27](image)

Stress whitening
Left: Stress whitening on an integral hinge
Right: Stress cracks on salad servers (damage visible several weeks after purchase)
2.10.2 Correcting Stress Whitening/Stress Cracks

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 13.

2.11 Incompletely Filled Parts

Injection moulded parts with incompletely developed outer profiles are called incompletely filled parts (or short shots). An example is shown in Figure 28. This

Inquiry

Stress whitening due to strong deformations? Yes
(1) reduce external stress*

No

Demoulding under residual pressure? Yes
(1) earlier change over to holding pressure
(2) reduce holding pressure
(3) reduce demoulding temperature
   (increase cooling time)
(4) stiffen mould by changing design

No

Partially crystalline thermoplastic? Yes
(1) reduce mould wall temperature
(2) reduce melt temperature

No

Amorphous thermoplastic? Yes
(1) increase mould wall temperature
(2) increase melt temperature
(3) reduce holding pressure
(4) change injection speed (+)**
(5) reduce cooling time**

No

Can another moulding compound be used? Yes
(1) choose compound under consideration
   of the surrounding material
(2) use partially crystalline material
(3) high molecular weight or narrow
   distribution of molecular weight desirable

No

(1) ensure constant mould temperature
(2) ensure even filling
(3) change geometry of moulded part***

* deformation (e.g. integral hinges) should occur in warm condition
** only for demoulding without residual pressure
*** e.g., rounding off edges, avoiding wall thickness variations, etc.

Flow Chart 13

Correcting stress whitening/stress cracks
kind of defect often appears far from the gate if there are long flow distances, or on thin walls (e.g., ribs as shown in Figure 29). Due to insufficient mould venting, this defect can also occur in other areas.

2.11.1 Physical Cause

There are several physical causes for incomplete filling:

- injected compound volume too small (e.g., shot volume too small)
- melt flow impeded due to venting problems
- injection pressure not sufficient
- premature freezing of a channel cross-section (e.g., low injection speed or wrong temperature control in the mould).

Incomplete filling due to venting problems does not necessarily cause the diesel effect (see Section 2.8). Therefore the cause for the defect is often hard to determine.

2.11.2 Correcting Incompletely Filled Parts

Check and/or change machine settings, change mould or moulding compound. start new cycle and go through Flow Chart 14.

2.12 Oversprayed Parts (Flashes)

Flashes are often created near comissures, sealing faces, venting channels or ejectors. They look like a more or less developed film-like plastic edge. Fine flashes are not often immediately visible. Large area thick flashes on the other hand sometimes stick out several centimetres over the nominal profile as shown in Figure 30.

2.12.1 Physical Cause

The different possibilities can be divided into four main groups:

- allowed gap widths exceeded (mould tightness insufficient, production tolerances too large or damaged sealing faces)
Troubleshooting Injection Moulding

Inquiry

1. Screw at the very front?  
   - Yes: (1) increase dosage  
     \(\) (2) check non-return valve
   - No

2. Is maximum injection pressure reached?  
   - Yes: (1) increase maximum injection pressure  
     \(\) (2) increase melt temperature
   - No

3. Is there a drop in pressure during the filling?  
   - Yes: (1) belated pressure change-over  
     \(\) increase change-over pressure  
     \(\) increase change-over distance  
     \(\) increase change-over time
   - No

   - (1) change injection speed (+)  
     \(\) (2) increase mould wall temperature  
     \(\) (3) improve venting  
     \(\) (4) change gate geometry  
     \(\) (5) check nozzle bore and temperature

Flow Chart 14
Correcting incomplete filling

- clamping force of the machine insufficient or set to low (mould opening force higher than clamping force, mould cannot be kept close; clamping force deforms platens and mould)
- internal mould pressures too high (shaping pressure at the gap is so high that the melt is pushed even into very small gaps)
- viscosity of moulding compound too low (high internal mould pressures and low flow resistances favour flash formation).

Flash formation can occur very quickly (few cycles) and damage the sealing faces (parting surface).

Figure 30
Large area overspraying (flash)
2.12.2 Correcting Oversprayed Parts (Flashes)

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 15.

2.13 Visible Ejector Marks

Ejector marks are depressions or elevations on the ejector side of the moulded part surface. These wall thickness variations can cause gloss differences and depressions on the visible surface of the moulding as shown in Figures 31 and 32.

Flow Chart 15
Correcting oversprayed parts (flashes)

Figure 31
Gloss differences near the ejector
2.13.1 Physical Cause

The different possibilities can be divided into four main groups:

- process-related causes (e.g., premature demoulding or high demoulding forces due to unfavourable machine settings)
- geometric causes (e.g., wrong fitting or wrong ejector length)
- mechanical or strength-related (e.g., faulty dimensioning and design of the mould, the moulded part or the demoulding system)
- thermal causes (high temperature differences between ejector and mould wall).

2.13.2 Correcting Visible Ejector Marks

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 16.

2.14 Deformation During Demoulding

Depending on the degree of damage there is a classification into extraction marking, cracks, fractures, overstretched areas and deeply depressed ejectors. Critical are moulded parts with undercuts, which are demoulded without movable parts (e.g., slides). Examples of two defective mouldings are shown in Figure 33.

2.14.1 Physical Cause

The causes of deformations can be classified as follows:

- the forces necessary for demoulding cannot be applied to the moulded part without damaging it
- the demoulding movement is disturbed.

The amount of demoulding force applied is a crucial criterion and should thus be kept small. Beside other factors the shrinkage of the moulded part has a direct impact on the demoulding forces. Shrinkage and demoulding force can be influenced considerably by varying the process parameters. It is to be considered though that the geometry of the moulded part is a very important influencing factor.

Figure 32
Shrinkage near an overheated and poorly fitted ejector

Figure 33
Deformation during demoulding
Left: Demoulding grooves on a textured surface; Right: Defomation due to forced demoulding at an undercut
Inquiry

Gloss differences?
- Yes
  - Avoid pressure peaks inside the mould:
    (1) optimise change over point
    (2) reduce holding pressure
    (3) reduce holding pressure time
    (4) constant mould temperature
    (5) change ejector design/system
- No

Ejector not evenly fitted or axial clearance?
- Yes
  - (1) fit in ejector
    (2) check indentations and bearing surfaces of ejector heads
- No

Raised ejector marks?
- Yes
  - (1) use longer ejectors
- No

Premature demoulding?
- Yes
  - (1) increase cooling time
- No

High degree of mould deformation?
- Yes
  - Avoid pressure peaks inside the mould:
    (1) optimise change over point
    (2) reduce holding pressure
    (3) stiffen mould
- No

High demoulding forces?
- Yes
  - (1) vary holding pressure
    (2) vary cooling time
    (3) improve core ventilation
    (4) check drafts and undercuts
- No

(1) reduce holding pressure
(2) reduce holding pressure time
(3) reduce mould wall temperature

Flow Chart 16
Correcting visible ejector marks
In general, low shrinkage is desirable for sleeve and box-shaped parts, since these parts tend to shrink onto the core (== increase holding pressure or reduce cooling time).

Near ribs, the shrinkage retracts on the demoulding force, because the ribs are being detached from the mould walls (== decrease holding pressure or increase cooling time).

2.14.2 Correcting Deformation During Demoulding

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 17.

2.15 Flaking of the Surface Layer

The layers of material are not homogeneously joined together and start flaking. This can occur at the gate or on the moulded part, and can be either large or very small and thin, depending on the intensity. Examples of both are shown in Figure 34.

2.15.1 Physical Cause

Flaking of surface layers is due to insufficient bonding of adjacent surface layers. The different layers are formed by different flow effects and cooling conditions over the cross-section. Shear stresses and inhomogeneities can reduce the bonding of these layers to such a degree that single surface layers start flaking off as shown in Figure 35.

Figure 35
Flaking on a cross-section of a moulded part with different structure formation

High shear stresses and thermal damage can be caused by:

- high injection speeds
- high melt temperatures.

Inhomogeneities can be caused by:

- impurities or other materials among the granules
- incompatible dye or master batch
- moisture in/on the granules
- poorly melted moulding compound.

2.15.2 Correcting Flaking of the Surface Layer

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 18.

2.16 Cold Slugs/Cold Flow Lines

2.16.1 Physical Cause

Cold slugs are formed when melt solidifies in the gate or in the nozzle before the compound is injected, and is transported into the mould with the following shot sequence. If the cold slugs do not melt again, they will cause markings which look like comet tails. They can be spread all over the moulded part. The cold slug can also jam a runner, forcing the melt to part. The results are surface defects similar to weld lines. An example is shown in Figure 36. Cold slugs are often caused by a wrong nozzle temperature or belated retraction of the plasticising unit. Small nozzle diameters can also have a negative effect. An illustration of the mechanism is shown in Figure 37.
Troubleshooting Injection Moulding

**Flow Chart 17**
Correcting deformation during demoulding

**Inquiry**

- **Demoulding under residual pressure?**
  - Yes:
    - (1) earlier change-over to holding pressure
    - (2) decrease holding pressure
    - (3) increase cooling time
    - (4) stiffen mould
  - No:

- **Penetrated ejectors?**
  - Yes:
    - (1) increase cooling time
  - No:

- **Deformations due to or on undercuts?**
  - Yes:
    - (1) reduce cooling time
    - (2) check demoulding system
  - No:

- **Extraction markings?**
  - Yes:
    - (1) reduce holding pressure
    - (2) increase cooling time
    - (3) check surface structure of mould walls
  - No:

- **Strong demoulding forces due to shrinkage on the core?**
  - Yes:
    - (1) reduce cooling time
    - (2) increase holding pressure
    - (3) optimise holding pressure time
  - No:

- **Strongly ribbed moulded part?**
  - Yes:
    - (1) reduce holding pressure
    - (2) reduce holding pressure time
    - (3) increase cooling time
  - No:

- (1) vary mould wall temperature
- (2) increase ejector speed
- (3) check core venting
- (4) check demoulding system
- (5) check drafts
- (6) use mould release agent
**Troubleshooting Injection Moulding**

**Inquiry**

Does the defect occur after a change of material or colour?

---

**Flow Chart 18**

Correcting flaking of the surface layer

---

2.16.2 Correcting Cold Slug/Cold Flow Lines

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 19.

2.17 Entrapped Air (Blister Formation)

2.17.1 Physical Cause

During injection, air is entrapped in the melt and appears as a hollow (air blister) on the moulded part. Primarily there are two factors responsible for this defect:

- decompression too high or too fast
- plasticising performance too low.

There are two types of hollows, entrapped air and voids. Voids are vacuole hollows, formed by the shrinkage of the moulding compound (see ‘sink marks’). Distinguishing between the two is very hard, because of their similar appearance. The following hints might be helpful:

- when opening the hollow in a fluid, a void (vacuum) shows no gaseous bubbles
- entrapped air defects can be reduced by using no decompression
- changing the holding pressure or the holding pressure time has no effect on the size of the hollows.

Moulded parts with hollows are usually not as strong as parts without. Non-transparent parts should be randomly tested by opening them. Examples of trapped air are shown in Figure 38.

---

**Figure 36**

Cold slug near the sprue

---

**Figure 37**

Cold slug is transported into the mould by the flow front
Inquiry

Can the decompression be reduced?

Yes → reduce decompression

No

Can the plasticising unit be retracted earlier?

Yes → retract plasticising unit earlier

No

(1) check nozzle temperature (e.g., fixing of heating elements)
(2) increase nozzle temperature
(3) increase nozzle cross-section
(4) apply longer gate extension
(5) use shut-off nozzle

Flow Chart 19
Correcting cold slug/cold flow lines

Figure 38
Entrapped air
Left: Air bubbles (solidified while flowing around the core); Right: blisters due to injected air


2.17.2 Correcting Entrapped Air (Blister Formation)

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 20.

2.18 Dark Spots

2.18.1 Physical Cause

Black or dark spots appear on the surface due to wear, thermal damage or dirt. Different factors can cause the formation of dark spots or speckled parts:

- Process-related causes, e.g., melt temperature too high or residence time in the plasticising unit too long; wrong temperature profile in the hot-runner system.
- Mould-related causes, e.g., dirty gate system or wear (dead edges) in the hot-runner system.
- Machine-related causes, e.g., dirty plasticising unit or worn screw and cylinder.
- Caused by polymer or dyeing, e.g., impurities in the granule, high reclaim content or unsuitable dye/masterbatch.

Figure 39 shows dark spots resulting from thermal damage to the polymer.

2.18.2 Correcting Dark Spots

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 21.
Figure 39
Dark spots due to thermal damage

Inquiry

Impurities in the granule?  Yes  Check granule for impurities

No

Do dark spots appear after a change of material?  Yes  Clean plasticising unit

No

Is the melt temperature exceeding the processing range?  Yes

Reduce melt temperature:
(1) vary cylinder temperature (-)
(2) vary screw speed (-)
(3) reduce back pressure

No

Is the residence time of the melt within the critical range?  Yes

(1) reduce cycle time
(2) increase plasticising time delay
(3) check dimensions of plasticising unit

No

(1) check hot runner temperature
(2) reduce reclaim content
(3) check dye for compatibility
(4) check plasticising system, gate system and hot runner for impurities, wear and dead edges

Flow Chart 21
Correcting dark spots
2.19 Dull Spots Near the Sprue

2.19.1 Physical Cause

Dull spots near the sprue are mainly caused by:

- small gates
- high injection speeds.

Due to high injection speeds, small gate cross-sections and bypasses behind the gate, extremely strong orientations of the molecule chains are formed during injection. If there is not enough relaxation time directly behind the gate, so the peripheral layers of the melt are frozen while still strongly oriented. Such peripheral layers can only be stretched to a minimum degree and crack under the impact of the high shear stresses.

The hot melt inside flows to the mould wall and forms very small notches as shown in Figure 40. The dull appearance is caused by the widespread reflection in this area.

2.19.2 Correcting Dull Spots Near the Sprue

Check and/or change machine settings, change mould or moulding compound, start new cycle and go through Flow Chart 22.

Inquiry

Can the injection speed be reduced?
Yes
reduce injection speed or use injection profile (slow-fast)

No

Can the gate be modified?
Yes
(1) round off transition from gate to cavity
(2) increase gate diameter
(3) move gate*

No

(1) increase melt temperature**
(2) vary mould wall temperature (-)**

* The gate should be placed so that the melt does not have to flow around sharp edges
** The effect of these parameters is small

Flow Chart 22
Correcting dull spots near the sprue
3 Case Studies of Injection Moulded Components

The following examples highlight potential errors that can be made in injection moulded components as well as solutions to overcoming them.

3.1 Threaded Connecting Sleeves for Ink Drafting Apparatus

With this thin-cavity three-plate mould arrangement, series injection took place in the parting plane. The filling process and the pressure ratios in the two cavities were thus different. The effect of this was that the component did not have a good surface. Moreover, very narrow tolerances could not be maintained. These effects could be overcome by correcting the flow path lengths in the runner. Identical flow path lengths on multiple equipment in the mould are the basic prerequisite for maintaining narrow tolerances.

This basic principle is generally valid in injection moulding technology.

3.2 Meter Cases

On this meter case, there are dovetail guides on the four side faces. The varying wall thickness caused the meeting of flowpaths resulting in an air blister in the vicinity of the gate. The following measures were adopted to try and remove this air blister:

1. Reduction of initial injection speed; however, a hole now appeared at a new point, where the compound was no longer coalescing.

2. Raising the compound temperature; initially this was a success, in that, by raising the compound temperature step by step, it was possible to reduce the initial injection speed as much as possible.

However, after a certain amount of time, warping occurred, which can clearly be traced back to very high internal orientation stresses resulting from excessively slow filling.

In order to remove the air blister even at faster initial injection speeds, the mould clamping force, which had previously been set very high (too high) was reduced until satisfactory running was achieved again. This example shows that a mould clamping force which is not too high, and which is satisfactorily set, guarantees better air venting.

Moreover, the equipment is looked after better: the lower the mould clamping force, the lower the wear.

3.3 Wristwatch Glass

A glass for a wristwatch displayed convergence points opposite the runner, i.e., very visible joint lines. It was possible to establish clearly, after a filling sequence with this mould, that no uniform flow front was formed.

When the sample components were measured later, there were thickness variations of 0.1-0.15 mm. The variations in wall thickness were overcome by supplementary work on the core.

Now a uniform flow front could be generated, and the faults caused by the joint lines are a thing of the past.

After the fault referred to above had been eliminated, there was still some dissatisfaction with the surface lustre of the watch glass, although the mould inserts were high-gloss polished. The required surface gloss could not be obtained until new mould inserts had been manufactured from non-porous vacuum steel (in accordance with the vacuum arc refining process).

3.4 Alarm Clock Glass

In the manufacture of an alarm clock glass, the following problem arose during sampling: a uniform flow front was not being formed, due to the edges being some tenths of a millimetre thicker, and an air blister was formed on the side of the component opposite the runner. Since there were electroplated inserts in the core and the mould insert, it was not possible to correct the wall thickness by secondary work. The electroplated inserts would have had to be manufactured again.

It was decided to remove the air blister by a simpler method. A gas vent was ground, 8.0 mm wide and 0.3 mm thick. The convergence point, with the air, could now be forced out, and it was possible to manufacture good components.

3.5 Glass Cover for Digital Gauge

This component displayed slight sink marks on the face, above the fins, especially on the side away from the gate.
Troubleshooting Injection Moulding

Injection was carried out with a film gate into the parting plane. However the film runner was produced in such a way that the cross-runner to part space was too large. In addition, the runner cross-section was too small.

By moving the cross-runner closer to the component (shorter gate) and by better formation of the accumulation base, it was arranged that the gate stayed open longer.

This not only made it possible to avoid the sink marks, but it was also no longer necessary to select such high melt temperatures and initial injection pressures. This also improved the quality of the component.

3.6 Plug Boards with Insert Pins

On this component, despite all the technical skills that injection moulding technology can offer, voids were forming in the centre of the moulding. The reason why the voids had formed was because the components had been directly connected to the cross-runner. Since a gate point of this kind very quickly freezes, the holding pressure was not able to act for long enough.

It is generally true in injection moulding technology that gates should start in the centre of the runner or the runner system, so that a plastic flow can form properly from the gate outwards. Direct connections from the runner are thus very unfavourable.

4 Effects of Injection Moulding Parameters

This section will discuss the importance of the various injection moulding parameters and their effect on the overall quality of an injection moulded part. Process stability and product quality are also affected by the machine specification itself.

The properties of an injection moulded part depend upon the working material and on the processing conditions. In the production of a series of parts, a certain deviation in quality features such as weight, dimensional consistency and surface characteristics may always occur. The size of this deviation will vary from machine to machine and from material to material. Furthermore, external influences or negative factors have an effect on the quality of an injection moulded part. Examples of such negative factors may include changes in the viscosity of the melt, temperature changes in the mould, viscosity changes of the hydraulic fluid and changes in the characteristics of the plastic.

The causes through which these negative factors may arise are, for example, machine start-up after a long period of non-operation (12), changes in material properties in the processing of a new lot or a different colour, and environmental influences such as the ambient temperature at the time of processing.

4.1 Internal Mould Temperature and Pressure

The decisive factor for all quality features that are concerned with dimension and weight, is the internal pressure of the mould (68). Constant maintenance of this pressure curve in every cycle guarantees uniformity of the quality of injection moulded parts. If the mould internal pressure curve is maintained at a constant, all of the negative factors mentioned above are compensated, this can mean:

- Significant reduction in start-up cycles. The required consistency in quality characteristics is achieved after just a few cycles.
- Better reproducibility of the parts. The deviation spread of the various dimensions lies significantly below that of a non-regulated machine.
- Cycle-time reduction. By the ability to visualise the internal pressure signal, the sealing point can be determined much more easily and accurately.
- Restarts. If the same internal pressure curve is applied at a restart, the resulting parts are exactly alike.
- Improved quality of the parts through effective speed and pressure profiles. Internal pressure profiles without spikes make possible the production of parts with low residual stresses. Switch-over as a function of internal pressure prevents overinjection of the part, regardless of the selected dosage stroke.

The enormous significance of a mould internal pressure curve is characterised by the large number of parameters that can influence the appearance of the curve, the most important influencing factors are:

- In the injection phase: the injection speed, the flow resistance as a function of the type of plastic, the material temperature and the mould wall temperature.
In the pressure holding phase: the material temperature, the mould temperature, the level of the holding pressure and the duration of the holding pressure.

In relation to the maximum mould internal pressure: the injection speed, the material temperatures, the switch-over point and the material flow.

The internal pressure curve additionally affects the following quality data:

In the injection phase: the appearance, the surface characteristics, the orientation and the degree of crystallinity of the moulded part.

In the pressure holding phase: the formation of ridges, the weight, dimensions, shrinkage, shrink holes and sink marks and the orientation.

The properties and the quality of a component are predominantly determined by the moulding process in the mould. The dominating limiting quantities here are the pressure and temperature cycles in the mould cavity. It would be ideal if pressure and temperature were uniform at any point in the cavity, and if the temporal pressure and temperature cycle also remained the same from batch to batch. Then shrinkage would be the same in all component batches, there would be no internal stresses and no tendency towards warping in the component, and one component would fall out in just the same condition as another.

This ideal pressure and temperature distribution within the mould, as uniform as possible, is practically impossible to achieve with injection moulding, as a pressure drop is bound to occur while the mould is being filled, due to the flow resistance. Temperature differences will also arise because filling takes a finite time, even if this is usually very short. To get close to an ideal state, i.e., to aim for the most uniform possible filling process, the flow resistance during the filling of the mould plays a decisive role. The lower the flow resistance, the faster the mould is filled, and the smaller are the local pressure differences in the mould.

These factors have corresponding consequences for the design of the component and mould, and the process parameters chosen.

As regards the influence of the mould geometry, the following is generally valid: the flow resistance should be kept as low as possible, e.g., by avoiding sharp edges in the component (pressure losses due to abrupt turning by the compound flow).

For the process parameter settings the following points can be generally applied:

- screw injection speed as high as possible,
- compound temperature as high as possible.

High temperatures result in low viscosity for the compound flowing in, low pressure losses, and thus low pressure differences and short filling times.

In practical machine setting, there are naturally limits here. Here are just a few examples.

It will not always be possible to take the injection speed right up to the machine’s performance capability limit. As the injection speed rises, the tendency to free jet formation and thus to the occurrence of surface faults increases. If assistance cannot be provided here by suitable mould design, the machine must be operated at a low injection speed – it may be that two or three speed stages will be available for injection. The compound temperature must naturally not become so high that heat damage occurs. The more sensitive the compound, the better to select a larger safety margin from the upper temperature limits.

Too much caution can bring about the exact opposite of the desired effect: low temperatures increase the viscosity, and thus cause higher flow losses due to friction – which heats up the compound again as it is injected into the mould. In this way, cylinder temperatures that are too low can actually lead to higher compound temperatures in the mould than in materials where the cylinder temperature was set higher.

The higher the mould temperature is set, the longer the cooling-off lasts and the longer the cycle time is. Therefore a temperature should be chosen which is only as high as the desired quality demands in order to be able to produce components as economically as possible. Figure 41 provides a summary of the most important factors in producing quality components.

4.2 Relationship of Injection and Mould Cavity Pressures

The internal mould pressure follows the injection pressure, with a time delay. The internal cavity pressure can be measured by sensors within the mould, and can be indicated, or visually displayed, using an oscilloscope or a pen recorder. The pressure cycle in the vicinity of the gate is the most informative factor.
First the cavity is volumetrically filled, and then the compound is packed in the mould. The maximum internal mould pressure is not reached until some time after the maximum injection pressure is obtained. Even if the injection pressure stays the same, the internal mould pressure drops slightly, as a result of shrinkage of the compound. From here the pressure drops rather faster, because now no more compound can be pushed back, right to the residual pressure, when the mould is opened.

### 4.3 Injection Pressure and Injection Time

The injection pressure and holding pressure selected must be as high as necessary to fill the cavity sufficiently fast, completely and efficiently, but, on the
other hand, as low as necessary to produce low-stressed injection moulded components and avoid difficulties when the components are ejected from the mould.

The injection time (injection time and holding time), i.e., the duration of effect of the injection pressure, must be selected to be just long enough to solidify (seal) the gate. If the injection time is too short, compound can flow back out of the cavity, sink marks occur, and in general there are larger tolerance variations. Overlong times are uneconomic and increase the internal stresses of the injection moulded component, especially close to the gate. The correct injection time can be determined by weight measurement.

With injection times greater or equal to curing time, the injection moulded component weight remains practically the same (does not increase). With injection times less than curing time, the injection moulded component weight decreases. The occurrence of sink marks is also a sure indication that the injection time (duration of effect of pressure) is shorter than the curing time.

With amorphous thermoplastics holding pressure reduction is necessary. This can avoid difficulties in ejecting the parts and is necessary to get low-stress injection moulded parts.

With semi-crystalline thermoplastics a constant holding pressure is recommended in order to ensure an undisturbed crystallisation process.

### 4.4 Filling Speed

The smaller the flow path cross-section is in relation to the screw/piston surface, the higher the filling speed is. A larger injection cylinder in the same injection unit thus produces a higher filling speed for the same initial injection speed. The initial injection speed, and with it the filling speed, should be selected to be as high as possible, so that the mould is filled as quickly as possible with compound with as uniform a temperature as possible. Then the temperature and pressure variations in the mould are slight, and low-stress components can be obtained. In this way, the component should be filled as uniformly as possible, with the flow head moving away from the gate. Free jet formation is to be avoided by suitable design.

For thin-walled parts (69), the optimum filling speed is higher than for thick-walled parts, so as to obtain uniform filling of the moulding through the flow head. Too low a filling speed causes a greater temperature variation between those parts of the preform near the gate and those far from it, due to increased cooling off of the compound while the cavity is being filled. The higher viscosity of the colder compounds also requires higher injection pressures, which in turn require stronger locking pressures.

An excessive filling speed can also lead to surface faults. If compound which has already solidified onto the mould wall is displaced by a subsequent filling, cross-grooves occur vertically to the direction of flow (gramophone record effect, Section 2.9).

### 4.5 Filling Speed and Orientation

During the filling of the mould, orientation effects can arise, especially through friction influences. The molecules initially lying randomly in the compound are now stretched and orientated in the direction of flow. Such orientations lead to non-uniform shrinkage and non-uniform preform properties (anisotropy). The higher the shear rates that are exerted on the molecules, the greater the resultant orientation of the polymer chains. Also, the higher the filling speed and the greater the viscosity of the compound, the higher the shear rate that is produced. Thus, higher filling speeds are bound to lead to an increased tendency to orientation.

However, the higher the compound temperature is, and therefore the lower the viscosity value, the less negative effect a high filling speed will have. A high compound temperature, in connection with a high mould wall temperature, will cause the oriented molecules to lose their orientation after the filling process has ended (relaxation). This reduces orientations, along with their negative effects. Therefore, before any reduction in the filling speed, a check should be made on whether orientation phenomena can be reduced by increasing the compound temperature and the mould temperature. Here also, preference should be given to compound temperatures and mould temperatures that are as high as possible (as already stated when dealing with the most favourable injection pressure).

In terms of the flowability of the materials themselves, sometimes material suppliers illustrate the relationship between wall thickness and injection speed as a flow path/wall thickness ratio (L/s). If a ratio of 100:1 is given, this means for a wall thickness of 1 mm, then the length of flow from the gate will be 100 mm. Because flow is dependent on wall thickness a variety of mould wall thickness may be quoted. If the material
is required to flow further, e.g., 125:1, more pressure will be required to fill the cavity and more orientation in the material will result. Therefore, ideally moulds should be designed with consideration of flow path lengths and wall thickness ratio in mind.

4.6 Effects of Too High Filling Speed

A high filling speed causes a high shear rate between the compound in the core and the compound on the mould wall. The shear stress arising under such conditions can lead to impairment of the plastic (shear fracture). Particularly high shear stresses arise if the compound has to turn sharp corners, especially with abrupt changes in the cross-section. This should be taken into account in the design of the moulding.

Many plastics display particularly high shear fracture sensitivity, e.g., fluoroplastics such as Teflon. But, PMMA or PC also display more pronounced tendencies to shear fracture than, for example, the polystyrenes.

If the filling speed is high, the air must be removed from the cavity sufficiently quickly. If this is not the case, the compression, and thus the heating of the air increases (Diesel effect, see Section 1.8). This can lead to heat damage of the material, or can even cause burns. So care should be taken to ensure that the air removal system in the parts of the mould filled last works well. Under certain circumstances, it is sufficient to reduce the mould clamping force to the necessary level, if the air can be extracted through the parting plane.

A high filling speed can cause non-uniform mould filling due to:

• free jet formation at gate (‘sausage injection moulding’), which results in surface faults, and/or

• splitting of the compound flow, which leads to unnecessary joint line formation, and/or

• tearing loose of batches already solidified, which causes a deterioration in the surface finish and usually in the mechanical properties as well.

These faults can usually be avoided by suitable construction design, even at high speed.

Finally, high filling speeds can lead to uncontrolled and excessive heating of the compound, due to strong constrictions in runner cross-sections that are too small. This is particularly the case if the working compound temperature is too low, and thus the melt viscosity is higher. In certain circumstances, heating due to constriction losses can become so great that, when the set cylinder temperatures are reduced, the compound temperature in the mould cavity does not fall, but rises. This matter will be referred to again in connection with the cylinder temperatures.

5 Machine Specifications

Problems can arise if the machine being used is unsuitable for the moulding product. To select the correct machine, consideration should be given to the projected area, the shot weight, the injection pressure and the design of the cylinder assembly.

5.1 Clamp Force

The projected area is all surfaces of the part that are normal (at 90 degrees) to the injection unit and is required to calculate the clamp force required by the machine. This is done by multiplying the projected area by the material specific tonnage per cm². This information can be obtained from the polymer supplier.

In simple terms, the clamp force required is the force required to hold the mould closed during the injection stage. Generally, 0.4 tons per cm² should be applied for amorphous plastics and 0.6-0.7 tons per cm² for semi-crystalline polymers. In very thin walled parts consideration must also be given to the flow length as the tonnage demands are higher (92, 107).

5.2 Injection Unit (56, 60, 70)

The first aim of the injection unit is to produce a homogeneous melt for the next stage where the material enters the mould. A second important function of the injection unit is the actual injection into the mould. Here, it is important that injection speeds are reproducible as slight changes can cause variations in the end product. The reciprocating screw piston injection unit is the most common type of unit and will be the basis for further discussion in this section. Thermoplastics as well as thermosets and classical elastomers can be processed with screw piston injection units. In most cases a general purpose screw will achieve the desired homogeneous melt; however some polymers run better on screws with modified characteristics.
As examples, ABS and acetal require very different screw configurations for optimum moulding efficiency. In cases like these therefore, running a material on a non-specific screw can cause problems. Insufficient homogeneity or mixing may result if the screw does not mix effectively, or degradation of the material and poor performance in service life if the screw is too severe. In both cases an inferior moulding is produced.

In the screw piston injection unit, the material is plasticised and dosed simultaneously. Important parameters for these screws are:

- The diameter (D) of the screw and its ratio to the length (L) (L/D ratio). For example a general purpose screw for thermoplastics may have an L/D ratio of 20:1, or 14:1 with thermosets, elastomers and liquid silicone rubber (LSR).

- For extended plasticising screws the L/D may be 24:1. This is usually used for thermoplastics with colour additives, especially with PP and PE. This enables better mixing of the colorant. On fast cycle machines with increased capacity, a higher L/D ratio may also be beneficial.

- Shot capacity. The shot capacity is the full amount as a weight or volume of material injected during moulding from the screw. This is usually given as a shot capacity for polystyrene, and will vary with material. The shot size is the amount of material required to fully fill a moulding tool.

- Plasticising rate (plasticising capacity). This is the maximum rate at which the injection unit can deliver polymer melt. In extrusion this is a continuous process. However, it should be remembered that injection is an intermittent process; therefore the plasticising rate will be lower. To calculate the melting rate consideration should be given to the overall cycle.

- Injection pressure. This is the force that the screw can exert upon the plastic during filling and packing of the moulded part. The larger the diameter of the screw being used then the lower the injection pressure that will be available. This type of information can be found in machine specifications.

To select the correct configuration of injection unit for a particular material or material range, consideration must be given to the following factors:

- The selection of the correct nozzle type, e.g., flat, radius or shut-off.

- Screw and cylinder outfitting must be adapted to suit the raw material being processed. The geometry of screw must be correct and the screw should be of a suitable corrosion resistance (e.g., nitride, Arbid, bimetallic).

- The dosage volume should be approx. 20-80% (41).

- Dosage capacity and melt capacity must be sufficient for processing requirements

- Whether a mixing cylinder (screw) is required for use with colour additives

- Whether a hydraulic accumulator is necessary for moulding with long lines of flow.

It is the design of the screw that is most important for plasticising.

The design of the screw along its length is not constant but varies. Generally screws are designed with three distinct regions: a feed section (1), a melting transition region (2-compression region) (2) and a metering section (3). The size of these regions will vary depending upon the characteristics of the material it was designed for.

The compression ratio can be defined as the ratio of the flight depth in the feed section to that in the metering section. As an example a screw for a polyamide material for may have a compression ratio of 3:1 on a 20L/D screw with a 30 mm diameter.

A standard compression ratio is roughly 2:1 for thermoplastics, for sensitive thermoplastics such as PVC or with metal/ceramic-powder this may drop to 1.6:1. Compressionless screws with a compression ratio of 1 are used for processing materials such as elastomers and LSR.

In cases where an increased mixing ability in the screw is required, such as with the use of colorants (50, 164) there are two potential solutions: to add mixing elements or to use an extended screw design. The latter is suitable:

1. If a high melting capacity is required (raw material with a high specific thermal capacity, e.g., polyethylene, polypropylene and polyamide).

2. If masterbatch is used for colouring purposes and the homogeneity of the colours is of great importance.
3. If the temperature level during the moulding process must be reduced or peak temperatures must be eliminated.

The combination of cylinder and screw depends on the specific case requirements.

Mixing screws are unsuitable for long fibre materials as they break up the fibres. For these materials a general purpose screw is more appropriate (29).

The overall effectiveness of the plastication stage will depend on the shot size, cylinder capacity, screw design, screw speed and heater band power. It will also vary from material to material. However, before the material enters the cylinder it has to pass through the hopper which can bring problems of its own.

5.3 Feeding Hopper

Many plastics are hygroscopic and require drying before moulding. Large amounts of hygroscopic materials left for long periods in the hopper will soon reabsorb water and this should be avoided. The hopper must be designed to avoid material bridging in the throat so as to let gravity feed the material, and material hold up spots must be avoided. With standard polymers this should not present a problem but additives, especially when they are different weights to the polymer, may tend to accumulate and be fed inconsistently. This can lead to variations in melt quality. The hopper may contain magnets to collect metal contamination, which must be prevented from entering the feed system (87). It may also contain grids to prevent large particulates from entering and blocking the feeding system, especially important if using recyclate materials. Attention to the temperature of the hopper throat is also important, if material begins to melt in the throat of the feeding system it may stick to the sides and in extreme cases block the machine completely.

Long fibre moulding can produce its own unique problems (29) as these tend to be longer than standard pellets and flow can be impeded by magnets.

5.4 Barrel Residence Time (19)

The residence time of a material is the time required for the material to pass from one end of the plastication unit to the nozzle or hot runner. This tends to be an average value since in reality the time a granule takes to pass through the system will vary depending on flow, the geometry of the injection barrel and whether there are areas where material can become trapped.

Each plastic material has particular processing requirements in terms of barrel temperature. This will include both the temperature range and the exposure time to the temperature. Overexposure can lead to degradation. This can be of particular importance if using a small shot size on a larger machine. If residence times are excessive, switching production to a smaller machine is advised.

The potential barrel residence time can be calculated either by experiment (1) or by taking into account the design of the barrel (2):

(1) A common method employed to calculate the residence time is to pour a small amount of pigment concentrate onto the screw, once shot metering is complete. Moulding then re-commences, counting each moulding produced, until the pigment becomes visible in the moulded part. Since the pigment will probably be distributed across a number of shots, it is the moulding having the deepest colour intensity that is used in the following calculations.

Mean residence time =

\[
\text{Number of shots} \times \text{Cycle time}
\]

(2) To calculate the residence time it is necessary to know the screw channel volume, the shot volume and the cycle time.

Residence time =

\[
\frac{0.8 \times \text{Screw flight volume}}{\text{Shot volume (weight/density)}} \times \text{Cycle time}
\]

5.5 Precompression of the Melt (18)

A particular problem associated with thin-walled moulding is that of the flow length which requires much higher injection pressures to achieve filling than would normally be required. Unlike standard injection moulding, with thin-walled parts the cooling cycle is not the dominant issue as cooling can occur extremely quickly; likewise the holding phase is also of less importance. The use of precompression enables higher flow ratios relative to the wall thickness to be achieved. It works by compressing the material during the injection stage and not opening the shut-off nozzle until the desired filling injection pressure has been achieved.
An alternative to generating sufficient pressure is to use a pressure accumulator unit (45) to give a large and constant rate of injection force.

5.6 Check Valve

The check valve assembly is required to allow the screw to act as a metering pump, to melt and convey the plastic, and as a ram, to inject the plastic into the mould. Many materials require the use of a valve with a check ring to be fitted to the end of the screw to prevent backflow. They also help to ensure the constant cavity pressure discussed in Section 2.1.1 is maintained. The most important design consideration is that they should avoid flow restrictions or hold up of the melt flow. Non-return valves are more prone to wear than other components, so it must be ensured that suitably toughened materials are used in manufacture.

5.7 The Nozzle

The nozzle provides the connection between the injection cylinder and the mould tool. Its job is to convey the material with minimal pressure or heat change.

The nozzle itself may not necessarily be made of just one piece. A tip that is screwed into the nozzle body can be replaced or repaired. This may need to be an abrasion and corrosion resistant tool steel tip. For optimum flow conditions, there must be no material hang-ups. Therefore the flow must be streamlined. The land length is generally kept to a minimum dictated by the strength requirements. For high pressure applications an increased flange diameter may be required.

It is essential that the temperature of the nozzle be controlled. The location of the heating and control is equally important else material degradation or premature material freezing (cold slugs) may occur. A thermocouple can be used close to the gate and heater. Thermocouples may also extend into the melt rather than measuring the temperature of the nozzle.

5.8 The Feed System

The design of the feed system must be suitable for the material being moulded. This includes gates, runners and sprues. For example an insufficient gate depth can cause considerable moulding problems such as short shots and increased cycle times. This problem tends to be more acute in the moulding of amorphous materials since they generally require bigger gates than semicrystalline materials (24, 37, 55, 61, 74, 75, 111, 123, 134). It is better to design a tool with the material already chosen and specified so that tooling can meet the specific demands of the material.

5.9 The Mould Temperature

The mould temperature or mould wall temperature is one of the most important process parameters (142, 153). The mould temperature influences the shrinkage and thus the dimensioning of the compound in the mould, the surface finish and the orientations in the injection equipment and also, not least, the cycle time – through the cooling off time – and thus the component costs.

Economic quality improvement in injection moulding is not possible without good, repeatable and uniform temperatures in the mould. Even with a more expensive injection process control or adjustment system, the negative influence of unsatisfactory mould temperatures cannot usually be balanced out. If it is a question of narrowing the tolerances of the components, the first step is to check the mould temperature data. A prerequisite is the measurement of the mould temperature.

The optimal mould temperature level is a parameter specific to the material and should be obtained from the plastics manufacturer.

High mould temperatures cause the component to cool slowly, which is necessary, for example, with the majority of semicrystalline thermoplastics, in order to obtain components that are to size and have constant dimensions. The crystallisation of these compounds must be completed in the mould, i.e., it must be over before the components are ejected from the mould. Otherwise, aftercrystallisation occurs over the course of time, which in every case causes alterations in dimensions, and frequently leads to warping of the component.

High mould temperatures improve the flow behaviour of the compound in the mould, and the injection pressure requirements are lower. The surface finish of the components improves. High mould temperatures break down orientations that arise during the filling of the mould, and there are thus fewer orientations in the moulded component.

The upper limit for the mould temperature is determined by the maximum temperature at which
Uniformity has two aspects here. Dimensional variations through varying shrinkage remains the same from batch to batch lead to parts to warp (27). Mould temperatures that do not component. Local temperature differences can cause shrinkage, and thus the later dimensions of the mould. Thus in the selection of the mould temperature level, a choice often has to be made between higher quality and a more favourable price for the components. A ‘semi-optimum’ temperature level will very often lead to an economically acceptable solution.

The level of the mould temperature influences the shrinkage, and thus the later dimensions of the component. Local temperature differences can cause parts to warp (27). Mould temperatures that do not remain the same from batch to batch lead to dimensional variations through varying shrinkage. Uniformity has two aspects here – the spatial temperature distribution in the mould and the temporal temperature behaviour in the production cycle.

Uniform temperature distribution in the mould is essentially dependent upon the mould temperature system. Adequate and uniform temperatures are of importance, not only in relation to the warping tendency, but also for economic reasons from the point of view of the unit time. It is necessary to wait until even the hottest part of the component has cooled enough before ejecting the component from the mould. Thus, a uniform intensity of temperature becomes a pre-requisite for economic manufacture. With cores, when adequate temperature patterns often cost more to achieve, there are often signs of omission in the mould design. The mould certainly becomes cheaper then, but it means that a substantial increase in the cycle time – often up to 100% and more – must usually be taken into account.

The temperature systems must be matched to the mould as regards their production capacity, i.e., they must be in a position to supply or extract the necessary amounts of heat sufficiently quickly. In order to guarantee a repeatable, uniform temperature distribution in the mould, even after a change of mould or a refit, the inlet and outlet paths of the temperature control fluid at the mould must be unambiguously marked. If the connections are mixed up, this will certainly alter the temperature conditions, which, admittedly, need not always have a negative effect, but which can often lead to substantial deterioration, especially in cooling cores.

Satisfactory results can only be obtained from mould temperature control if the performance of the temperature control unit is suitable for the quantities of heat to be exchanged in the mould. For example, if the temperature control unit not only operates basically well, but also sufficiently rapidly, so that only slight temperature variations occur in the mould (38, 125, 136, 149).

Unfortunately, the transmission pressure on a number of temperature control units on the market today is insufficient. A safety valve is frequently built into such units, which opens a parallel circuit within the unit, once a limiting pressure has been exceeded. Unfortunately this is not always noticeable to the user. Only a fraction of the flow delivery then flows through the mould, and the temperature control suffers accordingly. Naturally, the flow resistances of the temperature control circuits should be kept as low as possible. To this end, there should be sufficiently thick hoses, as short as possible, between the temperature control unit and the mould. The temperature control channels in the mould must be of suitable dimensions.

It is also important that the heat transfer ratios on the walls of the temperature control flues do not deteriorate over the course of time. The temperature control channels must be suitably maintained and must be checked for cleanliness after each mould change at least. If water is used for temperature control, then special attention must be paid to rust deposits and also, at higher temperatures, to scale formation.

Most information concerning the injection process cycle can be supplied by a temperature measurement point mounted directly in the moulding nest wall (mould wall temperature). During the cycle, this temperature value can be observed during the compression phase and a lower value during ejection. The lower value can give a good guide for the ejection temperature. A measurement point position like this is not suitable for regulating the mould temperature, because of the temperature variations that occur here. The temperature gauge should therefore be sufficiently far away from the mould wall, so that at the measuring point the temperature variations have already been sufficiently dampened. But it should also be an adequate distance away from the temperature control channels, so as to exclude reverse effects from this side.

If no fixed temperature measuring point is incorporated in the mould, it is possible, to use probe thermometers as an aid. To carry out any
measurements in the cavity, you will be forced to interrupt the cycle. The negative effects, which thus arise on the security of measurement and the production cycle must not be left out of consideration. But in no case should the measurement of the mould temperature – at least at one specific comparison point or reference point – be neglected.

A sufficiently uniform spatial temperature distribution can be obtained in the mould if the inlet and outlet temperatures of the temperature control medium do not differ by more than 5 °C from one another. In order to achieve this, a sufficiently high throughput volume of the temperature control medium is required.

### 5.10 The Importance of Adequate Venting

An important design aspect of injection mould tooling is the need to provide vents for compressed air and gases to escape during moulding (13, 46, 82). Trapped air and gases can cause a variety of moulding defects which are more fully described in Section 2. To remove such defects it is common practice to slow down injection to give air a chance to escape. However, a reduction in injection speed may cause other problems such as insufficient packing, to leave sink marks.

Common venting methods are to provide parting line vents, vent plugs and pins. More recent developments include the use of porous metals that allow gas to escape but not the polymer. These materials also often allow for the venting area to be increased. As a general rule, runner vents tend to be deeper than part vents and depend on the material being used in the moulding process. Vents should be placed near weld lines and near the last areas of the cavity to be filled and should be located on the mating surface of one of the mould halves.

### 5.11 Multi-Cavity Moulds

There are a large number of variables in injection moulding, as can be seen from the examples previously introduced. Multi-cavity tools present even more of a challenge due to both shot to shot variations (119) and cavity to cavity variations (30, 42, 138, 282). Mould variations can be caused by shear induced flow imbalances which occur even in balanced runners. Different cooling effects across the mould and mouldings of different physical sizes can also cause imbalances in mouldings.

### 5.12 General Information on Wear and Tear

Whilst the importance of everyday machine maintenance should not be underestimated (137, 144), there are also several causes of wear and tear including:

- incorrect adjustment of process parameters, e.g., back pressure too high, dosage speed too high, no dosage delay, incorrect adjustment and setting of temperatures for plasticising cylinder and feed yoke.
- wear and tear generated by raw materials, e.g., mechanical wear caused by fibre glass, glass spheres, stone powder, metallic powder, ceramic powder (31, 36, 79).
- chemical corrosion, e.g., with additives, flame resistant materials, materials containing fluorides.

There are several ways to determine any mechanical wear and/or chemical corrosion. Mechanical wear can be seen by grooves and surface abrasion in one direction. Chemical corrosion can leave large and small holes in different areas and directions as well as surface deposits. To determine the wear of the screw and barrel consideration must be given to the original heat treatment method used. With nitride and Arbid methods the surface thickness can be measured. With bimetal outfitting the surface can be examined. Generally if the heat treated surface has worn down this signifies that the units have worn out.

There are ways to minimise wear and tear on the injection units by use of proper process parameter adjustment, the correct selection of barrel and screw for the job and suitable heat treatment outfitting. Unit hardening treatments include nitride, Arbid, BMA, BMK, VSX, PH and PK.

### 6 Conclusion

Successful troubleshooting of injection moulding should begin not when a defect part is produced on the shop floor but when a part is conceived at the design stage. With consideration for correct mould design, ideally constructed for use with the materials of choice in mind, a large number of potential pitfalls are instantly eliminated.

Likewise on the production shop floor, care and maintenance of machinery and tooling is paramount for an efficient moulding environment. The choice of
suitable equipment for the job at hand, such as machine size and screw configuration further reduces potential problems, as does attention to preparation of materials and processing recommendations from material manufacturers which are readily available.

Once production has commenced, attention can therefore be focused on optimising the machine parameters based on the experience of the machine setter, ensuring that major costly downtimes can be minimised or avoided altogether.

**Abbreviations and Acronyms**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ABS</td>
<td>acrylonitrile-butadiene-styrene</td>
</tr>
<tr>
<td>CA</td>
<td>cellulose acetate</td>
</tr>
<tr>
<td>L/D</td>
<td>length/diameter</td>
</tr>
<tr>
<td>LSR</td>
<td>liquid silicone rubber</td>
</tr>
<tr>
<td>MFI</td>
<td>melt flow index</td>
</tr>
<tr>
<td>PA</td>
<td>polyamide</td>
</tr>
<tr>
<td>PBTB</td>
<td>polybutylene terephthalate</td>
</tr>
<tr>
<td>PC</td>
<td>polycarbonate</td>
</tr>
<tr>
<td>PE</td>
<td>polyethylene</td>
</tr>
<tr>
<td>PMMA</td>
<td>polymethyl methacrylate</td>
</tr>
<tr>
<td>PP</td>
<td>polypropylene</td>
</tr>
<tr>
<td>RPM</td>
<td>revolutions per minute</td>
</tr>
<tr>
<td>SAN</td>
<td>styrene-acrylonitrile</td>
</tr>
</tbody>
</table>
Abstracts from the Polymer Library Database

Item 1
Injection Molding
12, No.2, Feb.2004, p.32-4
MATERIALS ANALYST: PART 61. THE EQUIVALENCE OF MATERIAL PROPERTIES AND DESIGN
Sepe M Dickten & Masch Mfg.Co.

When a product fails to perform as expected, the problems can always be traced to shortcomings in one or more areas: tool design, part design, material selection and processing. A table illustrates a general scheme for determining the role of design, material property and application environmental influences on part performance. Highlighting the distinction between brittle and ductile behaviour is useful because when products fail, it almost always involves an unexpected manifestation of brittle behaviour. A case study is presented involving products moulded from HDPE. A small percentage of the parts cracked when placed under the flexural load that was a normal part of use. Failure occurred at a design feature that contained a sharp corner. It is shown that increasing the radius in a corner detail has the same effect as the manipulations to material properties.

USA
Accession no.906380

Item 2
Kunststoffe Plast Europe
93, No.11, 2003, p.23-4
GETTING THE COMBINATION RIGHT
Hickmann T; Klemp E Eisenhuth GmbH KG Praezisionsformenbau; Bosch-Siemens Hausgeraete GmbH

Problems in the production of injection moulds are discussed and it is shown that none of the standard mould-making techniques combines the requirements for rapid, flexible, inexpensive and durable mould production. The possibility of combining the various standard processes with new ones is examined and hybrid moulding is described. A hybrid mould consists essentially of metal/laser-sintered mould inserts and steel inserts produced from standard mould frames and elements by high-speed cutting. (For graphs/tables, see German version in Kunststoffe, ibid, p.60/3)
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.905532

Item 3

WELD LINES? WHAT WELD LINES? GETTING BETTER APPEARANCE FROM METALLIC PIGMENTED MOULDINGS
Wheeler I R Silberline Ltd. (Rapra Technology Ltd.)

Metal flake pigments are an increasingly common constituent of moulded plastics. Unfortunately, due to their asymmetric shape, their use can make weld lines significantly more visible in the moulded article. Recent work to establish the degree to which the severity of weld lines may be reduced by judicious choice of pigment type, loading and injection moulding machine parameters is discussed. It is briefly shown why metal flake pigments make weld lines more prominent than other pigment classes. This is followed by illustrations of the nature of the problem and a description of a purpose-built injection moulding tool. Systematic changes to pigment particle size, shape and concentration, plus moulding machine parameters, chiefly temperatures, injection speed and injection and holding pressures are covered, and, finally, the effect of polymer transparency and polymer melt flow index are considered. Observations made during the study are brought together to demonstrate synergy capable of virtually eliminating visible weld lines in many formulations. 15 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.904735

Item 4
Injection Molding
TROUBLESHOOTER PART 63: MASTERING CYCLE TIME ESTIMATION
Hatch B Prime Alliance Inc.

This article discusses cycle time determination. A good place to start is with a cooling rate chart that sets out how long it takes for the material being moulded to go from a fluid to a solid at a given wall thickness. The cooling rate, plus the time to inject the plastic, open and close the mould, and add in any insert loading or other operator activities will add to the cycle time. A cycle time estimation programme was included as part of IDES’ Costmate part quoting programme and is a very useful tool. The accuracy of cycle time calculations depends on an optimised mould: correct barrel heats, injection pressures and mould temperatures.
USA
Accession no.904735

Item 5
Injection Molding
Frequently when a part fails, a client will focus on one of two issues: moisture in the raw material at the time of melt processing or use of regrind. Poor control over either of these factors can result in degraded polymer, resulting in brittle behaviour in the material and the possibility of failure. In spite of all the impressive analytical tools that can be brought to bear on a problem, reconstructing the moisture content or the regrind content in the raw material at the time a part was moulded is not possible.

USA
Accession no.904734

Item 6
Asian Plastics News
Nov.2003, p.33-4
English; Chinese

HOLD TIME TOO SHORT
Wilkinson R; Poppe E A; Leidig K; Schirmer K
DuPont

In practice, many injection moulders, working from their experience of amorphous polymers, tend to use shorter hold pressure times and longer cooling times. Unfortunately, this approach also tends to be used for semi-crystalline polymers such as POM, PA, PBTP and PETP. This article discusses the most important points to help machine setters choose the most suitable hold pressure time.

USA
Accession no.900917

Item 7
Injection Molding
11, No.12, Nov.2003, p.67

EJECTOR DESIGN CURES HANGUPS IN ELASTOMER SPRUES
Neilley R

The use of materials like thermoplastic elastomers and liquid silicone rubber is steadily growing. Their flexibility and elasticity, which make these materials logical choices for applications such as housing seals and grips, can be anything but an advantage when a traditional gate design is used to effect automatic separation of the sprue from the part during demoulding. Elastomeric material can be stretched out of the conical undercut of the tunnel gate when the intention is to hold it there firmly. The entire sprue can thus remain stuck inside the sprue bushing on the nozzle side. Arburg has come up with a specific design for a sleeved ejector pin that solves the problem. Undercuts on the ejector pin tip hold the elastomer as the mould opens.

ARBURG GMBH
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.900892

Item 8
Asian Plastics News
Sept.2003, p.33-4

FEED SYSTEM TOO SMALL
Wilkinson R; Poppe E A; Leidig K; Schirmer K
DuPont

Parts made of engineering polymers nowadays are designed with the help of complex methods such as CAD, finite element analysis and mould-flow calculations. Though useful, they sometimes fail to take enough account of the importance of the correct design of the feed system. This article considers the basic elements of correct feed system design for semi-crystalline polymers. These elements need to be applied in combination with a correctly positioned gate and the right hold time.

USA
Accession no.895731

Item 9
Kunststoffe Plast Europe
93, No.7, 2003, p.30-1

ABSOLUTE TRANSPARENCY
Cuttat K P

The use of insulated hot runners for gentle processing of thermally-sensitive moulding compounds is discussed. It is shown that transparent speck-free polycarbonate cups can be manufactured using a two-cavity, hot runner injection mould. The selection of runner system is considered and it is demonstrated that closed hot runner manifold blocks are generally unsuitable for processing thermally sensitive transparent polymer melts. The necessity of avoiding ‘flow shadows’ in the melt, as these result in a high reject rate due to trapped degradation products, is emphasised and the use of the flow-promoting, insulated hot runner is shown to avoid this problem. (For tables, see German version in Kunststoffe, p.62-4)

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.895365

Item 10
Injection Molding
11, No.9, Aug.2003, p.67-9

TROUBLESHOOTER PART 61: CARING FOR HOT RUNNER SYSTEMS
Hatch B
Prime Alliance Inc.

So far, this series of articles has worked its way through the five basic elements of troubleshooting an injection moulding problem: nozzle, sprue, runner, gate and vents. Connected with the nozzle section are the problems most commonly associated with heated sprue bushings and hot runner systems. First of all, the moulding machine nozzle must be drilled out or opened to match the flow tube.
diameter of the heated sprue bushing or hot runner manifold. Problem number two is gate sizing and the relationship of the diameter to the angle of the taper. Many moulding problems associated with heated sprue bushings or hot runner systems, such as hard-to-fill parts, flashing of mould vents and material additives plating out on the core of the mould, are connected to improper sizing of the material flow path. Equally as important as sizing the flow path is following the correct design according to the gate type selected.

USA
Accession no.894427

Item 11
Materials World
11, No.8, Aug.2003, p.18-20
LIVING IT LARGE: INJECTION MOULDING AIRCRAFT CANOPIES
Cleevely S T

The first injection moulded polycarbonate canopy will take to the skies later this year aboard the US Air Force’s T-38 training jet. Moulded windshields for the F/A-22 will be tested and flown in 2004. EnviroTech, Boeing and the Air Force have succeeded in manufacturing aircraft transparencies with the required thickness (up to 66mm thick), structural properties and optical clarity. The first optically-correct part was made in January 2003, following the development of a new method to polish the moulds. The two-stage bulk injection moulding process can produce a canopy every hour. One of the most challenging tasks was to in-mould the large fixing inserts. This was a major factor in reducing the assembly time of the canopy to the aircraft fuselage.

ENVIROTECH CORP.
USA
Accession no.892425

Item 12
Plastics Technology
49, No.7, July 2003, p.46-7
INJECTION MOLDING TROUBLESHOOTER - AVOID COMMON MOLD SET-UP MISTAKES
Lamb D; Andrist B
Donnelly Custom Manufacturing Co.

This article is one of a series of troubleshooting reports relating to injection moulding. This one deals in particular with the mistakes most commonly made when setting up the mould. Six tips are offered from a company which has mastered the art of smooth mould-changeover, Donnelly Custom Manufacturing: avoid unnecessary idling, organise mould storage, follow a check-list, commit to training, communicate effectively, and don’t neglect maintenance.

INTERNATIONAL PLASTICS CONSULTING CORP.
USA
Accession no.891010

Item 13
Injection Molding
11, No.7, June 2003, p.88-92
TROUBLESHOOTER PART 60: VENTING
Hatch B
Prime Alliance Inc.

The runner and each cavity must be vented extremely well in order to get rid of the air in the runner channels and in the part cavities. Runners are vented at the sprue puller and at the end of each runner. Part vents can be individual or perimeter types. Blind pocket vents are also discussed.

USA
Accession no.889621

Item 14
Kunststoffe Plast Europe
93, No.3, 2003, p.70-1; p.A73-5
English; German
SAFELY WARP-FREE
Budinger M; Sundermann M; Reisinger A
Resin Express GmbH; Coko-Werk GmbH; Butz-Ieper Automotive GmbH

Top of the range vehicles must be fitted out with a luxurious but practical interior. For winter holidays, this includes the facility to easily stow two pairs of skis in a limousine without compromising passenger comfort, road behaviour and the vehicle’s exterior appearance. The BMW 7 series accommodates this need by means of a ski bag integrated into the rear seat backrest, with a lockable loading hatch integrated into the centre armrest. The ski bag, developed and supplied by Butz-Ieper Automotive of Langenfeld, Germany consists of a cover with a sliding frame in the boot and an open panel with cover in the rear-seat backrest. The folded ski bag is accommodated in the interspace that this creates. With the armrest folded down, the panel in the rear-seat backrest becomes accessible. The ski bag can be drawn out after the cover in the panel is opened. The injection moulded parts of the cover and panel are made of ABS Magnum from Dow, supplied by Resin Express. Mould design was supported and verified by simulation of mould filling and warpage. Because of this preliminary work, the product could go into mass production rapidly and with no start-up problems.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.889375

Item 15
THERMAL INSULATION IN THE THERMOSET MOLDING. INTRODUCTION
Polito J
Albany International Corp.  
(SPE, Thermoset Div.; SPE, Piedmont Coastal Section)

Thermal insulation, as it is used in thermoset moulding, is examined. The basics of insulation theory are described, through to addressing problems facing moulders today. Comparisons are made between the different materials commonly used, showing their advantages and disadvantages. In conclusion, a moulding insulation case study of a large manufacturer showing its problems, its needs, the solution chosen and the benefits realised are presented. Some company information is included on Albany International, explaining who the company is, what it does, where its technology comes from, and where it gets its expertise in thermal insulation. An overview is presented of insulation theory, together with a study of different insulation materials, showing benefits of insulation. The thermal/mechanical requirements in industrial applications and the tradeoffs made to achieve an acceptable balance are addressed. A specific study is outlined of materials commonly used today in thermoset moulding (primarily glass fibre-reinforced polyester and calcium silicate), showing their advantages and disadvantages. Pyropel is introduced, with direct comparisons and explanations of the benefits it brings to moulders. A case study from a Honeywell thermoset moulding facility is presented.

USA  
Accession no.889308

Item 16
Brookfield, Ct., SPE, 2003, p.65-78, 27 cm, 012
MELT MANAGEMENT TECHNOLOGIES & A MOLD COMMISSIONING STRATEGY: TOOLS DESIGNED TO REDUCE LEAD TIME
Hoffman D A
Beaumont Runner Technologies Inc.  
(SPE, Thermoset Div.; SPE, Piedmont Coastal Section)

Competition within the plastics industry is growing fiercer every day. As a result, the demand for faster part-to-production lead times also continues to grow. Lead times for new mould builds have decreased drastically over the past few years for a number of reasons. However, all too often a great deal of time and money is spent on sampling and debugging the mould and the moulding process to produce acceptable product during initial mould commissioning. The end result is typically a part-to-production lead time increase of weeks to months due to the problems experienced during the mould commissioning stage of the production process. These hindrances are often caused by cavity-to-cavity variations hidden inside the mould. These variations take a large amount of resources (including toolmakers, processors and engineers) to diagnose and try to correct them. Often the proposed solutions do not solve the root cause of these variations, thus causing long-term issues throughout the production life. A new mould commissioning strategy and recent advancements in melt-management technologies help to correctly diagnose and quantify these variations and minimise the overall part-to-production lead time. 5 refs.
USA  
Accession no.889307

Item 17
Popular Plastics and Packaging
48, No.5, May 2003, p.56-62
STACK MOULDS
Batra R C

The problem facing a plastics processor was production of a large number of two-part disposable syringes on a 60 ton injection moulding machine, having a shot weight of 110g in PP. Whereas it was possible to run a 24 cavity mould for the syringe barrel satisfactorily - both the clamping force and shot weight were adequate - the mould for the plunger could contain only 12 cavities because of the large projected area of the product, as placed in the mould. The moulding weighs only 2g, with a projected area of 9 sq.cms. The solution was to use a 2x12 cavity stack mould. The accompanying design diagrams depict all important features of the stack mould.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE  
Accession no.887268

Item 18
British Plastics and Rubber
April 2003, p.18-9
PRECOMPRESSION PREVENTS PROBLEMS IN THIN WALL MOULDING

Thin wall moulding has been adopted increasingly in recent years for packaging and also for technical mouldings used in electronics. Netstal’s Applications Department has carried out a series of comparative tests into thin wall moulding focusing on the precompression technique in which the compression of the melt is disconnected from the injection phase. Melt precompression enables higher ratios of flow length to wall section - thinner walls can be filled safely.
NETSTAL  
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE  
Accession no.886151

Item 19
Injection Molding  
11, No.4, 15th April 2003, p.50-1
MATERIAL ANALYST. 57. HOW STABLE IS YOUR MATERIAL? II
Sepe M
Dickten & Masch Mfg.
The last article (part 1, ibid, March 2003) ended with a brief discussion of materials that can degrade by either prolonged exposure to elevated melt temperature or the presence of excess moisture during processing. Polyesters, polycarbonates, PUs and polyamides are the material families of greatest concern. Not coincidentally, these are the materials that fail with the greatest frequency due to process-induced degradation. When these failures occur, a variety of methods that measure average molecular weight can verify that degradation has occurred. However, with greater emphasis placed on root cause analysis, it has become increasingly important to determine the exact mechanism that produced the degraded polymer. While the mode of degradation can sometimes be determined from IR spectroscopy, experience has shown that degradation must be significantly advanced before the IR spectrum will show signs of the chemical modifications that can distinguish between thermal and hydrolytic degradation. In addition, the root cause is not always an either/or proposition. Often excessive heat and moisture levels work together to produce an effect that neither factor alone could. However, with all of the materials mentioned above, one factor is usually more important than the other. Actual experimentation using the moulding process and a simple method for evaluating the moulded parts can verify which factor is most critical. This knowledge, in turn, can be translated into a control plan for preventing further difficulties. Emphasis is placed on the moulding of PETP and PBTP with 30% loadings of glass fibre.

**Item 20**

**Injection Molding**

11, No.3, March 2003, p.61-2

**ADDITIVE ADDS EFFICIENCY PRECISION TO EDM**

Deligio A

Makino’s Die/Mold Technologies Group was working with a client on a speaker grille application. Created using EDM, the grille’s tool, a P-20 mould with a hardness of 40 Rockwell C and a cavity perimeter of 12 x 18 in., was moulding parts reluctant to release despite a Teflon-nickel coating, lapping compound and wire-brush treatment, and a mould release application prior to every shot. In addition, the final step in the part’s 72-second cycle involved a worker gingerly extracting it from the mould by hand while trying not to cause any distortion or warpage. The customer only had one description of this step for the company - it was like peeling the skin off an orange. Peeling an orange can be a tedious, difficult process. Peeling a part proved equally time-consuming, and costly. Scrap rates ranged from 30-40%. The methods employed in order to overcome this problem are described.

**MAKINO DIE/MOLD GROUP**

USA

Accession no.884535

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**Item 21**

**Revista de Plásticos Modernos**

83, No.550, April 2002, p.378/83

Spanish

**RAPID APPROXIMATION TO AUTOMATIC RUNNER BALANCING**

Chen K C; Chang R Y; Hsu D C; Lin A S; Lu K Yue Ki Industrial Co.Ltd.; National Tsing Hua University; CoreTech System Co.Ltd.; Takaotec Corp.

The flow balance index concept is proposed as an approach to solving the problem of runner balancing for multi-cavity injection moulds. An algorithm based on this concept is introduced, and its use with the Moldex-Expert computer aided engineering software developed by CoreTech System is described. 3 refs.

**TAIWAN**

Accession no.884062

**Item 22**

**Polimery**

48, No.2, 2003, p.100-5

Polish

**SOME PROBLEMS OF POLYMER FLOW IN INJECTION MOLD**

Sikora R; Bociaga E Lublin,Politechnic; Czestochowska,Politechnika

Descriptions of liquid polymer flow in injection mould channels in the literature are reviewed. The flow is shown to be unstable and non-isothermal. The symmetrical model is generally used to describe it, although this model is true only under determined stable conditions. When thermal or kinetic conditions at both sides of the channel vary, e.g. because of the differences of temperature or surface roughness, thermokinetic flow asymmetry occurs. This asymmetry may also be caused by the change of flow direction in the channels, e.g. in the area where the sprue joins the runner or in the cavities with inserts, bosses and ribs. In multicavity moulds, the polymer stream can change direction several times, leading to non-uniform filling of cavities. The weld line areas are also areas of polymer flow disturbances. Asymmetrical and non-uniform flow affects the injection moulding efficiency evaluated on the basis of determinations of functional properties and surface qualities of moulded parts. 32 refs.

**EASTERN EUROPE; POLAND**

Accession no.882166

**Item 23**

**Popular Plastics and Packaging**

48, No.3, March 2003, p.72-4

**TIPS FOR PLASTICS PROCESSORS - PART 2**

Kulshreshtha A K Indian Petrochemicals Corp Ltd.

This article discusses the causes of warpage in injection moulded products and the minimisation of weld lines.

**INDIA**

Accession no.881723
Item 24
Injection Molding
11, No.2, Feb.2003, p.44/6
TROUBleshooter. LVIII. SIZING RUNNERS
Hatch R
Prime Alliance
A method for sizing a runner, based on the type of material being used, the wall thickness and the number of cavities, is presented. Data are given on runner diameters in a balanced mould for amorphous materials and semicrystalline materials. It is shown that full-round runners are the best design for any gate, but half-round or trapezoidal runners can be used with subgates.
USA
Accession no.881165

Item 25
Materials World
11, No.2, Feb.2003, p.32-3
SEEING IS BELIEVING - PLASTIC LENSES FASTER AND WITH FEWER REJECTS
Producing lenses for ophthalmic correction is one of the most demanding procedures an injection moulding machine can be asked to perform. However, advances by Krauss Maffei in machine design have created a process that is faster and produces fewer rejects. The innovative development showcased at last year’s K show in Germany could be set to revolutionise the production of optical lenses in terms or quality and productivity.
KRAUSS-MAFFEI AG
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.880378

Item 26
ANALYSIS OF TIGER STRIPING IN INJECTION MOLDED TPO
Jayaraman K; Papworth P; Shu C; Wolkwicz M D
Michigan,State University; Basell Polyolefins (SPE)
Alternating dull and glossy bands (tiger striping) on the surface of injection moulded components of two thermoplastic olefins (TPOs - blends of polypropylene and ethylene-propylene rubber) was investigated. Short shots from a standard tensile bar mould were sectioned and etched to remove the ethylene-propylene rubber phase, and the particle size, shape and distribution of the near wall dispersed phase determined. Asymmetric flow was observed, with the flow front oscillating between the walls. Flow marks formed along the walls furthest from the flow front, and out of flow mark regions were associated with the walls closer to the flow front. Droplets of the dispersed phase were stretched into strands in the out of flow mark regions, the strands retracting on the way to the flow mark regions. Under certain conditions, the retraction was arrested by sheer induced folding of the strands. It is proposed that the component rheologies may be controlled to minimise the onset of flowlines. 12 refs.
USA
Accession no.878320

Item 27
ROLE OF SIMULATION AND COMPUTER AIDED ANALYSIS IN INJECTION MOLDED PRODUCTS
Adetunji P
RMIT University (SPE)
Injection moulded, rubber-modified polypropylene car mudguards exhibited variable surface finishes on either side of a mark which resembled a weld line. To cure this fault, injection moulding simulation software was used to study the flow pattern during mould filling. It was shown that the fault was associated with different shrinkages and degrees of crystallisation in different parts of the product, caused by different flow rates and cooling rates, arising from significant differences in product thickness. Further simulations showed that a more uniform flow would result from a reduction in thickness difference from 1.3 to 0.5 mm, and a more gradual thickness transition. Implementation in production solved the surface appearance problem, and also reduced materials consumption by 30% and reduced the cycle time by reducing the cooling time. 5 refs.
AUSTRALIA
Accession no.878304

Item 28
INVESTIGATION OF STRESS CRACKING AND FATIGUE FAILURE IN TWO-SHOT CAVITIES USING FINITE ELEMENT ANALYSIS
Camlin D D
Pennsylvania,State University (SPE)
Commercial finite analysis software was used to establish the cause of cracking in injection moulding H-13 tool steel cavity blocks. It was shown that the stresses arising from contact with the valve gauge tip were sufficiently high to result in fatigue failure, and that the calculated location of maximum stress corresponded with the observed crack position.

USA
Accession no.878303

Item 29
Plastics Technology
49, No.1, Jan.2003, p.40-1
INJECTION MOLDING TROUBLESHOOTER - COMMON MISTAKES IN LONG-FIBER MOLDING
Miklos M; Gregory R
LNP Engineering Plastics Inc.
This article is part of a series on injection moulding troubleshooting, and looks in particular at the moulding of long-fibre reinforced plastics, and eight commonly-made mistakes in this field: rough-and-tumble conveying, built-in clogging and bridging, too-small loaders, maintenance-prone filters, undersized injection units, wrong screw, long narrow nozzles, and restricted flow paths in the mould.
USA
Accession no.878078

Item 30
Brookfield, Ct., SPE, 2002, Paper 4, p.1-11, 27 cm, 012
ADVANCES IN HOT RUNNER TECHNOLOGY
Beaumont J P; Hoffman D
Penn State University; Beaumont Runner Technologies Inc.
(SPE,Moldmaking/Mold Design Div.)
The use of hot runner systems can often have advantages over cold runner such as less material scrap or the elimination of regrind, less tonnage required, and more versatile gating locations but they also introduce additional variables to an already complicated injection moulding process. These added variables create more challenges and generally require higher skilled personnel. These variables also complicate the ability to identify the true source of problems, such as mould filling imbalances, when they do arise. Although ‘fishbone’ or ‘tree’ runner layouts are occasionally used, most hot runner manifolds are designed with more conventional geometrically balanced designs to achieve uniform mould filling. In many cases these layouts may be similar to those used in cold runner moulds. However, as the runner does not have to be ejected between cycles, the hot runner manifold provides more opportunities to improve upon the geometrically balanced methods used in cold runners. As a result, manifolds manifolds may combine level changes at various branches within ‘H’ or ‘X’ branching patterns to accommodate geometrical balances between cavities. Despite the fact that hot runners use the geometrically balanced design, far too often a mould filling imbalance still exists. The results of a study demonstrating that a major cause of flow imbalance in multi-cavity hot runner moulds is the result of shear induced melt variations created when flow is split at a runner branch are presented. It is also shown how these shear induced variations can be managed to achieve both balanced filling and balanced material properties in cold runners, hot runners and stack moulds. 6 refs.
USA
Accession no.877751

Item 31
Brookfield, Ct., SPE, 2002, Paper 4, p.1-11, 27 cm, 012
COATINGS AND FINISHES FOR MOLD REPAIR AND MAINTENANCE
Bales S
Bales Mold Service Inc.
(SPE,Moldmaking/Mold Design Div.)
Customer demands for shorter delivery times and increased production, while maintaining high quality, makes planning for maintenance or repair essential for every successful mould making and moulding operation. There are many important differences between finishes and coatings for moulds. Aspects covered include how finishes affect lubricity, increase in production by pairing effective finishes with precision protective coatings, how and when protective coatings should be used as wear indicators for optimum maintenance and mould aid performance, and the more effective use of plating build-ups. The objective is a greater understanding of the latest finishing and coating technologies that will ultimately them meet tighter production deadlines with fewer problems and improved productivity.
USA
Accession no.877750

Item 32
Polymer Engineering and Science
42, No.12, Dec.2002, p.2471-81
DEVELOPMENT OF RAPID HEATING AND COOLING SYSTEMS FOR INJECTION MOLDING APPLICATIONS
Yao D; Kim B
Oakland,University; Massachusetts,University
A novel method for alleviating thermal stress problems in injection moulding by utilising rapid heating and cooling systems consisting of a metal heating layer and an oxide insulation layer with closely matched low thermal expansion coefficients is described. The effects
of various design parameters, such as layer thickness, power density and material properties, on the performance of mould inserts are explored with the help of heat transfer simulation and thermal stress simulation and rapid thermal response mould inserts capable of raising temperatures from 25 to 250°C in 2 seconds and cooling to 50°C in 9 seconds are constructed. 6 refs.

USA
Accession no.876643

Item 33
ADVANCED SEQUENCING AND PROTECTION OF VALVE GATE SYSTEMS
Linehan T P
DME Co.
(SPE)
The enhanced flexibility and additional features offered by the use of computer-controlled valve gate sequencing as an alternative to hard-wired systems are discussed. Time-based or limit switch systems are less flexible and provided less control than those based upon screw position and cavity pressure. More flexible systems, operating multiple valve gates, provide greater consistency and minimise weld lines. The addition of a signal interface between the machine control and the valve gate control can be used to prevent hot runner damage caused by such faults as valve gate malfunction, and water cooling problems.
USA
Accession no.874787

Item 34
IMPROVING THE AESTHETICS AND THE MECHANICAL PROPERTIES OF THE INJECTION MOULDED PARTS USING A MOULD WITH HIGH TEMPERATURE
Yoo Y-E; Park S; Lee S-H
LG Chemical Ltd.
(SPE,Detroit Section)
Injection moulding is cost effective and competitive for mass production. It can also be very useful to mould products in various applications. Moulded parts have become more complex in their shape and thinner in many cases. These require the use of multi-gated moulds and inserts, which result in weld line in the final product. Weld line, a common defect in injection moulding cannot often be eliminated and causes some problems. First of all, weld line on the surface causes visible defects and requires post processing like painting to hide weld lines. Besides, weld line also affects mechanical properties, such as tensile or impact strength. Many engineers have examined the dominant processing parameters and tried to improve the characteristic of the weld line by various methods. Details are given of a new injection process, designated MmSH (momentary mould surface heating), which can raise the mould temperature over 200 deg.C with the usual cycle time. The influence of MmSH on the visual characteristics of weld line is investigated. Weld line tensile strength is examined for samples from the process. 6 refs.
KOREA
Accession no.873707

Item 35
Plastics Technology
48, No.11, Nov.2002, p.62/7
HOW TO INJECTION MOLD CYCLIC OLEFIN COPOLYMERS
Lamonte R R; McNally D; Music K; Hammond D
Ticona
This detailed article focuses on a new family of clear engineering thermoplastics, “Topas” metallocene-catalysed cyclic olefin copolymers (COCs), from Ticona. It looks in particular at how to injection mould the new family, for optical and medical parts. Section headings include: COC properties and moulding, equipment considerations, typical start-up conditions, machine settings, moulding guidelines, troubleshooting COC injection moulding, and secondary operations.
USA
Accession no.873057

Item 36
MOULD STICKING, FOULING AND CLEANING
Packham D E
Bath,University
Edited by: Humphreys S
(Rapra Technology Ltd.)
Rapra.Review Report No.150
This review is concerned with the related problems of mould sticking, fouling and cleaning associated with the moulding of polymeric materials. The review discusses major studies first of mould release followed by mould fouling, with the aim of elucidating the significant material and process variables affecting the phenomena. Publications particularly relevant to the practical guidance on the selection of surface treatment for moulds, the selection of release agents, the cleaning of moulds and the measurement of mould release and fouling, are considered. 433 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.872183


**Item 37**

**Injection Molding**

10, No.12, Nov.2002, p.74-6

**TROUBLESHOOTER PART 57: TOO MUCH OF A GOOD THING**

Hatch R
Prime Alliance

A series of troubleshooting reports from one of the spot problem solvers in the moulding industry is continued. The main issue for which requests are made to address is that of undersized gates. Materials such as PE, PP, unfilled nylons and PBTP are compatible with small gates, but amorphous materials such as PS, ABS, ASA, SAN, acrylic and polycarbonate require bigger gates. Since the gate depth or diameter is based on the thickness of the wall into which is being gated, and since gating should be made into the thickest wall section of the part, it is not difficult to calculate the depth or diameter of a gate. A case history is presented.

USA

Accession no.870754

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**Item 38**

**Kunststoffe Plast Europe**

92, No.9, Sept.2002, p.50-2

**TRACING THE COST FACTORS, FAILURE ANALYSIS IN THERMAL MOULD DESIGN**

Steinko W
GTT W. Steinko GmbH

The need for modern injection moulders to keep unit costs constantly under surveillance in order to remain competitive is discussed and the importance of careful design of the mould cooling system is emphasised. GTT GmbH’s consultancy work on analysis of the part, the mould and the process, identification of the inadequacies responsible for deficient quality and cycle time, and their documentation is described. The use of IR thermography for thermal problem analysis in injection moulding is considered. The German version of this article, which appears on p.121-4, includes illustrations.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.869233

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**Item 39**


**ROOT CAUSE ANALYSIS: FUNDAMENTALS AND APPLICATIONS**

Elleithy R H
Polymer Diagnostics Inc. (SPE)

The application of root cause analysis in the identification of polymer failures is described. Seven sequential steps are proposed: definition of required performance; establishing actual behaviour; identification of the problem; identifying what the problem is not; detailing the differences between the previous two steps; investigation of probable causes; and determining corrective action. The procedure is illustrated by two injection moulding case studies: breakage of an acrylic clip; and breakage of a living hinge. 3 refs.

USA

Accession no.871792

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**Item 40**

**European Rubber Journal**

184, No.11, Nov.2002, p.16-8

**MODELLING INJECTION MOULDING PROCESSES**

Shaw D

A new injection moulding software package has recently been launched which appears to offer the rubber industry unmatched ability to model what happens in the mould chamber during both the injection phase and the curing phase. According to Sigma Engineering, the SigmaSoft software can help with the positioning of heaters, cooling channels, gate positions, runner balancing and flow paths within the mould, to avoid dead spots, weld lines and other problems with complex components. SigmaSoft is different from its rivals in that it calculates in three true dimensions, as opposed to estimating some values based on two-dimensional flows. It also uses Napier-Stokes equations to calculate the flow within the mould.

SIGMA ENGINEERING GMBH
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.868178

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**Item 41**

**Modern Plastics International**


**OVERLY SMALL MOLDS, LARGE MACHINES CAUSE DAMAGE**

Dealey B
Dealey’s Mold Engineering

Typically, if a mould is too big for an injection moulding machine, there is an obvious problem. However, a machine that is too big for a mould is also a problem, as is a mould that is too small for a machine. Ideally, the shot size should be between one-third and two-thirds of the barrel capacity. Mould-to-machine match is discussed.

USA

Accession no.871778

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**Item 42**

**Modern Plastics International**

TECHNIQUES SOLVE MELT FLOW IMBALANCE FOR EVEN CAVITY FILLING
Mapleston P
One of the biggest bugbears of multicavity moulds is getting balanced flow across all the cavities. One of the reasons is the variations in temperatures across runner channels that often do not show up in flow simulation programmes. MeltFlipper technology from Beaumont Runner Technologies aims to solve this problem. It currently works on cold-runner systems, but the company plans to demonstrate a hot-runner manifold incorporating a new version of its technology at NPE2003.

BEAUMONT RUNNER TECHNOLOGIES INC.
USA
Accession no.867327

Item 43
STUDY OF FLOW MARKS DURING INJECTION MOLDING
Guojun Xu; Koelling K W
Ohio,State University (SPE)
Relationships between the process parameters and alternating dull and glossy regions on the surface of injection moulded product was investigated. Rectangular bars of 1 or 5.08 mm thickness were injection moulded using polypropylene with melt and mould temperatures in the ranges 190-260 C and 22-85 C, respectively; and high density polyethylene with melt and mould temperatures in the ranges 180-240 C and 20-70 C, respectively. The polymers were characterised by rheology measurements. Alternating flow marks did not occur at higher injection speeds, and their generation was attributed to entry viscoelastic instability. It was established that synchronous flow marks were not caused by slip, and that they could be alleviated by coating the mould surfaces. 18 refs.
USA
Accession no.866950

Item 46
Injection Molding
THE TROUBLESHOOTER. PART 56: EVEN FILL WITH FLOW RESTRICTORS
Hatch B
Prime Alliance
The manager of technical service and customer support at Prime Alliance offers advice on how to solve a problem with mould filling in the manufacture of ABS shower head handles, which were displaying surface defects, knitlines and sink marks. He identifies the problem as being caused by the sprue and nozzle orifice being too small, an undersized flow path and moulded-in stress and suggests that it may be overcome by the proper venting of runners, enlarging of the sprue and nozzle, the addition of a mould restrictor and the use of an open flow path.
USA
Accession no.866512
Item 47
Modern Plastics International
PREVENTIVE PURGING HAS PRACTICAL BENEFITS
Moore S

Purging compound suppliers claim regularly-scheduled purgings prevent quality problems and yield operational benefits. These include fewer rejects, less scrap after purging, shorter purging cycles and, consequently, greater machine uptime. Dyna-Purge documented one case where an injection moulder cut the cost of purging by 87% by adopting Dyna-Purge M compound to scrub carbon deposits from the barrel and nozzle. The user, Rexam in Antwerp, formerly used 400 kg of virgin PP to remove specks from a machine that moulded yellow food containers. Lost production time was reduced from 14 to 2 hours. Tackling potential carbon specks before they have a chance to form is one key in effective purging.

WORLD
Accession no.865460

Item 48
Plastics Technology
48, No.6, June 2002, p.45/7
INJECTION MOLDING TROUBLESHOOTER - AVOID PITFALLS IN MULTI-MATERIAL MOLDING
Ehritt J
Battenfeld of America

This article is part of a series on injection moulding troubleshooting, and looks in particular at multi-material moulding. It explains the challenges faced when moulding with two or more different materials, the variables involved, factors to keep in consideration, and possible solutions to the commonest problems.

USA
Accession no.863850

Item 49
Kunststoffe Plast Europe
92, No.8, Aug. 2002, p.19-20
CUTTING COSTS
Uske K
BASF AG

Regrind is generated in thermoplastics injection moulding as a result of the granulation of sprues or reject parts into particles just a few millimetres in size. In this form, the regrind can be recycled back into the injection moulding process, so minimising scrap disposal requirements. In the production of moulded parts to high specifications from high-quality engineering thermoplastics, the use of regrind is possible only to a limited extent. The reason for this restriction is the degradation of the moulding material during injection moulding and granulation. A series of trials with PBTP and polyamide 6 was carried out and some of the results are discussed here. Graphs relating to this article are included in the German version p.61-62.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.858081

Item 50
Brookfield, Ct., SPE, 2002, Paper 1, Session M1-Color and Appearance, pp.4, CD-ROM, 012
INJECTION MOLDING AND COLOUR: A BASIC LOOK AT DESIGN, PROCESSING, & TROUBLESHOOTING
Angel G
PolyOne Corp. (SPE)

The addition of colour at the injection moulding machine is compared with the use of pre-coloured polymer in terms of cost and processing. The causes of colour-related product problems are briefly reviewed in terms of machine, tooling design, and materials composition.

USA
Accession no.864082

Item 51
Melton Mowbray, 2000, pp.20, 29 cm, 18/6/02
EVOPRENE, EVOPRENE SUPER G; EVOPRENE G; EVOPRENE COGEE; EVOPRENE GC; EVOPRENE. THERMOPLASTIC ELASTOMER COMPOUND SERIES. TECHNICAL MANUAL
AlphaGary Ltd.

Comprehensive product data are presented for grades of Evoprene thermoplastic elastomers from AlphaGary Ltd. Grades described are Evoprene Super G, Evoprene G, Evoprene COGEE, Evoprene GC, and Evoprene general purpose grades of styrenic TPEs. Property data are tabulated for each grade, with details of features and benefits. In particular, the fluid resistance of Evoprene G compounds is described, and Evoprene grades for the window gasket market are indicated. Flame retardant grades are also discussed. A processing guide for both injection moulding and extrusion is included with a troubleshooting guide for each.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.858081

Item 52
Orpington, 2001, pp.2, 27 cm, 20/6/02
MOLDFLOW PRODUCT GUIDE
Moldflow (Europe) Ltd.

Details are given of Moldflow’s suite of software products, designed for plastic part design and manufacturing engineers.
to eliminate problems and costly downtime on the manufacturing floor. Included are details of plasticszone.com, the company’s website; Moldflow Plastics Advisors, an advanced process simulation package; Moldflow Plastics Insight, in depth simulations which allow for the determination of optimal combinations of part geometry, materials, mould design and processing parameters; Moldflow Plastics Xpert, which offers solutions to reduce mould commissioning times; Moldflow EZ-Track for production monitoring and reporting; Moldflow Shotscope for process and production monitoring; and Moldflow Plastics Labs for state-of-the-art material testing services.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.858060

Item 55

Injection Molding
10, No.5, May 2002, p.70-1

THE TROUBLESHOOTER. PART 54: SIZING RUNNERS FOR PBT
Hatch B
Prime Alliance

A description is given of how problems encountered during the injection moulding of small PBTP parts using an eight cavity, cold runner were identified and solved. The problem, which entailed inconsistent filling of the mould cavity, was solved by enlarging the nozzle, sprue, runners and gates, which eliminated the need for extra barrel heat and injection pressure, resulting in no short shots and faster cycle times.

USA
Accession no.853482

Item 56

Kunststoffe Plast Europe

PLASTICISING IN CRITICAL AREAS
Buerkle E; Wuertele M
Krauss-Maffei Kunststofftechnik GmbH

An in-depth discussion is presented on the physical limitations of single-screw injection moulding machines and methods of overcoming some of these limitations. The advantages of a novel injection moulding machine, the Injection Moulding Compounder, from Krauss-Maffei, which overcomes some of the problems encountered when using single-screw injection moulding machines are also discussed. This novel machine combine an extruder and an injection moulding machine into one unit, which allows for gentle, homogeneous compounding and mixing of fillers and additives. (Kunststoffe, 92, No.3, 2002, p.38-44)

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.851004

Item 57

Barcelona, Rapra Technology Ltd., 2002, Paper 18, p.243-5, 30cm, 012

ORIGIN OF THE SURFACE DEFECT “SLIP-STICK” ON INJECTION MOULDED PRODUCTS
Schepens A; Bulters M
DSM Petrochemicals
(Rapra Technology Ltd.; ASCAMM)

An investigation was carried out into the influence of injection moulding parameters on the “slip-stick” effect on the surface of filled PP in order to identify the cause of this moulding fault. Flow instability at the melt front was identified as the cause of the effect and a remedy for eliminating this effect is suggested. 4 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; NETHERLANDS; SPAIN; UK; WESTERN EUROPE
Accession no.850461
Item 58
SURFACE “MARBLING” IN MINERAL FILLED NYLON: ORIGINS AND SOLUTIONS
Legrix A; Fugler A; Greenhill D; Goodman R; Paynter C Imerys Minerals Ltd. (Rapra Technology Ltd.; ASCAMM)
An investigation was carried out into the possible mechanisms responsible for gatemarking in injection moulded, calcined clay filled polyamide 6. The effects of processing conditions on the surface finish of the moulded plaques and the influence of thermal, rheological and mechanical properties on gatemarking were assessed and a mechanism for gatemarking/marbling is proposed. Solutions and guidelines for improving the surface finish of the filled polyamides are also presented. 5 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; UK; WESTERN EUROPE
Accession no.850460

Item 59
Plastics and Rubber Weekly
15th March 2002, p.1
DYSON STAFF SLAM MOULD SHOP WASTE
Bagshaw S
Dyson’s in-house mould shop is wasteful, inefficient and run by managers inexperienced in plastic component production, according to staff at the Malmesbury plant. Current employees say that had more attention been paid to increasing efficiency in the Wiltshire factory, there would have been less incentive to relocate vacuum cleaner production to Malaysia. One mould shop employee said waste was widespread and undermined effectiveness. On one occasion nine tonnes of lavender ABS is said to have been just thrown away due to processing problems. Standard mould shop practices are reported to have reduced further profitability. When a colour change is carried out, the material system is not allowed to run out; the machine is just stopped. Half a tonne of virgin material is disposed of every week due to this. According to the employee, the management has not looked at the plant’s efficiency before deciding to move production. Some company information is presented.
DYSON APPLIANCES LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.849582

Item 60
Injection Molding
9, No.12, Dec.2001, p.68/70
TROUBLESHOOTER - PART 52: SIZING SPOKE RUNNERS
Hatch B
Prime Alliance
This article is part 52 of a series of troubleshooting reports relating to injection moulding. It deals with sizing spoke runners. A case history is included to illustrate the point-in-hand. Details are given of the symptom and cause, the solution, and the result.
USA
Accession no.848832

Item 61
Revista de Plasticos Modernos
81, No.540, June 2001, p.636/41
Spanish
HOT RUNNER SYSTEMS WITH GATE VALVES
Gauler K
Incoe International Inc.
The technical advantages of hot runner injection mould systems with gate valves are discussed. Applications of these systems in plastics injection moulding processes generally and in gas injection moulding, coinjection moulding and structural foam moulding are described.
USA
Accession no.849069

Item 62
Injection Molding
TAMING OF THE SCREW
Deligio T
Westland believes that screw design plays a fundamental role in high-quality moulding, although for many moulders, screw and barrel design is not a high priority. Avon Plastic Products is a custom moulder serving the automotive interior and trim market. The company had successfully colour concentrated ABS and PP using the standard screws that came with its machines, but colour concentrating acetal was causing problems. Westland specifically designed the Eagle screw for the process profiles that Avon required. The Eagle’s mixing section uses wiper flights with large helix angles to force the melt over barrier lands or through one of six mixing notches. This motion encourages thorough mixing without the excessive shear that can degrade material. Avon says the benefits of switching to these high-performance screws specifically designed for certain resin systems are tremendous.
WESTLAND CORP.; AVON PLASTIC PRODUCTS INC.
Accession no.849582

Item 63
Oberhausen, 2001, pp.4. 30cms. 5/2/2002
GUR PE-UHMW: SPECIALTY INJECTION MOLDING - GUR SPECIALTY PRODUCTS FOR

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HIGHLY SPECIALIZED INJECTION MOLDED PARTS
Ticona GmbH

Technical information is presented on GUR ultra-high molecular weight polyethylene, for use in the production of specialised injection moulded parts. Parts manufactured from GUR 5113 and Hostalloy 731 feature high abrasion resistance, self-lubrication, high notch impact strength, good chemical resistance, low density, and good low temperature properties. The engineering polymers can be successfully used in chemical plants, conveyor systems, valves, fittings, pumps and other industrial, consumer and mechanical applications. Tables of data show typical physical properties and optimum processing conditions for the materials, while a troubleshooting guide to possible problems is also included.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.846353

Item 64
Injection Molding
10, No.3, March 2002, p.66-8
TROUBLESHOOTER PART 53: BLUSH WITH A FILLED PC
Hatch B
Prime Alliance Inc.

A moulder was having problems with blush at the front tip of a glass-filled polycarbonate part. Upon examination of the tunnel portion of the subgate, it was found that the gate was too restricted to shoot glass-filled polycarbonate through it. The trouble was that the pin gate sliver was only 0.060 inch thick where it contacted the part and 0.065 inch where the subgate fed into it. The sliver was not thick enough to fill and pack the part without extra heat and pressure. Second, the subgate that fed the sliver was too small in diameter. The solution was to change the straight pin gate to a wedge-shaped pin gate and open taper where the subgate feeds the thick section of the wedge gate.
USA
Accession no.847817

Item 65
Wayland, Ma., 2001, pp.6. 30cms. 4/1/2002
PLASTICS XPERT: CHANGING THE WAY PLASTICS PARTS ARE MANUFACTURED
Moldflow Corp.

Moldflow Plastics Xpert has been developed to automate the process of injection moulding machine setup, optimisation, and control. Its use allows moulding machine operators to consistently and systematically set up the process, perform an automated design of experiments to determine a robust processing window, and automatically correct the process should problems occur. In addition, use of iMPX extends the capabilities of Xpert by allowing for real-time, Internet-enabled production monitoring via a standard web browser. iMPX gives manufacturing managers the ability to remotely monitor their production facilities and identify processing problems before downtime becomes necessary.
USA
Accession no.842946

Item 66
Revue Generale des Caoutchoucs et Plastiques
78, No.797, Sept.2001, p.30/7
French
SURFACE DEFECTS IN INJECTION MOULDED PARTS
Lacrampe M F; Pabiot J
Douai,Ecole des Mines

Types of surface defects occurring in injection moulded plastics parts are examined, and the influence of part geometry, polymer type and properties and injection moulding conditions on the development of such defects is discussed. A number of studies which relate the appearance of surface defects to flow instability are reviewed. 12 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.846238

Item 67
160th ACS Rubber Division Meeting - Fall 2001.
Cleveland, Oh., 16th-18th October 2001, Paper 5, pp.16, 012
SELECTIVE SELF-ADHESIVE SILICONE FOR LIQUID INJECTION MOLDING SYSTEM(LIMS)
Azechi S; Yamakawa N; Sekiguchi S; Meguriya N
Shin-Etsu Chemical Co.Ltd. (ACS,Rubber Div.)

A selective self-adhesive silicone rubber was developed to solve the adhesion problem in insert moulding with thermoplastics by allowing the liquid injection moulding material to bond to the thermoplastic insert but not to the metal surface of the mould. Adhesion was shown to take place even after a very short curing time so that the selective self-adhesive silicone could be used in primerless insert moulding or co-injection moulding to make a firmly integrated composite with thermoplastics. The composite prepared by this primerless insert moulding showed high adhesion durability in various types of severe conditions, such as high temp. (120C), high humidity (85C/85% relative humidity) and heat cycle (-40C to 120C). Even after 300 hours under these conditions, more than 90% cohesive failures within rubber were observed.
JAPAN; USA
Accession no.842946

Item 68
Revue Generale des Caoutchoucs et Plastiques
78, No.796, June/July 2001, p.46/5
French
MEASURING PRESSURE IN THE MOULD CAVITY
Galland C
Kistler SA

The measurement of cavity pressure in the injection moulding process is discussed, and the use of pressure measurements as a means for the quality control of moulded plastics parts is examined.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.842594

Injection Moulding Troubleshooter - Secrets of Thin-Wall Molding
Weiss K
GE Plastics

This article is part of a series on injection moulding troubleshooting, and looks in particular at the process of moulding thin-walled parts. It explains that thinner wall sections bring changes in processing requirements: higher pressures and speeds, faster cooling times, and modifications to part-ejection and gate arrangements. These changes in turn prompt new considerations in mould, machinery, and part design.
USA
Accession no.839288

Sepe M
Dickten & Masch Mfg.

The idea of material analysis as part of the product development process is not a popular notion. This arises largely from the fact that analytical testing services come from outside the moulding and mouldmaking facility and are therefore a visible cost. A case study is presented in an attempt to capture the costs related to a particularly troublesome programme launch and contrast those costs with the dollars spent in the lab to actually find the root cause of the problem. The programme involved a large part weighing almost 9lb which was produced in a 90-second cycle. The mould used a hot runner system with multiple gates. The material was a dark grey polycarbonate with a nominal MFR of 22g/10min. The problem on initial startup was an apparently incurable splay. After about a week of at-the-press troubleshooting, several material samples were sent for analysis. Testing showed up a melt stability problem, traced back to the omission of a stabiliser package that should have been incorporated during colour compounding.
USA
Accession no.837214

WHAT HARDENS SURFACES
Thierfelder W; Hoffmann A; Schmidt S; Ohm F; Eulenstei T
Plansee AG; Reutte; Luedenscheid,Plastics Institute

The problem of wear of injection mould surfaces and mould components is addressed and the use of a molybdenum alloy (a carbide-dispersion-hardened TZM alloy) to make mould components hardened using novel SHN hardening treatment to provide surfaces with a high...
surface hardness and reduced wear is demonstrated. The results of wear trials carried out using mould components made from these alloys and other materials are briefly reported. (Kunststoffe, 91, No.11, 2001, p.15-7)

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.837213

Item 74
Kunststoffe Plast Europe
91, No.11, Nov. 2001, p.11-2
SELF-INSULATING HOT-RUNNER WITH NEEDLE VALVES
Lindner E; Cuttat K P

The use of a self-insulating hot-runner with hydraulically operated needle valves to prevent problems occurring as a result of colour change from dark to light during the manufacture of the ABS back wall of an alarm clock housing is demonstrated. The heating system and colour change technique are briefly described and the demoulding stages for the manifold are illustrated. (Kunststoffe, 91, No.11, 2001, p.38-40)
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; SWITZERLAND; WESTERN EUROPE
Accession no.837211

Item 75
HOT RUNNERS IN INJECTION MOULDS
Frenkler D; Zawistowski H

The aim of this book is to provide an objective view of the topic of hot runners in injection moulds based on the broad personal experiences of the authors. It introduces a logical division of hot runner systems, illustrates the design of nozzles, manifolds and other system components, discusses the principles of selection, building, installation and use, analyses the causes of faults and suggests ways of eliminating them, and presents examples of applications. Each chapter is well referenced.
EASTERN EUROPE; EUROPEAN COMMUNITY; EUROPEAN UNION; POLAND; UK; WESTERN EUROPE
Accession no.837008

Item 76
Michigan, Guiness Technologies, 1994, 30cm, 831
INJECTION MOLDING SET-UP MANUAL
Wolfer S
Guiness Technologies

This loose leaf folder provides a compilation of information from the top 100 injection moulders in North America with regard to all aspects of setting up and using injection moulding processes. The guide is split into 15 sections: Safety; hand tools; Micrometers and callipers; Conversion tables; Plastic materials; The mould; The machine; The injection moulding cycle; Procedures; Troubleshooting; The specification sheet; Equipment information; Calendar/ Monthly planner; Phone numbers; Conclusion.
USA
Accession no.836997

Item 77
Injection Molding
9, No.10, Oct. 2001, p.92/5
TROUBLESHOOTER. PART 51: COPING WITH GATE JETTING
Hatch B
Prime Alliance

The problem of gate jetting (snake tracks) starting at the gate and continuing for 5 in. inside the gate in black ABS parts is addressed. This problem is identified as edge gating coming off the side of a trapezoidal runner, which results in a high shear gate. The remedy suggested is changing from the trapezoidal runner to a curved tunnel gate or tab gate and resizing the sprue O-diameter and nozzle orifice to increase flow. Information on good gate design is included.
USA
Accession no.833151

Item 78
Injection Molding
9, No.10, Oct. 2001, p.54/6
PART DESIGN - DEPTH OF HOLES
Beall G
Beall G.,Plastics Ltd.

Some recommendations are presented for avoiding core deflection when injection moulding parts, such as hypodermic needle sheaths, designed with deep holes. Methods of minimising bending or increasing resistance to bending of core pins, which involve either allowing high-pressure melt to impinge on both sides of the core pin or supporting the core pin at both ends, are illustrated.
USA
Accession no.833146

Item 79
Plast’ 21
No.101, April 2001, p.74-5
Spanish
INCREASING THE USEFUL LIFETIME OF MOULDS
Rodriguez R
Asociacion de la Industria Navarra

Ion implantation is examined as a method for the surface treatment of injection moulds to increase their service life, and the costs and technical aspects of this process are discussed in comparison with other surface treatment techniques.
EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.831328
WA VE DEFECTS ON THE SURFACE OF INJECTION MOULDED PP: INFLUENCE OF PROCESSING PARAMETERS AND THE FOUNTAIN EFFECT
Monasse B; Mathieu L; Stockman L; Vincent M; Haudin J M; Gazonnet J P; Durand V; Barthez J M; Roux D; Charmeau J Y
Paris, Ecole des Mines; Pole Europeen de Plasturgie; Ecole Superieure de Plasturgie

Results are presented of injection moulding studies and designed experiments undertaken to investigate the causes of wave defects on the surface of parts produced from talc filled, EPM modified PP. The influence of moulding conditions, the fountain effect and flow instability was examined.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.831313

PRODUCTION CYCLE OF THERMOPLASTICS INJECTION MOULDING. IV.
Reig M J
Alcoy, Escuela Politecnica Superior

The effects of frozen layer formation on melt flow in injection moulds are examined, and the influence of flow rate and injection temperature on the pressure required to fill the cavity is discussed. (Parts I and II: Ibid., 80, No.533, Nov.2000, p.527-30; Part III: Ibid., 80, No.534, Dec.2000, p.640-2).
EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.831301

THE TROUBLESHOOTER. PART 50: VENT BEFORE YOU MOULD
Hatch B

A description is given of how a small cosmetic defect, which looked like melt fracture or shear splay radiating from the gate, in a thick walled, clear PS or SAN handle or knob was eliminated through adjustments to the gating and runner sizes and the venting of all runners and cavities.
USA
Accession no.830434

MINIMISING THE SINKMARKS IN INJECTION-MOULDED THERMOPLASTICS
Liu S-J; Lin C-H; Wu Y-C
Chang Gung, University

The effects of several processing parameters on the formation of sink marks in injection moulded thermoplastics (general-purpose PS and LDPE) was investigated using a profile meter to characterise the sink marks. Parameters examined included rib corner geometry, rib width, melt-injection pressure, melt temperature, packing pressure and mould temperature. Experimental design based on an orthogonal array of the

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Taguchi method was employed in an attempt to minimise sink mark formation. It was found that ribs with undercut geometries and a small width were most likely to produce parts with the least sink marks. 12 refs.

TAIWAN

Accession no.825988

Item 86

Injection Molding
9, No.6, June 2001, p.90-4
THE TROUBLESHOOTER: PART 49. TROUBLE IN TWO MOULDS
A description is given of how Bob Hatch from Prime Alliance solved the problem of sinks in injection moulded polycarbonate parts.
PRIME ALLIANCE
USA
Accession no.820384

Item 87

Popular Plastics and Packaging
46, No.6, June 2001, p.86-7
FAULT DUE TO “METAL IN PLASTICS”
Mankde M; Prayag H D
RIECO Industries Ltd.
Some of the reasons for the presence of metal impurities in plastics and the problems occurring as a result are outlined and the use of metal separators to detect and remove metal impurities from plastics is suggested. The metal separator may be fitted to an injection moulding machine above the hopper to remove any metal impurities from the plastics material being fed into the machine.
INDIA
Accession no.818665

Item 88

Injection Molding
8, No.12, Dec.2000, p.112/5
TROUBLESHOOTER - PART 45: ELIMINATING SHEAR SPLAY
Hatch B
Prime Alliance
This detailed article is part 45 of a series of troubleshooting reports relating to injection moulding. This part deals with how to eliminate shear splay. A case history is included to illustrate the point-in-hand. Details are given of the symptom and cause, the solution, and the result.
USA
Accession no.818350

Item 89

Injection Molding
8, No.12, Dec.2000, p.52/8
DESIGN - MATERIALS ANALYST: PART 38
Sepe M
Dickten & Masch Mfg.Co.
This is part 38 of a series of articles designed to help injection moulders understand how a few analytical tools can help diagnose a part failure problem. It deals with the myths of heat deflection temperature, and is part 3 in a mini-series on this topic. The author recaps on ground already covered, (which included the deflection temperature under load test), then looks in this article at a better method of determining the properties of materials at elevated temperatures.
USA
Accession no.818341

Item 90

Massachusetts, Kluwer Academic Publishers, 1995, pp.xxii, 1145, 26cm
INJECTION MOLDING HANDBOOK - SECOND EDITION
Donald D; Donald D
Plastic Fallo; Rhode Island, School of Design
This, the second edition of this practical handbook, provides a complete review of injection moulding. It examines technological advancements, particularly computer methods and provides insights into trends in the field. Main headings include: The complete injection moulding operation, Injection moulding machines, Plasticising screw process, Mold design and operation, designing products, Plastic moulding materials, Process control technology design features that influence performance, Computer operations, Auxiliary equipment and secondary operations, Troubleshooting, Testing and quality controls, Statistical process and quality controls, Effective costing and plant financial control, Specialised injection moulding process, Competitive processes, Moulding with profit. 179 refs.
USA
Accession no.817927

Item 91

Injection Molding
9, No.4, April 2001, p.94/6
TROUBLESHOOTER PART 48. ACETAL’S SPECIAL NEEDS
Hatch B
An injection moulding troubleshooting exercise is described, involving a copolymer acetal, but which could just as easily have been a homopolymer, and a four-cavity, cold runner, two-plate mould with small parts. A metal insert was moulded into each part, making them look like little metal rods with moulded-on bushings. The complaint was that the levels of moulded-in stress were too high and the dimensions were going out of the acceptable tolerance range.
PRIME ALLIANCE
Accession no.815859
Moulders have traditionally used an equation that determines the tonnage requirements for a given moulded part. This rule of thumb has prevailed in the industry for years, but recently moulders and machinery suppliers have begun to tweak this well-known calculation to bring new flexibility to the moulding process. Robbins Scientific, a captive moulder of laboratory disposables such as tubes, trays and pipette tips was having trouble moulding a thin-wall tube plate made from general purpose PP. The part weighs in at a mere 18g. While technically the mould is single cavity, it is composed of several cores that make it unusually complex and challenging. The company required a smaller-tonnage press with larger tiebar spacing. The company’s needs coincided with Husky’s development of a new 100-ton hybrid injection machine. Details are given.

ROBBINS SCIENTIFIC CORP.; HUSKY INJECTION MOLDING SYSTEMS LTD.
CANADA; USA

Accession no.815855

During the injection moulding process, melt flows from the gate through the cavity. This is a melt flow process, and that imposes limitations on what can and cannot be moulded. The ideal shape for an injection moulded part is a poker chip with a centrally located gate. If the poker chip has a uniform wall that is thick enough, the melt will flow uniformly from the gate and reach all of the periphery of the cavity at the same time. This would be an ideal situation. If that poker chip contains a deep recess or a through hole, the melt would have to separate into two flow paths that would pass around those obstructions and reunite on the other side. There would then be an interruption in the flow, and the melt would not reach all of the periphery of the cavity at the same time. Rotational moulding is a sintering process. Thermoforming and blow moulding are stretching processes. These are not melt flow processes. They can mould parts with thinner walls and no weld lines. In spite of its melt flow limitation, injection moulding is the product designer’s most frequently specified moulding process. Weld lines are an integral part of this process; aspects covered include materials selection, moulding considerations and design guidelines.

USA

Accession no.815856

The injection moulding sector’s practice of relying on machine setting adjustments to overcome basic processing problems, such as mixing, rather than addressing root causes means many are missing out on considerable efficiency gains. Mixing problems usually only become apparent where on-machine colouring is being carried out and show up in streaking on the part. A study has shown that processors using a Sulzer static mixer in the nozzle to promote material mixing have been able to reduce their masterbatch addition levels by between 15 and 40%. The study found that the ability to achieve good pigment dispersion at lower back-pressure, barrel temperature and screw speed settings means that melt temperature can be as much as 30°C lower. This enables cycle times to be reduced by up to 36%.

SULZER CHEMTECH
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no.814603
NUMERICAL SIMULATION OF THERMALLY INDUCED STRESS AND WARPAGE IN INJECTION-MOLDED THERMOPLASTICS
Gu Y; Li H; Shen C
Dalian, University of Technology; Zhengzhou, University

Thermally induced stress and the relevant warpage caused by inappropriate mould design and processing conditions are problems confounding overall success of injection moulding. Numerical simulation and finite element method are studied to predict thermally induced warpage and residual stress of injection moulded parts generated during the cooling stage of the injection-moulding cycle. A thermorheologically simple two-dimensional thermoviscoelastic material model is used in the numerical computing. The initial temperature field of the analysis corresponds to the end of the filling stage. The fully time-dependent algorithm is based on the calculation of the elastic response at every time step. Numerical results are discussed with respect to temperature and pressure, and compared with experiment results. 14 refs.

CHINA
Accession no.808582

Item 97
Revista de Plasticos Modernos
79, No.527, May 2000, p.554-8
Spanish
STUDY OF THE SURFACE QUALITY OF PVC FITTINGS ON THE BASIS OF INJECTION MOLDING PARAMETERS
Castany F J; Llado J; Sanchez B; Javierre C; Aisa J
Taller de Inyeccion de la Industria del Plastico; Zaragoza, University

The influence of injection moulding conditions on the occurrence of surface defects on PVC pipe fittings was studied experimentally and by finite element analysis. Comparison of the experimental results with theoretical predictions allowed optimisation of the processing conditions for the production of parts having the required surface quality. 3 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.807113

Item 98
Revista de Plasticos Modernos
79, No.527, May 2000, p.550-3
Spanish
INFLUENCE OF GATE THICKNESS ON THE MECHANICAL BEHAVIOUR OF POLYPROPYLENE
Gordillo A; Santana O O; Miranda F; Martinez A B
Centre Catala del Plastic; Catalunya, Universidad Politecnica

Results are presented of a study of the effects of injection moulding conditions, including gate thickness, holding pressure and holding time, on the shrinkage, degree of crystallinity and mechanical properties of PP specimens. 21 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.807112

Item 99
Orlando, Fl., 7th-11th May, 2000, paper 726
PRACTITIONER TRAINING PROGRAM FOR TROUBLESHOOTING INJECTION MOLDED PART DEFECTS
Shanor M; Swantner D; Baird D T
Pennsylvania, State University (SPE)
The cause and general solutions for a number of injection moulding faults are described and illustrated by case studies, including: vacuum voids, stuck parts, colour streaks, and discoloration. Injection moulding trials were conducted using a range of processing parameters to establish the most significant factors creating the faults.

USA
Accession no.805734

Item 100
Orlando, Fl., 7th-11th May, 2000, paper 720
TRAINING PROGRAM FOR TROUBLESHOOTING INJECTION MOLDED PART DEFECTS
Bloom D; Gorman C
Pennsylvania, State University (SPE)
The cause and general solutions for a number of injection moulding faults are described and illustrated by case studies, including: burn marks, bubbles, splay and glass fibre streaks. Design of experiment techniques were used to establish the most significant factors creating the faults.

USA
Accession no.805728

Item 101
Orlando, Fl., 7th-11th May, 2000, paper 719
PRACTITIONER TRAINING PROGRAM FOR TROUBLESHOOTING INJECTION MOLDED PART DEFECTS
Schickline A; Schmidt J
Pennsylvania, State University (SPE)
The cause and general solutions for a number of injection moulding faults are described and illustrated by case studies, including: dimensional variations, flash, gate blush, and weld lines.

USA
Accession no.805727
CAE APPROACH TO RELIEVE NOTEBOOK CONNECTOR AIR-TRAP PROBLEMS
Rong-Yeu Chang; Lin A S; Hsu D C; Fu-Ming Hsu
Taiwan, National Tsing Hua University; CoreTech System Co.Ltd.; Horn-Chi Precision Machinery Co.Ltd.
(SPE)
The use of computer aided engineering software to prevent air trap problems, as an alternative to trial-and-error, in the design of moulds for injection moulding applications is discussed, using the production of a notebook computer connector as a case study. Mould design modifications included: the introduction of an additional gate to facilitate melt flow; the provision of gating at the original air trap position; and modifications of the gate dimensions to balance flow. 6 refs.
TAIWAN
Accession no.805702

THE IMPOSSIBLE PART - ON THE VERGE OF FAILURE?
Golmanavich J; Hofmaster B
Lucent Technologies
(SPE)
The case history of a part with a web of 4.625 mm in diameter but only 0.125 mm in thickness, to be manufactured by injection moulding, is described. Flow software indicated that incomplete filling would occur. Nevertheless, a trial mould was produced, and with increasing injection speed, mould temperature and material temperature, filling using polycarbonate was eventually achieved. A change to a polycarbonate/ABS blend with enhanced flow properties, and an increase in web thickness to 0.175 mm, gave further improvements, leading to the commitment to produce an eight-cavity production mould and the acceptance of the part for production. 1 ref.
USA
Accession no.803358

TROUBLESHOOTER - PART 43: TAKING SINKS OUT OF ACRYLIC
Hatch B
Prime Alliance
This article is part 43 of a series of troubleshooting reports relating to injection moulding. It deals with sink in the thick sections when moulding with acrylic. A case history is included to illustrate the point-in-hand. Details are given of the symptom and cause, the solution, and the result.
USA
Accession no.802401

BY DESIGN: PART DESIGN 202 - PROJECTION HEIGHT
Beall G
Glenn Beall Plastics Ltd.
This article examines an issue important to part design engineers and the moulding industry: projection height (projections being any structural detail that is attached to the nominal wall of the moulded part). Design faults leading to incomplete filling of moulds are discussed. Section headings include: melt flow, venting considerations, ejection problems, and finally, length of projections.
USA
Accession no.802393
Item 108

*Injection Molding*
8, No.10, Oct.2000, p.54/60

**DESIGN - MATERIALS ANALYST: PART 36**
Sepe M
Dickten & Masch MFG.Co.

This is part 36 of a series of articles designed to help injection moulders understand how a few analytical tools can help diagnose a part failure problem. It is the first part of a short set of articles which deals with the myths of heat deflection temperature. The deflection temperature under load test is discussed in depth, and its limitations analysed.

DOW CHEMICAL
USA

Accession no.802392

Item 109

*Journal of Injection Molding Technology*
4, No.4, Dec.2000, p.167-76

**DEFECTS IN SURFACE APPEARANCE OF INJECTION MOULDED THERMOPLASTIC PARTS - REVIEW OF SOME PROBLEMS IN SURFACE GLOSS DISTRIBUTION**

Lacrampe M F; Pabiot J
Ecole des Mines de Douai

A review is presented of surface defects occurring in injection moulded thermoplastic parts. The key parameters affecting surface defects, including part and mould cavity geometry, incidence of processing parameters and incidence of the nature and properties of the thermoplastic material, and possible mechanisms of defect formation are discussed. 12 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE

Accession no.801510

Item 110

Orlando, Fl., 7th-11th May, 2000, paper 203

**USE OF COPPER ALLOYS TO REDUCE MOLD CONDENSATION PROBLEMS**

Hayden K; Engelmann P; Shoemaker J; Monfore M; Dealey R
Western Michigan,University; Mouldflow Corp.; Johnson Controls Inc.; Dealey’s Mold Engineering (SPE)

The prospect was investigated of substituted higher thermal conductivity copper alloy components for less conductive steels in injection moulding moulds, so permitting an increase in temperature of the cooling water, which in turn would eliminate surface condensation problems. Using a single cavity 33 mm bottle cap mould with a C18000 copper alloy or type 420 stainless steel core and cooling water temperatures of 10 C or 21 C (below and above the dewpoint, respectively), parts were moulded using a propylene copolymer. The moulding was also modelled using commercial modelling software. Operating with the coolant temperature above the dewpoint prevented the formation of condensation. The cooling simulation accurately predicted the relationship between the core material, the coolant temperature and the temperature of external surfaces. The increase in temperature in conjunction with the copper alloy core increased the cycle time by approximately 0.5 s. At temperatures below the dewpoint, the steel core ran hotter than the copper alloy core, the warpage of the steel core-moulded parts stabilising at cycle times of 2 s longer than with copper cores. 7 refs.

USA

Accession no.799723

Item 111

*Medical Device Technology*
11, No.9, Nov.2000, p.36/40

**MOULDING PROBLEMS: FEED SYSTEM TOO SMALL**

Wilkinson R; Poppe E A; Leidig K; Schirmer K
DuPont

It is explained that, in order to produce good quality mouldings, manufacturers need to ensure that their feed systems are designed correctly. This article outlines the key characteristics of an efficient feed system when making parts from semi-crystalline polymers.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; SWITZERLAND; UK; WESTERN EUROPE

Accession no.798905

Item 112

*Injection Molding*
8, No.11, Nov.2000, p.94/7

**TROUBLESHOOTER PART 44: PREDICTABILITY OF GATE BLUSH**

Hatch B
Prime Alliance Inc.

A polycarbonate alloy part was displaying a line of splay oriented in line with the gate and blush at the gate. The moulder was also experiencing screw slippage on the moulding machine which was lengthening the cycle. It was recommended that the moulder open the sprue O diameter to at least 0.375 inch, shorten the gate land to no more than 0.030 inch and lower the barrel heats. The changes were made and the parts improved and slippage was eliminated.

USA

Accession no.797206

Item 113

Orlando, Fl., 7th-11th May, 2000, paper 133

**COVER PART AS AN APPLICATION EXAMPLE FOR GAS-ASSISTED INJECTION MOLDED PARTS**

Hansen M
The process of gas-assisted injection moulding is briefly described in terms of material properties, processing parameters, part design, and the injection moulding technique, and procedures for tool design illustrated using the production of a cover part, 985 mm x 560 mm of 3 mm wall thickness, as an example. The importance of consistency in the filling phase, and difficulties associated with gas distribution, the packing of areas remote from the gas injection points, the avoidance of sink marks are discussed. 5 refs.

USA

Accession no.795488

Item 114
Orlando, Fl., 7th-11th May, 2000, paper 124
POLYMER RAW MATERIAL, PROCESS AND PRODUCTION FINGERPRINTS IN INJECTION MOULDING
Dawson A J; Key A; Coates P D
Bradford,University; Polymer Insights
(SPE)
The use of in-line rheometers to monitor polymer consistency, and injection pressure-time relationships to monitor changes in material quality and process conditions during injection moulding are discussed. A pressure-time monitoring system was developed which condenses the data to a single value, giving a process index, and results are presented for the mean hydraulic pressures obtained from a production machine moulding ABS. Following the setting of appropriate control limits, the system is capable of rejecting products produced outside process limits. 12 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.795479

Item 115
Orlando, Fl., 7th-11th May, 2000, paper 80
PREVENTING SINK MARKS OF INJECTION MOULDED PARTS USING CAE ANALYSIS
Ni S
Lexmark International Inc.
(SPE)
Commercial computer software was used to model the injection moulding of a small laser printer component, so as to alleviate a sink problem. The predictions of the sink dimensions were in agreement with measurements on production parts, and the software was used to redesign the mould and to modify the process conditions to eliminate the problem. 5 refs.
USA
Accession no.793811

Item 116
Kunststoffe Plast Europe
90, No.10, Oct.2000, p.25-7
E-MAIL FROM AN INJECTION MOULDING MACHINE
Schwab E; Marzineak R
KMI; Markischen,Fachhochschule
Internet technology has made available all communication possibilities required for remote maintenance applications for injection moulding machines. With the aid of modern communication technologies and systems that can detect faults at an early stage, it is now possible to monitor injection moulding machines from anywhere in the world, carry out measurements and adjustments and evaluate results. Details are given of technology available for permanent plant monitoring, early detection of potential faults, and automatic routing of malfunction alarms to control centres. 6 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.791851

Item 117
Plastics and Rubber Weekly
UNIVERSITY CHALLENGE
Volex Powercords makes 13a cords for various high profile OEMs, including manufacturers of computer and office equipment, white goods, brown goods and power tools. Most products are made from injection moulded, flexible PVC. In 1995, batch-to-batch variations started to cause major process problems. The company turned to the Manchester Materials Science Centre which discovered there were differences in the rheology of the materials at high shear rates. Volex found that by sourcing material from just one compounding machine, uniformity was significantly improved. A Teaching Company project with Salford University involved flex testing of a cable/plug attachment, while a project at Manchester Metropolitan University looked into the effect of additives and base polymer on heat dissipation in 13a plugs.
VOLEX POWERCORDS
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.791062

Item 118
Polymer Engineering and Science
40, No.10, Oct.2000, p.2161-74
INVESTIGATION OF WAVELIKE FLOW MARKS IN INJECTION MOULDING: A NEW HYPOTHESIS FOR THE GENERATION MECHANISM
Tredoux L; Satoh I; Kurosaki Y
Tokyo,Institute of Technology; Tokyo,University of Electro-Communications
The results of flow visualisation studies during the injection moulding of PS and HDPE carried out to ascertain the way in which wavelike flow marks generate are used to develop a flow mark generation hypothesis. This hypothesis is based on a mechanism of non-uniform thermal contraction of the polymer in the solidifying layer close behind the contact line. A mathematical model is proposed to account for non-dimensional flow mark curvature in terms of processing conditions, thermal properties of the polymer and mould and the interval of flow mark generation and the implications of the hypothesis are considered. 15 refs.

Item 119
London, June 1999, p.18-27
MONITORING BATCH TO BATCH VARIATION IN INJECTION MOULDING
Kelly A L; Dawson A J; Key A; Woodhead M; Coates P D
Bradford, University
Edited by: Coates P D
(Institute of Materials; UK, Interdisciplinary Research Centre in Polymer Science & Technology; Bradford, University)

Injection moulding studies are reported, using in-process measurements to monitor batch-to-batch variation of a number of production grade polymers. Instrumented high-precision moulding machines (servo electric and servo hydraulic) are used to mould different batches of the same grade of material, while process variables are monitored. These include specific injection pressure integrals, nozzle melt pressure and temperature. Three materials are studied - polyamide, acetal and flexible PVC - all taken from production runs by industrial collaborators. Instrumented high precision electric and servohydraulic moulding machines are used to mould parts inhouse from a number of different material batches. Moulding conditions are kept constant throughout and several process variables are monitored during injection, including melt pressure, melt temperature and viscosity index - a specific pressure integral calculated from primary injection. Part weights are measured to provide an indication of part quality. Results show that in each case, variations between batches produce a measurable effect on part quality. These variations are detected by in process measurements, particularly by viscosity index, which track significant changes in part weight. Several ‘problem’ batches not identified by the compounder’s internal quality checks are detected, and the influence of regrind and a development compound are also clearly identified. No simple relationship between viscosity index and part quality is observed for the limited processing range covered. Overall, the studies show the potential of in process measurements to provide a real time, sensitive indication of process variation. 13 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no. 7899906

Item 120
Injection Molding
8, No.9, Sept.2000, p.94/6
TROUBLE SHOOTER. XXXII. COPING WITH THICK WALLS AND GATES
Hatch R
Prime Alliance

A series of troubleshooting reports from one of the leading on-the-spot problem solvers in the moulding industry is continued, with emphasis on thick-walled parts and gating.

USA
Accession no. 789947

Item 121
Plastics, Rubber and Composites
29, No.1, 2000, p.23-30
IN PROCESS MONITORING OF POLYMER BATCH TO BATCH VARIATION IN INJECTION MOULDING
Kelly A L; Woodhead M; Rose R M; Coates P D
Bradford, University

Injection moulding studies are reported, during which in process measurements are used to monitor batch-to-batch variation of several production grade polymers. Three materials are studied: a polyamide 6, a polyacetal and a flexible PVC, all of which are commercial injection moulding polymers supplied by industrial collaborators. Instrumented high precision electric and servohydraulic moulding machines are used to mould parts inhouse from a number of different material batches. Moulding conditions are kept constant throughout and several process variables are monitored during injection, including melt pressure, melt temperature and viscosity index - a specific pressure integral calculated from primary injection. Part weights are measured to provide an indication of part quality. Results show that in each case, variations between batches produce a measurable effect on part quality. These variations are detected by in process measurements, particularly by viscosity index, which track significant changes in part weight. Several ‘problem’ batches not identified by the compounder’s internal quality checks are detected, and the influence of regrind and a development compound are also clearly identified. No simple relationship between viscosity index and part quality is observed for the limited processing range covered. Overall, the studies show the potential of in process measurements to provide a real time, sensitive indication of process variation. 13 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no. 789906

Item 122
Journal of Injection Molding Technology
4, No.3, Sept. 2000, p.114-9
PROCESS AND TOOLING FACTORS AFFECTING SINK MARKS FOR AMORPHOUS AND CRYSTALLINE RESINS
Tursi D; Bistany S P
Drexel, University; Montell Polyolefins

An investigation was carried out on the effects of material, processing and tooling on sink mark formation during the injection moulding of a semi-crystalline PP and an amorphous polymer (Centrex 811) using a plaque tool
specially built to facilitate changing rib features. Processing variables examined included melt temperature, mould temperature, injection rate, holding pressure, holding time and cooling time. A screening study was performed to determine the most influential factors affecting sink and a response surface study to better define the relationships. The effects of beryllium copper rib-insert material and rib-base radius on sink depth were also evaluated and optical microscopy and DSC were employed to determine crystallisation and molecular orientation differences between plaques having various degrees of sink. 11 refs.

USA
Accession no.789499

Item 123
Canadian Plastics
58, No.9, Sept. 2000, p.33/6
TAKING THE HEAT OFF HOT RUNNER SELECTION
LeGault M

The design and selection of hot runner systems is discussed with reference to return on investments. Dynisco HotRunners recommends using a worksheet to forecast which helps customers work out their ROI for a hot runner by taking into account factors such as material costs, estimated scrap rates, moulding and machine conditions, electricity rates, cycle time savings and costs to run auxiliary equipment. Also recommended are mould flow software programs to optimise channel size, and Mold-Masters’ Internet-based system, Merlin.

INCOE CORP.
NORTH AMERICA
Accession no.788920

Item 124
Injection Molding
8, No.7, July 2000, p.88/92
TROUBLESHOOTER - PART 41: MOLDFILLING ANALYSIS DERAILED
Hatch B
Prime Alliance

This article is part 41 of a series of troubleshooting reports relating to injection moulding. It deals with mould-filling analysis. A case history is included to illustrate the point-in-hand. Details are given of the symptom and cause, the solution, and the result.

USA
Accession no.787871

Item 125
Injection Molding
8, No.7, July 2000, p.72/5
WATER BASICS FOR MOLDS
Tobin B
WJT Associates

In this article the author, who spends his time diagnosing moulding problems, offers his comments on water cooling problems. After an introduction, section headings include: hot and cold pockets, parallel or serial?, restrictions, and finally, flow is everything.

USA
Accession no.787869

Item 126
Injection Molding
8, No.7, July 2000, p.42/8
DESIGN - MATERIALS ANALYST: PART 34
Sepe M
Dickten & Masch Mfg.Co.

This is part 34 of a series of articles designed to help injection moulders understand how a few analytical tools can help diagnose a part failure problem. It deals with the techniques required to carry out a full analysis of a compound, such as gel permeation chromatography (GPC), the oxidation induction time (OIT) test, and energy-dispersive X-ray spectroscopy.

USA
Accession no.787854

Item 127
Plastics and Rubber Weekly
No.1854, 15th Sept.2000, p.10
TEST AND RESOLVE
Gavin P

A troubleshooting approach is recommended for finding the possible causes of ‘short’ mouldings in injection moulding practices. Potential variables which might be causing the short mouldings are discussed, and include: the machine, the material, the tool, the ancillaries, technical staff, machine operator, and ambient conditions. Any of the scenarios described can result in or appear to result in the fault known as ‘a short’, with all seven variables having a direct effect on the finished product. The problem-solving method proposed involves a process of elimination.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.786533

Item 128
Canadian Plastics
58, No.7, July 2000, p.36
VIEW FROM THE FLOOR
Anderton J

This article discusses some problems which may be encountered when injection moulding reinforced thermoplastics. Issues including part ejection, fibre orientation, shrinkage and fibre distribution are examined.

CANADA
Accession no.785044
Item 129

Modern Plastics International
30, No.5, May 2000, p.52/5

INJECTION TECHNOLOGIES CAST
SPOTLIGHT ON LENSES
Moore S

Discussed in this detailed article is the production of optical lenses by injection moulding, with emphasis on the reduction of cycle times and lowering of reject rates - which can still run as high as 50 percent for difficult lenses.

NETSTAL MASCHINEN AG;
SINGAPORE, PRECISION ENGINEERING APPLICATION CENTRE; SINGAPORE
PRODUCTIVITY & STANDARDS BOARD;
SAMSUNG ELECTRONICS CO.LTD.; APPLIED IMAGE GROUP/OPTICS; FERROMATIK; KONICA OPTICS TECHNOLOGY CO.; NIPPON ZEON CO.; TEIJIN BAYER POLYTEC; TEIJIN CHEMICALS;
BAYER AG; ROEHM GMBH; TICONA GMBH;
SUMITOMO HEAVY INDUSTRIES; SODICK CO.
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY;
WESTERN EUROPE
Accession no.780271

Item 130

Molding Systems
58, No.3, June 2000, p.34-9

UNDERSTANDING THERMOPLASTIC PART WARPAGE
Saile R
LNP Engineering Plastics Inc.

Thermoplastic part warpage is one of the most common problems encountered by injection moulders today. Differential shrinkage is the primary cause of internal stresses in the part and can result from a variety of factors. Four areas must be considered: material, part design, tool design and processing.

USA
Accession no.782590

Item 131

Revista de Plasticos Modernos
79, No.523, Jan.2000, p.79-84
Spanish

INFLUENCE OF MOULDING CONDITIONS ON PRODUCTIVITY
Canovi P N
Processing New Technologies Consulting

An examination is made of the influence of processing conditions on productivity in the injection moulding of amorphous and semi-crystalline plastics and on the quality of moulded parts. Processing parameters discussed include mould temperature, injection speed and pressure, holding time and melt temperature.

EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY;
WESTERN EUROPE
Accession no.780265

Item 132

Revista de Plasticos Modernos
79, No.523, Jan.2000, p.34/7
Spanish

INJECTION TEMPERATURE AND POST-MOULD SHRINKAGE OF POLYAMIDES
Radici Group

Relationships between injection temperature in the injection moulding of polyamides and the post-mould shrinkage of moulded parts are discussed. Data are presented for the shrinkage of non-reinforced and glass fibre-reinforced nylon-6,6 moulded at 30, 60 and 85C and of glass fibre-reinforced nylon-6,6 after heat treatment at different temperatures.

EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY;
WESTERN EUROPE
Accession no.779046

Item 133

Canadian Plastics
58, No.5, May 2000, p.27/32

LIVIN’ LARGE
Anderton J

It is explained that moulders moving up to large tonnage injection moulding machines might be in for a few surprises - such as the need to reinforce floors, upgrade cranes for larger moulds, and learn new techniques for filling large moulds successfully. This article looks in detail at what is involved.

VAN DORN DEMAG CORP.; STEPHEN SALES LTD.; ENGEL; HUSKY INJECTION MOLDING SYSTEMS LTD.; UBE MACHINERY INC.; DAIMLERCHRYSLER; TOSHIBA; JSW PLASTICS MACHINERY INC.; HPM CORP.
CANADA
Accession no.775818
Item 135

Plastics Newsletter
No.2, 2000, p.1-4
Chinese

COMMON DEFECTS OF GAS ASSISTED INJECTION MOULDINGS
Zhu T-L; Wang M-J
Dalian, University of Technology
Defects of products moulded by gas-assist injection moulding are analysed. Corresponding methods to solve the problems of moulding defects are discussed in detail. 12 refs.
CHINA
Accession no.775769

Item 136

Plast’21
No.86, Nov.1999, p.58-60
Spanish

MOULD COOLING IN THE INJECTION MOULDING PROCESS
Barcelo A
ASCAMM
The principles of heating and cooling in plastics injection moulding are examined, and aspects of mould design for optimum cooling are discussed.
EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.773242

Item 137

Plastics and Rubber Weekly
No.1831, 7th April 2000, p.11

GOOD MACHINE MAINTENANCE STARTS OUT WITH A FEW BASICS
Dziech D
Ferromatik Milacron
Injection moulding machine maintenance is the subject of this article. A list is presented of nine basic recommendations that will help keep machine-related faults to a minimum. The list includes information on oil contamination, filters, water quality, lubrication, alignment checks, platens, heater bands, and safety devices.
NORTH AMERICA
Accession no.772010

Item 138

Journal of Injection Molding Technology

TROUBLESHOOTING CAVITY TO CAVITY VARIATIONS IN MULTI-CAVITY INJECTION MOULDS
Beaumont J; Ralston J; Shuttlewoth A; Carnovale M
Behrend College; Osram Sylvania Products Inc.
Significant differences are commonly seen between parts moulded in multi-cavity injection moulds. The elimination of these variations is complicated by the large number of variables existing within the mould, the injection moulding process, and the material. A means of isolating and quantifying the primary causes of these variations is presented. By isolating the causes, the moulder can more effectively and efficiently address the differences between parts moulded in different cavities and thereby maximise productivity. 5 refs.
USA
Accession no.771542

Item 139

Journal of Injection Molding Technology
3, No.2, June 1999, p.67-72

ANALYSIS OF HALO EFFECTS ON INJECTION MOULDED PARTS
Dharia A
Solvay Engineered Polymers
The problem of a specific type of surface defect called ‘tiger stripes’ or ‘halos’ on the injection moulded parts of a thermoplastic olefin blend is investigated. First, the method to reproduce such defects on the small parts is described, and then the results of a rheological method to predict materials prone to producing tiger stripes are presented. Results indicate that both the molecular weight and relaxation behaviour are critical determinants. Materials with large molecular weights, as predicted by very high melt viscosity at zero shear rate and short relaxation time, tend to form fewer tiger stripes. 14 refs.
USA
Accession no.771539

Item 140

Journal of Injection Molding Technology
3, No.2, June 1999, p.54-60

ULTRASONIC DETECTION OF FILLER CONCENTRATION IN PLASTIC INJECTION MOULDING
Ibrahim IA; Petersen P F
Cleveland, State University
The demand for precision moulded parts, such as automotive-electrical connectors and electronic circuit holders, is becoming a major segment of the overall plastics market. This new and fast-growing market segment is placing stringent requirements on the performance of polymer materials and is pushing the limits and capabilities of current manufacturing processes and controls. Raw material variations constitute a significant source of problems in processing. Variations caused by contamination, moisture content, regrind levels, lot-to-lot variations, and filler concentration can significantly affect the performance and efficiency of the injection moulding process. In addition, the more stringent quality requirements of today’s products reduce the levels...
of tolerable variations in the material properties. To this end, a proprietary ultrasonic coupling device is developed to allow the use of ultrasonic sensors to detect the variations of material properties prior to injection. 11 refs.

USA
Accession no.771537

Item 141
Polymer Composites
21, No.2, April 2000, p.322-31
OCCURRENCE OF SURFACE ROUGHNESS IN GAS ASSIST INJECTION MOLDED NYLON COMPOSITES
Shih-Jung Liu; Jer-Haur Chang
Chang Gung,University
The surface roughness which may occur during gas-assisted injection moulding was investigated using 15% and 35% glass fibre-filled polyamide-6 composites, moulded using an 80-ton injection moulding machine with a high-pressure nitrogen injection unit. The influence of melt temperature, mould temperature, melt filling speed, short-shot size, gas pressure, and gas injection delay time on the surface quality of the moulded parts was measured using a roughness meter. The surface roughness was mainly due to exposure of the glass fibre, which may have been caused by jetting and irregular flow of the polymer melt during filling. 29 refs.

TAIWAN
Accession no.770553

Item 142
Popular Plastics and Packaging
Special Issue, Suppl.Feb.2000, p.123-8
TECHNOLOGICAL TOOLS FOR PART DESIGN, MOULD DESIGN AND MANUFACTURING OF MOULD
Bolur P C
Power Plastic Consultants
Technological tools in injection moulding are described, with emphasis on part design, mould design and mould manufacture. Aspects covered include failure troubleshooting, steps for part and mould design, technological advancement in mould making, difficulties and benefits of CAE and CAD technology, CAE as a powerful tool for moulder and learning environment, use of CAE, CAD/CAM, global trends in development of plastics parts and mould and assembly and testing of moulds.

INDIA
Accession no.769274

Item 143
Injection Molding
8, No.4, April 2000, p.100/5
PACKING OUT THICK PARTS
Hatch B
Prime Alliance Inc.
This article concerns an acrylic part with a very thick wall in its middle section attached to a fairly thin wall. The moulder was having problems with airless voids in the thick section and cracking where the thick part attached to the thinner wall section. The solution was to fill with injection pressure and raise packing pressure to 1100psi, and raise barrel heats and nozzle temperature to 475F to aid material flow. Although the voids disappeared, the sprue and nozzle orifice remain too small for the volume requirements of the part, which slows cycle time.

USA
Accession no.768547

Item 144
Modern Plastics International
30, No.2, Feb.2000, p.84-6
MACHINE MAINTENANCE: A NEGLECTED PROFIT CENTRE
Snyder M R
Milacron claims that maintenance oversights cause injection moulders at least as many problems as mould and material related issues. Maintenance conducted after a machine breakdown costs three times as much as work done on a preventive basis. The cost of replaced components will be easily recovered by savings from better performance, longer component life, less oil replacement, fewer repairs and more uptime. Computerised maintenance management software is commonly available.

WORLD
Accession no.766818

Item 145
British Plastics and Rubber
Feb.2000, p.27
TURN YOUR TROUBLESHOOTER INTO A MARKSMAN
Maier C
Injection Moulding Troubleshooter is a new programme from training specialist BPTA which aims to make troubleshooting more effective. Training mode concentrates on fundamentals and is the learning part of the programme. Fast Track mode is more a support tool for practical production troubleshooting. Both deal with the same nine major injection moulding faults, but the approach is different.

BPTA
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.765387

Item 146
Injection Molding
8, No.3, March 2000, p.126/9
TROUBLESHOOTER: ACETAL FLOW LINES
Hatch B
Prime Alliance Inc.
A moulder running acetal copolymer was getting some flow lines on a round, flat surface just inside the gate on the part. After watching the process, it was found that the mould temperature was only 140°F, too low to produce glossy, rigid parts from acetal. The data sheet provided by the material supplier suggested mould temperatures from 75 to 180°F. The mould temperature was raised to 180°F and the flow lines disappeared.

USA
Accession no.764508

Item 147
Troy, Mi., 1998, pp.8, 28 cms. 13/3/00
SCREEN-PAC FILTERS FOR INJECTION MOLDING MACHINES. PREVENTS PLUGGED GATES AND ORIFICES
Incoe Corp.

Screen-Pac filters from Incoe Corp. are described with reference to their theory of operation and design features. They are barrel mounted tubular filters which protect tiny mould gates used in runnerless moulds, from plugging and allow recycling of regrind. They have a negligible pressure drop, and can be purged quickly. A list is included which can be used to identify the most appropriate filter for specific injection moulding machines. Technical product data are enclosed for machine mounted versions SPM-600 and 350, and in addition, a case history is included, in which a troubleshooting expert identifies the need for a melt filter to remedy blocked valve gates.

USA
Accession no.764356

Item 148
Injection Molding
8, No.1, Jan.2000, p.94/9
TROUBLESHOOTER - PART 36: BALANCING FAMILY MOLDS
Hatch B
Prime Alliance

This article is part 36 of a series of troubleshooting reports relating to injection moulding. It deals with the problem of balancing family moulds. A case history is included to illustrate the point-in-hand. Details are given of the symptom and cause, the solution, and the result.

USA
Accession no.763284

Item 149
Injection Molding
8, No.2, Feb.2000, p.94/7
TROUBLESHOOTER: COLD MOLDING CREATES CRACKS
Hatch B
Prime Alliance Inc.

A part had been successfully moulded for several years before it began cracking. The material was a polycarbonate/polyester alloy. Lowering the mould temperature below the minimum recommended by the material manufacturer proved to be the cause of the problem.

USA
Accession no.761532

Item 150
Injection Molding
7, No.12, Dec.1999, p.74/8
HOW STRONG ARE YOUR CAVITIES?
Tobin B
WJT Associates

A case history is described of a cavity failure in a two-cavity mould destined for the production of over a million parts. Causes for the breakage are identified, and recommendations are given for the avoidance of similar problems.

USA
Accession no.757691

Item 151
Injection Molding
7, No.12, Dec.1999, p.44/8
MATERIALS ANALYST: PART 27, CONTAMINATION SPRINGS FROM COST PRESSURES
Sepe M
Dickten & Masch Mfg.

The current emphasis on cost reduction can lead to problems with quality, it is suggested, and two examples of injection moulded parts are given which highlight this. They both involve contamination of raw materials when sourced with price as the deciding factor, and both illustrated that the longer term costs of rectifying problems with contamination in terms of the possibility of down times and failure analysis outweigh any potential raw materials savings.

USA
Accession no.757685

Item 152
London, 9th-10th Nov.1998, paper 13
INFLUENCE OF PIGMENTS ON THE DIMENSIONAL STABILITY OF MOULDED PLATES
Tomlins P E; Banyard J; Butler B; Lord G
UK,National Physical Laboratory
(Rapra Technology Ltd.)

Many of the vibrantly coloured inorganic pigments prized for their colour fastness and thermal stability contain heavy metals such as cadmium and are, or have been, phased out because of their environmental unacceptability. Some of the organic pigment replacements are renowned
for causing problems of dimensional instability in mouldings, particularly those manufactured from polyolefins. The influence that pigments have on the in-plane shrinkage and warpage and out-of-plane distortion of a plate moulding manufactured from HDPE is assessed. Variables such as plate thickness and post-moulding treatment are considered as well as colour.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no.757025

Item 153

Macplas
24, No.211, Sept.1999, p.71-3

Italian

PITFALLS IN THE DESIGN OF MOULDED PARTS
Spann J; Belski V
C-Mold Inc.; Viadelo

Some common problems occurring in the design of moulds and plastics parts for injection moulding are examined, and the value of computer simulation in design processes is discussed.

EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; USA; WESTERN EUROPE

Accession no.754650

Item 154

Kunststoffe Plast Europe
89, No.11, Nov.1999, p.13-4

MOULD TECHNOLOGY FOR THE AIRMOULD CONTOUR PROCESS
Jaroschek C; Hunold M; Blomeke C

With highly ribbed injection moulded parts in particular, sink marks on the visible side are often a problem. By using a special mould technology in airmould contour injection moulding, this risk can be eliminated. The process utilises gas pressure exerted on the surface of the product. In this way, pressure can be applied over a large area of melt while it is still plastic. If the ribbed reverse side of the moulding is chosen as the surface on which the pressure acts, a deliberate sink mark can be produced in this way.

BATTENFELD AG
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.754264

Item 155

Injection Molding
7, No.11, Nov.1999, p.116-8

TROUBLESHOOTER, PART 35: GLASS-FILLED NYLON PARTS
Hatch B
Prime Alliance

This issue of The Troubleshooter deals with a glass-filled nylon 6,6 part moulded using an eight-cavity cold runner tool. Parts produced had a dull surface finish and had a slow cycle time. Problems discovered on inspection of the mould and analysis of the moulding cycle, included flow path restrictions, gating into thin sections, a small main runner, no venting, high injection pressure and a cold mould. By opening up the flow path, venting the tool and running at a lower temperature, glossy parts, with resin-rich surfaces and shorter moulding cycles was achieved. Particular considerations relating to the injection moulding of glass-filled materials, are discussed.

USA

Accession no.752975

Item 156

Composites Science and Technology
59, No.12, 1999, p.1923-31

WARPAGE OF CORNERS IN THE INJECTION MOULDING OF SHORT FIBRE-REINFORCED THERMOPLASTICS
Mlekusch B
Leoben, University

Short fibre-reinforced thermoplastics (SFRT) show significantly greater corner-warpage in injection moulding compared with non-reinforced systems. It is suggested that this additional warpage effect is attributed to the anisotropy of the material. According to the microstructure of SFRT, which usually shows a boundary-core-boundary layer structure, a multi-layer model is used for calculating the thermoelastic problem of cooling a cylindrical segment. A generalised plane-strain state is assumed. The model predicts the full deformation state as well as the residual stresses. For each single layer an orthotropic constitutive equation is used. The material data are calculated from images of polished cross-sections together with a micromechanical model. The model predictions are compared with the warpage of a specially designed experimental component. This comparison shows that the additional warpage observed for short fibre-reinforced materials can be attributed to the anisotropy of the material. 11 refs.

AUSTRIA; WESTERN EUROPE

Accession no.751375

Item 157

Kunststoffe Plast Europe
89, No.7, July 1999, p.11-13

A VOIDANCE OF SURFACE DEFECTS IN GAS-ASSIST INJECTION MOULDING
von Riewel A; Eyerer P; Knoblauch M
Fraunhofer-Institut fuer Chemische Technologie

Characteristic surface defects in gas-assisted injection moulding are described, including changeover marks, gas bubble marks, sink marks as a result of melt accumulation and fingering effect problems. Methods for avoiding these defects are recommended. 11 refs. (German version of this paper, which includes graphs and tables, is on p.44/8)
Item 158

Injection Molding
7, No.9, Sept.1999, p.106/11
TROUBLESHOOTER PART 34: SINKS INSIDE A MOULDED PLUG
Hatch B
Prime Alliance Inc.

A moulder was having trouble with sink marks on the interior wall of a nylon plug. It was found that the small nozzle orifice was forcing the moulder to run high melt temperatures, and the uniform runner dimensions were causing pressure losses and flow restrictions. Inadequate cooling in the core of the mould was also adding to the problems. It was recommended that jumpers were removed from mould cooling lines and cascade core bubblers be replaced with baffle-type bubblers. Part venting should be increased and runner venting added. The main runner and feed opening in the sprue bushing should be enlarged.

USA
Accession no.747193

Item 159

Plast' 21
No.81, May 1999, p.31-2
Spanish
DETECTION OF COMMON DESIGN ERRORS
Pastorinni N

The causes of common errors in the design of plastics products are discussed, with particular reference to parts produced by injection moulding.
EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.745849

Item 160

Revista de Plasticos Modernos
77, No.514, April 1999, p.378-83
Spanish
SOLVING PROBLEMS IN THE INJECTION MOULDING OF PARTS FOR DOMESTIC APPLIANCES
Gomez J L; Alonso J R; Campo J J; Martinez R
Gaiker,Centro Tecnologico

Results are presented of a computer simulation study undertaken by Gaiker to optimise the design and injection mouldability of a PS tray for use in refrigerators produced by Fagor Electrodomesticos.
FAGOR ELECTRODOMESTICOS
EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.745765

Item 161

Metallic Pigments in Polymers
Wheeler I

The purpose of this book is to bridge the technology gap that has developed over the last 20 years by providing a comprehensive account of the nature, manufacture, formulation and applications of the diverse metallic pigments commercially available today. Whilst the text concentrates on direct pigmentation of polymers there are also two chapters on metal pigment coatings for polymer substrates. In addition to the familiar colouristic applications there is a chapter on the many, often novel, functional applications in which colour is either accidental or irrelevant.

Accession no.743913

Item 162

Revue Generale des Caoutchoucs et Plastiques
No.777, May 1999, p.39-45
French
DESIGN OF INJECTION MOULDED PARTS. I.
Hasenauer J; Kuper D; Laumeyer J E
Du Pont de Nemours E.I.,& Co.Inc.

Aspects of design and materials selection for injection moulded non-reinforced and fibre-reinforced thermoplastic parts are discussed. The influence of design features such as wall thickness and ribs and of injection moulding conditions on the properties of mouldings is examined.
USA
Accession no.742608

Item 163

Injection Molding
7, No.7, July 1999, p.42/5
MATERIALS ANALYSIS. XXII. STRESS CRACKING: HOW TO AVOID THIS SILENT KILLER. I
Sepe M
Dickten & Masch Mfg.Co.

Stress cracking is one of the most common problems associated with field failures in plastic products. One estimate from Rapra Technology states that in almost a third of all failed plastic applications the problem is stress cracking. Other anecdotal data from experienced plastic part designers tends to echo this testimony. It is illustrated how it is so difficult to predict when this problem will occur, and why is it so difficult to diagnose when it does present itself.
RAPRA TECHNOLOGY LTD.
USA
Accession no.741798

Item 164

Injection Molding
7, No.6, June 1999, p.86/93
GUIDE TO COLOUR TROUBLESHOOTING
Angel G
Hanna M.A., Color Technical Center

Colouring plastics at the press is one of the most functional, value added features a moulder can impart to a moulded product. Self-colouring not only improves aesthetic properties, it can also improve UV stability and make processing easier. Adding colour at the machine is also almost always less expensive than purchasing precoloured material from a supplier. There is just one problem: once the colour system has been incorporated into the polymer matrix, it becomes an integral part of the material and may alter its engineering properties as well as its processability. As a result, it is important to be aware of some of the common problems involved with melt colouring plastics and how to avoid them. Generally, aesthetic flaws can be attributed to three different causes: equipment, moulding and design/formulation. Details are given.

USA
Accession no. 741686

Item 165
Injection Molding
7, No. 6, June 1999, p. 78-80
TROUBLESHOOTER. XXXI. LESSON IN MATERIAL SUBSTITUTION
Hatch R
Prime Alliance Inc.

The continuation of a series of troubleshooting reports from one of the leading on-the-spot problem solvers in the moulding industry. The optical quality problems encountered when injection moulding an acrylic medical device, following a material grade change, are described.

USA
Accession no. 741685

Item 166
Injection Molding
7, No. 6, June 1999, p. 39/43
SINK MARKS IN NOMINAL WALLS
Beall G
Beall G., Plastics Ltd.

The importance of an injection moulded part’s nominal wall has already been established. Selecting the optimum wall thickness and maintaining that thickness throughout the part have also been reviewed. Emphasis is placed on sink marks in the nominal wall. Sink marks are an inherent part of the injection moulding process. They are the topic of endless debates among marketing, quality assurance, product designers and injection moulding suppliers. The causes of sink marks, their indication of stress and minimisation of sink marks are discussed.

USA
Accession no. 741664

Item 167
Kunststoffe Plast Europe
89, No. 5, 1999, p. 8
PREVENTION INSTEAD OF STOPPAGES
Schwab E

A new software program has been developed by EuroKMI, (Plastics Machinery Institute for Europe GmbH) called Win-IPS. It is designed to facilitate the implementation of and use of preventative maintenance planning and control for injection moulding machines. At specified intervals, an inspection order with instructions for the individual machines and zones is automatically initiated, and each inspection is documented according to ISO 9000, QS 9000 and VDA 6.1. Machine availability is calculated for each machine, and any problem areas can be identified. The core data for the software are listed. (Translated from Kunststoffe 89 (1999) 5, pp. 48)

EUROKMI GMBH
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no. 739920

Item 168
Injection Molding
7, No. 5, May 1999, p. 54/60
DESIGN - MATERIALS ANALYST: PART 20 - FINDING PROBLEMS IN HOT RUNNERS
Sepe M
Dickten & Masch Mfg.

This is part 20 of a series of articles designed to help injection moulders understand how a few analytical tools can help diagnose a part failure problem. It deals with finding problems in hot runners. Two case histories are included, one entitled “the case of the sticky residue” and the other “the case of the plugged gate”. Full details of the problems and the solutions are presented.

USA
Accession no. 737617

Item 169
Plastverarbeiter
48, No. 6, 1997, p. 64
German
SMALL, SMALLER, AT ITS SMALLEST
Spork E
Guenther Heisskanaltechnik

This article is part II in a series of six about injection moulding small components and covers narrow interspacing of cavities and the problems linked with it. During the set-up of hot channel systems injection moulding of small components requires other criteria than articles with larger dimensions or weights. By using moulding examples from screw injection moulding, medical and laboratory technology and devices produced by the firms Guenther Heisskanaltechnik from
Frankenberg, Schosser from Knittlingen and Boehringer Mannheim GmbH, the author shows what the user has to look out for.

BOEHRINGER MANNHEIM GMBH
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.735816

Item 170
INJECTION MOULDING OF SILASTIC LIQUID SILICONE RUBBER
Dow Corning STI Ltd.

Fundamental guidelines are given for the injection moulding of Silastic liquid silicone rubber, (LSR) from Dow Corning. The characteristics and injection moulding of LSR are discussed, followed by the principles of mould design for LSR, criteria for machine selection, production and troubleshooting.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.735011

Item 171
Mouldmaking '95. Conference proceedings.
Solihull, 2nd Feb.1995, paper 7. 83
PREDICTING MOULD FILLING FOR MOULD DESIGN
Leo V
Solvay & Cie-SA
(BPF; Gauge & Toolmakers’ Assn.)

Flow analysis software is about twenty years old. Tremendous progress in the computer power-to-cost ratio, as well as a better understanding of injection moulding, have led to the present situation where it is now difficult to justify not using this sort of technology when designing a complex tool. The moulding industry itself has considerably and the current most successful stories invariably involve a concurrent engineering approach, where the part design, the moulding tool definition and the process optimisation itself are simultaneously addressed at the early stage of the project. Dimensional, as well as mechanical, properties of the part are a direct consequence of the material processing history. The process involves different stages which were addressed separately in the past, reflecting the development of the software technology. Today, the only correct approach is a global one, where the moulding process is regarded as a complex physical problem involving very transient and strongly coupled thermal and rheological phenomena. Certainly, when talking about mould filling, the concept should be extended to the end of the packing phase, considering that during this pressure-controlled stage a significant amount of melt is still entering the cavity. Some of the essentials of the physics involved in the process are reviewed, in order to present some of the capabilities of the software, as well as some of the limitations.

Accession no.734277

Item 172
INJECTION MOULDING OF SILASTIC LIQUID SILICONE RUBBER
Dow Corning STI Ltd.

The injection moulding of liquid silicone rubber is discussed, together with details of the technological advantages of Silastic LSR, and its potential applications. Characteristics and injection moulding are outlined, followed by principles of mould design for LSR, criteria for machine selection, details of two-component injection moulding and injection moulding of one-component HCR Silastic RapidCure, and a section on troubleshooting.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.734383

Item 173
New York City, 2nd-6th May 1999, p.2959-63. 012
EFFICIENT COPING WITH PRODUCTION BREAKDOWNS USING KNOWLEDGE-BASE APPROACH
Bluvband Z; Shavit A
ALD
(SPE)

Injection moulding product quality is affected by many process parameters. The usual troubleshooting procedures suggest a list of possible corrective actions for each potential failure of a product, without taking into account possible side effects. There is one optimal corrective action, leading to the most stable process and product quality. A methodology that helps the operator to select the most efficient corrective action is presented, using knowledge-base approach, relying on a Y-shape matrix (failure-cause-solution) with theoretical rules and practical statistics. 7 refs.

ISRAEL
Accession no.734277

Item 174
New York City, 2nd-6th May, 1999, p.1045-7.012
PROPER UTILIZATION OF POROUS MOLD STEEL TO SOLVE VENTING PROBLEMS
Bowen R
International Mold Steel Inc.
(SPE)

Porous mould steel, with 25vol% porosity, is manufactured by sintering stainless steel powder. Three grades are available, with average pore sizes of 3, 7, or 20 micrometres. Benefits from the use of inserts of this steel in injection moulding moulds, in addition to self-venting, include: reductions in injection pressure, cycle times, shots size and scrap rates; elimination of flow lines, short shots, and
material burning. Practical advice is given on the design and use of porous steel inserts.

USA
Accession no.734093

**Item 175**
New York City, 2nd-6th May 1999, p.3665-9. 012

**COOLING RATE EFFECTS ON SHRINKAGE**
Resler A E
Behrend College
(SPE)

A study on how the cooling rate can produce variations in a plastic material’s pressure-volume-temperature (PVT) characteristics, which are used in creating shrinkage data for injection moulding simulation programs, is presented. Most available PVT data are created using a cooling rate of only 3 deg.C/min. The problem with this data when used to predict shrinkage is that during injection moulding, materials experience much faster cooling rates. The possibility of these variations in cooling rates significantly affecting shrinkage values used by mould filling analyses is discussed. 5 refs.

USA
Accession no.733980

**Item 176**

**Plastics Technology**
45, No.3, March 1999, p.58-62

**WHAT YOU CAN LEARN FROM SHOT PROFILES**
McAlister B
Branden Technologies Inc.

It is explained that, in injection moulding, there is no better tool than the electronic “signature” provided by process-monitoring curves of cavity pressure and other variables. The article provides seven real-world moulding case-histories, as revealed through shot profiles. They are: correcting cold slugs, hard-to-hit transfer position, an “incapable” machine, the case of the vanishing cushion, inconsistent screw starting position, controlling cavity pressure with hydraulic pressure, and the case for robots.

VISION PLASTICS; TRIQUEST PRECISION PLASTICS; STATISTICAL PLASTICS CORP.

USA
Accession no.733800

**Item 177**
New York City, 2nd-6th May, 1999, p.723-7. 012

**UTILIZING AN ENGINEERING RESIN SUPPLIER’S TECHNICAL SUPPORT**
Jaarsma F C
Ticona LLC
(SPE)

Advice is provided to injection moulding companies on the technical assistance which can be provided by polymer suppliers. Issues discussed include making the initial contact with the supplier, published and non-published literature, computer aided engineering services, part failure analysis, testing and laboratory analysis, moulding trials, and training seminars.

USA
Accession no.732986

**Item 178**
New York City, 2nd-6th May, 1999, p.675-9. 012

**INJECTION MOLD’S PROBLEMS SOLVED BY CAE ANALYSIS**
Kalnin F A; Zluhan G P
Brazil, Centro de Mecanica de Precisao de Joinville
(SPE)

The benefits of commercially available computer aided engineering software in the design of injection moulded parts are discussed, and demonstrated using two industrial case studies. 4 refs.

BRAZIL
Accession no.732976

**Item 179**
New York City, 2nd-6th May, 1999, p.532-8. 012

**ANALYSIS OF HALO EFFECTS ON INJECTION MOLDED PARTS**
Dharia A
Solvay Engineered Polymers
(SPE)

The surface defect called “tiger stripes” or “halos”, seen on automotive components which are injection moulded using blends of polypropylene and ethylene copolymers, consists of alternating concentric surface bands of high and low gloss. The influence of injection speed, mould temperature, back pressure, melt temperature, and injection pressure on the incidence of this fault was investigated. It was concluded that the defect were caused by melt flow instability, and the inability of the melt to recover from the stress changes at the cooling flow front. 14 refs.

USA
Accession no.732950

**Item 180**
New York City, 2nd-6th May, 1999, p.486-90. 012

**OPTIMIZATION OF THE WELD LINE IN INJECTION MOULDING VIA AN EXPERIMENTAL DESIGN APPROACH**
Chang T C; Faison E
Iowa State University
(SPE)
The Taguchi method was used to design an experimental investigation into the influence of melt and mould temperatures, injection and hold pressures, cooling and holding times, and back pressure on the weld line width and tensile impact properties of polyethylene injection moulded dog-bone bars. The width of the weld line was most affected by the melt temperature, and to a lesser degree by mould temperature and injection pressure. The tensile impact properties were influenced most by the mould temperature, followed by melt temperature, injection pressure and cooling time. 17 refs.

USA
Accession no.732941

Item 181
New York City, 2nd-6th May,1999, p.461-6. 012
TROUBLE SHOOTING CAVITY TO CAVITY VARIATIONS IN MULTICAVITY INJECTION MOLDS
Beaumont J; Ralston J; Shuttleworth A; Carnovale M Pennsylvania,State Erie; Osram Sylvania Products Inc. (SPE)
A procedure for isolating and quantifying the causes of variation from cavity to cavity in multi-cavity injection moulds was developed. Three causes were considered: flow induced imbalances in geometrically balanced runners; dimensional variations in the mould; and cooling effects. The weights of short shot moulded parts from each cavity were compared, and it was concluded that short-filling to 80% was better than the common industrial practice of filling to 95% when determining and solving mould imbalances. 5 refs.

USA
Accession no.732936

Item 182
Injection Molding
7, No.4, April 1999, p.117-8
TROUBLESHOOTER - PART 30: A LESSON IN SHEAR AND DIAMETERS
Hatch B
Prime Alliance
This article is part 30 of a series of troubleshooting reports relating to injection moulding. It deals with the case of a torch housing made from ABS which the moulder could not consistently fill out, and with which the moulder was experiencing a lot of rejects. Details are given of the symptom and cause, the solution, and the result after changes were made.

USA
Accession no.729341

Item 183
Injection Molding
7, No.4, April 1999, p.92-4

Trouble Shooter - Part 30: A Lesson in Shear and Diameters
Hatch B
Prime Alliance

This article is part 30 of a series of troubleshooting reports relating to injection moulding. It deals with the case of a torch housing made from ABS which the moulder could not consistently fill out, and with which the moulder was experiencing a lot of rejects. Details are given of the symptom and cause, the solution, and the result after changes were made.

USA
Accession no.729341

Item 184
Injection Molding
7, No.4, April 1999, p.58/64
DESIGN - MATERIALS ANALYST: PART 19
Sepe M
Dickten & Masch Mfg.
This is part 19 of a series of articles designed to help injection moulders understand how a few analytical tools can help diagnose a part failure problem. It deals with the particular case of exterior parts moulded from flexible PVC that developed black stains after a relatively short period of time exposed to the elements. Full details of the problem and the solution are presented.

USA
Accession no.729317

Item 185
Journal of Injection Molding Technology
2, No.4, Dec.1998, p.184-91
DEVELOPMENT OF A METHODOLOGY FOR DEFECT REDUCTION IN INJECTION MOULDING USING PROCESS SIMULATIONS. PART II. A MULTI-FACTOR DESIGN OF EXPERIMENTS APPROACH
Patel S A; Mallick P K
Michigan,University
The procedures developed in paper 1 are extended to find the effects of seven process variables on nine faults. Process variables are inlet melt temperature, coolant temperature, fill time, ejection temperature, fill/pack switchover by percentage of stroke, hold time and injection rate. The defects were burn marks, sink marks, warpage, shrinkage, degradation, short shots, flashing, weld lines and air traps. Evaluation and selection of the optimum solution is explained. 4 refs.

USA
Accession no.729193

Item 186
International Polymer Processing
14, No.1, March 1999, p.3-9
POLYMER PROCESSING PROBLEMS FROM NON-RHEOLOGICAL CAUSES

Nakajima N
Akrnon, University

Problems and cause considered include (a) gels or fish eyes resulting from non-uniform distribution of giant molecules, incomplete melting during extrusion, crosslinking in the extruder or contamination of machinery by material from a previous operation, (b) non-uniform PP filaments coming from spinnerettes, (c) microscopic foreign objects causing stress cracking in HDPE bottles, caused by changing grade of polymer to reduce costs and overcome by polymerisation in dedicated reactors for special objects, e.g. video and audio discs, (d) smear patterns in injection moulded fibre-filled polymers attributed to either non-uniform distribution of fibres or weld lines, (e) warping of blends resulting from immiscibility, (f) existence of pure polymer domains in PVC/NBR blends caused by restricted miscibility range, (g) inconsistent processing due to morphological effects in PVC and ABS, (h) reduced flow rate in HDPE caused by branching, (i) variation in weight and length of polyoxymethylene extrudates resulting from degradation and content of gas bubbles, (j) non-uniformity of plasticised PVC resulting from melting and reforming of crystallites during production, (k) unexplainable brittleness in rigid PVC containing small amounts of plasticiser, (l) difficulties in explaining variations in processing of successive batches of PTFE, and (m) difficulties moulding and extruding UHMWPE because it acts as a rubber rather than a true thermoplastic. Citations range from 1958 to 1986. 12 refs.

USA
Accession no.728751

Item 187
Kunststoffe Synthetics
German
RECEPTOR MIXTURE DECIDES THE QUALITY
Klamann J-D

The article forms part of a series on PVC processing. This particular article examines injection moulding PVC, where shaping is down to the processor, not the plastic producer, as is often the case in other plastics. In western Europe 290,000 tonnes of PVC are injection moulded each year, representing 6% of the total PVC used in Europe. Two thirds is solid PVC, of which most is used as fittings for the pipe industry. PVC does not have a defined melting point and is better suited to extrusion and calendering. A stabilising of the rheology is needed to make it suitable for injection moulding, lest such problems as deficient surface tolerances, delamination in oven-testing and incomplete shape-forming are encountered. In western Europe stabilisation is based on lead or zinc. Fittings are made mostly from granules in order to keep homogeneity and equal dispersions. The article also examines the importance of choosing appropriate external lubricants for good shape forming. Calcium soap can be used, though this can result in delamination. This can be traced to the high viscosity of the melted calcium stearate. Polyethylenes such as Loxiol G70S are also used as external lubricants. Zinc can be used for internal and external lubrication, whereas lead is for internal. Dry blend lead is particularly used in thin-walled fittings for drainage and sewage pipes. Only completely homogenous systems guarantee results, hence the use of granules. In receptors internal lubricants such as Loxiol G60 are used, whereas Loxiol G32 is used externally. The USA and Japan lead the use of PVC in injection moulding. In the USA, PVC/ABS blends are common, using 50-70% ABS and zinc as a lubricant. ABS increases the impact resistance and durability when heat formed, and PVC reduces the flammability. Soft injection moulded PVC is no longer a matter of interest in western Europe. Calcium-zinc stabiliser is an attractively priced and ever more commonly used additive in soft PVC injection moulding. It has no toxic side effects and has been used in the medical sector for decades.

HENKEL KGAA
WESTERN EUROPE-GENERAL
Accession no.728603

Item 188
Molding Systems
57, No.4, April 1999, p.34-8
PAY ATTENTION TO MAINTENANCE BASICS
Hilt R
Milacron Inc.

This article discusses how to eliminate the eight chief causes of injection moulding machine downtime. These are oil cleanliness, control cabinet filters, water quality, toggle link lubrication, machine levelling, platen squareness, heater band care and safety equipment.

USA
Accession no.726031

Item 189
Plastics Technology
44, No.12, Nov.1998, p.59/62
CLEAN COOLING WATER CLEARS UP MOLDING PROBLEMS
De Gaspari J

In this article it is explained that raising the quality of the cooling water in injection moulding systems translates into higher quality moulded parts. It examines closed-loop cooling, which provides tight temperature control that in turn provides an improvement to moulding consistency. A closed-loop cooling system (such as that employed by Windsor Mold of the USA, an automotive injection moulder) is fully described.

WINDSOR MOLD; AUTOPLAS; PRECISION AUTOMOTIVE PLASTICS; ENGINEERED
**PROCESS COOLING SYSTEMS**
USA
Accession no.723869

**Item 190**
*Injection Molding*
7, No.1, Jan.1999, p.92-5
**TROUBLESHOOTER - PART 29: THE SECRETS OF HOT RUNNER MOLDS**
Hatch B
Prime Alliance

This article is part 29 of a series of troubleshooting reports relating to injection moulding. It deals with hot runner moulding problems. A case history is included where a moulded part, a storage box, is of poor appearance. Details are given of the problem, the solution, and the result.

MOLD-MASTERS; HUSKY; D-M-E
USA
Accession no.723639

**Item 191**
*Injection Molding*
7, No.3, March 1999, p.77
**MELT FILTER PAYS OFF FOR VALVE GATE**
Tobin B

Problems with valve gates on injection moulding machines are discussed. A case history is presented in which a company producing milk crates from low melt-index-toughened polypropylene with some recycled content experienced clogging, and leaking valve gates in the mould and breaking valve pins. The problem was solved by the use of nozzle filters.

USA
Accession no.723167

**Item 192**
*Plastverarbeiter*
48, No.2, March 1997, p.74-6
**PROBLEMS WITH PROCESSING THERMOPLASTIC POLYURETHANES**
Endres E; Zipp O; Kallweit J-H
Elastogran GmbH; Osnabrueck,Fachhochschule

This article forms Part II of a study on thermoplastic polyurethanes (TPUs), relating particularly to TPU absorption of humidity. In Part I (Plastverarbeiter 46, no.10, p.94 ff.) basic principles were explained for measuring permeation and absorption processes in TPUs. Also examined was the influence of environmental parameters on the absorption of humidity by TPU granules. The present Part II deals with which chemical and physical structures in TPUs influence hydrophilic properties and why absorbed humidity leads to increased material damage during processing. The examination includes comment on rheometrical measurements performed on injection moulding machines.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.721847

**Item 193**
*Kunststoff Journal*
**CHALLENGE TO TOOL FAULTS**
Thienel P; Hoster B; Kuerten C
Kunststoff-Institut Fur Die Mitt Wirts NRW GmbH

Damage to tools when used for thermosetting materials is often expensive and difficult to put right. The K.I.M.W. Plastics Institute at Ludenscheid, Germany is producing the FAAS program (fault analysis and remedy system), based on the actual experience of processors, raw material manufacturers and machine manufacturers.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.721512

**Item 194**
*Molding Systems*
57, No.2, Feb.1999, p.46-7
**CONTROLLER HELPS ENSURE TOOL QUALITY**
Tycos Tool makes injection moulds for large automotive parts. To ensure tool quality, the company likes to fully test its moulds before shipment to its customers. The Gammaflux Series 9500 hot-runner temperature controller provides Tycos with the detailed tool analyses it needs. The controller tests the performance of the heaters and thermocouples in the hot-runner system and diagnoses failing heaters and wiring problems. The software completes a performance analysis of the hot-runner manifold.

TYCOS TOOL
CANADA
Accession no.721104

**Item 195**
*Polymer Engineering and Science*
38, No.12, Dec.1998, p.2020-8
**WELD LINE MORPHOLOGY OF INJECTION MOULDED POLYPROPYLENE**
Mielewski D F; Bauer D R; Schmitz P J; van Oene H
Ford Research Laboratory

The goal of this work was to identify the cause of weld line weakness in PP systems. The morphology of weld lines in a high molecular weight PP (Profax 6823 from Montell Polyolefins Inc) were studied. It was found that the PP contained a hindered phenolic antioxidant additive that was not soluble in the polymer at the standard...
processing conditions. TEM pictures revealed the additive existing as a dispersed phase in the bulk polymer. Even though very small concentrations of this additive are normally used (0.1 to 0.5%), large quantities were found at weld lines in a band approximately 100 nm wide and penetrating about 10 micrometres into the surface of the part, hindering strength development at the weld line. X-ray photoelectron spectroscopy results confirm enhanced concentrations of antioxidant on the flow front and mould wall surface of short shot samples. The mechanical properties (Izod impact, TS) are measured for samples moulded at various processing conditions, varying amounts of antioxidant additive and with and without weld lines. The results are consistent with the presence of the additive playing a key role in strength development at PP weld lines. Impact strength is reduced 50-75% by the additive. 12 refs.

USA

Accession no.718718

Item 196
Plastverarbeiter
46, No.4, April 1995, p.92-97
German
SURFACE DEFECTS IN THERMOPLASTIC MOULDINGS, PART I
Thienel P; Broer E; Vitz Ch
The authors present an overview of the most frequently occurring types of surface defects in injection-moulded products. The defects are described with regard to their external appearance, their physical cause is elucidated, and a few possible ways of remedying them are given. Articles from this journal can be requested for translation by subscribers to the Rapra produced International Polymer Science and Technology.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.716847

Item 197
Injection Molding
6, No.11, Nov.1998, p.119/22
MANUFACTURING - TROUBLESHOOTER
PART 27: MOLD FILL PROGRAMS DO A PRETTY GOOD JOB
Hatch B
Prime Alliance
This article is part 27 of a series of troubleshooting reports relating to injection moulding. It deals with the case of parts made from polycarbonate where a swirl had developed at the end of the fill. The problem was found to be related to the flow, and the solution was to optimise runner sizes for better flow. Full details are given.
EMPLAST
USA
Accession no.711950

Item 198
Injection Molding
6, No.11, Nov.1998, p.103/8
MANUFACTURING - THE BASICS OF COLOR: PART II
This is the second part of a two-part series where colour experts from two US companies share fundamental knowledge about colour in moulded parts, to help designers and moulders avoid problems. The first part dealt with standards and metamerism. This article focuses on the issues of base resin and colour.
TEKNOR COLOR CO.; MINOLTA CORP.
USA
Accession no.711947

Item 199
Injection Molding
6, No.11, Nov.1998, p.54/8
DESIGN - MATERIALS ANALYST: PART 15 - DISTINGUISHING AMONG FILLERS
Sepe M
Dickten & Masch Mfg.
This is part 15 of a series of articles designed to help injection moulders understand how a few analytical tools can help diagnose a part failure problem. It deals with two types of “detective work”: identifying the composition of an unknown material, the properties of which would be useful in a new product, and determining if a formulation of a known material had changed when products start to fail or perform uncharacteristically. Two case-histories are included to illustrate the points-in-hand.
USA
Accession no.711929

Item 200
Kunststoffe Plast Europe
85, No.11, Nov.1995, p.15-6
AVOIDING FAULTS ON MOULDINGS - WELD LINES, SHRINKAGE AND DISTORTION
Michaeli W; Wisinger G; Galuschka S; Zachert J
RWTH; Petra GmbH Paul Braun; Widia GmbH; Institut fuer Kunststoffverarbeitung
Computer-assisted mould design is shown to be beneficial in realising and eliminating weak spots in the moulding early in the design process. Examples are given which describe the benefits and auxiliaries which are available to the mould designer, with particular reference to the CAdmould-3D program. Consideration is given to the selective location of weld lines, the avoidance of weld lines via the process technology, and the source of shrinkage and distortion in a 24-point edge connector made of glass-reinforced PBTP. 3 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.709862
TROUBLESHOOTER PART 28: POLYCARBONATE MOLDING PROBLEMS
Hatch B
Prime Alliance

This article is part 28 of a series of troubleshooting reports relating to injection moulding. It deals with appearance difficulties (weld lines) when moulding a polycarbonate part. A case history is included to illustrate the point-in-hand.
USA
Accession no.706332

MANUFACTURING - WHY THIS PART WON'T RUN IN THAT MACHINE
Tobin B

In this article, the author solves a common injection moulding shop floor manufacturing problem - why a part will run in one machine but not in another. He does this with the help of a case history illustrating the point-in-hand.
WJT ASSOCIATES
USA
Accession no.706331

MATERIALS ANALYST: PART 16 - FOLLOWING THE PATH OF A FAILED PART
Sepe M
Dickten & Masch MFG

This is part 16 of a series of articles designed to help injection moulders understand how a few analytical tools can help diagnose a part failure problem. It deals with how amorphous and semi-crystalline materials handle fatigue. A case history is included to illustrate the point-in-hand.
USA
Accession no.706312

Kunststoffe Plast Europe
88, No.11, Nov.1998, p.10-1; p.2006-8
English; German

TO THE POINT
Nachtsheim E

Many years of practical experience, sometimes gained at great expense, have shown that most errors in mould design can be attributed to gating. Expensive corrections can be avoided by systematically working through a design checklist prior to mould conception. Experienced professionals will certainly be familiar with and generally heed all the design aspects discussed. However, careless errors are still made in the day-to-day routine of production. These could be reduced by carefully working through the list of questions given. Any one of these questions answered with ‘no’ can result in expensive post-modifications to the mould. The checklist can also be incorporated into a failure mode and effects analysis for mould design. The individual problems are explained.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.705893

TROUBLESHOOTING FLAT, FULL PARTS
Hatch R
Prime Alliance Inc.

Problems in mould filling often result in cosmetic defects. Prime Alliance, a US-based resin distributor, gives some advice on keeping parts flat and full.
USA
Accession no.704754

LASERS PROTECT MOULDS FROM DAMAGE
MMT SRL
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.704753

MOUNTING LOCATIONS FOR MEASURING CAVITY PRESSURE
Kirkland C
Victorinox of Ibach, Switzerland, the famous maker of the Swiss Army knife, and Kistler Instrumente have enjoyed a co-operative customer/supplier relationship for more than 20 years. The very first Kistler sensor and charge amplifier used at Victorinox are still in use. Originally, Kistler’s systems solved machine cycle consistency problems and subsequent part quality troubles in insert moulding the nylon cores of the knives around the manually inserted knife blades at Victorinox. Based on its initial successes, Victorinox wanted to mould its knife shells, but the 6 mm diameter Kistler transducers available at the time were too big. As a result, Victorinox switched to indirect (behind-the-pin) force sensors using smaller, 2 mm diameter pins. Since then, Victorinox Kistler have developed direct 2.5 mm sensors. Victorinox and Kistler have subsequently developed a complex method to test in-mould performance of direct and indirect cavity pressure sensors. Details are given.

VICTORINOX; KISTLER INSTRUMENTE AG SWITZERLAND; WESTERN EUROPE
Accession no.704749

Item 208
Injection Moulding International
3, No.6, Oct./Nov.1998, p.32/4
CASE OF THE MISSING FILLER
Sepe M
Dickten & Masch Mfg.
Fillers and reinforcements provide a valuable option for improving the properties of many thermoplastics and thermosets. Semicrystalline thermoplastics such as nylon, PP and polyester are especially big users of these additives, but they can also be found in amorphous materials like polycarbonate and PPO. Glass fibre is one of the most important reinforcements used to increase strength, stiffness, creep resistance and fatigue properties. When a processor or an end user specifies that a part is to be made in a reinforced material, the percentage of that reinforcement is one of the key items that must be controlled in order to ensure that the properties of the compound are consistent and achieve desired levels. Quality problems experienced when injection moulding a 40% glass fibre-reinforced PP material are examined.
USA
Accession no.704735

Item 209
Kunststoffe Plast Europe
85, No.1, Jan.1995, p.9-10
INSIGHTS
Bogensperger H
After demoulding, monitor ejection bezels may warp in a similar way to a shoe box. During this process the upper and lower edges are drawn inwards and the sides are drawn outwards. The ensuing deformation may be compensated for by a bulge in the cavity. The time-consuming and expensive change to the contours of the mould has to be correctly dimensioned. The supplier has therefore initiated a project with the aim of computer modelling the rheological and thermal behaviour of the moulding and mould, and their effects on shrinkage and warpage. The results are used to derive the dimensions of the bulge. A bulge that is planned in advance and correctly dimensioned increases the cost of the mould by approx. 5 to 7%; in contrast, a bulge introduced retrospectively or a modification occasioned by incorrect predictions, increases the cost by more than 30%. This does not take into account the time delays and costs for additional testing of samples. The expense for complete simulation, by contrast, is less than 5% of the mould costs. A central department at Siemens, Munich, which offers a wide variety of computational techniques as an interdivisional service, has carried out computations using Moldflow software. Siemens has employed injection moulding simulation processes since the beginning of 1981. The simulations have a proven record as a useful and reliable aid for recognising problems in advance, as early as in the development phase of mouldings. Details are given. Illustrations may be found in Kunststoffe, 85, No.1, 1995, p.44/7.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.704431

Item 210
Kunststoffe Plast Europe
MELT FILTERS FOR INJECTION MOULDERS
Rossback R
Thermoplastics waste provides a comprehensive source of raw material for the plastics processing industry. It may be divided into three categories according to origin: manufacturing scrap, non-domestic post-consumer waste and domestic post-consumer waste (heavily contaminated). As a rule, domestic post-consumer waste is contaminated and unsorted and so can be recycled for further processing only via a central reprocessing unit. To ensure problem-free processing of all three types of waste, particularly in injection moulds with small gate cross sections, hot runner moulds, three-plate moulds and moulds with a tunnel gate, an optimum melt filter system is indispensable. Such a system must be straightforward to install and easy to clean while offering high filtration efficiency. It must prevent contaminaints contained in the thermoplastics waste from clogging gates in the injection mould. There are basically two different melt filter systems which can be used in processing thermoplastics: filter plates and filter inserts. Illustrations may be found in Kunststoffe, 85, No.2, 1995, p.193/5.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.704421
An automated design methodology for minimisation of weld lines by optimising the part and mould design is described. Weld lines are quantitatively evaluated based on their length and location and the melt front movement with the aid of commercial injection moulding simulation software which provides an integrated analysis. A combined implementation of the Complex method and injection moulding simulation is developed to reduce and relocate the weld line or to improve the weld line strength. Two parts, Gillette’s deodorant base and Cavallero’s capacitor can, are chosen for the weld line minimisation. Reduction and relocation of weld lines for the deodorant base prevent the cracking problem in the original design. For the capacitor can, the original 15.5 mm weld line is minimised to zero and the burnt mark due to air trap is eliminated by optimising the gate location. The results of simulation based on the automated design methodology agree well with the experimental findings. 23 refs.
produced International Polymer Science and Technology.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY;
WESTERN EUROPE
Accession no.700387

Item 217
Molding Systems
56, No.7, Sept.1998, p.36-9
INJECTION MOLDING TROUBLESHOOTING
DEMYSTIFIED
Bryce D M
Texas Plastic Technologies Inc.
This article, part 5 of a series, concludes an investigation
of the potential causes and solutions for common
moulding defects. Excessive shrinkage, sink marks and
splay are examined.
USA
Accession no.700083

Item 218
Injection Molding
TROUBLESHOOTER: PART 26: DISK GATES
CAN BE TROUBLE
Hatch B
Prime Alliance
This case history involves a valve cover injection moulded
from glass filled nylon 66 using a disk-gated single cavity
mould. It is presented with surface defects and blemishes,
including flow marks and roughness, and also short shots
at the end of fill were being obtained. The problem was
found to be that the disk gate was too small, the sprue
was too small, and the parting line was not vented.
Solutions suggested involved an enlarged sprue and gate
area and the addition of venting, which resulted in an
improved appearance and better cycle time.
USA
Accession no.699890

Item 219
Plastics Technology
‘FLIP’ THE MELT FOR BALANCED MOLD
FILLING
Ogando J
Problems with filling imbalances of multi-cavity moulds
have been addressed by the development of the ‘melt flipper’.
The device has been introduced following research at Penn
State Erie using mould trials and finite element analysis.
The research traced flow imbalances to temperature
stratification within the melt stream caused by asymmetrical
shear distribution. The melt flipper, intended for H-pattern
and other geometrically-balanced moulds of eight cavities
or more, changes the orientation of the melt stream. Located
at runner intersections, the flipper forces the melt stream
through changes in level and direction as it splits.
PENN STATE ERIE
USA
Accession no.699587

Item 220
Kunststoffe Plast Europe
88, No.9, Sept.1998, p.20-1,1396/402
German; English
CLEAN-ROOM PRODUCTION: CENTREPIECE
OF MEDICAL TECHNOLOGY. ECONOMICAL
CLEAN-ROOM PRODUCTION
Kudlik N
Netstal-Maschinen AG
The particular problems involved in injection moulding of
medical parts are discussed, with emphasis on the suitability
of the clean-room production system. The requirements
on the machine and peripheries and on operators and service
staff are described. The necessary rapid process control
and detailed documentation are considered and expected
future developments are outlined. 5 refs.
SWITZERLAND; WESTERN EUROPE
Accession no.699031

Item 221
Kunststoffe Plast Europe
88, No.9, Sept.1998, p.7-9,1338/42
German; English
MICRO-INJECTION MOULDING -
TRANSgressing THE LIMITS OF THE
FEASIBLE
Seidler D; Zelenka R
HB-Plastic GmbH
Problems in the injection moulding of micro plastics parts
are discussed and the adoption and exploitation of new
technology which solves the problem of poor productivity
resulting from inadequate metering accuracy and
homogeneity of extremely small volumes of melt are
described. The advantages of the micro-injection
moulding technology are illustrated by a direct
comparison, using an operating pin of a microswitch
(made from Vectra LCP) as an example. 3 refs.
AUSTRIA; WESTERN EUROPE
Accession no.699024

Item 222
Kunststoffe Plast Europe
88, No.9, Sept.1998, p.6-7,1331/6
German; English
MICRO-INJECTION MOULDING - THE AIMS
OF A PROJECT PARTNERSHIP
Kukla C; Loibl H; Detter H; Hannenheim W
Wiener Neustaedter Bildungs- und ForschungsgesmbH;
Vienna,Technical University
The work of an Austrian project partnership set up to solve the specific problems of micro-injection moulding is summarised. The problems discussed are related to the machine, the mould, the process, quality control, further processing and packaging, and integration. The broad range of applications of the process is briefly considered. 4 refs.

AUSTRIA; WESTERN EUROPE

Accession no.699023

Item 223

Revue Generale des Caoutchoucs et Plastiques
No.761, Sept.1997, p.27-30
French

TEN TOPICS CONCERNING THE INJECTION MOULDING OF ENGINEERING POLYMERS. IV.
Poppe E A; Leidig K; Schirmer K; Jayle L
Du Pont de Nemours (Deutschland) GmbH; Du Pont de Nemours (France) SA


EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; GERMANY; WESTERN EUROPE

Accession no.698952

Item 224

Injection Moulding International

SOLUTIONS TO COSMETIC DEFECTS, PART 3: PLATING PROBLEMS FROM BLUSH AND HAZE
Hatch B
Prime Alliance

Problems with surface defects on a plating grade of injection moulded ABS are troubleshooted. The part was an oval shape which had haze on the curved section and blush at the gate. Details are given of changes made to the size of the runner to improve the flow path and run lower barrel heats, and in addition, the runners were vented to get rid of excess air that was being forced through the gates and overloading the parting line vents. The gates were found to be undersized and were causing blush on the part. This was rectified and the gates were perimeter vented. Improved cycle time was achieved as well as an almost zero rejection rate from the plater.

USA

Accession no.696443

Item 225

Injection Molding
6, No.6, June 1998, p.74/7

KODAK COOLS CARTRIDGE COVER WITH COPPER ALLOY CORES
Sloan J

This article looks at the initial difficulties experienced by Eastman Kodak, in the production of the grey 35mm film canister lids so familiar to photographers. The problem was that hot stainless steel cores were causing pulled centres where the parts failed to eject. It describes tests carried out by the company to ascertain whether a copper alloy, Ampcoloy 940, would be a preferable core material.

EASTMAN KODAK CO.
USA

Accession no.696131

Item 226

Injection Molding
6, No.8, Aug. 1998, p.92/9

TROUBLESHOOTER: PART 25: THIN-WALL ABS PARTS WITH SURFACE DEFECTS
Hatch B
Prime Alliance

This month’s troubleshooting problem involves a thin-walled end cover manufactured from ABS using a three-cavity, two-plate mould with edge gating. The finished product displayed blemishes and blushing, which were found to be caused by the use of trapezoidal runners which were improperly sized, a too small gate size and too great a thick-to-thin transition. The solution offered involved recutting the runners to round, making the main runner larger than the secondary one, enlarging the gate, and cutting venting into the mould.

USA

Accession no.693221

Item 227

Injection Molding
6, No.8, Aug. 1998, p.89-90

BACKFLOW REVISITED: THE STREAK IN THE RUNNER
Sloan J

Statements questioning the existence of the backflow phenomenon are challenged by Klay Schulz of Phillips Plastics. He cites the example of an automotive lightswitch cover, moulded in two shots in a two-material process. The first shot consists of a black ABS overmoulded by a clear acrylic. Proof of backflow is presented in the form of the acrylic runner which had a streak of black ABS running through the centre of it. Efforts to solve the problem by alterations in holding time are reported.

PHILLIPS PLASTICS
USA

Accession no.693219

Item 228

Injection Molding
6, No.8, Aug. 1998, p.74
MOUNTING LOCATIONS FOR MEASURING CAVITY PRESSURE
Kirkland C

Problems in the production of moulded nylon knife shells at Victorinox were solved by the use of direct pressure transducers with threaded mounting nuts from Kistler Instrumente AG. The previous use of indirect sensors on the bottom moulds in shuttle- or rotary-table insert moulding machines showed differences of up to 725.5 psi in pressure gradients between the moulds even when moulds with identical sensors were run under identical injection conditions. Details are given of the method devised by the two companies to test in-mould performance of direct and indirect cavity pressure sensors.

VICTORINOX; KISTLER INSTRUMENTE AG SWITZERLAND; WESTERN EUROPE
Accession no.693215

Item 229

METALLIC LOOKING PLASTICS WITH NEW SILVER AND COLOURED ALUMINIUM PIGMENTS
Bunge H-H
Eckart America LP (SPE)

The use of aluminium pigments in plastics has presented a problem in the past due to the flow line they caused in injection moulded parts. By using aluminium pigments with an average particle size of 60 to 330 μm and larger, it is possible to avoid these flow lines and produce plastic parts with a metallic appearance. This concept has been taken one step further by depositing colourants on these aluminium pigments, thereby creating blue, green and golden metallic colourants that can be used in plastics without flow lines. These pigments offer exceptional styling effects by themselves and in combination with other colourants, including bronze pigments. 1 ref.

USA
Accession no.692787

Item 230

MATERIALS ANALYST. II. FINDING THE CULPRIT IN PLUGGED SUBGATES
Sepe M
Dickten & Masch Mfg.Co.

Polymer analysis is generally thought to involve sophisticated processes designed to probe the most obscure details of molecular structure. It is rarely thought that the same tools used by researchers to develop new materials and study fundamental structure-property relationships can also be used to solve a mundane production problem like plugged sub-gates. Details are given of the troubleshooting employed with samples of subgates containing an ingredient that was shutting off cavities at random in a high-production, 32-cavity tool. Some of the obstructions were partial and resulted in short shots that had to be sorted out of the production. However, most of the time the gates were completely plugged. If the mould ran unattended for any length of time, the technician would return to find the mould running only 29 or 30 parts. The remaining cavities tended to be overpacked which led to additional problems with poor dimensional control and sticking of parts in the mould. The parts were being moulded in an unfilled propylene copolymer; details are given.

USA
Accession no.691740

Item 233
Injection Molding 6, No.5, May 1998, p.45-6

MATERIALS ANALYST: PART 9
Sepe M
Dickten & Masch Mfg.

This is the ninth part of a series of articles designed to help injection moulders understand how a few analytical tools can help diagnose part failure problems. It looks at,
and explains, the processing window of thermoplastics, and discusses detecting the onset of degradation. A case history is included.
USA
Accession no.691739

Item 234
Injection Molding
6, No.5, May 1998, p.24-5
PRIMARY CAUSE OF HYDRAULIC SYSTEM FAILURE: DIRTY OIL
Sloan J
This reports on information given at a recent seminar in Canada, where the president of Van Dorn Demag, the injection moulding machine giant, explained that a study by his company had shown that 70-85 percent of all hydraulic system failures and component wear problems can be attributed to solid-particulate contamination within the hydraulic system. In this article we see how to avoid this problem.
TECH-TRAX; VAN DORN DEMAG CANADA
Accession no.691736

Item 235
Revue Generale des Caoutchoucs et Plastiques
No.760, June/July 1997, p.47-9
French
EMBRITTLEMENT OF COMPOSITE PARTS
Tancrez J P; Pabiot J
EUDIL; Douai,Ecole des Mines
A study was made of brittle fracture in injection moulded short glass fibre-reinforced PP composite specimens. The influence of the type of PP matrix, coupling agents, fibre content, length and orientation and injection moulding conditions was investigated. 10 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.691333

Item 236
Revue Generale des Caoutchoucs et Plastiques
No.760, June/July 1997, p.41-4
French
TEN TOPICS CONCERNING THE INJECTION MOULDING OF ENGINEERING POLYMERS. III.
Poppe E A; Leidig K; Schirmer K; Jayle L
Du Pont de Nemours (Deutschland) GmbH; Du Pont de Nemours France SA
The influence of melt temperature and mould temperature on the quality of injection moulded semi-crystalline engineering plastics parts is examined. Recommended processing conditions are presented for a number of non-reinforced and glass fibre-reinforced polymers. (Part I: Ibid., No.757, March 1997, p.25-9; Part II: Ibid., No.759, May 1997, p.27-30).
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; GERMANY; WESTERN EUROPE
Accession no.691331

Item 237
Molding Systems
56, No.6, Aug.1998, p.42-6
INJECTION MOULDING TROUBLESHOOTING DEMYSTIFIED
Bryce D M
Texas Plastic Technologies Inc.
This article, part four of a five-part series investigating the potential causes and solutions for common moulding defects, examines flash, flow lines, knit lines and short shots.
USA
Accession no.690637

Item 238
Injection Moulding International
3, No.4, June/July 1998, p.39-41
PRINCIPLES OF DESIGN: HOW TO RELEASE UNDERCUTS
Erhard G
BASF AG
Sometimes a designer’s attempts to integrate as many functions as possible into a single component has an undesirable consequence - often simple part release is prevented by undercuts. Several parting lines and opening directions become necessary, thus making the mould more expensive and prone to malfunctions. There are a number of ways to get around the problem, from simple to complex - forced ejection, mould-related measures, releasing undercuts, avoiding undercuts, changing the design and contacting or blocking core. Details are given.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.687964

Item 239
Injection Moulding International
3, No.4, June/July 1998, p.26-7
ANALYSING BRITTLENESS
Sepe M
Dickten & Masch
Poor final properties in a moulded part are often caused by degradation of the polymer during processing. As most moulders know too well, this degradation can come from excessive heat and long barrel residence times, or it can be the result of exposure to high levels of moisture. However, in some instances, both of these conditions can be carefully controlled and a product still does not perform as expected. The discovery of the problem is often made accidentally.
A person involved in assembling a product will notice that a particular boss cracks with surprising ease. This typically leads to a more quantitative evaluation by the quality control department. The use of analytical techniques to solve problems of brittleness in moulded parts is described.

USA
Accession no.687950

Item 240
Revue Generale des Caoutchoucs et Plastiques
No.759, May 1997, p.27-30
French
TEN TOPICS CONCERNING THE INJECTION MOULDING OF ENGINEERING POLYMERS. II.
Poppe E A; Leidig K; Schirmer K; Jayle L
Du Pont de Nemours (Deutschland) GmbH; Du Pont de Nemours France SA

The influence of the positioning of injection points and of holding times on the quality of injection moulded engineering plastics parts is examined. (Part I: Ibid., No.757, March 1997, p.25-9).
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; GERMANY; WESTERN EUROPE
Accession no.686294

Item 241
Atlanta, Ga., 26th-30th April 1998, p.836-40. 012
GETTING HEAT OUT OF THE MOULD WHERE WATER WON’T GO
Engelmann P; Dawkins E; Dealey R; Monfore M
Western Michigan,University; Dealey’s Mold Engineering; Ralston Foods
(SPE)

Removing heat from complex areas of an injection mould is difficult and often remains unresolved in production tooling. Cycle times and/or dimensional stability are often sacrificed because of hot spots in the tool. A variety of strategies employing copper alloys with and without water to the mould core are investigated. Several surprises occur; one practical method for removing heat from non-watered cores is identified. The application of high thermal conductivity copper alloys to the correct combination of components should allow mould engineers to solve both current and future mould cooling problems. 5 refs.
USA
Accession no.684631

Item 242
Atlanta, Ga., 26th-30th April 1998, p.515-19. 012
HALO SURFACE DEFECTS ON INJECTION MOULDED PARTS
Salaman B A; Koppi K A; Little J
Dow Plastics
(SPE)

Halos are aesthetic defects that may occur on centre gated parts made with multi-phase polymer systems. In general, they are circular in shape, concentric with the gate, and lower in gloss than the surrounding area. Halos are also common in parts moulded with hot runner manifolds and may even be seen in edge-gated parts (half halo). Temperature gradients along the length of the feed system to the part are shown to be a cause of this halo defect, particularly gradients where the downstream temperature is colder than the upstream temperature. The effect of process conditions on halos is discussed along with a mechanism for their creation. 9 refs.
USA
Accession no.684003

Item 243
Molding Systems
56, No.5, May/June 1998, p.36-9
INJECTION MOULDING TROUBLESHOOTING DEMYSTIFIED
Bryce D M
Texas Plastic Technologies Inc.

This article discusses the causes of and solutions for specific injection moulding defects. These include brittleness and delamination, contamination, cracking and crazing, and discolouration.
USA
Accession no.682396

Item 244
Revue Generale des Caoutchoucs et Plastiques
No.757, March 1997, p.25-9
French
TEN TOPICS CONCERNING THE INJECTION MOULDING OF ENGINEERING POLYMERS. I.
Poppe E A; Leidig K; Schirmer K; Jayle L
Du Pont de Nemours (Deutschland) GmbH; Du Pont de Nemours France SA

The importance of the drying of polymer granules for moisture removal and of injection channel design in the injection moulding of engineering plastics is discussed.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; GERMANY; WESTERN EUROPE
Accession no.682350

Item 245
Popular Plastics and Packaging
42, No.12, Dec.1997, p.75-81
TECHNOLOGICAL SOLUTIONS FOR TOTAL QUALITY IN INJECTION MOULDING OF PLASTICS
Bolur P C
Powder Plast

The problem-free running of injection moulding machines is discussed with reference to the use of
computer controls and computer aided design and manufacturing techniques to ensure repeatability of the process and the quality of the moulded goods. Typical problems arising with injection moulding are discussed and details are given of possible mould- and machine-related causes. Mould design and filling techniques involving the use of computer analysis techniques are proposed.

INDIA
Accession no.681273

Item 246

Popular Plastics and Packaging
42, No.12, Dec.1997, p.69-74
TROUBLESHOOTING IN INJECTION MOULDING
Shekar A R
DuPont India

Typical problems occurring during injection moulding operations are examined and possible causes and remedial actions are suggested.

INDIA
Accession no.681272

Item 247

Molding Systems
56, No.4, April 1998, p.24-7
INJECTION MOULDING TROUBLESHOOTING DEMYSTIFIED
Bryce D M
Texas Plastic Technologies Inc.

This second part of a five-part series looks at potential causes and solutions for common injection moulding defects. These defects are investigated as they are associated with the moulding machine, the injection mould, the plastic material and the machine operator, in that order.

USA
Accession no.680057

Item 248

Plastics and Rubber Weekly
No.1735, 8th May 1998, p.8
ION SURFACE TREATMENT CUTS WEAR PROBLEMS
JBL Feedscrews is offering injection moulders ion implanted screws which can provide up to four times the durability of a conventional nitrided product in demanding processing applications. Ion implantation is a low temperature metal treatment process that raises the hardness of the surface layer.

JBL FEEDSCREWS LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.678962

Item 249

Injection Molding
6, No.2, Feb.1998, p.92/6
TROUBLESHOOTER PART 20: WARPING AND VOIDS IN NYLON
Hatch B
Prime Alliance

This article continues a series of trouble-shooting reports from a leading on-the-spot problem solver in the moulding industry. It deals with warping and voids in the shaft of a glass-filled nylon part. A full explanation of the cause of the problem (orifice in heated sprue bushing too small; gate feeding into part shaft too small), and also the solution to it, is provided.

USA
Accession no.677286

Item 250

Injection Molding
6, No.2, Feb.1998, p.35-6
DESIGN - CRACKING AROUND INSERTS
Cramer R
Dow Materials Engineering Center

This is part one of a three-part series, and provides valuable insights into eliminating cracks around metal inserts in injection moulded parts, by using sound design engineering principles. The author draws on actual projects conducted with customers during his years as a senior development scientist with a leading company. 1 ref.

USA
Accession no.677264

Item 251

International Polymer Processing
12, No.4, Dec.1997, p.396-402
IN-MOULD SHRINKAGE MEASUREMENTS OF PS SAMPLES WITH STRAIN GAUGES
Pantani R; Jansen K M B; Titomanlio G
Salerno,University

The problem of shrinkage in injection moulding is studied by means of a new technique based on strain gauges placed on mould surface before injection. The local shrinkage development, from the moment it starts inside the mould to soon after ejection, can be followed by means of this method. With reference to a simple rectangular cavity, the effects of different holding pressures, of geometrical constraints placed inside the mould, of position in the cavity and of total cavity length on local shrinkage of injected PS samples are analysed. Shrinkage inside the mould is registered: it starts later if higher holding pressures are applied; furthermore, any factor which produces an enhancement of shrinkage evolution before complete solidification gives rise to a corresponding increase of final shrinkage. 23 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.676559
Item 252
Injection Molding
6, No.4, April 1998, p.106/8
TROUBLESHOOTER, PART 22: PARTING LINE RUNNERS AND GATES
Hatch B
Prime Alliance
A small handle of glass filled nylon with voids in the thick section of the part was investigated. The problem was shown to be caused by the flow path freezing off before the part fills, and the runner diameter and nozzle orifice were not large enough. The solution to the problem was to open up the runner to .250 inch, and drill the nozzle orifice out to .225 inch. This resulted in the voids disappearing, a lowering of the barrel heat and injection pressure, and improved cycle times.
USA
Accession no.675524

Item 253
Injection Molding
6, No.4, April 1998, p.97-8
IMPROVING UPTIME BY AVOIDING FAILURES
Kirkland C
Benefits of MicroPulse magnetostrictive transducers as used at White Oak Plastics Inc. on their injection moulding machines are described. The company, a busy custom moulder, can ill afford downtime on its machines, and linear potentiometers were found to cause reliability and accuracy problems due to dirt and wear. Details are given of the company’s business.
WHITE OAK PLASTICS INC.
USA
Accession no.675529

Item 254
Injection Molding
6, No.4, April 1998, p.85-8
MOLD IMBALANCE GOES WITH THE FLOW...
Sloan J
Theories surrounding the reasons why in an eight or greater cavity mould, heavier parts are always produced from the inside cavities, are suggested, and a solution to the problem in the form of the Runner Flipper from John Beaumont of Penn State University is proposed. The problem is connected with the distribution of shear across the melt as it moves through the runner. The viscosity of plastic is affected by temperature and shear, and in a runner shear is greatest next to the outer wall, generating higher temperatures and decreasing the viscosity of the melt, while material in the centre of the flow experiences less shear, and therefore is cooler and more viscous. The use of the Runner Flipper designed by Beaumont, used as a runner insert, takes the melt through a series of dips, twists and turns, to reorient the shear distribution, turning the melt stream so that the high temperature, low viscosity material rests on the bottom half of the runner, with the cooler, high viscosity material on top.
PENN STATE UNIVERSITY
USA
Accession no.675525

Item 255
Injection Molding
6, No.3, March 1998, p.102/6
THE TROUBLESHOOTER. PART 21: FILL, PACK, AND STICKING PROBLEMS
Hatch B
Prime Alliance
A polypropylene utility cart wheel was injection moulded using a hot runner mould with three channels per drop. The moulded wheel exhibited surface defects including flow lines and voids in thick sections, and in addition, was sticking in the front half of the mould. The problem was diagnosed as being restricted flow paths, insufficient heat in the gate area, and residual mould spray causing a vacuum and making the parts stick. A solution is offered and discussed, and includes increasing flow channels, the addition of beryllium copper heater tips, and an adjustment of the injection and holding pressures.
USA
Accession no.675533

Item 256
Injection Molding
6, No.3, March 1998, p.92/4
VARIABLE MACHINE CONDITIONS PRODUCE CRITICAL MEDICAL PART WITH CONSISTENT QUALITY
Sloan J
Problems arising from the injection moulding of a polycarbonate canister used to filter blood during heart bypass operations were solved by the use of cavity pressure sensors. Optimisation of the part was achieved by the use of variable machine conditions where the hydraulic profile was allowed to vary to meet the set cavity pressure. By transferring on cavity pressure, less start-up scrap was created, a lower reject rate, and more energy efficient processing was achieved.
DTM PRODUCTS INC.
USA
Accession no.675536

Item 257
Plastics and Rubber Weekly
No.1728, 20th March 1998, p.9
TOP 10 MOULDING PROBLEMS
Wilkinson R; Poppe E A; Leidig K; Schirmer K
DuPont Co.
This article discusses the possible causes and remedies for deposits on the mould surface when injection moulding
engineering thermoplastics such as POM, PA, PETP and PBTP. The most common reasons for the formation of mould deposits are thermal decomposition, excessive shear and inadequate venting. 

USA 
Accession no.672988

Item 258
Kunststoffe Plast Europe 
DEFECT ANALYSIS IN INJECTION MOULDING
Michaeli W; Zachert J
RWTH; IKV
The use is discussed of computer simulation techniques to solve problems associated with the injection moulding of a guide block for fibre optic plugs. Three-dimensional calculation of the filling process offers new possibilities in error analysis to the user, and processes at the flowfront and secondary flows can be calculated. This allows potential solutions to problem zones to be worked out in the simulation. 10 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.6671865

Item 259
British Plastics and Rubber 
Feb.1998, p.29
MAINTENANCE AND REFURBISHMENT
Brooks C
Marshall Tufflex
The value is discussed of investment in the training of injection moulding operators in order to reduce downtime, increase productivity and profitability, by enabling machine operators to troubleshoot processing problems and for at least half of the staff on each shift to be qualified as a tool setter. The experiences of Marshall Tufflex in this area are reported.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.669235

Item 260
Plastics and Rubber Weekly 
No.1726, 6th March 1998, p.12
TOP 10 MOULDING PROBLEMS
Wilkinson R; Poppe E A; Leidig K; Schirmker K
DuPont Co.
Partially crystalline engineering polymers such as POM, PA, PBTP and PETP tend to warp far more than amorphous ones. This point should be taken into account at the outset when designing moulds and mouldings. This article discusses the causes of warpage and steps that can be taken to prevent and reduce it.
USA
Accession no.669096

Item 261
Injection Moulding International 
3, No.1, Jan./Feb.1998, p.48-9
TROUBLESHOOTING HOT RUNNERS
Hatch B
Prime Alliance
This comprehensive article describes the possible problems that can occur with hot runners and heated sprue bushings, and outlines methods of preventing and solving them. The article focuses on gate diameter and land length for hot runner moulds and optimised sprue bushing design, for successfully moulding parts with hot runners.
USA
Accession no.668678

Item 262
Injection Molding 
6, No.1, Jan.1998, p.44/50
THE MATERIALS ANALYST: PART 5
Sepe M
Dickten & Masch Mfg.
This article comprises the fifth in a series designed to help moulders understand how analytical tools can help diagnose a part failure problem. The article describes the analytical techniques that can successfully determine the cause of a particular part failure problem, whether material, additive, colourant, or process, saving unnecessary wastage of time, effort and cost.
USA
Accession no.668657

Item 263
WARPAGE IN INJECTION MOULDED FRP: ESTABLISHING CAUSES AND CURES USING NUMERICAL ANALYSIS
Kukula S; Saito M; Kikuchi N; Shimeno T; Muranaka A
Kobe Steel Ltd.
(SPI,Composites Institute)
Retail price wars in the computer and consumer electronics market have led to massive cost reductions in case manufacture. Injection moulded FRP costs have been reduced by using thinner walls. However, this has increased the risk of warpage. While this can be predicted for given conditions, little work has been done on the inverse problem; how to achieve minimum warpage. With product lifetimes as short as six months, reducing time spent in the analysis loop by improving the accuracy of the ‘first guess’ is critical. A major cause of warpage in short fibre-reinforced plastic is believed to be anisotropy in thermal expansion coefficients due to local fibre orientation. A combined analytical and experimental research programme is carried out, examining the effects of a wide range of structural and manufacturing variables
on warpage of injection moulded FRP. These include wall thickness, gate position and mould temperature. The analysis used an inhouse system to examine flow-induced effects on material properties and mechanical warpage for given injection conditions. These results are compared with samples from a specially-designed mould allowing variation of overall dimensions, thickness, gate position and layout, temperature and moulding speed. The aim is to establish a reference catalogue for the causes of FRP warpage, identifying preventative design measures and reducing the time needed for design iteration. 6 refs.

Japan
Accession no.665449

Item 264
Injection Molding
5, No.12, Dec. 1997, p.86/91
TROUBLESHOOTER. PART 19: DISK GATES FOR BIG PARTS
Hatch B
Prime Alliance

This troubleshooting problem involves the moulding of a circular part 20 inches in diameter and .750 inches thick made from black polypropylene. It was being injection moulded using a single-cavity mould, with the disk gate fed from a cold sprue. The moulded part was subjected to voids and warping. It was discovered that the disk gate depth was too shallow, and restricted the flow of the material causing barrel temperatures and injection pressures to be raised too high. The suggested solution was to trim the core pin, leave the spreader on the end of the pin, increase the disk gate to .375 inch, lower the barrel heat, increase the mould temperature and raise the hold pressure.

USA
Accession no.664189

Item 265
Plastics Technology
43, No.12, Dec. 1997, p.17/9
CANT’AFFORD REJECTS? TRY REAL-TIME CAVITY-PRESSURE CONTROL
Naitove M H

Advantages to moulders of using a process regulation system developed by Arburg are described. The system is of value to moulders who wish to reduce their reject rate by use of cavity pressure regulation which corrects each shot in real time while the part is being moulded. The system is said to be most beneficial to producers of metal powder injection moulded parts, as well as some makers of medical products and other critical precision parts, where parts carry a high value, and precision tolerances are tight.

ARBURG INC.
USA
Accession no.664145

Item 266
Injection Molding
5, No.11, Nov.1997, p.98/105
TROUBLESHOOTER. XVIII. DIMPLES IN OVERMOULDEd TPR
Hatch R
Prime Alliance

The problem of dimples appearing at the gates of a glass-filled PP roller overmoulded with a thermoplastic elastomer material is described. Both moulds are eight-cavity and each has a balanced runner feeding material into the cavities. The troubleshooting process employed to solve the problem is outlined.

USA
Accession no.661823

Item 267
Injection Molding
5, No.11, Nov.1997, p.84-5
CHRONIC HEATER BURNOUT LEADS TO LOANER LEADS TO SOLUTION
Sloan J

Tradesco Mold delivered a mould late last year to moulder Medline Industries - a four-cavity tool with a hot runner system, designed to mould PP water pitchers for hospital and healthcare use. However, the hot runner heaters kept burning out, not just on this particular tool but on several throughout the shop, up to one burnout every other week. Medline is a moulder of disposable medical devices such as bed pans, wash basins, water pitchers and carafes. Its 500,000 sq.ft plant holds 40 presses ranging from 80-750 tons. Shifts of the 120 employees work 24 hours a day, seven days a week. The material of choice is PP and operations are supposed to be fast and efficient, with lots of robots and dependent secondary operations. The company was frustrated, and losing money over the heater burnouts. Gammaflux offered to loan Medline one of its Series 9000 hot runner control systems, to see if it would control the problem; the success encountered using this control equipment is described.

USA
Accession no.661820

Item 268
Injection Molding
5, No.11, Nov.1997, p.75/7
POROUS STEEL TAKES COOLING TO THE PART
Sloan J

A considerable amount of time in any moulding cycle is spent cooling the part. Therefore, the faster and better a part is cooled, the faster the cycle. The problem with traditional cooling is that transfer of heat away from the moulded part depends on the thermal conductivity of the mould material, water temperature, the water flow rate and the position of the water channel in the mould. All of
these variables, taken together, can make for inconsistent or unstable cooling, leading to hot spots and thermal stress, which can prolong the cycle and cause part rejects. Aga Gas has developed a way to transfer heat directly from the surface of the part, bypassing the traditional water channel configuration. The technology that makes this possible is called Toolvac. It uses cores and cavities made of a sintered microporous tool steel combined with liquid CO2 gas. The tool surface temperature is controlled by evaporating the liquid CO2 and transporting it through the steel’s pores directly to the part. This speeds cooling, which speeds the cycle. Details are given.

AGA GAS; ELECTROLUX
USA
Accession no.661817

Item 269
Plastics and Rubber Weekly
No.1716, 12th Dec.1997, p.8
TOP 10 MOULDING PROBLEMS
Wilkinson R; Poppe E A; Leidig K; Schirmer K
DuPont Co.

This article is the sixth in a series of ten designed to address the most common problems experienced by injection moulders. When moulding semi-crystalline engineering plastics such as POM, PA, PBTP and PETP, it is important to make sure than the surface temperature of the tool is correct. The consequences of the wrong tool temperature are outlined and recommendations for setting the correct tool temperature are presented.

USA
Accession no.661592

Item 270
Plastics and Rubber Weekly
No.1714, 28th Nov.1997, p.12
TOP 10 MOULDING PROBLEMS
Wilkinson R; Poppe E A; Leidig K; Schirmer K
DuPont Co.

Choosing the right melt temperature is vital for part quality when moulding semi-crystalline engineering polymers. In this fifth chapter of a ten-part series, the question of melt temperature is considered when moulding POM, PA, PBTP and PETP. Temperatures that are too high degrade the polymer, while too low a temperature results in a structure that fails to achieve the required homogeneity.

USA
Accession no.659448

Item 271
Plastics and Rubber Weekly
No.1711, 7th Nov.1997, p.12
TOP 10 MOULDING PROBLEMS
Wilkinson R; Poppe E A; Leidig K; Schirmer K
DuPont Co.

This is the fourth in a series of articles designed to address the most common problems experienced by injection moulders working with engineering polymers. The most important points to help machine setters chose the most suitable hold pressure time to achieve optimum results are discussed. The effective hold time can be determined on the machine by weighing a number of mouldings. To obtain optimum moulded part properties, the hold time should be determined by the weighing method and the cooling time should be reduced to the required minimum.

USA
Accession no.659330

Item 272
Machine Design
69, No.17, 11th Sept.1997, p.76/8
ART OF BALANCING MOULD RUNNERS
Tyler D; White R
Lexmark International Inc.

The problems of runner balancing are described. When the industrial designer hands over concept drawings to the mechanical design team, a topic that rarely comes up is the location of weld or knit lines - points at which two advancing waves of resin meet in a mould fed by multiple gates. Frequently, the subject is left to be resolved later, most typically in manufacturing. But the best approach is to design the runner system early so the knit lines don’t cause problems. Several reasons make it critical to visualise the construction of the tool throughout the design process. This planning helps address many limiting factors, including the performance of runners. In the case of the widely used Moldflow simulation software, cavity analysis and runner design are two distinct steps. Accurate simulation results require incorporation of proper moulding material data including shear dependent viscosity curves over the process window, the pressure-volume-temperature relationship, mechanical and thermal properties, optimised moulding conditions and a finite-element mesh model of the part. Details are given.

USA
Accession no.656978

Item 273
Design Engineering
Oct. 1997, p.19
MOULD PROBLEMS SOLVED

The value is discussed of using software to analyse sink mark and warpage problems in a PP injection moulded internal trim panel for the bottom lip of a boot on a Ford car. The surface showed sink marks directly above the internal ribs on the underside, caused by shrinkage at the junction of the rib and the main skin, and distortion of the trim panel used in the corner of the vehicle’s boot. Moldflow’s MF/MFLOW software showed warpage was due to the inability to transmit packing pressure uniformly across the part causing non-uniform shrinkage, and
remedial measures included using an additional feed point plus a pressure profile during the packing phase to ensure all areas of the part froze at similar pressures, thus reducing the warpage to an acceptable level. Packing analyses were also carried out using the various packing profiles to assess their effects on sink mark depth.

FORD MOTOR CO.
USA
Accession no.655774

Item 274
Injection Molding
5, No.10, Oct. 1997, p.115/7
TROUBLESHOOTER, PART 17: STRESS CRACKS IN ABS
Hatch B
Prime Alliance

This troubleshooting example refers to an injection moulded ABS fan assembly which exhibited stress cracking where the blades attach to the housing. The problems were found to be the use of ABS which deteriorated in outdoor applications, and an unbalanced fill resulting in out-of-balance dynamics when the blade was rotated, thus stressing the attachment points. Solutions are discussed, and include the use of ASA for better UV protection, the use of five gates to fill the five fan blades, added perimeter venting, balanced and vented runners, and a funnel-shaped disk gate for the single-cavity mould.

USA
Accession no.655673

Item 275
Injection Molding
5, No.9, Sept. 1997, p.92/5
TROUBLESHOOTER, PART 17: COSMETICS
Hatch B
Prime Alliance

This part of the troubleshooting series for injection moulders deals with cosmetics. The part is an ABS oval shaped speaker cover that will be plated, and the tool is a four-cavity, cold runner with a heated sprue bushing. Symptoms included haze on the curved section and blush at the gate that disturbed the plating process, and a slow cycle time. A mould filling analysis had not indicated these problems. Problems discovered included the use of undersized runners and gates, and poor venting. Solutions offered are discussed, and include the use of enlarged runners and gates, venting of the parting line and perimeter, and decreased melt temperatures.

USA
Accession no.655631

Item 276
Injection Molding
5, No.8, Aug. 1997, p.92/5
TROUBLESHOOTER, PART 16: COSMETICS
Hatch B
Prime Alliance

This article on troubleshooting is concerned with sink marks and flow lines on injection moulded ABS parts. The problem is analysed by checking the sprue, runners, gates and vents in turn. It was found that the sprue was undersized, the depth of runners was alright, but the gates were undersized, and venting was virtually non-existent. On rectifying these problems, a slight increase in cycle time was achieved, and no sink marks were produced.

USA
Accession no.652392

Item 277
Plastics and Rubber Weekly
TOP TEN MOULDING PROBLEMS
Wilkinson R; Poppe E A; Leidig K; Schirmer K
DuPont Co.

This series of articles is designed to address the most common problems experienced by injection moulders. The position of the gate is decisive for the flow front profile and the effectiveness of the holding pressure and, as a result, for the strength and other properties of the moulded part. The possible negative consequences of poor gate position are discussed and recommendations for optimum gate position are presented.

USA
Accession no.652364

Item 278
Injection Molding
5, No.4, April 1997, p.94/7
ACRYLIC BREAKAGE
Batch B
Prime Alliance Inc.

This article discusses the failure of an acrylic part due to restricted flow and cracking in the thick to thin transition. The flow lines indicated that the gates were somewhat restricted for the flow properties of the material. As the part was already being moulded in an easy-flow grade of acrylic, the flow path needed to be opened up. To optimise the tool, the sprue O diameter was resized, runner and nozzle diameters were increased, sub gates were opened up, and venting provided at the sprue puller, the end of the main runners, the end of the sub runners and in the part cavity itself.

USA
Accession no.650789

Item 279
Plastics and Rubber Weekly
No.1704, 19th Sept.1997, p.9
TOP 10 MOULDING PROBLEMS
Wilkinson R; Poppe E A; Leidig K; Schirmer K
DuPont Co.
This article considers the basic elements of correct feed system design for semi-crystalline polymers. If the gating system is too narrow, the holding pressure cannot remain effective beyond the desired holding pressure time. In that case, volume shrinkage cannot be adequately compensated, resulting in the formation of voids, sink marks or pinholes. In designing the feed system, the first point to be considered is the wall thickness of the moulded part. Nowhere should the diameter of the runner be less than the wall thickness of the injection moulding.

USA
Accession no.649853

Item 280
Plastics and Rubber Asia
12, No.72, July/Aug.1997, p.14
CINPRES SOLVES PHILIPS WARPAGE PROBLEM
Omni Plastics experienced moulding problems with the production of a CD-ROM tray. It was found that due to the differing wall sections, differential shrinkage occurred leading to distortion in both directions, across the length and across the width of the component. Cipres became involved in the project only after the design of the component was fixed and tooling underway. The use of gas injection technology has resulted in a moulding with a distortion of less than 0.07mm.

CINPRES LTD.; OMNI PLASTICS
SINGAPORE
Accession no.647894

Item 281
Wear in Plastics Processing: How to Understand, Protect and Avoid.
Munich, Carl Hanser Verlag, 1995, p.298-332. 9522
WEAR UNDER INDUSTRIAL CONDITIONS: INJECTION MOULDING
Johannaber F; Kaminski A; Schoenthaler W
Edited by: Mennig G
The economics of the injection moulding process for producing moulded parts have been questioned due to wear-related effects no later than the beginning of the 1960s with the introduction of short glass fibre-filled thermoplastics. Solutions based on the requirements and economics were given equal attention. Initially, the rather high investments for wear-resistant plasticating units occupied the foreground. To the extent that downtime, resulting from problems associated with procurement of replacement parts and the costs for the rejects produced, gained in importance, the argument prevailed that measures to prevent wear were necessary. Aspects covered include the problem of wear in this process, the injection moulding manufacturing process, process-related loads, protection against wear in injection moulding and the economics of wear protection.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.641374

Item 282
Kunststoffe Plast Europe
87, No.1, Jan.1997, p.15-6
English; German
“REPRESENTATIVE CAVITY” TECHNIQUE REDUCES REJECTS
Potente H; Wischke T
What is meant by “representative cavity” is explained in an inset. The bulk of the article discusses the use of the representative cavity principle which is easy to apply and simplifies quality assurance for injection moulding with multi-cavity moulds. A practical case study is included.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.639458

Item 283
Toronto, 27th April-2nd May 1997, p.989-93. 012
USE OF POROUS STEEL TO ELIMINATE GAS ENTRAPMENT AND MATERIAL BURNING DURING MOULDING PROCESS
Taylor L.A
International Mold Steel Inc. (SPE)
Since its introduction to the North American mouldmaking market, a new porous, self-venting mould steel has proved to be remarkably successful. This porous steel has allowed moulders to reduce injection pressure, cycle times, shot size and scrap rates. Additional benefits have included elimination of flow fines, short shots, material burning, and ghosting on the edges of textured parts. Sintokogio has introduced a sintered powder mould steel designated Porcerax 111, that offers a revolutionary solution to venting problems. Its patented manufacturing process produces a highly machinable mould steel that is 25% air by volume. This results in a mould steel that contains an inter-connected pore structure that, when properly installed and vented to the atmosphere, allows trapped gasses to escape directly through the steel, eliminating material burning, short shots and trapped gas problems. By using Porcerax II in appropriate areas, gas build-up is eliminated, injection pressure is reduced, cycle times are lowered and scrap and reject rates are substantially reduced.

USA
Accession no.637353

Item 284
Toronto, 27th April-2nd May 1997, p.588-91. 012
TROUBLESHOOTING MOULDING PROCESS
Golmanavich J
Lucent Technologies (SPE)
Investing in a monitoring system for an injection moulding shop can result in some unexpected benefits. Systems are
built per the customer’s requirements and usually comprise production scheduling software and processing tools. The system purchased by Lucent Technologies provides the capability of reading machine hydraulic information along with cavity pressure data when transducers are installed into moulds. There are two charts available to extract information from the graphics screen - a summary chart (upper) and a cycle chart (lower). The types of information collected can include fill time, peak cavity pressure, peak hydraulic pressure, and several cycle integrals. As the system is being implemented, case histories are collected which reveal information probably not available had it not been for the monitoring system. This kind of information is typically not available from system suppliers. Examples demonstrate how a monitoring system can verify results of experiments, solve problems and lead to a better overall understanding of the injection moulding process.

USA
Accession no.636722

Item 285
Toronto, 27th April-2nd May 1997, p.532-7. 012

OCCURRENCE OF FLOW MARKS DURING INJECTION MOULDING OF LINEAR POLYETHYLENE
Heuzey M-C; Dealy J M; Gao D M; Garcia-Rejon A
McGill University; Canada,National Research Council (SPE)

Injection moulded parts often show several types of surface defect. It has been hypothesised that wall slip is associated with some of these defects. The occurrence of flow marks during injection moulding of linear PE are analysed and its possible relation to wall slip evaluated. It is found that injection speed is the controlling factor for the generation of flow marks. As the resin shows no tendency to slip in capillary flow experiments, and as a PTFE coating does not affect the occurrence of flow marks, it can be concluded that there is no relationship between wall slip and the generation of flow marks. Microscopic observation of moulded surfaces suggests instead that flow marks result from the filamentation and stretching of semi-solidified material in the neighbourhood of the three-phase contact line. 15 refs.

CANADA
Accession no.636712

Item 286
Injection Moulding International
2, No.2, April/May 1997, p.72-5

PRACTICAL REMEDIES FOR THERMOSET SURFACE DEFECTS

The five most common surface defects resulting during the injection moulding process - porosity, blistering, cracks, clouds and colour streaks - are discussed, together with their causes and a troubleshooting guide.

DEUTSCHES KUNSTSTOFF-INSTITUT
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.635784

Item 287
Injection Moulding International
2, No.2, April/May 1997, p.46-8

TWO WAYS TO AVOID WELD LINES WITH HOT RUNNERS

A high percentage of today’s larger moulded parts are appearance parts: housings, cabinets, panels, bezels, etc. To the product’s potential buyers, appearance is the most obvious sign of quality, or its lack. Naturally, surface quality requirements for these products are high and continually rising. However, as quality levels have been increasing, wall thicknesses of large parts have been decreasing. A typical wall today is 2-3 mm thick; a few years ago it was 4-6 mm. As wall sections become thinner, weld and flow lines become more visible. Multiple gating is one solution to the problem, but frequently it affects the part’s mechanical and optical properties. It can also impair paint adhesion in the finishing commonly done with large parts. Fortunately, weld and flow line problems can also be solved by actively influencing mould filling to gain exact control of flow-front formation. Details are given.

EUROTOOL HOT RUNNER SYSTEMS
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.635783

Item 288
Plastics Technology
43, No.4, April 1997, p.38-43

50 WAYS TO CUT YOUR INJECTION MOULDING CYCLE TIMES
Ogando J

Fifty tips on how to introduce injection moulding cycle time improvements are presented. Once all the time-consuming aspects of the cycle have been identified, there are still incremental gains to be achieved by focusing on materials selection, screw design and process optimisation.

USA
Accession no.631885

Item 289
European Plastics News
24, No.5, May 1997, p.33-4

HOLE STORY
Anscombe N

When Electrolux wanted to reduce the cycle time for a high volume part, a levelling foot, it decided to concentrate on the mould design. The company uses a porous mould steel, Toolvac developed by Aga, to vent air from the cavities during the production of the part. Cycle times
have been cut from 32 to 20 seconds and quality has also improved. International Mold Steels markets a permeable mould steel developed in Japan by Sintokogio. Called Porcerax, the steel solves a number of gas-related problems including burning, weld lines and shrinkage.

AGA AB; INTERNATIONAL MOLD STEEL INC.
SCANDINAVIA; SWEDEN; USA; WESTERN EUROPE
Accession no.631459

**Item 290**

**Injection Molding**
5, No.3, March 1997, p.106-9

**TROUBLESHOOTER. XII. HOT RUNNERS**

Hatch R
Prime Alliance Inc.

Problems with hot runners and heated sprue bushings always seem to be in one of three places. The first problem area is usually the gate diameter, second is the gate land, and third is the size of the nozzle orifice. When troubleshooting hot runner problems, the gate diameter and land length are the first places to look. The gate diameter should be at least half the wall thickness for PE and PP and bigger for the more shear sensitive amorphous materials such as ABS, acrylics, and polycarbonates. The length of these hot tip gates should be 0.005 inch, usually indicated as a sharp edge on prints. When the flow path is restricted because of a small gate diameter or a long land length, you will usually see higher heat settings being used by the moulding technicians to get the parts to fill and pack out. The problem with this approach is that it usually causes warpage of the parts, cosmetic defects around the gate area, and long moulding cycles. Other troubleshooting advice on the hot runner aspects of injection moulding is presented.

USA
Accession no.630733

**Item 291**

**Injection Molding**
5, No.3, March 1997, p.83/5

**ON/OFF TIPS FOR DIRECT GATING PETP**

Kirkland C

PETP is reported to have emerged as a better alternative to glass in a number of markets, including blood collection phials in the medical industry, but the material's highly crystalline nature can make direct gate, hot runner moulding of such products difficult. Extremely rapid cooling is required to prevent white marks, caused by crystallisation, from forming in the finished products. Rapid melting and cooling at the gate area can be extremely difficult in a hot runner mould. Seiki Spear System America has developed open-tip probes and valve gate systems using its field-proven temperature control systems to solve these problems. Details are given.

SEIKI SPEAR SYSTEM AMERICA INC.
USA
Accession no.630729

**Item 292**

**Injection Molding**
5, No.3, March 1997, p.39/42

**TROUBLESHOOTING DESIGNS FOR ENGINEERING RESINS**

Maniscalco M

It is reported that when investigating the causes behind aesthetic defects and part performance shortcomings, it can be tempting to blame the material. Before succumbing to this theory, however, the many other factors that affect the final part should be considered, such as mould design, gate location, runner systems, process temperatures, residence time, part design, filling patterns, etc. Where engineering resins are concerned, the interactions among all of these variables can be critical. Details are given.

ENTECPOLYMERS
USA
Accession no.630720

**Item 293**

**Injection Molding**
5, No.3, March 1997, p.24/8

**MACHINE STATES**

Woodrell W
Woodrell Project Management

In the course of troubleshooting, it is very useful to break the machine’s cycle down into basic states to quickly analyse the problem at hand and get the machines back on line. There are dozens of individual steps that take place in any cycle; these steps are identified, breaking them down into ten easily recognisable stages and a couple of auxiliary stages that are basic to all moulding equipment. It is assumed that a normal cycle on either a toggle or standard hydraulic clamp with a single reciprocating screw is currently run; that is, without sprue break or nozzle valve function. References to cores are also left out due to the many different configurations that may be applied depending on the mould.

Accession no.630717

**Item 294**

**British Plastics and Rubber**
March 1997, p.18-20

**HYDRAULIC PRESSURE MONITORING IS NOT GOOD ENOUGH FOR PRECISION MOULDING**

Griesser E
Sensotron Inc.

The problem with injection moulding machines is that peak filling pressure and packing pressure generally vary too much for precision applications. Hydraulic pressure variations have a direct bearing on nozzle pressure and hence on shot weight variation. This article discusses the selection of an appropriate injection pressure sensor to replace and improve on the hydraulic system transducer.

USA
Accession no.628608
Item 295
Injection Molding
5, No.2, Feb.1997, p.76/81
MOULD VENTING
Hatch B
Prime Alliance Inc.

A problem in an injection moulding shop concerning noticeable knit lines and poor surface cosmetics was traced to lack of vents in the mould. Moulders routinely slow down injection speeds to get rid of burns, but materials perform better if they are injected quickly. The design of runner, parting line, ejector and core pin vents and blind vent pockets are discussed.

USA
Accession no.624882

Item 296
Injection Molding
5, No.2, Feb.1997, p.69
EJECTOR PIN PUSH-BACK BLUES
Sloan J

A toolmaker in Michigan recently reported problems with ejector pin push-back causing wart-like pads on the parts coming out of the mould. Pencil Logic, a mould services company, says the amount of bending the toolmaker was experiencing was probably due to the size of the mould and the injection pressures from the press. Inadequate support for the ejector plate is a common problem and Pencil Logic recommends that a stop button (pin) be installed at least every six inches and nearest the point of greatest injection pressure.

PENCIL LOGIC
USA
Accession no.624881

Item 297
Injection Molding
5, No.2, Feb.1997, p.11/5
MACHINE STATES
Woodrell W
Woodrell Project Management

In the course of troubleshooting, it is useful to break the injection moulding machine’s cycle down into basic states in order to analyse the problem at hand. This article examines the first five states of moulding: clamp close, mould protect, clamp lockup, injection forward and injection pack/hold.

USA
Accession no.624872

Item 298
Injection Molding
TROUBLESHOOTER. X. UNBALANCED RUNNERS

Hatch R
Prime Alliance Inc.

The problems encountered with unbalanced runners in injection moulding are addressed and solutions proposed.

USA
Accession no.618643

Item 299
Kunststoffe Plast Europe
86, No.11, Nov.1996, p.13-4
100% CONTROL OF SURFACE QUALITY
Burger T

Inspection of the component surfaces in plastics injection moulding is becoming increasingly important because the faults often occur very abruptly and cannot be determined by means of conventional methods of quality assurance using random samples. There is a certain naivety of some quality assurance advisers who build up SPC systems to replace 100% control. Apart from specific applications of statistical process control, practice increasingly approaches 100% control, the main reason being product liability legislation. Today image processing means more than two-dimensional measurement, completeness checks, position determination and identification of markings. Specifically with components from the automotive and electrical industries, quality characteristics such as a homogeneous and perfect surface also are of great importance. In most cases the numbers of parts produced by series production can no longer be subjected to a manual 100% surface quality control within reasonable cost limits. Details are given.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.616969

Item 300
Plastics and Rubber Weekly
PERENNIAL PROBLEMS PERSIST

There are still too few plastics product designers who call in the mouldier and toolmaker at an early enough time for them to have an influence on design, according to the Gauge & Tool Makers’ Association’s Moulds and Dies Section. The continuing difficulties by mouldmakers to produce perfect moulds for customers, which appear to be the same year after year, are described.

GAUGE & TOOL MAKERS’ ASSN.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.614440

Item 301
Injection Molding
4, No.11, Nov.1996, p.154-5
TROUBLESHOOTER. IX. WARP AND DISTORTION
Hatch R
Prime Alliance

Practical advice is offered to solve problems encountered in injection moulding; emphasis is placed on the problems of warpage and distortion.

USA
Accession no.614299

Item 302
Injection Molding
4, No.11, Nov.1996, p.152-3
HOW TO FIX COLOUR STREAKING AND REDUCE CYCLE AT SAME TIME
Sloan J

Custom moulder Sun Plastics had experienced a colouring problem, and had been awarded a contract to mould red PP medical waste bins with a quoted cycle time of 18 seconds. The problem was that the red colourant required a cycle time of 22 seconds to properly mix the melt, or the bins were red streaked, not solid red. An attempt was made to install a dispersion disk and a mixing nozzle, to no avail. Sun could not reduce the cycle time to below 22 seconds. To solve the problem, the company turned to Koch Engineering and the KMH mixing head series. Sun installed the mixer on the 375-ton press. The company reports that part improvement and colour uniformity were immediate. In a week, the average cycle time was reduced to 18.5 seconds and machine efficiency increased from 87% to more than 95%. Details are given.

SUN PLASTICS INC.; KOCH ENGINEERING CO.
USA
Accession no.614298

Item 303
Injection Molding
4, No.11, Nov.1996, p.142/6
UNDERSTANDING AND PREVENTING SCREW WEAR

It is evident that the injection screw is wearing when slippage is noted and there is a failure to develop enough pressure. Eventually the parts become unacceptably inconsistent. It is common to continue moulding because either there is not enough time to stop the job long enough to pull the screw, or there is no replacement. An understanding of how screws (and barrels and nozzles and valves) wear, and what can be done to anticipate it, will help keep an injection moulding operation running smoothly. Details are given.

WESTLAND CORP.
USA
Accession no.614296

Item 304
Injection Molding
4, No.11, Nov.1996, p.106/12
COINJECTION HOT RUNNER BASICS
Kirkland C

Coinjection moulding with hot runners is a popular topic. Coinjection, or sandwich moulding, is the injection moulding of two or more plastic materials where a thin outer skin layer (for instance an expensive engineering resin) is formed surrounding one or more core layers (an inexpensive material or recylcate). The benefits of the process increase when hot runners are used. However, according to Dynisco’s Kona Hot Runner Systems, little information has been published acquainting moulders with basic details about the process. The following solutions to basic processing problems should help to familiarise with the advantages and disadvantages of coinjection moulding.

DYNISCO INC.; KONA HOT RUNNER SYSTEMS
USA
Accession no.614294

Item 305
Plastics Technology
42, No.11, Nov.1996, p.50-2
NO MORE STREAKS!
Martin M; Salamon B
Dow Plastics

Black and brown streaks and splay are reported to be among the most common flaws seen in polycarbonate parts. Streaks are the visible signs of heat degradation caused by a combination of time and temperature. Another degradation effect, splay, is caused by bubbles of gas that form at the flow front. Typical causes of both problems include moisture from improperly dried resins, exposure of the melt to an iron-rich surface, or machine-design factors such as the screw, check valve, end-cap, or temperature control. Severity of streaking or splay can increase significantly when these factors combine to create a corrosive environment in which moisture-degraded polycarbonate reacts with exposed iron surfaces. The critical importance of these factors - especially those related to equipment design - was demonstrated by a laboratory study performed by Dow Plastics on a moulding project of a manufacturer of HVAC equipment. During the evaluation of materials to be used in an appliance cover, the moulder observed streaking in parts moulded from a beige ignition-resistant polycarbonate. Details are given.

USA
Accession no.614280

Item 306
Kunststoffe Plast Europe
86, No.9, Sept.1996, p.7-9
REDUCING MOULD-GAP WIDTHS
Mueller D H; Feng Y
Bremer Instituts fuer Konstruktionstechnik; Tongji,University

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Factors affecting mould gap widths and the subsequent deformations caused by flash in the parting plane of injection moulding machines, are examined. This problem is discussed with particular reference to the injection moulding of elastomers when injection pressures are high. Gaps between the mould halves may be avoided by very rigid designs or by designs that ensure that the deformations are identical in the mould cavity regions. The use of computer models for the analysis of deformations is discussed.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.610533

**Item 307**
**Injection Molding**

**THE TROUBLESHOOTER. PART 8: ACETAL WITH SPLAY PROBLEM**
Hatch B
Prime Alliance Inc.

Problems are examined associated with splay on the surface halfway between the gate and the end of fill on a large acetal part with .180-inch nominal wall. Corrections made to the injection moulding process to amend this fault are described, and include the attempt to simulate higher compression ratio by increasing back pressure with existing screw, and the use of lower heats and a machine with a bigger injection unit to reduce cycle time.

USA
Accession no.610498

**Item 308**
**Injection Molding**

**RAISING THE BAR ON TEXTURING STANDARDS**
Gurr A

The need for a Master Grain and Gloss Standard plaque is examined, and the problems involved with producing such a standard discussed. Collaboration between GM Motors, Schulman Inc., Bernard Mould, and International Mold Steel resulted in the production of a Standard plaque which reproduces maximum texture and gloss definition. It involved the use of Porcerax II porous mould steel to solve venting problems.

GENERAL MOTORS CORP.; SCHULMAN INC.; BERNARD MOULD LTD.; INTERNATIONAL MOLD STEEL INC.
USA
Accession no.610494

**Item 309**
**Asian Plastics News**
Nov. 1996, p.20

**GAS-ASSISTED INJECTION MOULDING TROUBLE-SHOOTING**

This is a table showing potential errors in moulded parts that can occur with the gas-assisted injection moulding process, and the elimination steps that can be taken to prevent them.

IKV
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.609876

**Item 310**
**Asian Plastics News**
Nov. 1996, p.19/21

**GAS INJECTION PART TWO: PROCESS OPTIONS AND TROUBLESHOOTING**

This article forms the second part of a series of four articles on gas-assisted injection moulding. Here, process engineering options and troubleshooting are focused upon, with a particular look at nozzle selection and wall thickness.

IKV
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.609875

**Item 311**
**Asian Plastics News**
Nov. 1996, p.17

**HOLE STORY**

This article reports on an air-permeable steel, developed in Japan by Sintokogio, that is helping to overcome many of the gas venting problems faced by injection moulders. The heart of the success of “Porcerax II” is explained.

SINTOKOGIO
JAPAN; USA
Accession no.609874

**Item 312**
**Modern Plastics International**
26, No.11, Nov.1996, p.54-9

**MOULDERS CONFRONT CHALLENGES OF AT-THE-PRESS COLOURING**
Snyder M R

As the practice of introducing colourants at the press becomes more widespread, injection moulders are more able to solve colour problems, frequently in close working relationships with suppliers of colourants, feeding equipment and mixing screws. Examples of recent case histories are given to illustrate how problems were resolved. These include streaking in orange recreational vehicle fenders moulded in HDPE, and problems with unmelted particles and inadequate colour dispersion in a PP part.

USA
Accession no.608961
Absorption of water after injection moulding of hygroscopic materials, such as polyphthalamide or nylon, causes changes in the dimensions of the final product. This can cause a problem with dimensional stability and may cause a part that is within tolerance after moulding to fall out of the tolerance before it reaches the customer. For this reason two- and three-stage injection moulding strategies, % moisture when moulded, mould temperature and regrind values are analysed to determine the most stable process when the part begins to reabsorb moisture. The findings appear to show that the mould temperature was the major factor in controlling the effect of moisture on the final dimensions of the part. A follow-up study is being conducted to separate the effects of annealing and moisture absorption on the part dimensions. 2 refs.

USA
Accession no.608838

The difficulties are described, which are being experienced by Otron Tech Inc. in the injection moulding of large HDPE and PP sheets for marine deck applications. The company has invested in a Hettinga injection unit with a shot capacity of 176 pounds, but is having problems reducing the current cycle time to make the sheets which have a closed-cell foam core.

OTRON TECH INC.
USA
Accession no.608245

A troubleshooting guide is presented which deals with the question of cycle times for thick-walled parts. Aspects considered include barrel heats, heats in relation to materials, barrel sizes, size of shot, and the optimisation of flow paths. The example of a large airfoil made from HDPE is used to illustrate the necessary

mould modifications, and the actual process conditions are reported.
USA
Accession no.608154

This article is one in a series of troubleshooting reports concerning the problem of parts sticking to moulds and sprue bushings. The problem was identified as a loss of temperature in the drier, causing residual moisture in the nylon that made it flow too easily. Increasing the heat setting on the drier to achieve thorough drying solved the problem.
USA
Accession no.604494

This article is part 5 of a continuing series of troubleshooting reports in which injection moulding manufacturing problems are solved by Bob Hatch, manager of technical service for Prime Alliance of the USA. This article investigates distortion and blush.
USA
Accession no.603688

Approaches to the successful injection moulding of thin-walled portable electronic components such as cellular telephones and computer housings in engineering plastics are discussed. Aspects of flow length and machine design, methods for improving the aesthetic qualities of mouldings, impact strength requirements and advantages of thin-wall moulding in terms of reduced cycle times are examined.
USA
Accession no.602955
Item 319

Plastics Technology
42, No.7, July 1996, p.100

“NO-SWEAT” MOLDING RAISES BOTTLE OUTPUT

This article explains how Graham Packaging of the USA, who produce HDPE motor oil bottles, overcame mould sweating problems with a mould dehumidifier system from the Cargocaire Div. of Munters Corp. The system is described in detail.

GRAHAM PACKAGING; MUNTERS CORP.
USA

Accession no.598907

Item 320

Plast'21
No.42, April 1995, p.50-3

Spanish

FAULT DIAGNOSIS BY A MANUFACTURER OF VEHICLE LIGHTS
Azcarreta R; Barrutia C; Basagoiti J; Gil A M
Rinder Industrial SA

Results are presented of a study undertaken by Rinder Industrial of Spain to determine the causes of defects in injection moulded vehicle lights.

EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE

Accession no.598398

Item 321

Kunststoffe Plast Europe
86, No.6, June 1996, p.10-2

WEAR RESISTANT PLASTICISING UNITS
Heinze M

For a long time, wear problems have been associated with plastics treatment and processing in plasticising units, and the resulting economical impact is no surprise. Wear affects those machine components that are in contact with the moulding material to be processed, i.e. cylinders, screw, non-return valve, and possibly also the forming mould. A BMFT investigation performed in Germany estimates the costs arising from wear in plasticising units at 750 million DM. Even the replacement parts for screw compounders used for plastics treatment give rise to expenses that are assessed at 220 million DM worldwide. Total wear-related costs, including indirect loss (production downtime, rejects, customer complaints, and depreciation for unused investments) are probably much higher. This creates the necessity to reduce this wear as far as possible by adequate tailor-made measures. Protection against wear is based on two major approaches: suitable material selection respecting material treatment, and load-related constructive design of the corresponding machine components.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no.596166

Item 322

Injection Molding
4, No.6, June 1996, p.108/10

THE TROUBLESHOOTER PART 4: STRESSED OUT
Hatch B
Prime Alliance

A case study involving a cracking problem in a hollow polycarbonate T-connector, being part of an airline application, is examined. Such cracking problems in a thermoplastic part, that occurs after moulding when the part is exposed to external pressure or force such as assembly pressures, are claimed often to be caused by moulded-in stresses. Moulded-in stress is most likely to occur, it is explained, when molten material, injected into a cavity under excessive pressure, is forced to cool quickly. Squeezed through undersize flow paths, polymer molecules can become unnaturally aligned or stressed.

USA

Accession no.594209

Item 323

Injection Molding
4, No.6, June 1996, p.79/82

REVERSE GATING DRIVES BLUSHES AND BLEMISHES AWAY
Kirkland C

The use is described of reverse gating techniques which eliminate gate marks in parts moulded with hot or cold runner systems. Advantages of the system are discussed, and details are given of Kona technology which allows moulders to produce reverse gated parts while gaining all the benefits of hot runner moulding. Kona has used finite element analysis to solve the problems of the different temperatures of the material in the gate area and hot material at processing temperatures further upstream which result in a cloudy blush when using hot runners, by its patented seal technology to optimise tip and insert geometry. In addition, its patented heat pipe technology helps by providing a uniform temperature over the length of the flow path. Successful applications are reported.

KONA HOT RUNNER SYSTEMS
USA

Accession no.594201

Item 324

Injection Molding
4, No.5, May 1996, p.88/90

THE TROUBLESHOOTER PART 3: CYCLE TIME
Hatch B
Prime Alliance Inc.

A case history is presented as an example of troubleshooting cycle times. The use of process settings that differ from the norm should only be as a step in reaction to unanticipated independent and temporary
variations in the moulding process, it is warned, and that if a moulder habitually operates too far off the optimum norm, then he will have no room left to manoeuvre when the unexpected happens. An example of a PP ribbed structure with too long a cycle time is investigated and several suspicious process conditions are examined which lead to the primary cause of undersized flow paths being identified.

USA
Accession no.592431

Item 325

Plastics World
54, No.6, June 1996, p.17-20
WHAT PROCESSORS NEED TO KNOW ABOUT RELEASE AGENTS
McCarthy D F; Dyer M R
Franklynn Industries Inc.

The thermosetting urethane materials used in RIM/SRIM and open casting are prone to aggressive sticking. Because these processes involve chemical reactions, it is critical that the release agent has a positive impact on the process. Water-based semi-permanent releasants alleviate many of the concerns raised with solvent-based systems including VOCs, exposure concerns, combustibility, and handling. Water-based systems are well proven for multiple release of injection moulded parts, with little or no transfer to the finished part. Given the wide number of variables in RIM and SRIM processing, it is critical to select a mould release supplier capable of providing a formulation specifically tailored to meet processor needs. A troubleshooting table is presented.

USA
Accession no.592179

Item 326

Emerging Technologies Retec ’95. Conference proceedings.
Erie, Pa., 9th-10th Aug.1995, paper 11. 8
PRINCIPLES, CAPABILITIES AND APPLICATIONS
Grossman E M
Scortec Inc.
(SPE,Northwestern Pennsylvania Section; Penn State Erie,Behrend College Plastics Technology Deployment Center; US,National Tooling & Machining Assn.)

Scorim is a new injection moulding process which, for the first time, creates dynamics to the molten plastic inside the mould cavity. This process offers useful and economic solutions to existing problems in thin and thick sectioned parts and has considerable value to the moulder, the resin supplier, the product and part designer, the plastics and applications engineer, and the quality and reliability specialist. Test results are presented to demonstrate the improved mechanical characteristics and the reduction in weld and flow lines, sinks and voids, and dimensional instability that can be achieved with the Scorim process with both unfilled and filled engineering and high temperature thermoplastics and thermosets. Information and data on fibre orientation in reinforced plastics are presented. Finally, application use and practice are described. 2 refs.

USA
Accession no.591700

Item 327

British Plastics and Rubber
June 1996, p.8/10
COOLING BY NUMBERS
Maier C

Cooling time accounts for quite a slice of the average injection moulding cycle, yet cooling circuit design is often a minor consideration when laying down a tool. Kestrel Injection Moulders added MF/Cool cooling analysis to its existing Moldflow mould filling software on the strength of a study made by Moldflow on a Hellerman fibre optic cable connector moulded in PP. Computer simulation exposed problems in conventional best practice and allowed various solutions to be tried at virtually no cost. The final cooling circuit design provided efficient and uniform heat extraction plus reduced cooling time.

KESTREL INJECTION MOULDERS
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.591177

Item 328

Injection Molding
4, No.3, March 1996, p.77/80
PROCESSING. THE TROUBLESHOOTER PART 1: POSTMOULDING CRACKS
Hatch B
Prime Alliance

An example of troubleshooting a production problem is given, with reference to cracking and crazing appearing after a moulded part was assembled and put into service. It involved a cover on a consumer leisure item made from easy-flow polycarbonate. Solutions offered are discussed, and include the change to a stiffer flow polycarbonate, increased flow paths, radiused sharp corners and edges, and increased height of support bosses.

Accession no.590990

Item 329

Plastics Southern Africa
25, No.9, Feb.1996, p.20
FLASHING - CONFLICTING VIEWS ACTUALLY BOTH CORRECT
Fourie J
Cape Technikon

This comprehensive article outlines a number of factors which can cause flashing to occur in the injection
moulding process. The article describes the faults that can occur, together with a chart which provides a system of checks and solutions to rectify the faults causing the flashing to occur.

SOUTH AFRICA
Accession no.590147

Item 330
*Kunststoffe Plast Europe*
86, No.4, April 1996, p.11-12
QUALITY CONTROL OF OPTICAL COMPONENTS - MODERN CONTROL STRATEGY IN INJECTION MOULDING
Michaeli W; Kudlik N; Vaculik R
Aachen, RWTH; IKV

A highly sensitive measurement system based on digital imaging, which can detect extremely small faults, is described for use in quality control of optical components such as lenses. A surface camera records a line grid imaged by the lens and transmits it to the image evaluator. An evaluation algorithm determines through half tone analysis the deviation of the imaged lines from a reference image. The distortions of the lines by the lens are a direct measure of its optical properties. At the same time, surface defects such as streaks can be determined and classified. (Translated from Kunststoffe, 86, No.4, April 1996, p.478-80)

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.588801

Item 331
*Kunststoffe Plast Europe*
86, No.4, April 1996, p.8-10
SYSTEMATIC REDUCTION OF FAULT POTENTIAL - POKA-YOKE APPROACH IN INJECTION MOULDED PRODUCTION
Bourdon R
Rodinger Kunststoff-Technik GmbH

A report is presented on Poka-Yoke, a total quality management system developed by Toyota which offers many different and effective possibilities for implementation in injection moulding. The aim of the system is systematic minimisation of fault potential in routine plant operation. Practical examples of fault reduction in mould installation include hoses for the mould temp. control system, flow rate through the temp. control system, incompletely filled parts and granulators. (Translated from Kunststoffe, 86, No.4, April 1996, p.472-4)

TOYOTA
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.587581

Item 332
*Polymer Engineering and Science*
36, No.6, March 1996, p.807-18

MODELLING AND SIMULATION OF THERMALLY INDUCED STRESS AND WARPAGE IN INJECTION MOULDED THERMOPLASTICS
Shih-Jun Liu
Chang Gung College of Medicine & Technology

Thermally induced stress and the relevant warpage caused by inappropriate mould design and processing conditions are problems that confound the overall success of injection moulding. A viscoelastic phase transformation model, using a standard linear solid for the solidified polymer and a viscous fluid model for the polymer melt, of two-dimensional finite element scheme with 8 noded overlay isoparametric elements was used to simulate and predict the residual stress and warpage within injection moulded articles as induced during the cooling stage of the injection moulding cycle. The approach proposed is to examine and simulate the injection moulding solidification process with the intent of understanding and resolving more inclusive and realistic problems. 29 refs.

TAIWAN
Accession no.587575
Item 335

**Journal of Applied Polymer Science**
60, No.3, 18th April 1996, p.353-62

**CORRELATION BETWEEN FLOW MARK AND INTERNAL STRUCTURE OF THIN PC/ABS BLEND INJECTION MOULDINGS**
Hamada H; Tsunasawa H
Kyoto, Institute of Technology

Clarification is given of a mechanism of the flow mark that appears on the surface of thin polycarbonate/ABS blend injection mouldings through the observation of the internal structure at various processing conditions. The flow mark had two different constitutions, such as a lustre part and a cloud part, alternately on the both surfaces. 9 refs.

**JAPAN**

*Accession no.582788*

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Item 336

**Innovations in Interior and Exterior Plastics for Automotive Applications. Retec proceedings.**
Dearborn, Mi., 8th-9th Nov.1995, p.173-81. 63Tr.Ro

**BENEFITS OF A SEQUENTIAL FILL VALVE GATE HOT RUNNER SYSTEM FOR MOULDING AUTOMOTIVE BUMPER FASCIAS**
Betters J E
JEB Consulting; Kona Corp.
(SPE, Detroit Section; SPE, Automotive Div.)

Automotive bumper fascias have become very complex over the past several years; design engineers are integrating many features into the bumper such as grilles and light openings to reduce tooling and manufacturing costs. Also, to save material, bumpers are designed with thinner walls and hot runner systems are incorporated in the mould design. Due to the complex cavity geometries and increased flow length vs. wall thickness ratios, it is difficult to predict the actual flow pattern during mould filling. Although computer aided design software is used in the design stage to determine optimum processing conditions, gauge locations and runner diameters for a balanced fill, variations in steel dimensions, mould cooling and inadequate venting alter the predicted filling pattern. Process engineers are therefore faced with a non-uniform fill resulting in poor dimensional stability of the bumper along with surface appearance and paint adhesion problems. Details are given of a technique developed by a consortium for controlling the fill pattern during the actual filling phase. 10 refs.

**USA**

*Accession no.582780*

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Item 337

**Plastics Engineering**

**MINIMISING CORESHIFT IN INJECTION MOULDED CONTAINERS**

Shepard T A; O’Connell M; Powell K; Charwinsky S
Becton Dickinson Research Center

Maldistribution of flow around the core pin during packing is shown to be the primary cause of core-pin displacement, and a process window that minimises the problem is determined. A fast injection speed is recommended, and the need to balance pack time and pack pressure between minimising coreshift and maximising part weight, is emphasised. 7 refs.

**USA**

*Accession no.582774*

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Item 338

**Injection Molding**

**A FLEXIBLE URETHANE CHALLENGE**
Rosen M

Problems associated with the moulding of a flexible thermoplastic urethane medical implant were solved by the use of a multilaminate, finite element filling and packing analysis using Fillcalc V from Rapra Technology Ltd. The medical device designed by ICI Corp. contained two halves which were solvent welded together after moulding. An aluminium prototype mould was used, details of which are
given, but which led to warpage, shrinkage, gas trapping, and high fill pressure. The results of the analysis, combined with a proper understanding of the flow behaviour of urethane, enabled modifications to be made to the mould. These included removing the submarine gate, and adding a gate at the ejector pin, and venting.

ICI CORP.; RAPRA TECHNOLOGY LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; USA; WESTERN EUROPE
Accession no.579555

Item 341
Injection Molding
4, No.1, Jan.1996, p.40

EFFECTIVE MEDICAL PART DESIGN: PART 1.
CONNECTOR DESIGN KEEPS PROCESS IN MIND
Maniscalco M

Design hints for moulding for the medical industry are presented by Eastman Chemical. Details are given of ways of designing for processability with reference to a connector moulded from polyester. Problems with cooling were eliminated by redesigning the part with a thinner flange, and by using two shorter bimetallic core pins.

EASTMAN CHEMICAL CO.
USA
Accession no.579548

Item 342
Antec 95. Volume III. Conference proceedings.
Boston, Ma., 7th-11th May 1995, p.4392-7. 012

IMPACT OF ENVIRONMENTAL TEMPERATURE AND HUMIDITY ON REJECT RATE IN A PLASTIC INJECTION MOULDING PLANT
Carter R V
Penn State Erie Plastics Technical Center (SPE)

The effects of temperature and humidity on reject rate during injection moulding are discussed. It is determined by examining the output graphs that, in order to reduce reject rates at the plant, the shop should be dehumidified, but not air conditioned. Dehumidifying the shop area will reduce moisture in the air and lower the dew point, decreasing the chance that condensation will occur on the mould surface, and, in turn, lowering the reject rate. 4 refs.

USA
Accession no.577996

Item 343
Antec 95. Volume III. Conference proceedings.
Boston, Ma., 7th-11th May 1995, p.4314-8. 012

IMPROVING PACKING IN THIN TO THICK MOULDED PARTS
Rydbom M
Penn State Erie Plastics Technical Center

(SPE)
The use of thermal insulation to improve packing problems associated with a thin to thick flow is considered. Specially-designed cavity inserts with insulating air gaps are used for this thermal insulation of the thin area. Stainless steel is also used as a cavity insert material to thermally isolate the thin area of an actual problem moulding. Results show these two techniques isolate the thin area from the mould’s cooling system and visibly improve the packing in the problem moulding studied. 4 refs.

USA
Accession no.577978

Item 344
European Plastics News
22, No.11, Dec.1995, p.31

BUMPER SA VINGS
Anscombe N

Ford’s plant in Genk, Belgium, has achieved huge savings by changing the screws in its injection moulding machines. The machines fitted with the innovative screw are being used to mould bumpers for the Mondeo. The Barr Energy Transfer screw has been developed especially for use with high viscosity engineering thermoplastics and is a type of barrier screw. The ET screw has been designed to improve mixing, but keep shear as low as possible. The low shear rate is important for the Ford bumper which is produced using GE Plastics’ Xenoy, a blend of polycarbonate and PBTP. Cycle times have been cut from 78 to 70 seconds, part weight is down by 50 grammes (1.5%), part weight consistency has improved and part reject rate has been reduced from 8 to 2%.

FORD MOTOR CO.
BELGIUM; EUROPEAN COMMUNITY; EUROPEAN UNION; WESTERN EUROPE
Accession no.576423

Item 345
Medical Design & Manufacturing Orlando. Conference proceedings.

MECHANISM FOR CORE SHIFT IN INJECTION MOULDED CONTAINERS
Shepard T A; O’Connell M; Powell K; Charwinsky S
Becton Dickinson Research Center (Canon Communications Inc.; Medical Device & Diagnostic Industry Magazine; SPE,Medical Plastics Div.)

Variations in wall thickness of thin-walled parts, due to displacement of the corepin, is a common problem. The mechanism by which core shift occurs is described and a process window to minimise the problem is identified. Maldistribution of flow around the corepin during packing is the primary cause of pin displacement. 7 refs.

USA
Accession no.575811
Item 346
Asian Plastics News
March/April 1995, p.83
INJECTION MOULDING TROUBLESHOOTING GUIDE - PART 11
Advanced Elastomer Systems Singapore Pte.Ltd.

Part 11 of this injection moulding troubleshooting guide relates to thermoplastic elastomers. Potential problems and possible solutions are offered for a variety of problems such as poor finish, weld lines, distortion, and colour degradation.

SINGAPORE
Accession no.572753

Item 347
Plastics Technology
41, No.11, Nov.1995, p.15
SCREW DESIGN CURES SPLAY PROBLEMS
Ogando J

It is reported that when injection moulding splay problems arise, it could be the screw design at fault rather than the material. Two major automotive operations have experienced this problem over the past year, both overcoming splay problems with polycarbonate blends after adopting a proprietary screw design from Great Lakes Feedscrews. The ET II screw is built under licence from Robert Barr, with Great Lakes Feedscrews having the sole licence to this design for the injection moulding market. Details are given.

GREAT LAKES FEEDSCREWS; BARR R.,INC.
USA
Accession no.571069

Item 348
Plastics World
53, No.9, Sept.1995, p.29-30
SOLVING THE WELD-LINE PUZZLE
Malloy R A

One of the manufacturing related problems that is commonly encountered when moulding parts is that of weld line formation. Weld lines are often visible to the naked eye, and as a result, represent a significant cosmetic concern. In addition, the local mechanical strength and chemical resistance in the weld zone can be significantly lower compared to other areas of the same part. Computer aided mould filling simulations can be used to predict the areas of the part where welds will form. Once in production, process variables such as increasing melt temperature or injection speed will tend to have a positive effect on weld performance by promoting molecular diffusion.

USA
Accession no.563339

Item 349
Plast Europe Kunststoffe
7, No.1, April 1995, p.20-3
SURFACE FAULTS IN INJECTION MOULDING

Bichler M
Mannesmann Demag Kunststofftechnik

It is explained that the quality of an injection moulded part is affected by a variety of factors which change from application to application. The quality shortcomings can be caused by incorrect settings of machine or process parameters, and inappropriate mould design or design of injection moulded parts. This article looks at some of the common faults such as sink marks, unmelted granules, and gloss deviations. It considers possible approaches to eliminate these faults.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.560600
MODELLING AND SIMULATION OF THERMALLY INDUCED STRESS AND WARPAGE IN INJECTION MOULDED THERMOPLASTICS
Liu S-J; Rietveld J X
Chang Gung College of Medicine & Technology; Wisconsin-Madison, University (SPE)

The warpage of a plastics product can be seen as primarily due to non-uniform differential shrinkages within the product which lead to the development of uneven residual stresses within the product. In order to predict the residual stress and warpage in a polymer product, the effects of the processing conditions, the material behaviour and the geometric effects must be accounted for. To date, several numerical models have been proposed to simulate the formation of thermally-induced stresses. The current numerical approaches to the residual stress and warpage problem tend to fall within two categories: a complex material model applied to a simple part geometry, or a simple material model applied to a complex part geometry. It is proposed to examine the thermally-induced stress and warpage problem using a novel material description and a more comprehensive geometric description with the intent of either reaching or understanding more inclusive/realistic problems. 24 refs.

EJECTOR PINS: ANALYSIS OF OPTIMUM MATERIALS AND TREATMENTS
Starkey G
Progressive Components/D&L Inc. (SPE)

Causes of ejector pin failure are described. Optimum criteria are then established followed by an analysis of materials and treatments which meet the defined criteria. 24 refs.

CALCULATION OF THE COOLING TIME OF PLASTICS IN THE INJECTION MOULDING PROCESS
Wileczynski K; Tyszkiwicz A

The problem of cooling of mouldings (in the form of plates) during injection moulding was examined with particular reference to the differences in the course of cooling of crystalline and amorphous plastics. The potential of analytical and numerical calculations were characterised and a solution was presented, using the finite difference method, to the problem of calculating the cooling time of crystalline plastics. A computer program was developed which made it possible to calculate the cooling time of crystalline and amorphous plastics and was used for simulation of the injection moulding process conditions on the curve of cooling of the plastic in the mould. 7 refs. (Full translation of Polim.Tworz.Wielk., No.2, 1995, p.109)

PREDICTING SURFACE DEFECTS IN INJECTION MOULDED PVC COMPONENTS
Weir S J
Geon Co. (SPE)

A study was made of the possibility of capturing the critical value of shear stress for a PVC compound in order to predict surface defects such as gate blush in injection moulded parts. Material testing was performed using a capillary viscometer, followed by mould filling simulation and verification testing of a moulded part using a four-cavity colour chip mould. The results suggested that some correlation could be made between analytical predictions of shear stress exceeding a critical value and visible defects in the surface of a moulded part. 2 refs.

FOLLOW THE 4 MS TO TROUBLESHOOT PROBLEMS
Czazasty J
Dynisco Instruments Inc.

Quality problems in mouldings are a function of the inter-relationship between the material quality, the machine and its settings, the mould and the man or operator. The relationship between melt temperature and thermal degradation of the material is one reason to consider monitoring melt temperature using the new infrared in-nozzle temperature sensors. A good way to detect variations in material is by looking for variations in viscosity. The causes of bubbles or trapped gas in mouldings and faults such as short shots are examined. Selecting the best process variables to monitor is critical. Appropriate instrumentation such as the previously mentioned temperature sensors or in-cavity pressure and
temperature sensors are excellent tools since they act as windows into the process.

USA

Accession no.556725

Item 357
World Class Injection Moulding. Retec proceedings.

INJECTION MOULDING CONDUCTIVE THERMOPLASTICS
Nielsen J M
RTP Co.
(SPE,Carolinas Section; SPE,Injection Molding Div.)
Conductive thermoplastic materials and applications are reported to make up the fastest growing segment of the plastics industry. The areas of concern facing moulders of conductive thermoplastic composite materials are explored, and proven techniques to prevent processing problems are offered.

USA

Accession no.553618

Item 358
World Class Injection Moulding. Retec proceedings.

MISUSE AND ABUSE OF PLASTIC PROCESS SIMULATION
Engelstein G
GR Technical Services Inc.
(SPE,Carolinas Section; SPE,Injection Molding Div.)
Mould filling, cooling and warpage analyses are very powerful diagnostic and troubleshooting tools. However, three are some limitations to what the simulations can be expected to do. Most bad analysis experiences arise from misapplying the technology to problems which are unsuitable. A wide variety of these limitations are discussed, arising from simulation assumptions, algorithmic implementations, rheological data and other sources.

USA

Accession no.553609

Item 359

EFFECTS OF DRYING TIME ON HYDROSCOPIC POLYMERS
Dunham J
Massachusetts,University
(SPE)
The effects of drying time on the impact strength and surface finish of injection moulded samples of virgin and regrind ABS and polycarbonate were investigated.

LOWELL,UNIVERSITY
USA

Accession no.546538

Item 360
Plastics Technology
41, No.2, Feb.1995, p.54/63
PORTABLE ANALISERS FIND WHAT AILS YOUR PROCESS
Ogando J
This comprehensive article supplies a detailed review of portable machine analysers. These data-acquisition and monitoring devices hook up to moulding machines and auxiliary equipment, gathering information that helps to identify the root causes of processing problems. The article compares the various features and advantages of various portable machine analysers currently on the market.
BRANDEN T.G.,CORP.; HUNKAR LABORATORIES INC.; NICOLLET PROCESS ENGINEERING; RJG TECHNOLOGIES INC.
USA

Accession no.546250

Item 361
Plastics Technology (Hong Kong)
No.18, Oct.1994, p.38-49
Chinese; English
INJECTION MOULDING OF POLYAMIDE 6 AND POLYAMIDE 66
A review is presented of the injection moulding procedures for use with polyamide 6 and 66, and the differences between them in terms of handling, machinery, and processing conditions. Included also is a troubleshooting guide. The materials used in this article refer to Akulon polyamides from DSM.
DSM NV
EUROPEAN COMMUNITY; EUROPEAN UNION; NETHERLANDS; WESTERN EUROPE

Accession no.546177

Item 362
Injection Molding
3, No.2, Feb.1995, p.71/3
MOULDING THICK-WALL PARTS WITH NO TRADE-OFFS
Maniscalco M
Problems associated with injection moulding thick-walled parts are discussed, with reference to warpage and differential shrinkage. Practical guidelines from experts at Creative Techniques Inc. are offered in order to assist in the avoidance of processing mistakes moulders can make when trying to eliminate warpage in thick-walled parts.
CREATIVE TECHNIQUES INC.
USA

Accession no.544990

Item 363
Injection Molding
REDUCING THERMOSET WARPAGE
Solutions are offered to warpage problems in a car headlight reflector and indicator unit which resulted in distortion causing the headlights not to reflect in the right direction. It was found that uneven cooling due to gate location caused temperature variation and uneven filling. The gate was moved to a different location to balance the resin flow. The use of Fillcalc V thermoset filling simulation software is discussed as an analysis tool.

EUROPE-GENERAL
Accession no.544988

Item 364
Plastics Technology
41, No.3, March 1995, p.48-52
GUIDELINES FOR TROUBLE-FREE GAS-ASSIST MOULDING
Caropreso M; Zuber P
GE Plastics
GE Plastics has produced a booklet in which practical guidelines to part and tool design, moulding and control techniques in gas-assisted injection moulding are detailed. Selected recommendations are excerpted in this article, which includes a troubleshooting guide.
USA
Accession no.544958

Item 365
Plastics Technology
41, No.1, Jan.1995, p.47-9
HOT RUNNERS FOR QUICK COLOUR CHANGES
Dewar N; Vettor D
Mold-Masters Ltd.
The article outlines the problems encountered by injection moulders, where frequent colour changes interrupt injection moulding runs. The article supplies detailed guidelines for selecting and operating a hot runner system that will save both time and material.
CANADA
Accession no.543807

Item 366
Injection Molding
2, No.9, Oct.1994, p.55
PROCESSING - SOLVING A BIG VOID PROBLEM
This describes how General Industries of the USA handled a project to provide HDPE fittings for very large natural gas pipes, for Phillips Driscopipe Inc. In particular, how General Industries overcame the biggest processing problem of air entrapment - voids - is explained.
GENERAL INDUSTRIES; PHILLIPS DRISCOPIPE INC.; PHILLIPS PETROLEUM
USA
Accession no.542031

Item 367
USE OF A DIFFERENTIAL SCANNING CALORIMETER AS A TROUBLE SHOOTING TOOL FOR INJECTION MOULDING
Thompson S L
Pennsylvania,State University (SPE)
The use of DSC for studying the effects of moulding conditions on crystallinity in injection moulded PP components is described. 3 refs.
USA
Accession no.541195

Item 368
MOVING BOUNDARY TECHNIQUE TO STRENGTHEN WELD LINES IN INJECTION MOULDING
Gardner G; Malloy R
Massachusetts,University (SPE)
The effects of an in-mould moving boundary system promoting local mixing in the weld line area during mould filling on the tensile and flexural strengths of the weld lines of injection moulded composite parts were investigated. The process used a cam operated reciprocating pin, or two such pins, to promote lateral displacement of the melt during mould filling. The systems evaluated were shown to be extremely effective in strengthening weld lines in parts made from glass fibre-reinforced PP and a glass fibre-reinforced ABS/polycarbonate blend, without giving rise to other types of defects. 12 refs.
LOWELL,UNIVERSITY
USA
Accession no.541169

Item 369
Plastics World
53, No.1, Jan.1995, p.21
DESIGNING AROUND RIBS
Malloy R A
U-Mass Lowell
Many injection moulded plastic parts contain ribs to increase the torsional or bending stiffness of the part. From a purely mechanical or structural point of view, the designer is concerned with variables such as rib placement, rib spacing and the individual rib dimensions as these all influence the overall stiffness of the plastic part. Unfortunately the rib manufacturing problems are more difficult to quantify. The sink mark that occurs opposite the rib is a particular concern in many consumer
product applications. The options open to part designers when dealing with sink marks are outlined.

USA

Accession no.539244

Item 370

INFLUENCE OF PROCESSING PARAMETERS ON QUALITY OF GAS-ASSISTED INJECTION MOULDED PARTS

Yang S Y; Liou S J
Taiwan,National University
(SPE)

Taguchi experimental design was used to study the influence of processing variables on the quality of PS parts produced by gas-assisted injection moulding. Part quality was judged on the basis of the average depth of sink marks. The variables examined included melt temperature, gas pressure, gas injection delay, injection rate, injection pressure and short shot size. Melt temperature and short shot size were found to have the most significant effect. 14 refs.

TAIWAN; USA

Accession no.537993

Item 371

VISUAL ANALYSES OF FLOW MARK GENERATION PROCESS USING GLASS-INSERTED MOULD. I. MICRO-GROOVED FLOW MARKS

Yokoi H; Nagami S; Kawasaki A; Murata Y
Tokyo,University; Mitsui Petrochemical Industries Ltd.; Sekisui Chemical Co.Ltd.
(SPE)

The generation of micro-grooved flow marks on injection moulded parts was observed by the use of a glass-inserted mould. The significant factors in flow mark generation were flow front velocity and mould temperature, while gate shape and resin temperature were insignificant. 1 ref.

JAPAN; USA

Accession no.537986

Item 372

STUDY OF SURFACE DEFECTS IN THE INJECTION MOULDING OF RUBBER-MODIFIED THERMOPLASTICS

Chang M C O
Monsanto Co.
(SPE)

A study was made of surface defects occurring in parts injection moulded in a rubber-modified acrylonitrile-
marks on mouldings, higher costs for repair and maintenance, a shorter service life of the machine, and the health hazards which exist from escaping fumes. Design criteria are examined for the construction of a vented injection mould.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no. 534649

Item 376
Kunststoff Journal
28, No. 4, Aug. 1994, p. 34-6
German

PROVEN TECHNOLOGY

Tools for thermoplastics, thermosets and elastomers, which are very expensive to manufacture, are subject to abrasion from chemicals and adhesives. Interruptions in use result in poor demoulding and similar problems, requiring frequent mould cleaning. Hard surface tool coatings made of PVD offer a good solution to these problems. Balinit A is three times as hard as glass fibre. Coating is carried out by a plasma high-vacuum process.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE

Accession no. 532999

Item 377
Asian Plastics News
Sept/Oct. 1994, p. 56

INJECTION MOULDING TROUBLESHOOTING GUIDE. IX. ACRYLIC

The ninth part of an injection moulding troubleshooting guide is presented, with emphasis on the processing of acrylic polymers. Problems addressed include splay marks, splash, silver streaks, mica surface and flow lines; weld and knit lines; sink marks; short shots and rippled surface finish; burning, or trapped air in mould; warping; internal bubbles; crazing; delamination temperature; and breaking or cracking of part when mould opens.

ASHLAND PLASTICS AUSTRALIA
AUSTRALIA

Accession no. 530010

Item 378
Asian Plastics News
July/Aug. 1994, p. 39

INJECTION MOULDING TROUBLESHOOTING GUIDE. VII. POLYESTER

The eighth part of an injection moulding troubleshooting guide, with emphasis on the processing of polyester. Aspects covered include short shots and ripples, splay marks, drooling at nozzle, warping and distortion, sink marks, voids, delamination and part sticking in cavity.

ASHLAND PLASTICS AUSTRALIA
AUSTRALIA

Accession no. 529997

Item 379
Asian Plastics News
March 1994, p. 37

INJECTION MOULDING TROUBLESHOOTING GUIDE. VI. PVC

The sixth part of a troubleshooting guide for injection moulding is presented, with emphasis on PVC. Problems discussed include short shot, sink or shrink marks, smudges and orange peel, dull streaks and flow lines, poor weld lines, flashing, blisters or bubbles, burned spots, burning in one part only, burning in part and runner, excessive shrinkage, and black flecks but no discoloured streaks.

ASHLAND PLASTICS AUSTRALIA
AUSTRALIA

Accession no. 529982

Item 380
Asian Plastics News
Jan/Feb. 1994, p. 18

INJECTION MOULDING TROUBLESHOOTING GUIDE. V. ABS

The fifth part of a troubleshooting guide for injection moulding, with emphasis on problems encountered when processing ABS. Problems covered include: short shots; trapped gas, bubbles, burn spots; surface imperfections, poor weld lines, sink spots or shrinkage, mould flashing, sticking in the sprue or cavity; and black streaking.

ASHLAND PLASTICS AUSTRALIA
AUSTRALIA

Accession no. 529967

Item 381
European Plastics News
21, No. 9, Oct. 1994, p. 23/6

MAKING THE RIGHT CHOICE
Reade L

This article discusses choosing an injection moulding machine and what criteria should be used when selecting a machine. The role that machine specification plays in achieving zero defect production is examined. An illustration is given of how “rule-of-thumb” techniques can lead to the specification of unnecessarily large machines. A graph for determining cavity pressure requirements is presented. Evaluation of a machine’s performance is also discussed. The primary emphasis of the evaluation should be to quantify the injection unit’s ability to delivery plastic with the maximum consistency. It is also important to determine the clamp’s ability to minimise mould deflections during the process.

WORLD

Accession no. 529217

Item 382
Plastics Technology
40, No. 1, Jan. 1994, p. 86

DON’T LET MOULD SWEATING SLOW
YOU DOWN

The article supplies details of a portable desiccant-bed dehumidification system manufactured by Bry-Air Inc. The mould dehumidifier solves the problem of mould sweating - condensation on the mould which causes water spots that mar the surface of the parts being moulded. Mould sweating increases cycle time and causes unacceptable levels of rejects. The dehumidifier is an inexpensive way of solving the problem.

PLASTIC INJECTORS; BRY-AIR INC.

Accession no.524960

Item 383
Injection Molding
2, No.5, May/June 1994, p.46/9

HARD WATER PROBLEMS? TRY MAGNETS
Kirkland C

The use is discussed of magnetics to prevent scale formation in injection moulds which use water for cooling. Improved heat transfer in equipment and less downtime for scaled equipment are benefits provided by the use of magnets which suspend particles of calcium carbonate in a solution which can be passed through the water system.

STEPCO CORP.; GLOBAL INDUSTRIES INC.

Accession no.524006

Item 384
Plastics News International

MOULDING POLYCARBONATES - WHAT’S CHANGED?
McCough J

This comprehensive article considers the problems encountered in the injection moulding of polycarbonates, such as in die design, gating and drying. The article outlines the keys to successful moulding of polycarbonates including the choice of mould materials, prototype tooling, sprues and runners, gating tolerances and shrinkage, mould temperature control and drying conditions.

GE PLASTICS
AUSTRALIA

Accession no.521224

Item 385
Plastics World
52, No.6, June 1994, Part I, p.62-4

ABC’S OF PROCESSING ABS
Petit R
GE Plastics

The problems of injection moulding ABS and possible ways of overcoming them are discussed. The most likely troublespots of drying, screw design, non-return valves or check rings, gate design, mould temperatures and ejector pins/draft are examined. It is claimed that the vast majority of troubleshooting calls can probably be resolved more by referring to the supplier’s processing guide, calling the local technical service representative or by following these basic guidelines.

USA

Accession no.519435

Item 386
Plastics World
52, No.4, April 1994, p.19-21

PROCESS CONSISTENCY IS A KEY TO SUCCESSFUL MOLDING
Smock D

This article provides a guide to polystyrene processing, investigating common problems encountered and basic errors made, with the help of troubleshooting experts from several large companies. A thorough troubleshooting guide-list is included.

BASF; DOW PLASTICS; GE PLASTICS; CHEVRON; FINA

USA

Accession no.513696

Item 387
British Plastics and Rubber
April 1994, p.20

‘COLD’ HOT RUNNER SOLVES COMPLEX FILLING PROBLEM
Vogel H
Ewikon GmbH

The injection moulded polycarbonate speaker grilles being used today by the automotive and electronics industries are said to be complex mouldings which present a range of problems for the mouldmaker. The ways in which an internally-heated hot runner manifold provided the precision necessary for the multiple gating of the polycarbonate grille are described.

EUROPEAN COMMUNITY; GERMANY; WESTERN EUROPE

Accession no.510985

Item 388
Plastics Technology (Hong Kong)

INJECTION MOULDING OF POLYPROPYLENE (PP)

This article provides comprehensive information on injection moulding with PP. PP’s chemical and mechanical characteristics are explained. An insight is provided into part designing considerations and mould design considerations. Injection moulding machine requirements are also examined. A “troubleshooting” list is included of all the common PP moulding problems, with possible causes suggested.

HIMONT
USA

Accession no.508969
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