Polymers in Asphalt

H.L. Robinson
(Tarmac Ltd., UK)

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

Title

EFFECT OF THERMAL HISTORY ON THE RHEOLOGICAL BEHAVIOR OF THERMOPLASTIC POLYURETHANES

Authors and affiliation

Pil Joong Yoon; Chang Dae Han
Akron, University

Abstract

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

Location

GOODRICH B.F.
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1 Introduction

It will not have escaped the attention of the road user that most of the roads in the UK are surfaced with asphalt as opposed to its main competitor, concrete, which is a good endorsement of the material’s durability and user-friendly nature. In 2003 the market demand for asphalt in the UK was approximately 28 million tonnes used mainly in the road maintenance and new build market. There are other uses for asphalt such as flooring and roofing. These volumes, however, are relatively small compared to the road market and these applications will not therefore be covered in any great detail in this review. Bituminous materials have a long history of use dating back thousands of years. Asphalt, however, has only been around a relatively short time making its debut in the UK around the early 1900s. Edgar Purnell Hooley obtained the first British patent for Tarmacadum in 1902 (a.1) and the following year formed the TarMacadam Syndicate Ltd., in Denby, Derbyshire. It was, however, several years later before it became widely used, aligned with the growth in traffic volumes. Before the advent of bituminous-bound road building materials, roads were constructed of unbound aggregate mixtures that relied on good aggregate interlock for stability.

Asphalt has been used for building roads over the past hundred years and during that time the industry has evolved into a sophisticated sector which is heavily regulated by national and European standards and governed by specifications developed largely by the Highways Agency, usually following consultation with industry. The material supply side of the industry also has its own trade associations, most notably the Quarry Products Association (QPA) (a.2) representing the asphalt suppliers and the Refined Bitumen Association (RBA) (a.3) representing bitumen companies. Both organisations work closely together as the Asphalt Industry Alliance (AIA) (a.4) to promote asphalt.

This review will explore the type of polymers used in asphalt, why they are used, where they are used in terms of applications and the benefits they offer to industry and the road user. In particular, the reader will understand how polymers can be used to enhance the functionality of asphalt, i.e., to overcome deterioration mechanisms by enhancing asphalt stiffness or flexibility, or by making it more resistant to deformation (rutting) caused by traffic.

Much of the research and development conducted by the material supply side of the asphalt industry is commercially sensitive, whereas the highway authorities generally publish their findings, which tend to focus on in-service performance.

This review represents the views of the author and is not intended to be a literary review, nor is it particularly aimed at practising asphalt engineers but rather at parties interested in polymers and their applications. The author has also taken into account commercial sensitivities when preparing the narrative and therefore only discusses general issues and limits technical details to broad generic descriptions.

2 The Asphalt Industry

Despite making significant progress over the years so that asphalt performance has become well controlled and fairly predictable, there is always room for further improvement. A key development over the past 20 years or so in the UK has been the utilisation of polymer-modified bitumens (PMB) to further improve asphalt performance. This has manifested itself either by enabling asphalt to have improved durability or alternatively by enabling asphalt layer thicknesses, in particular the main surface course layer, to be significantly reduced. Such reduction can offer material savings that appeals to clients concerned with lowering costs, but who are also tasked with meeting sustainability targets, e.g., local authorities.

The utilisation of polymer-modified binders in the UK has grown sharply over the past ten years from humble beginnings in the late 1970s when there was no means of specifying their use. Back then the asphalt industry’s liability was largely limited to supplying materials in accordance with specifications that called up standard recipe-based materials.

The UK aggregates and asphalt industry is fairly capital-intensive in terms of manufacturing plant and traditionally conservative in nature. Likewise the client side of the industry has traditionally taken a conservative view towards adopting new technology because of the need to protect public safety. However, in recent years there has been a growing acceptance that new technologies can offer the tax payer better value for money. This change has resulted in growing industry acceptance for new materials such as the adoption of polymers in asphalt, even though it has taken some considerable time, well over 20 years, from when the first road trials containing polymers were laid down for monitoring.
2.1 Industry Overview

The asphalt industry has a relatively low demand for polymers. The use of polymers in asphalt is still an emerging market in the UK, with approximately 3% of all the asphalt produced now containing a polymer of some sort, with nearly all of this present in the asphalt surface course layer.

The asphalt market represents over £1,000 million in terms of total product value. However, the total amount of polymers used in asphalt in the UK is estimated to have a value in the range of £2.5-4 million per year. The conservative and regulatory nature of the highways industry has traditionally presented many barriers which have restricted acceptance for new materials, including polymer-modified asphalts. However, this situation is now changing with the recognition that polymers can make a constructive contribution towards improving asphalt performance in terms of durability and, in some cases, cost reduction. Polymers are also making a significant contribution in terms of sustainability by enabling the design of asphalts that reduce the level of traffic noise, and by allowing thinner asphalt roads to be constructed, thereby requiring less material.

An asphalt road usually comprises four distinct layers starting with the ‘surface course’ laid on top of a ‘binder course’ which in turn is laid on top of a ‘base’ layer. These bound layer thicknesses usually increase the further down they are positioned within the road pavement structure. The ‘base’ layer sits on top of a granular unbound layer called a sub-base, which in turn is laid on top of the sub-grade (soil).

2.2 Recent Market Trends

Despite a number of large privately financed initiatives (PFI), particularly in the mid to late 1990s, the main markets for asphalt continue to be the publicly-funded highway works controlled either by the Highways Agency or local authorities. However, the private sector, i.e., commercial, industrial and housing, provides good opportunities for new materials where the client is often interested in asphalt with a particular functionality, such as coloured surface finish, fuel resistance or a free draining but durable pavement to control flood water.

2.2.1 Growth in Traffic

A critical driver for improving asphalt performance has been the growth in traffic using Great Britain roads over the past decade as shown in Figure 1. This data shows how road traffic has grown over the ten-year period 1992-2002, increasing by approximately 18% over that term. It is interesting to note that much of the road network in place today was not designed to carry the increased traffic volumes we are now seeing. As a result many roads will require increased maintenance, and in some cases complete reconstruction well before

![Road Traffic: All motor vehicles: 1992-2002](image)

**Figure 1**

The total activity of traffic on the road network in Great Britain is measured in vehicle kilometres. The traffic for each year relates to the public road network in place in that year. Thus growth over time is the product of any change in the network (kilometres) and the change in traffic flow (vehicles).
their expected design life is reached. It is recognised that there is a huge backlog of maintenance work needed to repair and maintain UK roads, which have suffered from under-investment over recent decades.

Using polymer-modified binders in asphalt to improve performance is one strategy that is available to the design engineer or specifier to mitigate the damaging effect of increasing traffic stresses as shown in Figure 2 to ensure asphalt roads do indeed meet their planned design life.

It is commercial goods carrying vehicles that cause the most damage as opposed to cars because of their heavier axle loading imparting heavier stresses on the road surface. The introduction of ‘super single tyres’ from the Continent with higher tyre pressure is another factor increasing the applied stress on asphalt roads that can lead to premature pavement failure, e.g., rutting and cracking. The increase in commercial freight traffic has increased on UK roads since 1992 as shown in Figure 3.

![Figure 2](image1.png)

**Figure 2**
A section of heavily used motorway where a polymer-modified asphalt could be used in the surface course to cope with high traffic levels

![Figure 3](image2.png)

**Figure 3**
Freight activity is measured in terms of the weight of goods (tonnes) handled, taking no account of the distance they are carried; this is termed ‘goods lifted’
2.2.2 Trends in Market Demand for Asphalt and Bitumen

The trend in asphalt market demand in Great Britain over the past ten years is shown in Figure 4. The fluctuation year on year reflects changing market conditions influenced largely by client spending patterns. The growth in bitumen demand during the past 80+ years is shown in Figure 5.

2.2.3 Surface Maintenance Treatments

Polymers are also used in the manufacture of water-based bitumen emulsions for road maintenance surfacing techniques, namely surface dressing and microasphalt. The main market for polymer-modified bitumen emulsions is surface dressing whereby the emulsion is sprayed onto the existing road surface by a mobile spray tanker, after which single-sized aggregates

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**Figure 4**

Trends in market demand for asphalt in Great Britain over the past ten years

**Figure 5**

Trends in market demand for bitumen in Great Britain between 1920 and 2000
or ‘chippings’ are applied to ‘dress’ the carriageway. The bitumen emulsion essentially acts as the glue to bond the chippings onto the road surface. After the dressed surfacing has received a few days traffic the chippings interlock and form a strong mosaic-like surface finish.

Although asphalt thin surfacing (ATS) systems have reduced the surface dressing market over the past ten years, mainly on the grounds of reduced traffic noise, it is still a significant market for polymers and is estimated to represent a polymer value in the region of £3 million per year, i.e., at a similar level to asphalt.

Microasphalt is a different maintenance technique involving the manufacture on site of cold-mix asphalt-like material using graded aggregates mixed with an emulsion that is then applied onto the road surface through a paving machine and laid typically 10 mm thick.

Such treatments are usually applied when the existing road surface is showing signs of distress or the surface has fallen below the required level of skid resistance. They are usually chosen by the highway authority because they offer a lower-cost short-term solution compared to laying a new hot-mix asphalt surface course. The durability of these surface maintenance treatments is, however, inferior to conventional hot-mix asphalt surface courses. So, over the longer term, using such treatments may prove more costly as a result of more frequent maintenance being required. Surface treatments can extend the life of a road pavement if used in a timely manner before the road condition deteriorates to a critical condition, which may then require full reconstruction.

### 2.3 Regulations

#### 2.3.1 Background

Various EU legislation and regulations have an impact on the asphalt industry, such as the Public Procurement Directives and others on liability, health and safety. The main one of note is the Construction Products Directive. This will be covered in Section 8.1.

Traditionally the asphalt industry has been averse to risk and conservative, due in part to heavy regulation in the form of product standards and specifications. However, over the past ten years this climate has started to change, to the extent that the asphalt industry is now actively engaged in developing new innovative products, many of which are based on polymers.

A key driver for change is recognition by client bodies that the traditional prescriptive approach, whereby the client stipulates which asphalt mixtures should be used and accepting the lowest price tender, does not always represent best value. This has resulted in a significant shift towards end product performance specifications, effectively passing performance liability and risk down the supply chain to suppliers. This means the asphalt suppliers and contractors take responsibility for designing their materials to comply with specific performance requirements. Where the required performance levels cannot be met with conventional paving-grade bitumens, then it may be necessary to use polymer-modified binders.

This approach has encouraged innovation within the industry, particularly by the bitumen and asphalt suppliers who have invested significantly in the research and development of new binders and asphalt materials.

#### 2.3.2 New Product Approvals Scheme

This new approach aimed at encouraging innovation is founded on allowing the use of proprietary products that have British Board of Agrément and Highways Authorities Product Approval Scheme certification (BBA HAPAS) which was set up by the Highways Agency, the County Surveyors Society (CSS) and the BBA (a.5). It was established to provide a means of gaining national approval for innovative products, materials and systems related to highway use, thereby removing the need for local highways authorities to undertake such assessments themselves. The scheme includes ongoing surveillance to give assurance that products do provide the specified level of performance in service. This is necessary because binder and asphalt performance tests are only predictive and cannot absolutely guarantee performance.

This scheme has become the main vehicle for gaining approval for the use of new proprietary asphalt materials and in particular those containing polymers. Further information is given in Section 8.3.

### 2.4 Distinct Technologies

#### 2.4.1 Background

The asphalt industry has a long history dating back to the early 1900s. There have, however, been many
significant changes and improvements over the past century. These have resulted in improved quality control for materials, more efficient plant and improved procedures for protecting worker safety, health and the environment (SHE). Site practices with regard to SHE have improved considerably in recent years to the benefit of company employees who work in quarries, on asphalt production plants and those involved with laying the material (contracting).

The asphalt industry today is dominated by a few major players who between them supply over 80% of the market. The core technology on offer from these companies is fairly standard, however, companies try and differentiate themselves through improved customer focus/service and by offering ‘special branded products’, i.e., low-volume specialist products aimed at high-value niche markets.

Road schemes are designed by client based and/or externally appointed designers, who will specify levels of asphalt performance based on the specific site requirements taking account of traffic levels, sub-grade condition and the expected pavement design life. In terms of the construction supply chain on major works, asphalt laying contractors are in the main appointed as sub-contractors to larger construction companies. Large asphalt companies such as Tarmac (a.6), have their own in-house contracting business to offer an integrated service.

2.4.2 Asphalt Material Description

In simple terms asphalt is a mixture of graded aggregates with filler (finely graded material with a particle size predominantly less than 63 μm) and bitumen. The latter acts as the binder and typically contributes between 4% and 6% of the total mixture by mass. The nature of the aggregate and bitumen properties and the mixture proportions greatly influence the resultant asphalt properties, although controlling the installation (degree of compaction) is also critically important to ensure the finished ‘mat’ has the desired density and air void content. There is little point in carefully designing asphalt in the laboratory with a view to it lasting several decades on a road receiving heavy traffic, if it is then poorly compacted during installation because it will fail prematurely due to air and water ingress, causing the bitumen to become hard and brittle due to oxidation.

2.4.3 Typical Asphalt Road Structure

Asphalt pavements, certainly on motorways and major trunk roads, are designed to achieve a specified design life by taking account of the prevailing traffic conditions and the condition of the sub-grade on which the pavement will sit and function. In simple terms, the weaker the sub-grade or soil, the thicker or stronger the pavement needs to be. Usually asphalt pavements consist of three distinct, bound layers sitting on top of

![Figure 6](image_url)

**Figure 6**

Cross-section of a flexible pavement showing three bound asphalt layers and one unbound granular sub-base layer
one unbound layer (sub-base) (Figure 6). The top layer of the road or pavement is called the surface course and is typically laid 25-40 mm thick. It is in this layer that polymer-modified binders are currently used to counter the stresses incurred through direct contact with vehicle tyres. However, the surface course is generally regarded as being a non-load-bearing layer as it translates the traffic load downwards into the pavement. The next layer down is called the binder course layer, which is laid typically 60 mm thick. The main structural-load-bearing layer is termed the base layer. It lies beneath the binder course layer and is typically laid 100-200 mm thick depending on the design requirements. The unbound granular sub-base layer is free draining, consists of graded aggregates and is usually laid at least 150 mm thick. Its main function is to provide a platform for construction traffic during the road building operation. However, new pavement design guidance (a.7) now recognises that sub-bases stabilised with slow cementing pozzolanic binders, such as lime, cement and slag, can make a significant contribution towards pavement performance.

2.4.4 Asphalt Production and Laying

Asphalt is produced in a specially designed plant (Figure 7), which enables hot, dried graded aggregates to be mixed with filler and hot molten bitumen under controlled conditions of mix temperature and mixing time. Following mixing, the asphalt is transported in covered delivery vehicles from the asphalt plant to the construction site where it is put through a paving machine (Figure 8). The asphalt layer is partially compacted when it passes through the screed at the back of the paver, however, full compaction is achieved by employing a heavy mobile compaction plant that travels back and forth, up and down the asphalt layer (mat) several times until full compaction is achieved. This is determined by measuring the asphalt density in situ using a nuclear density gauge (a piece of equipment used on construction sites to measure in situ asphalt density in a non-destructive way as opposed to removing cores and then having to measure density on the cores), and comparing the data with the density information obtained on the same asphalt mixture after being fully compacted under laboratory conditions. The percentage refusal density (PRD) achieved on site must comply with the contract specification.

2.4.5 Analytical Pavement Design

Another significant change occurred in the asphalt industry with the development of new asphalt testing equipment for measuring key mechanical properties such as ‘elastic stiffness’ and ‘deformation resistance’. Being able to measure these properties with some precision has facilitated the move away from empirical design procedures (a.8) towards analytical pavement
design and the development of end performance-based specifications, where the use of polymers features significantly.

The road designer can now specify asphalt in terms of critical performance metrics. Having the ability to test and measure the key performance properties has also enabled the benefits of using polymers in asphalt to be recognised. The asphalt engineer is now able to determine the ideal mixture of constituents necessary to deliver a required level of performance. Whereas using polymer-modified binders increases the asphalt material cost per tonne, PMB can help to reduce the overall asphalt cost per m² by enabling the asphalt to be laid in thinner layers without compromising durability and performance. Polymer-modified asphalts are usually specified when standard bitumen grades or other more economic additives such as cellulose fibres are perceived to be unable to deliver the required level of performance. Interestingly fibres, which contain polymers, are not regarded as ‘polymers’ in the asphalt industry because they do not alter or modify bitumen rheology in the same way as thermoplastic or elastic polymers; rather they are used to prevent binder drainage at elevated temperatures in high stone content mixtures by effectively ‘holding’ the bitumen on the aggregate skeleton.

New laboratory testing equipment such as the Nottingham Asphalt Tester (NAT) (a.9) is now used on a routine basis by the asphalt industry for assessing the mechanical properties of asphalt designs related to contract end performance specifications (Figure 9). The development of the NAT is a good example of how all sides of the asphalt industry can work together successfully with a common aim to improve the performance of asphalt roads, thereby offering better value for money to the road user. The NAT can be a useful tool for comparing the performance of different types of polymer-modified binders for use in asphalt to determine which ones offer the best value for money by balancing performance against cost.

2.5 Environment/Sustainability Issues

2.5.1 Legislative Drivers

Over recent years EU legislation has had a profound effect on the construction industry, and in particular the aggregates and asphalt sector. The industry is being encouraged, through fiscal instruments, such as landfill tax and the aggregates levy, to reduce waste generation, reduce disposal through re-use/recycling, reduce the use of primary materials, thereby protecting our finite mineral reserves, and reduce material movements, i.e., to use in situ materials where possible, facilitated by the use of ground stabilisation techniques using hydraulic binders, such as lime, Portland Cement, ground granulated blastfurnace slag (GGBS) and pulverised fuel ash (PFA). The latest revision of Mineral Planning Guidance (MPG6) further encourages the utilisation of secondary aggregates, setting new targets aimed at increasing the market share that currently sits at 24%. Some 50 million tonnes of recycled and secondary aggregates were used in the UK in 2001 with
over 400 companies now involved in processing and supplying recycled or secondary aggregates. Recyclate streams flow from both the private and public sectors, i.e., roads, buildings and bridges all produce arisings from construction and demolition waste which can be a valuable source of secondary aggregates. Other examples of EU and national policy affecting the growth in market share for secondary aggregates include the EU Waste Framework Directive, the EU Landfill Directive and the National Waste Strategy, all aimed at reducing the amount of material going to landfill and encouraging recycling and favourable planning policy towards recycling operations.

The local authority Agenda 21 initiative is one example of government policy affecting sustainable development, where local authorities are set targets by central government to develop local strategies aimed at protecting the environment and contributing towards a more sustainable society. Companies are also increasingly becoming good corporate citizens by implementing policies aimed at minimising environmental impact. The quarrying industry in particular has over recent years taken great strides towards environmental protection.

Certain industries (in particular steel making, electricity generation, foundries, slate, china clay and incineration of domestic waste) produce viable sources of secondary aggregates. Other major sources of secondary aggregates include construction and demolition waste, mixed highway arisings, road planings (these are produced when removing an old worn out asphalt road surface - it is basically planed up then crushed into aggregates), and crushed glass.

### 2.5.2 Availability of Secondary Aggregates

The current and future availability of secondary, manufactured and recycled aggregates in the UK, given in Table 1 highlights the main sources. The materials that offer significant growth potential are notably construction and demolition waste, incinerator bottom ash (IBA), and china clay sand and slate waste. All of the other sources listed are either fully utilised, are declining industries or have insurmountable distribution difficulties. IBA is perhaps a less well-known source and is worthy of note. It is the main by-product of the incineration of municipal waste in Energy from Waste (EfW) plants. Typically 25% of the input to an EfW plant becomes IBA. The unprocessed IBA contains small proportions of both ferrous and non-ferrous metals as well as unburnt waste. It is forecast that by the year 2020 there will be some 50 Mt per year of domestic waste produced in the UK which will be unable to be landfilled due to prevailing legislation. This means that a significant portion of this will be incinerated which, if current forecasts prove correct, could result in around 6 Mt per year of IBA aggregate (IBAA) being produced.
EU legislation related to environmental protection has started to impact on the asphalt industry in recent years. Directives aimed at reducing the amount of waste generated, increasing re-use and recycling, and protecting worker safety are now all impacting on product standards, specifications and industry guidance, driving asphalt companies to react accordingly by adopting new practices and developing new materials. Basically these directives are driving the development of a more sustainable construction industry.

The asphalt industry has made a considerable contribution towards the local authority Agenda 21 initiative by using increasing amounts of recycled aggregates (see Figure 10) in asphalt products and also by developing tougher, more robust asphalt materials that can be laid in thinner layers (thin asphalt surfacings), thereby using less material, and which result in quieter surfaces, i.e., result in reduced traffic noise. Modern asphalts designed using analytical testing techniques should result in longer lasting roads requiring less frequent maintenance, i.e., the development of more durable asphalt materials will make a significant contribution towards the development of a sustainable highways sector.

New recycling techniques based on using the existing road as a linear quarry (digging up and reusing an old road), thereby minimising the need to use primary aggregates, are also growing in acceptance. All of these initiatives contribute towards helping to conserve finite mineral reserves and to protect the environment.

A significant environmental benefit derived from the development of proprietary thin asphalt surfacings is that they reduce noise levels generated by traffic. This has been measured for a number of different products on the market and they have been found to offer noise reductions in the range 4-8 dB. This represents a significant equivalent reduction in traffic volume, with figures of around 50% claimed by some suppliers. Many of these proprietary asphalt products make use of performance-enhancing polymer-modified bitumens, whilst others use cellulose fibres.

In keeping with meeting customer demands for environmentally friendly ‘green’ products, the asphalt industry, particularly within the EU, has also been investing in the development of ‘low energy’ asphalts. These materials essentially require less energy to manufacture compared to conventional hot-mix asphalt materials.

Low energy asphalts, are produced using one of two distinct technologies:

(1) ‘Cold-Mix’ technology using foamed or emulsified bitumens, and
(2) ‘Warm-Mix’ technology using combinations of foamed, emulsified or powdered binders.

These technologies have actually been around for many years, particularly within mainland Europe and further overseas. Foamix technology, for example, has been used in Canada for several decades and emulsion-based cold mix asphalts (see Figures 11 and 12) have become established in places such as France and Scandinavia. The use of such materials in the UK is still relatively low. However, Foamix asphalt is now gaining in popularity with clients on the back of industry-led research that has validated its performance (a.10). Of these emerging low energy technologies, only emulsion asphalts currently make use of polymers to enhance performance. Apart from offering low energy materials, these technologies also make a significant contribution towards maximising the use of recycled aggregates.

More recently, the development of full-depth porous pavements (drainage pavements) has emerged, driven by changing land use from rural to urban with increasing flood risk. Developing a site, with hard paved areas and roofs, prevents the natural dissipation of rainwater

![Figure 10](image1.png)

**Figure 10**
Market demand for primary and secondary aggregates between 1994 and 2003

![Figure 11](image2.png)

**Figure 11**
Cold lay asphalt being used to repair a road
and increases both rate and volume of runoff water. The adverse effects of inappropriate development are cumulative and can lead to significant problems in the longer term. The Department for Transport, Local Government and the Regions (DTLR) Planning Permission Guidance Note 25 suggests that sustainable urban drainage systems (SUDS), which mimic the natural processes of recycling rainwater back to the air and ground, should be implemented. The Environment Agency is empowered by the government to advise planning authorities on development and flood risk matters, to use their powers to guide developments away from areas that may be affected by flooding, and to restrict development that would increase the risk of flooding. Polymer-modified binders are used particularly in the surface course layer to enhance long-term durability.

Further information on these environmentally-friendly asphalt technologies may be obtained from:

- Tarmac (a.6), for foamed bitumen technology and drainage pavements
- Nynas Bitumen (a.11), for cold-mix emulsion technology
- Shell Bitumen (a.12), for warm asphalt mix technology

### 3 Key Bitumen Properties

#### 3.1 Background

Bitumen has been in use as an essential construction material for thousands of years due to its binding and waterproofing nature. Above 100 °C, bitumen is a highly viscous liquid. It hardens at lower temperatures, tending to become hard and ultimately brittle at sub-zero temperatures.

In most highway applications, paving grade bitumens do a perfectly good job in meeting the demands of the UK’s busy road network, though there will be situations where the use of polymers is preferred. This may be required, for example, to improve asphalt’s resistance to permanent deformation at elevated service temperatures, to improve the asphalt’s ductility to reduce the risk of thermal cracking at low temperatures, to improve binder aggregate adhesion to reduce risk of aggregate stripping, or to lay asphalt surface courses in very thin layers (<25 mm) whilst maintaining texture retention, durability and delivering higher levels of traffic noise reduction. Today, more than 5 million tonnes of PMB is used by the global roads’ industry per year.

Since polymers used to modify asphalt behaviour are effectively modifying the bitumen component in the
mixture, it is appropriate for bitumen to be discussed briefly with some discussion of how polymers actually modify bitumen properties.

### 3.2 Bitumen Characteristics

#### 3.2.1 Background

Bitumen is derived from crude oil by subjecting it to a controlled distillation process that removes the light fractions (distillates), leaving bitumen as a heavy residue. Bitumen is a viscoelastic material and is particularly temperature sensitive. It is also prone to permanent deformation under an applied load, with the rate of deformation dependent on the bitumen grade, asphalt composition, ambient temperature, level of stress and load time.

#### 3.2.2 Bitumen Chemistry

The source and type of crude oil influences the bitumen chemical composition, which in turn influences its physical properties. Bitumen consists of complex hydrocarbons containing calcium, iron, manganese, nitrogen, oxygen, sulfur and vanadium. Bitumen structure varies for each crude oil and is impossible to map accurately. Bitumen chemistry is determined approximately using a saturates-aromatics-resins-asphaltenes (SARA) analysis to compare composition with rheology. There are approximately 1,500 sources of crude oil worldwide, mainly in the USA, Mexico, South America, the Caribbean, the Middle East and the old Soviet states, although relatively few are suitable for bitumen production.

#### 3.2.3 Bitumen Ageing

Bitumen ages (oxidises) in the presence of air, particularly when reduced to a thin film on an aggregate particle during asphalt production, storage and transportation when it is maintained at elevated temperatures. Oxidation leads to bitumen hardening and ultimately embrittlement. This results in asphalt failure in the form of adhesion failure with aggregate loss (fretting in the surface course) and cracking. Asphalt hardening in the base layers is thought to be helpful as it improves stiffness which contributes to improved performance. The rate of age hardening depends on a number of factors, most notably the composition of the asphalt mixture, the binder film thickness, the air void content of the asphalt and the bitumen composition. Air voids are particularly important; if air is unable to penetrate dense asphalt mixtures easily, then the rate of oxidation will be much slower compared to an open graded (a lower density more porous material – basically less dense due to the aggregate grading) material. Polymers can assist with helping to reduce ageing affects by enabling softer bitumen grades to be used without compromising resistance to high temperature rutting. Polymers are also claimed to improve binder aggregate adhesion, which will reduce binder stripping caused by water ingress, hence maintaining the asphalt mixture integrity and structural strength (stiffness). There are a number of test methods for characterising the resistance to ageing, most notably the rolling thin film oven test (RTFOT), which is specified for standard bitumen grades to simulate the oxidation that takes place during asphalt mixing, transportation and laying. Another ageing test is the high pressure ageing test (HiPAT), which uses lower test temperatures but higher pressures. Over recent years new tests for asphalt mixtures have been developed to take account of the binder aggregate interaction, and to understand the extent to which this influences ageing.

### 3.3 Standard Bitumen Specification Tests

Bitumen gives a complex response to applied stress, dependent on loading time and temperature. There are many empirical tests available for characterising the behaviour of bitumen, which are controlled by different Standards bodies, e.g., BSI, the Energy Institute and ASTM, with some differences between the various versions. However bitumen paving grades used for asphalt roads are usually classified in terms of penetration value (pen) measured at 25 °C reported in dmm (Figure 14) and the softening point reported in °C (Figure 13). These values are then used to designate the bitumen grade. There are other empirical specification tests available, but these are the main ones used as a proxy (approximation) for assessing the bitumen’s resistance to permanent deformation.

Tests are also available for measuring the dynamic viscosity of the bitumen at temperatures in the range 100-190 °C, which is particularly important for assessing pumpability and aggregate coating (Figure 15). This test involves heating bitumen in a sample chamber under controlled conditions and introducing a rotating spindle and measuring the torque resistance, which is converted and displayed automatically as a viscosity readout usually in centipoise (cP).
**Figure 13**
Ring and ball apparatus used in the bitumen softening point test

**Figure 14**
Bitumen penetration test apparatus

**Figure 15**
A Brookfield viscometer used for measuring bitumen dynamic viscosity
Other tests are available for measuring bitumen viscosity at lower temperatures. These may be important for assessing the risk of embrittlement, particularly if the bitumen is used in cold climates. The other main tests used in UK bitumen specifications include resistance to hardening (ageing), the flash point (required for safe handling), and solubility (used to assess purity).

For further information on bitumen tests, contact the Refined Bitumen Association (a.3).

### 3.4 Polymer-Modified Binders

#### 3.4.1 Background

Polymers in the main are used to modify bitumen properties in some way to effect a perceived improvement in asphalt performance. Improvements in the mechanical or structural properties of asphalt by using polymer-modified binders can sometimes be difficult to measure. For example, elastomeric polymers (see Section 5.2.1) can often result in a decrease in stiffness, although some improvement in deformation resistance and cohesive strength can be obtained. Polymers are usually used to:

- reduce rutting, i.e., permanent deformation,
- improve asphalt cohesive strength, and
- reduce risk of low-temperature thermal cracking by reducing the temperature susceptibility of the bitumen.

This section will touch upon these issues and also refer to how polymers affect bitumen rheology.

#### 3.4.2 Reducing Permanent Deformation (Rutting)

The improvement in the deformation resistance of the asphalt when using an elastomeric polymer-modified binder is illustrated in Figure 16. This shows how the binder when subjected to an applied load (stress) exhibits initial deformation (strain), then as the load is eventually removed the binder demonstrates some elastic recovery. However, overall, the binder suffers a degree of permanent deformation which would ultimately result in rutting under continued traffic loading. Polymers are mainly used to improve the binder’s elastic component, thereby delaying the onset of permanent deformation (Figure 17) by enhancing the binder’s ability to recover after each load cycle is removed. This is certainly the case for elastomeric polymers, whilst plastomeric polymers work in a different way by stiffening the bitumen rather than making it more elastic.
3.4.3 Improving Asphalt Cohesive Strength

Certain polymers can significantly improve bitumen cohesive strength as measured by the Vialit Pendulum test (a.13). This can be a useful test for ranking different polymer-modified binders for use in ATS systems.

A test for assessing the cohesive strength of asphalt has been developed by the Transport Research Laboratory (TRL). Called the scuffing test, it subjects asphalt test specimens to repeated tyre loads applied at an angle over a small test area for a pre-determined period and at a specified test temperature. The rut depth is measured at the end of the test to provide a qualitative measure of comparable performance between different binder grades using the same asphalt mixture or between different asphalt mixtures. Asphalts containing polymer-modified binders are known to demonstrate improved performance, i.e., reduced rate of rutting, in this test compared to standard asphalts. This is a useful test for differentiating between different types of polymer-modified asphalts.

3.4.4 Reduced Temperature Susceptibility (Thermal Cracking)

Elastomers are well known for reducing the temperature susceptibility of bitumen by elevating the softening point and reducing the brittle point. This means compared to standard bitumen grades, modified binders flows less at higher temperatures (increased viscosity) and are less brittle (more elastic) at lower temperatures. Thus the asphalt remains rut resistant at elevated surface temperatures during summer months and is less prone to thermal cracking at sub-zero temperatures during the winter. Elastomers are also claimed to improve the ‘fatigue resistance’ of asphalt properties which is an indication of improved durability, i.e., less prone to fatigue-induced cracking under repeated dynamic load.

Using plastomers such as ethylene vinyl acetate (EVA) to modify asphalt behaviour typically results in enhanced elastic stiffness and improved deformation resistance at elevated temperatures. However, plastomeric modifiers are known to have inferior low-temperature properties compared to elastomeric modifiers, i.e., they make the binder stiffer and more prone to low-temperature thermal cracking. This is not thought to be a significant issue for use in the UK but it could be in colder climates.

3.4.5 Modifying Bitumen Rheology

Bitumen is viscoelastic in nature. Viscous materials (liquids) flow under an applied stress and remain deformed when the stress is removed, whereas elastic
materials deform under applied load but tend to recover to their original state when the stress is removed. Paving grade bitumens behave as viscous fluids at high service temperatures (typically >60 °C) and as elastic materials at low ambient temperatures (typically <5 °C) although this behaviour is also dependent on the loading frequency, i.e., it is related to speed and axle loads of passing vehicles.

Over recent years the bitumen industry has been striving to develop more sophisticated tests for quantifying the viscoelastic behaviour of bitumens, and the use of dynamic shear testing has emerged as an apparently convenient method for doing this. A thin film of bitumen or binder under test is subjected to an alternating shear stress whilst measuring the resultant alternating shear strain. The stress-strain ratio is termed the complex stiffness modulus \((G^*)\). The difference between the shear stress and shear strain is known as the phase angle \((\delta)\) and is shown in Figure 18.

Whereas elastic materials exhibit a zero phase angle, viscous materials (fluids) show a 90° phase angle, and viscoelastic materials are characterised by values in between. For paving grade bitumens the phase angle is also influenced by load time (frequency) and test temperature, i.e., the lower the temperature the more elastic behaviour is exhibited, whilst at higher test temperatures, for example above 70 °C, bitumen demonstrates viscous behaviour. Similar measurements can be observed when comparing long load times at low temperatures with short load times at higher temperatures. Bitumen’s viscoelastic behaviour when measured over a range of temperatures and frequencies can be characterised using a master curve. A dynamic shear rheometer (DSR) is used for producing master curves.

A standard testing frequency of 0.4 Hz is referred to in Clause 928 of the Specification For Highway Works (a.14), representing slow moving traffic and the standard master curve is based on a plot showing complex stiffness modulus \(versus\) frequency at 25 °C. Trying to link bitumen viscoelastic behaviour to asphalt performance, and in particular asphalt failure mechanisms, is the subject of ongoing industry research.

The role of polymers is essentially to make bitumen more elastic, to reduce the risk of permanent deformation caused by viscous flow under applied loading. For unmodified bitumens the phase angle increases with increasing temperature, however, by introducing appropriate polymers the elastic recoverable component is reinforced and the phase angle is reduced accordingly. Of the types of polymers in everyday use it is the elastomeric polymers such as styrene-butadiene-styrene (SBS) which have the greatest impact on the phase angle recovery.

Testing equipment for characterising bitumen rheology, such as the DSR (Figure 19), has been around for many years and has been the subject of considerable development at industry level over the past ten years, resulting in its inclusion in the Specification for Highway Works (Manual of Contract Documents for Highway Works; MCHW 1). Being able to precisely measure bitumen rheology is seen as a key stepping stone towards the development of performance-based...
Another way of representing the extent to which polymers modify bitumen rheology is to plot the complex stiffness modulus ($G^*$) against the phase angle ($\delta$) – termed a Black Diagram. Figure 20 shows how a particular polymer-modified binder (PMB2), appears to be significantly more elastic by having a smaller phase angle compared to PMB1 and an unmodified bitumen. The difference in rheology between PMB1 and PMB2 is entirely due to the different polymer types used. It also demonstrates that polymer modification is not always beneficial, as PMB1 appears to perform in a manner not too dissimilar to the unmodified bitumen.

4 Key Asphalt Properties

4.1 Temperature Susceptibility

The mechanical properties of asphalt need to be designed to cope with the nature and speed of site traffic under the prevailing climatic conditions. Basically slow-moving heavy goods vehicles with high axle loads will impart significantly higher load stresses on asphalt than a fast moving car. For example, the slow lane of motorways will receive much higher stress levels than the outside lane so for this reason is more prone to rutting, particularly during the warmer summer months.

Because bitumen properties are temperature susceptible due to it’s viscoelastic nature, this means that asphalt behaves in a similar manner. In simple terms asphalt will soften during periods of warm/hot weather and become harder or stiffer during cold winter months. This means that the asphalt engineer has to take this into account when designing asphalt so that it doesn’t rut under traffic loading during summer months or crack during colder periods and, importantly, to ensure the asphalt road achieves its design life. Polymers help to reduce the temperature susceptibility of bitumen by elevating the softening point and lowering the brittle point, thereby reducing the risk of asphalt rutting and cracking. Polymers also reinforce the binder, making it tougher with enhanced cohesive strength.
4.2 Factors Influencing Asphalt Stiffness

Probably the most important mechanical property for asphalt is elastic stiffness. There are a number of variables which influence asphalt stiffness, however, the bitumen grade and content and aggregate type are especially significant assuming adequate compaction is achieved. The thermal history of the material will also influence the asphalt stiffness, particularly as measured on cores removed from the road surface. Because of the number of variables and the complexities involved, it is not uncommon for widely varying stiffness values to be measured on cores extracted from the same site. This is why it is important to adopt a statistical analysis on core test data when determining asphalt stiffness in situ.

4.3 Standards for Asphalt Mixtures and Flexible Pavement Design

There are two essential British Standards that advise the asphalt engineer on how to select the most appropriate constituent materials for use in asphalt: BS 4987 covering macadams (a.15) and BS 594 for hot rolled asphalt (HRA) (a.16). Macadams derive their stability mainly from coarse aggregate interlock with less dependency on the binder grade, whereas HRA mixtures derive their stability from the bitumen/filler mastic matrix and the use of harder grade bitumens.

Appropriate test methods to be used when designing asphalt are covered by BS 598 (a.17).

The Specification For Highway Works (MCHW 1) 900 series and Volume 7 Design Manual for Roads and Bridges (a.18) provide essential guidance on materials and pavement design respectively for the highway engineer.

4.4 Measuring Mechanical Properties

Since the arrival of the NAT, asphalt engineers have been able to use this equipment to measure three main properties: elastic stiffness, deformation resistance and resistance to fatigue cracking.

4.4.1 Elastic Stiffness

Measuring the elastic stiffness of asphalt mixtures is important because it provides an indication of the pavement’s performance under applied traffic load. In simple terms, the stiffer the asphalt the more resistant it will be to deforming or cracking under dynamic traffic load. However, if the asphalt becomes too stiff it may become brittle and prone to thermal or fatigue cracking. In terms of asphalt pavement design, it is the ‘base’ layer which provides the main load-spreading function.

Figure 20
A Black diagram showing bitumen complex stiffness modulus ($G^*$) plotted against the phase angle ($\delta$) for three different binders

Courtesy of Nynas Bitumen
Traffic load is translated through the thin surface course layer downwards into the binder course and base layers below. The surface course stiffness is less significant in terms of contributing towards the overall load-spreading ability of the pavement.

The NAT is used for measuring the indirect tensile stiffness modulus (ITSM) of asphalt, reported in MPa. Measuring stiffness in isolation is, however, no guarantee of pavement durability which can be influenced by other factors. Polymer-modified binders do not necessarily enhance asphalt stiffness, although certain plastomeric polymer types will do this. Elastomeric PMB on the whole tend to result in reduced asphalt stiffness but improved cohesive strength, although certain PMB based on elastomeric polymers can be designed to increase asphalt stiffness.

A recent development is the measurement of retained stiffness, by re-testing the asphalt after soaking in water and repeated over three test cycles. This is thought to provide a further indication of the material’s likely durability and is especially useful when vetting new mixture constituents.

### 4.4.2 Deformation Resistance

Resistance to permanent deformation can be measured on the NAT machine or alternatively by using wheel tracking equipment (Figure 21). The NAT machine tests cylindrical specimens in the repeated load axle test (RLAT) mode. The wheel tracker uses compacted asphalt slabs that are loaded with a tyre wheel as it passes over the test area for a predetermined period at a set temperature, usually 45 °C or 60 °C. The rut depth and rut rate are reported in mm and mm/h, respectively.

### 4.4.3 Fatigue Cracking

Whereas stiffness and deformation resistance are often specified, fatigue resistance is rarely specified and is mainly an area of ongoing research. Fatigue cracking in asphalt is related to binder hardening or ageing that is affected by a number of factors. Bitumen starts to harden due to oxidation during asphalt production. The rate of hardening is dependent on the mixing temperature, the residence time in the asphalt plant during mixing, time spent in the delivery vehicle prior to compaction, and the binder film thickness coating the aggregate. The type and source of crude oil from which the bitumen is derived is also thought to influence the manner in which bitumen ages. Bitumen hardening (also known as curing) is thought to have a beneficial affect by enhancing asphalt stiffness, although over time the bitumen will eventually age to a point where it becomes brittle leading to adhesion failure and cracking. Some polymers are claimed to effectively slow down the bitumen ageing process and thus improve asphalt’s resistance to fatigue cracking.

![Figure 21](image_url)

Wheel tracking machine used for assessing asphalt resistance to permanent deformation (rutting)
4.4.4 Adhesion between Aggregates and Binders

PMB are usually associated with improved aggregate adhesion, and there are a number of tests available for assessing this improvement, the most common being the total water immersion test (TWIT) that involves a visual assessment of bitumen-coated aggregates before and after soaking in water over a pre-determined period. Poor adhesion can lead to aggregate stripping in service linked to water ingress. The degree of compatibility between aggregate mineralogy and bitumen chemistry is thought to influence adhesion.

5 Polymers Used in Asphalt

5.1 Overview

The various proprietary polymer-modified binders used in the UK asphalt industry are based mainly on thermoplastic elastomers or thermoplastic plastomers (Figures 22 and 23), although there is also some experience in using thermosetting binders based on epoxy resins. The essential differences between elastomeric and plastomeric polymers are however, becoming less

Figure 22
Examples of different polymers used in asphalt - SBS/EVA

Figure 23
Examples of different polymers used in asphalt - latex/wax
obvious with continuous research in this area, particularly with the growth in co-polymer technologies. This section will briefly review the relative characteristics and benefits of these two main polymer types.

Other bitumen modifiers, such as natural rubber latex, pulverised crumb rubber and waste plastic, have been trialled. Certain chemical modifiers, e.g., sulfur and organometallic compounds, have also been trialed and claimed to have a finite stiffening effect on bitumen. However, all of these have proven to be less successful in use due to inferior performance, cost and health and safety grounds. A more practical reason restricting the use of different polymer-modified binders is the need for dedicated storage tanks, which is costly and potentially problematic for asphalt producers. Asphalt plants often have restricted areas for accommodating additional PMB tanks, and fluctuating market demand for polymer-modified asphalt means PMB can be left in hot storage for lengthy periods, sometimes resulting in remedial action being necessary to rectify the binder (take remedial action to return the binder’s properties back to being within specification). This is less common these days, however, due to improvements made by the bitumen supply industry in providing guidance on how to safely manage bitumen in storage.

5.2 Different Polymer Types

5.2.1 Elastomers

Elastomers are the most commonly used polymers in UK asphalt highway products. The most frequently used elastomers include synthetic thermoplastic rubber polymers, such as SBS (Figure 24), styrene butadiene rubber (SBR), styrene ethylene butadiene styrene (SEBS) and polybutadiene rubber (PB). Typical elastomeric polymer properties are listed in Table 2. However, in practice, SBS-type polymers have emerged time and again as offering the optimum combination of performance, reliability, ease of use and economy.

Styrenic block copolymers are based on styrene, butadiene and isoprene feedstocks. The styrene is polymerised in a precisely controlled reaction with either butadiene or isoprene. Both linear copolymers and radial (or branched) copolymers can be produced, with the latter usually having superior structural properties in terms of bitumen modification. It is the polystyrene (PS) component that imparts strength and elevates the bitumen softening point, whilst the butadiene component is responsible for making the binder more elastic. The polymer constituents will disassociate at elevated temperatures, then recombine to form a three-dimensional polymer matrix throughout the bitumen as the binder cools. The polymer constituents ultimately influence the properties of the end product. For example, SBS is suitable for footwear and the modification of bitumen/asphalt.

A great deal of information has been published on the use of polymer-modified bitumens over the past 30 years and an excellent source of reference is the Shell Bitumen Handbook (a.20). The Kraton Chemicals website (a.21) also provides a good reference source, although there are a number of polymer suppliers able to provide similar information.

![Figure 24](Diagrammatic representation of the physical structure of SBS polymers)

<table>
<thead>
<tr>
<th>Property</th>
<th>Radial SBS 30% bound styrene</th>
<th>SEBS</th>
<th>SBR</th>
<th>SIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength, MPa</td>
<td>18</td>
<td>35</td>
<td>0.5</td>
<td>15</td>
</tr>
<tr>
<td>Elongation at break, % at 25 °C</td>
<td>800</td>
<td>500</td>
<td>900</td>
<td>1200</td>
</tr>
<tr>
<td>Specific gravity, g/cm³</td>
<td>0.94</td>
<td>-</td>
<td>-</td>
<td>0.93</td>
</tr>
<tr>
<td>Hardness Shore A</td>
<td>81</td>
<td>-</td>
<td>-</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 2 Typical elastomeric polymer physical properties


5.2.1.1 Elastomeric Modification of Bitumen

Elastomeric polymers such as SBS modify bitumen rheology by enhancing the elastic component in the bitumen and effectively reducing the viscous component (see Section 3.4.2 and Figure 16). This results in improved elastic recovery after removing an applied stress, thus reducing the risk of permanent deformation. This also results in the temperature susceptibility of the PMB being reduced so the asphalt has reduced risk of rutting, particularly at elevated surface temperatures, and is less prone to thermal cracking at low ambient temperatures.

5.2.1.2 Manufacture of Elastomeric PMB

It is particularly important when manufacturing elastomeric PMB to ensure that the polymer is well dispersed throughout the bitumen, i.e., to achieve complete dissolution. This is usually achieved by using a purpose-built blending plant able to pump large volumes of PMB through a high shear mixer at elevated temperatures. The system configuration and the sequential process steps need to be designed and controlled to ensure the desired product is produced.

The shearing action of the mixer effectively mills the SBS pellets into micron sized particles, thereby increasing the polymer surface area and facilitating intimate contact between bitumen and polymer. The polymer absorbs some of the maltene/resin fraction present in the bitumen, resulting in rubber swelling. The end result is a homogenous interconnecting matrix of SBS polymer dispersed throughout the bitumen that significantly alters the binder’s rheology.

The extent to which the polymer modifies the bitumen rheology is dependent on a number of factors: polymer type and content, the degree of polymer dispersion, the compatibility between the polymer and the bitumen, and the thermal history. It is important not to overheat polymers such as SBS in bitumen for prolonged periods as it can lead to polymer degradation, which then adversely impacts on binder and asphalt performance.

The polymer/bitumen compatibility is especially important as it affects the long-term storage behaviour. Incompatibility leads to polymer phase separation, resulting in a polymer-rich upper layer in the storage tank. The resultant binder is unusable and remedial costs high, so bitumen companies go to great lengths to ensure this does not happen.

Compatibility is usually assessed in the laboratory by pouring the PMB into a vertical container, then storing it in an oven at elevated temperature typically for seven days before sampling the container from the top and bottom and measuring any difference in softening point between the layers. The PMB is deemed to be compatible if the difference is less than 5 °C.

Bitumen companies employ stringent quality control procedures to ensure PMB are manufactured correctly and comply with the quality supply specification agreed with the asphalt manufacturer. Table 3 shows typical properties of a 160/220 grade bitumen after modification with different polymer types. A simple test for checking polymer dispersion is the ring and ball softening point test because poor dispersion will result in a lower than expected softening point. Another way of assessing polymer dispersion is to look at a thin binder film under a microscope. The appearance of an SBS type polymer is shown in Figures 25 and 26 during and after mixing, respectively, using a high shear mixer at elevated temperatures, e.g., 180 °C.

<table>
<thead>
<tr>
<th>Polymer type</th>
<th>Pen at 25 °C,</th>
<th>Ring and Ball Softening Point, °C</th>
<th>Elastic Recovery at 5 °C, %</th>
<th>Fraass Breaking Point, °C, maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>160/220 grade bitumen control</td>
<td>160 - 220</td>
<td>35 - 43</td>
<td>N/d</td>
<td>-15</td>
</tr>
<tr>
<td>SBS (5%)</td>
<td>70 - 110</td>
<td>75 - 95</td>
<td>&gt;50</td>
<td>-20</td>
</tr>
<tr>
<td>SEBS (3%)</td>
<td>60 - 100</td>
<td>65 - 85</td>
<td>&gt;50</td>
<td>-18</td>
</tr>
<tr>
<td>SBR (5%)</td>
<td>100 - 130</td>
<td>56</td>
<td>&gt;70</td>
<td>-15</td>
</tr>
<tr>
<td>PB (1.5%)</td>
<td>106</td>
<td>48</td>
<td>&gt;80</td>
<td>-30</td>
</tr>
</tbody>
</table>

Fraass breaking point: This is the temperature at which a thin film of bitumen cracks when subjected to an applied strain
N/d: not determined
5.2.1.3 Availability of Elastomers

Elastomeric polymers are widely available from a number of major suppliers such as Kraton Chemicals and AtoFinaElf. They are usually made available in the form of porous pellets supplied in small bags, big bags or boxes for ease of handling. Porous pellets have good solid flow characteristics for handling and high bulk density for storage, and are well suited for systems equipped with high shear mixers.

Some elastomers are sold in different morphologies, e.g., in powder form to facilitate dispersion into the bitumen when a high shear mixer is not available. These tend to have lower molecular weight and as such offer a slightly reduced level of modification.

5.2.2 Plastomers

Plastomers are the second most popular polymer type used in UK asphalt highway products. The most
commonly used plastomer is EVA. There are a number of grades available, varying in terms of vinyl acetate content and molecular weight, which is usually defined in terms of a melt flow index. Table 4 shows typical plastomeric polymer physical properties. The type of EVA used influences the degree of bitumen modification obtained, and this is usually reflected in the modified binder’s penetration value, softening point to a lesser extent, dynamic viscosity and asphalt stiffness.

Other types of plastomers, including ethylene methyl acrylate, polypropylene (PP), PS and polyethylene (PE), have also been evaluated for use in asphalt although have proven to be less successful. They appear to make the bitumen too stiff and brittle, increasing the risk of premature asphalt failure. Some of these polymers are derived from sources of waste plastic, although refined to provide a consistent product.

EVA is thermoplastic in nature, and apart from being used in asphalt is also used in hot melt glues. One of the most common grades of EVA used to modify bitumen for use in asphalt is grade 18/150. This classification indicates a melt flow index of 150 and a vinyl acetate content of 18%. Typically 5% EVA by mass of the bitumen content is used in asphalt mixtures.

EVA was one of the first polymers to be used successfully in asphalt applications in the UK and became accepted by the Highways Agency and many local authorities for use in HRA during the 1980s. It essentially stiffens the binder and thereby makes the asphalt more resistant to traffic loading and rutting, particularly at higher road temperatures during hot summers when asphalt surfaces are at higher risk of softening and rutting under traffic.

One of the attractive features of using EVA is that it effectively acts as a diluent at elevated mix temperatures, i.e., typically above 100 °C. The polymer effectively melts and dissociates into the bitumen, thereby reducing the bitumen viscosity. As the temperature cools below 90 °C, the EVA tends to associate (recrystallise) and significantly stiffens the binder, increasing the binder viscosity. It is therefore important that the asphalt is fully compacted before this polymer phase change occurs, otherwise the asphalt could stiffen too quickly resulting in inadequate compaction which may result in premature failure. This problem can be exacerbated when laying asphalt in thin layers during cold winter months since the cooling rates tend to be faster, limiting the working window.

A great deal of information has been published on the use of EVA for modifying bitumen, particularly by polymer supply companies (a.22, a.23, a.24, a.25).

### 5.2.2.1 Plastomeric Modification of Bitumen

Whereas elastomers work by making the binder more elastic with reduced stiffness and improved ductility, plastomers effectively make bitumen stiffer. They reduce the binder’s temperature susceptibility, particularly at high service temperatures, which is important to reduce risk of rutting during hot summer months. However, plastomers are less effective at reducing the risk of low-temperature thermal cracking compared to elastomers.

### 5.2.2.2 Manufacture of Plastomeric PMB

As with elastomeric-modified bitumens, it is particularly important when manufacturing plastomeric PMB that the polymer is well dispersed throughout the bitumen. This is usually achieved by using a purpose-built plant able to blend the plastomer into bitumen at elevated temperatures, typically 170 °C. Plastomers generally melt into bitumen fairly easily at such temperatures so there is no need to use a high shear mixer. The extent to which plastomers modify bitumen rheology is dependent on a number of factors: polymer type and content, the degree of polymer dispersion, the compatibility between the polymer and the bitumen, and the thermal history. Plastomeric-modified binders tend

<table>
<thead>
<tr>
<th>Property</th>
<th>EVA 18/150 grade</th>
<th>EVA 30/45 grade</th>
<th>LDPE</th>
<th>HDPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melt flow index, g/10 min</td>
<td>135-175</td>
<td>38-48</td>
<td>155</td>
<td>16-20</td>
</tr>
<tr>
<td>Density</td>
<td>-</td>
<td>-</td>
<td>0.91</td>
<td>0.94</td>
</tr>
<tr>
<td>Softening point, °C</td>
<td>95</td>
<td>107</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tensile strength, MPa</td>
<td>5</td>
<td>10.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Elongation at break, % at 25 °C</td>
<td>500</td>
<td>800</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
to phase separate in storage due to differences in density and chemical incompatibility between the polymer and bitumen, so it is important that the PMB is stirred or at least circulated in the storage tank to maintain a degree of homogeneity. The same quality control tests are employed for EVA modification of bitumen as are used for SBS. Again microscopic analysis can be used for assessing polymer dispersion (Figures 27 and 28). Typical properties of a 70/100 grade bitumen modified by different plastomers is shown in Table 5.

5.2.2.3 Availability of Plastomers

Plastomeric-type polymers are widely available from major polymer suppliers such as AtoFinaElf (a.23). They are usually made available in the form of pellets supplied in small bags, big bags or boxes for ease of handling. Pellets have good solids flow characteristics for handling and high bulk density for storage, and are well suited for being screw fed or blown into bitumen mixing vessels.
Before ATS were introduced into the UK, the premier asphalt surfacing material was HRA. Whereas ATS rely on having a high stone content bound together with a rich bitumen/filler mastic matrix, HRA works in a different way by having a relatively low stone content, relying on a stiff mastic made of bitumen and filler in combination with a high stability sand to provide the necessary stiffness and resistance to rutting by traffic. Polymers have been used, and are still occasionally used, in HRA mixtures in accordance with clause 943 of the specification for highway works (Performance Related Design Mix). This was introduced after the hot summers of the mid-1990s caused a number of rutting problems across the road network. Hence they tend to be used on very heavily trafficked roads when conventional paving grade bitumens are considered unable to cope. The polymers used tend to be elastomeric (SBS usually) or plastomeric (EVA), however, a key requirement is resistance to rutting at high temperatures i.e., 60 °C.

PMB are also used in a range of proprietary asphalts with special designed functionality, e.g., fuel resisting or coloured surfacings. Fuel resisting asphalt surfaces historically were manufactured using tar-based binders. However, these are no longer used on health and safety grounds as they are deemed to contain carcinogens. Figure 29 shows a proprietary fuel resisting asphalt based on a polymer modified bitumen not tar.

Polymers reinforce bitumen by improving cohesive strength, making it more resilient and tougher. Thin asphalt surfacings are relatively new to the UK following their introduction in the early to mid-1990s. However, today, all of the major asphalt suppliers are able to supply such materials in accordance with clause 942 for thin surface course systems in the specification for highway works (a.14).

Before ATS were introduced into the UK, the premier asphalt surfacing material was HRA. Whereas ATS rely on having a high stone content bound together with a rich bitumen/filler mastic matrix, HRA works in a different way by having a relatively low stone content, relying on a stiff mastic made of bitumen and filler in combination with a high stability sand to provide the necessary stiffness and resistance to rutting by traffic. Polymers have been used, and are still occasionally used, in HRA mixtures in accordance with clause 943 of the specification for highway works (Performance Related Design Mix). This was introduced after the hot summers of the mid-1990s caused a number of rutting problems across the road network. Hence they tend to be used on very heavily trafficked roads when conventional paving grade bitumens are considered unable to cope. The polymers used tend to be elastomeric (SBS usually) or plastomeric (EVA), however, a key requirement is resistance to rutting at high temperatures i.e., 60 °C.

PMB are also used in a range of proprietary asphalts with special designed functionality, e.g., fuel resisting or coloured surfacings. Fuel resisting asphalt surfaces historically were manufactured using tar-based binders. However, these are no longer used on health and safety grounds as they are deemed to contain carcinogens. Figure 29 shows a proprietary fuel resisting asphalt based on a polymer modified bitumen not tar.

Polymers are also used in asphalt ‘bond coats’, which are spray-applied bitumen emulsion products used to promote formation of a good bond between asphalt layers (Figure 30).

Polymers are also used in bitumen emulsions for cold-mix asphalt manufacture. These materials are still under development in the UK, with research driven by the perceived energy savings and reduced carbon dioxide emissions associated with cold-mix asphalt production. Microasphalts and surface dressing maintenance techniques also make use of polymer-modified emulsion binders as discussed in Section 2.2.3.
It is widely acknowledged that using recycled aggregates in construction products will contribute to more sustainable construction. However, there needs to be good technical performance, an economic supply of sufficient quantity, methods of quality assurance and specification, and a market for products of a value appropriate to the costs of producing the processed materials.

Recent work by an industry and research consortium led by Tarmac, with funding from WRAP and the Department for Trade and Industry (DTI), has aimed to develop potential asphalt products incorporating waste plastic and rubber and giving due consideration to the aforementioned factors. A full report on this work can be downloaded from www.trl.co.uk. This work is ongoing, however, laboratory- and pilot-scale field trials have indicated the potential for using manufactured plastic aggregates based on mixtures of waste plastic in asphalt. Figure 31 shows mixed waste plastic after processing into aggregate particle sizes.

Approximately 0.2 million tonnes of plastic are recycled each year, and single-polymer recycled plastic can cost up to several hundred pounds per tonne. Industrial waste plastic arisings are difficult to separate and process, and these are potential sources of plastic ‘aggregates’, including mixed plastics and shredder...
wastes. There are significant volumes of plastic waste being generated from household and agricultural waste, e.g., plastic bottles, containers and packaging, and it is feasible for some of this material to be incorporated into asphalt as an aggregate replacement. The type of plastics/polymers most suited for use in asphalt are olefins such as low and high density polyethylenes (LDPE and HDPE). Although the infrastructure does not currently exist to provide these materials in bulk, changes in waste management regulation mean that these waste streams are likely to become more refined in future to enable applications in downstream markets such as asphalt to avoid landfill disposal costs. Specification of such materials will be problematic, and another significant disincentive to using aggregates generated from waste exists in the current interpretation of waste licensing regulations. This requires that these alternative aggregates be subject to waste regulation until they are incorporated into a product. However, at the time of writing this interpretation of the waste licensing regulations is under review by the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency. The European Aggregates Standards include manufactured and recycled materials, and this may provide opportunities for using manufactured aggregates based on plastic in asphalt mixtures when the new European standards for asphalt are implemented.

8 Legislation

8.1 The Construction Products Directive (CPD)

The main function of the CPD is to regulate and ensure the safety of the construction industry operating within the EU. The essential performance criteria outlined within the CPD are:

- Mechanical resistance and stability,
- Safety in case of fire,
- Hygiene, health and the environment,
- Safety in use,
- Protection against noise, and
- Energy economy and heat retention.

It is important to understand that the performance requirements relate to the total construction and not just the individual component parts, i.e., in the context of this review the total construction is the asphalt road. In support of the CPD requirements, the development of a series of European asphalt product standards is in progress and at the time of writing these are expected to be published in 2006. Product standards which define the performance characteristics of asphalt’s main
constituents, namely aggregates and bitumen, have, however, already been published. These are BS EN 13043 (a.28) and BS EN 12591 (a.29), respectively. Table 6 lists the paving grade bitumens contained within the scope of EN 12591.

The CPD permits three routes to compliance:

- Manufacture in accordance with European Product Standards (Euronorms, i.e., EN)
- Obtain a European Technical Approval (ETA), or
- Manufacture in accordance with a recognised national standard.

For anything specifically required by the Construction Products Directive (CE marking or ETA), EU member states have the responsibility for designating and notifying bodies to operate the attestation procedures required under Article 18 of the CPD. Article 18 is a requirement for both issuing an ETA and for CE marking to an EN. Member states may consider for designation and notification only those product certification bodies, factory production control certification bodies, inspection bodies and testing laboratories that come under their jurisdiction and which therefore are established in their territory. The UK government’s DTI does this with the assistance of the United Kingdom Accreditation Service (UKAS).

8.2 European Product Standards

As mentioned in Section 8.1 at the time of writing European product standards for asphalt have not yet been published. A new series of European Standards for Aggregates came into effect in the UK in January 2004. The relevant aggregates standard for use in asphalt is BS EN 13043:2002 (a.28). Other aggregate standards apply for use in concrete and mortar i.e., BS EN 12620:2002 (a.30) and BS EN 13139:2002 (a.31), respectively. These replaced the previous British Standards applicable to aggregates for use in asphalt, concrete and mortar. As a consequence there are a number of key changes affecting terminology, product descriptions, test methods, factory production control and CE marking. Further information is available on the internet (a.2).

A new European Standard for bitumen, BS EN 12591: 2000 (a.29) was introduced into UK in January 2002. This replaced the existing BS 3690 Part 1 for paving grade bitumens (a.32). However, it does not cover oxidised and hard grades, which continue to be regulated by BS 3690 (a.32). These tend to be used mainly in industrial applications such as roofing and flooring, respectively. Further information on bitumen standards is available on the internet (a.3).

The Energy Institute (a.33) publishes the standards for bitumen test methods associated with the specification EN 12591 (a.29).

Unlike standard bitumen paving grades, polymer-modified binders are not currently covered by European or national specifications. They are treated as proprietary products with individual manufacturers providing quality and performance data to suit specific applications. A provisional European Standard (prEN14023 for polymer-modified binders) is however, being progressed (a.34).

Table 6 Paving grade bitumens in BS EN 12591 (a.29)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Pen Range at 25 °C, dmm</th>
<th>Softening Point, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/30</td>
<td>20-30</td>
<td>55-63</td>
</tr>
<tr>
<td>30/45</td>
<td>30-45</td>
<td>52-60</td>
</tr>
<tr>
<td>35/50</td>
<td>35-50</td>
<td>50-58</td>
</tr>
<tr>
<td>40/60</td>
<td>40-60</td>
<td>48-56</td>
</tr>
<tr>
<td>50/70</td>
<td>50-70</td>
<td>46-54</td>
</tr>
<tr>
<td>70/100</td>
<td>70-100</td>
<td>43-51</td>
</tr>
<tr>
<td>100/150</td>
<td>100-150</td>
<td>39-47</td>
</tr>
<tr>
<td>160/220</td>
<td>160-220</td>
<td>35-43</td>
</tr>
<tr>
<td>250/330</td>
<td>250-330</td>
<td>30-38</td>
</tr>
</tbody>
</table>

8.3 European Technical Approvals

If a product is not covered by a national or European standard, an alternative route to gaining market acceptance for its use across the EU is to obtain a European Technical Approval (ETA). An ETA can only be issued by bodies appointed by EU member states to the European Organisation for Technical Approvals (EOTA).

The BBA is the UK member of the European Union of Agrément (UEAtc), represents the UK in the EOTA and is the body responsible in the UK for the issue of ETA, enabling products to achieve the commercially vital CE mark. The BBA is a national authority in its own right, whose Agrément certificates ‘provide authoritative and independent information on the performance of building
products’. The BBA holds UKAS accreditation for testing, calibration, product conformity certification and management systems certification, ISO 9000 (a.35).

For products not covered by the CPD, e.g., national standards, the UKAS is the sole national accreditation body recognised by government to assess, against internationally agreed standards, organisations that provide certification, testing, inspection and calibration services. Accredited bodies are able to certify, test and inspect company systems and products. UKAS-accredited certification bodies and registered companies can be found in the UK Register of Quality Assessed Companies. UKAS accreditation reduces the need for suppliers to be assessed by their customers. For further information on UKAS, visit www.ukas.com.

As discussed briefly in Section 2.3.2, in the absence of published European Standards for asphalt products, the HAPAS has been established to enable innovative asphalt products, including those containing polymers, to effectively obtain national approval. The HAPAS scheme is administered on behalf of the highways authorities by the BBA. A HAPAS certificate does not yet hold the same status as an ETA, however, this may change in the future as and when EOTA develop guidelines for obtaining an ETA applicable to ATS. However, when the series of European standards for asphalt are published, these will effectively supercede the ETA.

Under HAPAS, a new asphalt material can expect to receive BBA certification typically within three to five years after making an application, depending on how much information is available for auditing by the BBA. This may sound like a long time, but in the absence of such a scheme it really does represent a significant improvement, and this has led to a measurable increase in the use of proprietary polymer-modified binders in asphalt over the past few years.

The HAPAS scheme has been a key development because it enables a level of performance to be specified for an asphalt surfacing related to site conditions. This decision can now be based on an analytical approach to understanding the behaviour of asphalt under traffic stresses as opposed to the previous empirical approach of using ‘tried and trusted’ recipe mixtures. This new approach should represent better value for money to the tax payer by having roads which last longer, require less maintenance and are less disruptive to the road user. It also encourages industry to invest in research and development by providing a relatively quick route for suppliers to gain product approvals.

A HAPAS scheme similar to that developed for ATS is currently under development for the assessment and certification of polymer-modified bitumens. HAPAS certificates provide an independent expert opinion on the performance of highway related products, enabling highway engineers to confidently specify certificated products knowing they have been thoroughly evaluated.

In conclusion, this review has hopefully demonstrated the purpose and value in employing polymers in asphalt not only to improve performance and durability but also to play an important role in making asphalt more sustainable and environmentally friendly. The fact we are now seeing roads being built much faster, using less material and lasting longer is testimony to how far the asphalt industry has progressed over the past hundred years. It is anticipated that in future the role of polymers will become increasingly important in helping to drive forward continuous improvement in the asphalt sector.

Acknowledgements

Many thanks to Dennis Day of Nynas Bitumen UK for proof reading parts 3.4.5 and 5 and for providing the microscopic Figures and some of the tabulated data in Section 5.2 and the Black diagram in Section 3.4.5.
## Abbreviations and Acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIA</td>
<td>Asphalt Industry Alliance</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>ATS</td>
<td>Asphalt thin surfacing</td>
</tr>
<tr>
<td>BBA</td>
<td>British Board of Agrément</td>
</tr>
<tr>
<td>BSI</td>
<td>British Standards Institute</td>
</tr>
<tr>
<td>CPD</td>
<td>Construction Products Directive</td>
</tr>
<tr>
<td>CSS</td>
<td>County Surveyors Society</td>
</tr>
<tr>
<td>DEFRA</td>
<td>Department for Environment, Food and Rural Affairs</td>
</tr>
<tr>
<td>DSR</td>
<td>Dynamic shear rheometer</td>
</tr>
<tr>
<td>DTI</td>
<td>Department for Trade and Industry</td>
</tr>
<tr>
<td>DTLR</td>
<td>Department for Transport, Local Government and the Regions</td>
</tr>
<tr>
<td>EfW</td>
<td>Energy From Waste</td>
</tr>
<tr>
<td>EN</td>
<td>European Norm(s)</td>
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<tr>
<td>EOTA</td>
<td>European Organisation for Technical Approvals</td>
</tr>
<tr>
<td>ETA</td>
<td>European Technical Approval(s)</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EVA</td>
<td>Ethylene-vinyl-acetate</td>
</tr>
<tr>
<td>FBA</td>
<td>Furnace bottom ash</td>
</tr>
<tr>
<td>GGBS</td>
<td>Ground granulated blast furnace slag</td>
</tr>
<tr>
<td>HAPAS</td>
<td>Highway Authorities Product Approval scheme</td>
</tr>
<tr>
<td>HDPE</td>
<td>High density polyethylene</td>
</tr>
<tr>
<td>HiPAT</td>
<td>High pressure ageing test</td>
</tr>
<tr>
<td>HRA</td>
<td>Hot rolled asphalt</td>
</tr>
<tr>
<td>IBA</td>
<td>Incinerator bottom ash</td>
</tr>
<tr>
<td>IBAA</td>
<td>Incinerator bottom ash aggregate</td>
</tr>
<tr>
<td>ITSM</td>
<td>Indirect tensile stiffness modulus</td>
</tr>
<tr>
<td>LDPE</td>
<td>Low density polyethylene</td>
</tr>
<tr>
<td>MCHW</td>
<td>Manual of Contract Documents For Highway Works</td>
</tr>
<tr>
<td>MPG</td>
<td>Mineral Planning Guidance</td>
</tr>
<tr>
<td>NAT</td>
<td>Nottingham Asphalt Tester</td>
</tr>
<tr>
<td>PB</td>
<td>Polybutadiene</td>
</tr>
<tr>
<td>PE</td>
<td>Polyethylene</td>
</tr>
<tr>
<td>PFA</td>
<td>Pulverised fuel ash</td>
</tr>
<tr>
<td>PFI</td>
<td>Private Finance Initiative</td>
</tr>
<tr>
<td>PMB</td>
<td>Polymer modified bitumen(s)</td>
</tr>
<tr>
<td>PP</td>
<td>Polypropylene</td>
</tr>
<tr>
<td>PRD</td>
<td>Percentage refusal density</td>
</tr>
<tr>
<td>PS</td>
<td>Polystyrene</td>
</tr>
<tr>
<td>QPA</td>
<td>Quarry Products Association</td>
</tr>
<tr>
<td>RBA</td>
<td>Refined Bitumen Association</td>
</tr>
<tr>
<td>RLAT</td>
<td>Repeated load axial test</td>
</tr>
<tr>
<td>RTFOT</td>
<td>Rolling thin film oven test</td>
</tr>
<tr>
<td>SARA</td>
<td>Saturates, aromatics, resins, asphaltenes</td>
</tr>
<tr>
<td>SBR</td>
<td>Styrene-butadiene rubber</td>
</tr>
<tr>
<td>SBS</td>
<td>Styrene-butadiene-styrene</td>
</tr>
<tr>
<td>SEBS</td>
<td>Styrene-ethylene-butadiene-styrene</td>
</tr>
<tr>
<td>SHE</td>
<td>Safety, Health &amp; Environment</td>
</tr>
<tr>
<td>SIS</td>
<td>Styrene-isoprene-styrene</td>
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<td>SUDS</td>
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<td>UKAS</td>
<td>United Kingdom Accreditation Service</td>
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<td>WRAP</td>
<td>Waste and Resource Action Programme</td>
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References

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a.29 BS EN 12591, Bitumen and Bituminous Binders – Specifications for Paving Grade Bitumens, 2004.

a.30 BS EN 12620, Aggregates for Concrete, 2004.


a.32 BS3690, Bitumens for Building and Civil Engineering, 1990.
Polymers in Asphalt

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D.J. Carlson, Asphalt-Rubber sets the Bar for Modified Binders, Rubber India, 2003, 55, 11, 13 [Item 3]
P. Gardner Rubberised Asphalt on Test in California, Tyres and Accessories, 2003, 10, 76 [Item 25]


Ford Returns to the Roads, High Performance Plastics, 2003, July, 8, [Item 34]

P. Frantzis, Development of Crumb Rubber Reinforced Bituminous Binder Under Laboratory Conditions, Journal of Materials Science, 38, 7, 1397 [Item 36]


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Technological Progress for Modified Bitumens, Italian Technology, 1999, 3, 170 [Item 142]

Styrene Copolymers for Motorway Surfaces, High Performance Plastics, 1999, November, 9 [Item 143]

Polymers For Bitumen Modification, Exxon Chemical Europe Inc., Brussels, Belgium, 1996 [Item 150]

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Abstracts from the Polymer Library Database

Item 1
Polymer Degradation and Stability
86, No.2, 2004, p.275-82
EFFECT OF THE THERMAL DEGRADATION OF SBS COPOLYMERS DURING THE AGEING OF MODIFIED ASPHALTS
Cortizo M S; Larsen D O; Bianchetto H; Alessandrini J L
Buenos Aires,INIFTA; La Plata,Universidad Nacional; CONICET; CIC
The thermooxidative degradation of styrene-butadiene-styrene block copolymers having different structures and molec.wts. in the presence of asphalt was investigated under different ageing conditions using size exclusion chromatography and IR spectroscopy. The physicochemical properties of the polymer modified asphalts before and after ageing were determined and changes in these properties explained on the basis of the structural modifications arising as a result of thermal degradation. 20 refs.
ARGENTINA
Accession no.903412

Item 2
Reuse/Recycle
34, No.11, Nov.2004, p.83
ROAD PAVING WITH WASTE PLASTIC
It is briefly reported that a sixteen year old girl from British Columbia has received a gold medal and a 2,000 US dollars scholarship at the 2002 Canada-wide Science Fair for PolyAggreRoad, a proprietary road paving material she developed that uses 6% recycled plastic pellets from plastic bottles, 6% asphalt and 88% aggregate.
Ingenia Polymers
CANADA
Accession no.926662

Item 3
Rubber India
55, No.11, Nov.2003, p.13-6
ASPHALT-RUBBER SETS THE BAR FOR MODIFIED BINDERS
Carlson D J
Asphalt-Rubber was first defined in 1988 by ASTM as “a blend of asphalt cement, reclaimed tyre rubber and certain additives in which the rubber component is at least 15% by weight of the total blend and has reacted in the hot asphalt sufficiently to cause swelling of the rubber particles”. Once the appeal and success of the asphalt material started to spread, it caught the attention of oil companies as a means of making healthy profits on modified asphalt binders. The problem is that the majority, if not all the new “rubberised” asphalt binders are blended at the oil terminals and have specifications that require a very fine gradation of rubber. The rubber content of these materials ranges from a low of 3 or 4% to a high of 10%. It is claimed that a minimum of 15% of ground rubber is necessary to achieve the required resistance to reflective cracking.
USA
Accession no.906900

Item 4
Urethanes Technology
BRIDGE TO THE FUTURE
Reed D
PU elastomer materials from Elastogran GMBH (a subsidiary of BASF AG) are at the heart of the “sandwich plate system” (SPS) which was invented by a Canadian engineer and developed with input from the German company. The system, which uses an elastomer layer bonding two sheets of steel, has been used in marine applications, and has now for the first time been applied to a civil engineering application: a bridge in Canada. This article provides full details.
ELASTOGREN GMBH; BASF AG; INTELLIGENT ENGINEERING LTD.; CANAM MANAC GROUP; THYSSENKRUPP ASIA; AUSTRIA; CANADA; EUROPE-GENERAL; EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; MEXICO; NORTH AMERICA; UK; WESTERN EUROPE
Accession no.904536

Item 5
Journal of Materials Science
STYRENE BUTADIENE STYRENE POLYMER MODIFICATION OF ROAD BITUMENS
Airey G D
Nottingham,University
Details are given of the polymer modification of road bitumens using SBR. Six polymer modified bitumens were produced by mixing bitumen from two crude oil sources with an SBR copolymer at three polymer contents. Rheological characteristics were analysed by means of dynamic mechanical analysis using a dynamic shear rheometer. 35 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.906900
STUDY OF RHEOLOGICAL PROPERTIES OF PURE AND POLYMER-MODIFIED BRAZILIAN ASPHALT BINDERS
Da Silva L S; De Camargo Forte M M; De Alencastro Vignol L; Cardozo N S M
Rio Grande do Sul, Universidade Federal

A set of polymer-modified asphalt binders (PMB) was prepared using two Brazilian asphalts and four commercial polymers, i.e. SEBS, maleic anhydride-functionalled PE, and linear and star-shaped SBS. Both pure binders and PMB were analysed by classical and dynamic rotational rheology tests. The rheological analysis results were also compared with storage stability data and data on the morphology of PMB. The fitting capability of the Christensen-Anderson and Christensen-Anderson-Marasteanu rheological models was analysed for the two pure asphalt binders. Both models exhibited lack of fitness in the regions of lowest and highest frequencies. When using elastomeric modifiers, it was possible to demonstrate the existence and interrelation between the width of the phase angle master curve plateau and the thermal susceptibility and stability of PMB. This interrelation was supported by PMB storage stability data and microscopy analysis. 21 refs.

BRAZIL
Accession no.908086

POROSITY OF ASPHALT CONCRETE MADE WITH WASTE SHREDDED-TIRE RUBBER-MODIFIED BINDERS
Celik O N
Selcuk, University

A novel technique, which is based on the Leeds vacuum porosity meter, for measuring the porosity of asphalt concrete is described and applied to an investigation of the porosity of asphalt concrete containing shredded rubber in different amounts and of various particle sizes. 4 refs.

TURKEY
Accession no.909300

ROADS FROM RECYCLED PLASTICS
Plastic bags and other forms of packaging are known to cause litter problems all over the world, it is briefly reported. In a bid to find a solution to this problem, a unique use of recycled plastics has been initiated by Thiagarajar College of Engineering, Madurai, India. The college has conducted extensive research by modifying bitumen with about 10% of recycled plastics, and found that when used in the construction of roads, it enhances the process significantly. Further, the college has developed a special method of incorporating the recycled plastics into the aggregate more uniformly.

Accession no.911587
Item 11
Macplas International
May 2004, p.51
ADHESION ROAD

“Adhesive Road” road-on-a-roll consists of a rolled-up prefabricated asphalt layer with an adhesive base layer, and is used in a pioneering concept in asphalt road construction. Brief details are given of the product, which was developed by a consortium in the Netherlands, and which uses “Kraton” styrene block copolymers from Kraton Polymers.

KRATON POLYMERS
EUROPEAN COMMUNITY; EUROPEAN UNION; NETHERLANDS; WESTERN EUROPE
Accession no.914722

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Item 12
China Synthetic Rubber Industry
27, No.1, 1004, p.39-42
Chinese
STRUCTURE AND PROPERTIES OF SBS MODIFIED ASPHALT
Zuguang L; Shifeng W; Dizhen W
South China, University of Technology; Shanghai, Jiao Tong University

The results are reported of an investigation into the compatibility between styrene-butadiene-styrene triblock copolymer (SBS) and asphalt and the effect of mass fraction of SBS on the structure and properties of the modified asphalt. Various investigative techniques were employed, including DMTA and structural analysis. Increasing SBS mass fraction is shown to give rise to an increase in softening point and ductility and a decrease in penetration and stability. 4 refs.

CHINA
Accession no.916701

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Item 13
Iranian Journal of Polymer Science and Technology
Persian
STUDY OF VISCOELASTIC BEHAVIOR OF BITUMEN-POLYETHYLENE BLENDS
Ershad Langroudi A; Yousefi A A
Iran, Polymer & Petrochemical Institute

The results are reported of an investigation into the viscoelastic properties, morphological properties and rheological properties of bitumen, recycled PE and recycled PE-modified bitumen carried out using various techniques and mathematical models, including the Christenson-Lo model. The data obtained indicate that the viscoelastic behaviour of the recycled PE-modified bitumen is dependent upon the relative amount and distribution of the polymer in the matrix and changes in the mechanical properties of the bitumen upon mixing. 29 refs.

IRAN
Accession no.916710

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Item 14
Iranian Journal of Polymer Science and Technology
Persian
BITUMEN MODIFICATION VIA PS/PB BLEND
Barzegari M R; Yousefi A A; Zeynali M E
Iran, Polymer & Petrochemical Institute

A thermoplastic elastomer was prepared by mixing PS and polybutadiene and incorporated into bitumen. The mechanism of stabilisation and mechanical properties of the mixtures were investigated by means of optical microscopy, the Frass test, softening point measurement and penetration index. Compatibilised blends of PS, polybutadiene and SBR were also prepared and mixed with bitumen and their properties compared with those of the uncompatibilised blends. 16 refs.

IRAN
Accession no.916711

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Item 15
International Journal of Polymeric Materials
53, No.8, Aug.2004, p.671-84
RHEOLOGICAL PROPERTIES OF SBS-ASPHALT COMPOSITES AT HIGH DEGREE OF MODIFICATION
Blanco R; Rodriguez R; Castano V M
Universidad Autonoma Metropolitana-Iztapalapa; UNAM

The rheological properties of styrene-butadiene-styrene/asphalt compositions were investigated both experimentally and theoretically. The effects of styrene-butadiene-styrene concentration, frequency and temperature on the rheological properties were evaluated and the experimental data fitted with a percolation model. A WLF equation was modified to take composition into account and supported by a free volume theory, which enabled master curves to be generated with shifts in temperature and concentration. 8 refs.

MEXICO
Accession no.919393

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Item 16
Indian Rubber Journal
82, July-Aug.2004, p.46-8
NATURAL RUBBER MODIFIED BITUMEN FOR HIGH PERFORMANCE ROADS
Gopalakrishnan K S
India, Rubber Board

Several studies suggest that the useful service life of bituminous roads in India is only 2-4 years. Various experiments and studies have been conducted regarding the use of additives to bitumen, to improve the properties and increase the life of the road surfaces. Of these, the use of rubber in different grades and forms is of significance, as it provides better performance than conventional bitumen and this has led to the basis of rubberisation of roads. The development of natural rubber modified bitumen is outlined.
The Indian Road Congress has produced guidelines for the use of rubber and polymer modified bitumen. The selection criteria for different grades of modified bitumen are given.

INDIA

Accession no.919812

Item 17


USE OF RECYCLED POLYMER MODIFIED ASPHALT BINDER IN ASPHALT CONCRETE PAVEMENTS

Negulescu I I; Daranga C; Zhong Wu; Daly W H; Mohammad L M; Abadie C
Louisiana, State University; Louisiana, Transportation Research Center (SPE)

The possibility of recycling polymer-modified asphalt by blending with new material and using for new road construction was investigated. A standard composition were separated into its constituents and effect of ageing studied using infrared spectroscopy and chromatography. The standard material was subjected to accelerated ageing to the equivalent of 5-8 years service, and the aged material characterised by chemical and rheology studies. Blends of fresh material with naturally-aged material and also with that obtained by accelerated ageing were also evaluated. It was concluded that the polymer additive experienced long-term degradation, becoming brittle and stiff, such that it no longer contributed to the binder properties. Significant changes in material properties were observed on the introduction of aged material. 4 refs.

USA

Accession no.920545

Item 18

Muanyag es Gumi
41, No.6, 2004, p.213-4

Hungarian

CRUMB RUBBER MODIFIED BITUMENS

Thury P; Biro S; Bartha L
Veszpremi Egyetem

Several processes developed for production of bitumens modified by crumb rubber are described and the modified wet process developed at the University of Veszprem, Hungary, is discussed. Using this wet process, a chemically-stabilised rubber bitumen(CSRB) is produced, which exhibits good properties from the practical viewpoint and eliminates the main disadvantages of the classical rubber bitumen. The ageing, low temperature behaviour and shear stress properties of CSRB are discussed and its potential use as a binder in road construction is considered. 8 refs.

EASTERN EUROPE; HUNGARY

Accession no.922010

Item 19

China Synthetic Rubber Industry
27, No.4, 2004, p.221-4

Chinese

MECHANISM OF CHEMICAL REACTIONS OF RUBBER AND ASPHALT

Gui’an W; Yong Z; Yinx? Z
Fujian, Normal University; Shanghai, Jiao Tong University

The reaction between asphalt and rubber was investigated through toluene extraction of rubber vulcanisate/accelerator/asphalt blends and the structures of the blends were analysed by IR spectroscopy and elemental analysis. Rubber/asphalt blend preparation by reactive blending was simulated and the findings compared with those for vulcanised rubber/accelerator blends. 6 refs.

CHINA

Accession no.923467

Item 20

European Polymer Journal

RHEOLOGY AND STABILITY OF BITUMEN/EVA BLENDS

Gonzalez O; Munoz M E; Santamaria A; Garcia-Morales M; Navarro F J; Partal P
San Sebastian, Universidad del Pais Vasco; Huelva, Universidad

The effects of blending small proportions of virgin or recycled poly(ethylene-co-vinyl acetate)(EVA) copolymers of similar compositions, characterised by FTIR, DSC, TGA and dynamic viscoelastic measurements on the rheological properties of a 60/70 penetration grade bitumen were investigated. The stability of the blends is discussed in terms of phase separation on storage at high temperatures. 21 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE

Accession no.924898

Item 21

Materiale Plastice
40, No.4, 2003, p.206-8

Rumanian

STUDIES REGARDING THE ADDITIVITY OF ASPHALTS WITH PET WASTES

Brebeanu G; Stanica-Ezeanu D; Bombos D
Ploiesti, Universitatea Petrol-Gaze; Bucharest, Polytechnical University

The depolymerisation of PETP flakes to the monomer and higher oligomers (dimers and trimers) is discussed as a promising route to recycling of PETP. The monomers obtained can be used as building blocks to synthesize other polymers with higher economic values, such as unsaturated polyesters and polyols. A study was conducted with the aim of developing secondary end-use applications of
waste PETP. A method was developed for improving the quality of asphalt using different mixtures of oligomers obtained from waste PETP by chemical depolymerisation.

References and Abstracts

EASTERN EUROPE; RUMANIA
Accession no.902193

Item 22
Prague,Rubber Divisions of the Czech and Slovak Societies of Industrial Chemistry, 2002, Paper 51, pp.6, CD-ROM, 012
RHEOLOGICAL AND MECHANICAL PROPERTIES OF RUBBERIZED ASPHALTS
Chang Y-W; Chung J-H; Suh Y; Nah C; Chung K-H
Hanyang,University; Chonbuk,National University; Suwon,University
(Rubber Divisions of the Czech and Slovak Societies of Industrial Chemistry)
Blends of asphalt were prepared containing 15 wt% ground scrap tyres and 0-3.5 phr transoctylene rubber (TOR). The TOR was added to enhance particle dispersion and to increase interfacial interactions. The addition of TOR increased the softening temperature and reduced the needle penetration values, indicating improved deformation resistance at high temperature when used for road surfacing applications. The changes were attributed to crosslinking of TOR by free sulphur during mixing at high temperature. The tensile strength and elongation increased with increasing TOR content. The rate at which viscosity increased with mixing time increased with increasing TOR content. This could present processing problems, and it was concluded that an optimum addition of TOR was required to provide enhanced properties in service whilst still providing acceptable processability. 6 refs.
KOREA
Accession no.901566

Item 23
Scrap Tire News
17, No.11, Nov.2003, p.7
NEW RESEARCH STUDIES DIFFERENT METHOD FOR ASPHALT RUBBER
We are given very brief information in this short article about a new research project in the USA that utilises a different method of adding crumb rubber to hot mix asphalt. It involves the use of the polymeric additive “Vestenamer” which forms a chemical bond between the rubber and the asphalt binder.
CLEMSON,UNIVERSITY; ASPHALT RUBBER TECHNOLOGY SERVICE
NORTH AMERICA; USA
Accession no.901518

Item 24
Tire Technology International
Annual Review 2003, p.126-33
THE ROAD TO QUIETER TYRES
Sandberg U
Swedish National Road & Transport Research Institute
The problem of tyre/road noise is discussed and developments in low-noise tyres and in improved road surfaces are reviewed. Data are given on the distribution of noise levels for about one hundred summer and winter tyres and photographs are presented of the state of wear for two new, half worn and fully worn tyres, of an early version of a composite wheel and of a poroelastic road surface. Prospects for further developments are examined. 9 refs.
EUROPEAN UNION; SCANDINAVIA; SWEDEN; WESTERN EUROPE
Accession no.900567

Item 25
Tyres and Accessories
No.10, Oct.2003, p.76
RUBBERISED ASPHALT ON TEST IN CALIFORNIA
Gardner P
This article is based on a piece that appeared in the “Sacramento Bee” and discusses a state-funded project taking place in California, USA, where rubberised asphalt made with scrap tyres is being laid on a number of city streets. The advantages and disadvantages of the use of rubberised asphalt are also discussed.
CALIFORNIA,DEPT.OF TRANSPORTATION; CALIFORNIA,INTEGRATED WASTE MANAGEMENT BOARD
EUROPE-GENERAL; EUROPEAN COMMUNITY; EUROPEAN UNION; UK; USA; WESTERN EUROPE
Accession no.899513

Item 26
Journal of Applied Polymer Science
90, No.7, 14th Nov.2003, p1772-82
USE OF RHEOLOGICAL COMPATIBILITY CRITERIA TO STUDY SBS MODIFIED ASPHALTS
Becker Y; Muller A J; Rodriguez Y
PDVSA-Intevep; Simon Bolivar,Universidad
Stability tests, using fluorescence spectroscopy and softening point, and rheological evaluation were carried out on blends of asphalt and various block copolymers including styrene-butadiene-styrene (SBS), styrene-ethylene-butadiene-styrene (SEBS) and maleic anhydride grafted SEBS (SEBSgMAH), and comparisons were made with unmodified asphalt. SEBS, and even better SEBSgMAH modification showed increased compatibility compared to SBS, but rheological information did not give
adequate information on the complex systems to allow predictions on compatibility to be made. 46 refs.

**References and Abstracts**

**Item 27**
*Polymers and Polymer Composites*
11, No.6, 2003, p.477-85

**SBS/CARBON BLACK COMPOUNDS GIVE ASPHALTS WITH IMPROVED HIGH-TEMPERATURE STORAGE STABILITY**
Wang S; Zhang Y; Zhang Y
Shanghai, Jiao Tong University

In order to produce modified asphalts with high temperature storage stability, carbon black was added to styrene-butadiene-styrene tri-block copolymers. The effect of carbon black on the high temperature storage properties, dynamic rheology, mechanical properties (softening point, viscosity, etc.) and the morphologies of the modified asphalts were studied. It was found that the ratio of SBS to carbon black in the compound had a great effect on the high-temperature storage behaviour, and that the modified compounds were stable when the ratio was around 2. The introduction of carbon black was shown to have almost no effect on the dynamic rheology or the mechanical properties of the modified. The improvement in high-temperature storage stability is attributed to a decrease in density difference and an improvement in the compatibility between SBS and the asphalt. 16 refs.

**Accession no.898815**

**Item 28**
*Journal of Applied Polymer Science*
90, No.5, 31st Oct. 2003, p.1347-56

**MASTIC OF POLYMER-MODIFIED BITUMEN AND POLY(VINYL CHLORIDE) WASTES**
Singh B; Gupta M; Tarannum H
India, Central Building Research Institute

The use of micronised poly(vinyl chloride) pipe waste, activated by treatment with hydrogen peroxide, as a soft filler in the preparation of mastics based on a styrene-butadiene-styrene modified bitumen mixed with isocyanate production waste as binder, is described. The rheology of the modified binder was examined under frequency multiplexing, and the physico-mechanical (DMA, SEM, hardness number) and waterproofing properties of the mastic are discussed in terms of existing standard specifications. 23 refs.

**Accession no.898484**

**Item 29**
*China Synthetic Rubber Industry*
26, No.5, 2003, p.301-4

**CHINA**

**AGING BEHAVIOR OF SBS MODIFIED ASPHALTS**
Shifeng W; Yujun Z; Dizhen W; Dongshan L
Shanghai, Jiao Tong University

The oven ageing behaviour of SBS modified asphalt in the form of thin films was studied by IR spectroscopy, GPC and dynamic mechanical analysis. It was found that carbonyl and sulphoxide groups increased, asphalt molec.wt. and softening point increased and penetration and ductility at low temperatures decreased after ageing. 6 refs.

**Accession no.898100**

**Item 30**
*Asian Plastics News*
Oct. 2003, p.4

**WALKING ON PLASTICS?**

Kochi Refineries has been requested by the Indian Kerala state government to investigate the technical feasibility of using organic polymers as additives in bitumen mixes for roads and pavements. Experiments have been conducted on disposable plastics cups.

**KOCHI REFINERIES; INDIA, GOVERNMENT INDIA**

**Accession no.897291**

**Item 31**
*International Polymer Science and Technology*
30, No.6, 2003, p.T/61-4

**CHANGE IN THE THERMAL, ADHESION, AND MOLECULAR WEIGHT CHARACTERISTICS OF ASPHALT-RESINOUS OLIGOMERS DURING PRODUCTION**
Gladkikh I F; Kraikin V A; Sigaeva N N; Ionova I A; Zaikov G E; Monakov Y B
Russian Academy of Sciences

This work reports on a study of the changes in molecular weight and in the molecular weight-dependent physicochemical characteristics of asphalt-resinous oligomers (ASMOL). ASMOL is produced by the condensation of petroleum tars and bitumens with vat residues formed by rectification regeneration of dimethylformamide (isoprene production waste) and containing oligoisoprene fraction. The product is used as a weatherproofing agent, and as a protective coating. The softening point and adhesion to steel are investigated as MW dependent characteristics, occurring during production. On the basis of the results of the work, it is concluded that chemical interaction of the initial
components of ASMOL, occurs at the stage of their mixing and homogenisation. It is advised that the H2SO4 content be monitored, since unreacted sulphuric acid can lead to a reduction in the heat resistance and adhesion characteristics of ASMOL. 5 refs. (Article translated from Plasticheskie Massy, No.8, 2002, pp.36-8).

RUSSIA
Accession no.896790

Item 32
China Synthetic Rubber Industry
26, No.4, 2003, p.238-40
Chinese
DYNAMIC MECHANICAL PROPERTY OF LDPE/SBS BLENDS MODIFIED ASPHALT
Gao Guangtao; Zhu Yutang; Zhang Yong; Zhang Yinxi; Wang Lizi; Qin Lancheng
Shanghai, Jiao Tong University; Jiangyin Zhongyou Xingneng Asphalt Co.

The dynamic mechanical properties of asphalt modified with LDPE/SBS blend asphalt were studied using a strain-controlled rheometer. The effect of the reactive agent and the content of reactive agent and the LDPE/SBS blends on the performance of the asphalt at high temperature was studied. The addition of the reactive agent to the asphalt modified with LDPE/SBS blends was shown to improve the complex modulus of the original asphalt at high temperature and to decrease the tan delta. With increasing content of the LDPE/SBS blends, the performance of the asphalt at high temperature increased, while the thermosensitivity decreased. The addition of the reactive agent also improved the performance of the asphalt at high temperature. 7 refs.

CHINA
Accession no.895390

Item 33
FAPU
No.18, May-June 2003, p.6
German
NEW TEMPERATURE-RESISTANT HIGH-RESISTANCE FOAM UNDER MASTIC ASPHALT

Floor structures with mastic asphalt can be laid down immediately with pure GA 030 new floor insulating boards that can sustain temperatures up to 250°C for short spells and up to 200°C for long periods. This article looks at the high resistance of polyurethane foam, its heat conducting properties and optimum heat insulation for structures with mastic/melted asphalt.

PUREN-SCHAUMSTOFF GMBH
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.892435

Item 34
High Performance Plastics
July 2003, p.8

FORD RETURNS TO THE ROAD
At Ford Motor Co.’s plant at Dagenham in the UK, researchers are considering ways of incorporating waste plastics from cars into road surfaces, by combining quarry waste with the plastics. Ford is working with UK companies Plasmega and Aggregate Industries on this project. Brief details are presented.

FORD MOTOR CO.; PLASMEGA LTD.; AGGREGATE INDUSTRIES PLC
EUROPE-GENERAL; EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.891898

Item 35
Elastomery
7, No.1, 2003, p.12-6
Polish
EVALUATION OF INTERACTION OF ASPHALT AND RUBBER
Stepkowski R; Parasiewicz W
Stomil

Rubberised asphalt is a very promising application of rubber powder obtained by grinding waste tyres and other rubber products. The properties of such material are strongly influenced by interaction of asphalt and rubber. Investigations of swelling of special samples of vulcanisates in asphalt and non-oxidised residue of distillation of crude oil show that at 180 deg.C two competitive processes are running: penetration of melted asphalt into rubber vulcanisates and further crosslinking of polymer in rubber. It is concluded that rubber-asphalt interaction is mainly physical by nature and rubber granulate after swelling is more susceptible to scission forces. 9 refs.

EASTERN EUROPE; POLAND
Accession no.889424

Item 36
Journal of Materials Science
38, No.7, 1st April 2003, p.1397-401

DEVELOPMENT OF CRUMB RUBBER REINFORCED BITUMINOUS BINDER UNDER LABORATORY CONDITIONS
Frantzis P
Liverpool, University

Details are given of the use of crumb rubber produced from waste tyres for reinforcing bitumen. The development of a rubber reinforced bituminous binder used as an all-weather wearing course in flexible roads is discussed. Fatigue behaviour was investigated. 27 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.886799
Reference and Abstracts

Item 37
Scrap Tire News
17, No.2, Feb.2003, p.6/7
INNOVATIVE PROJECT RECYCLES TIRES, IMPROVES ROAD SURFACE

A pilot project has been completed on Nebraska’s Interstate 80 highway, which demonstrates an innovative use for scrap tyres. Over 47,000 of them have been blended into an asphalt mix in the resurfacing of a seven mile stretch - which now provides a quieter, smoother ride for vehicles. Details are given here.

NEBRASKA, DEPT. OF ENVIRONMENTAL QUALITY; NEBRASKA, DEPT. OF ROADS; DOBSON BROS. CONSTRUCTION CO.
USA
Accession no. 883289

Item 38
China Synthetic Rubber Industry
26, No.2, 2003, p.98-100
Chinese
REACTIVE PROCESS OF LDPE/SBS BLEND MODIFIED ASPHALT
Guangtuo G; Yutang Z; Yong Z; Yinxi Z; Lizhi W; Lancheng Q
Shanghai, Jiao Tong University; Jiangyin Zhongyou Xingneng Asphalt Co.

An investigation was carried out into the preparation of asphalt-modified LDPE/SBS blends in the presence of crosslinking agent using a strain-controlled rheometer. It was found that the reaction between SBS and crosslinking agent occurred at temperatures over 120°C and that the reaction rate increased with increasing temperature and level of crosslinking agent. Torque decreased after an initial increase and the temperature was over 230°C as a result of polymer degradation. 3 refs.

CHINA
Accession no. 883070

Item 39
Polimery
47, No.4, 2002, p.269-72
Polish
APPLICATION OF WASTE POLYCARBONATE-FURFUROL THERMOLYZATES TO MODIFICATION OF PETROLEUM BITUMENS
Osowiecka B; Zielinski J; Polaczek J; Machowska Z
Warsaw, Politechnic; Instytut Chemii Przemyslowej

Thermolysis of waste polycarbonate/furfurol extract mixes was carried out at 270°C for 3.5 hours and the thermomechanical properties, rheological properties, hardness and impact strength of the resulting thermolyses investigated. Thermolysates containing PS/asphalt heated to 170°C resulted in compositions, which were considered suitable as potential binders for sealant/isolation materials in the construction industry. 13 refs.
EASTERN EUROPE; POLAND
Accession no. 878361

Item 40
Popular Plastics and Packaging
47, No.12, Dec.2002, p.58
PLASTIC-TAR ROADS: SALEM TOWN SHOWS THE WAY TO HANDLE PLASTIC WASTE

Salem, an industrial town in Tamil Nadu, is the first to lay a plastic-tar road in India. The technology, developed at Thiyagarajar College of Engineering, combines bitumen and gravel with flakes or granules made from domestic plastic waste such as carrier bags and cups. Domestic waste comprising PE, PP and PS can be converted into flakes or granules for mixing with the aggregate. Alternatively, the plastic can be mixed with heated tar and later mixed with the gravel. PE can be used up to 5% and PS 20%.
THIYAGARAJAR, COLLEGE OF ENGINEERING
INDIA
Accession no. 874778

Item 41
Chemical Engineering
109, No.11, Oct.2002, p.50-3
FOR RIGIDITY PLUS ELASTICITY: STYRENIC BLOCK COPOLYMERS
Southwick J G; Vonk W
Kraton Polymers Inc.

Thermoplastic elastomers (TPEs) consist of either block copolymers or blends of polymers that form a soft elastomeric phase and a hard rigid phase. As this comparatively new family of polymeric products is versatile and is finding diverse markets, engineers can benefit from an awareness and understanding of them. Of particular interest are TPEs in which the rigid phase consists of PS. The chemical and physical behaviour of TPEs can better be understood by putting them in context. Traditional elastomers are composed of amorphous, flexible chains of high molecular weight polymer that are to some extent chemically crosslinked. According to the classic theory of rubber elasticity, the polymer coils function as ‘entropy-driven springs’. In an unstressed condition, the elastomeric coils are in a state of maximum entropy - non-oriented, entangled conformations. As the elastomer is stretched, the material cannot viscously flow, due to crosslinking, and the coils become extended to lower and lower states of entropy. Removal of the stress allows the material to spontaneously revert to the state of maximum entropy as dictated by thermodynamics. The degree of flexibility in the particular polymer molecules governs the ‘snap-back’ characteristics of the polymer. Styrenic block copolymers (SBCs) can be efficiently manufactured via anionic polymerisation. They offer properties useful in adhesives, asphalt modification, extruded and moulded goods, and footwear. The most commercially successful
SBCs have either polybutadiene or polyisoprene as the elastomer soft phase; these copolymers are referred to as SBS and SIS, respectively. Their basic polymerisation process is described, as is their molecular architectures and applications. 6 refs.

USA
Accession no.871958

Item 42

Popular Plastics and Packaging
47, No.11, Nov.2002, p.44
PLASTIC SOLUTION FOR ROADS

A combination of hot bitumen and molten plastic waste could well turn out to be the perfect solution for battered roads and disposing of plastic waste, it is briefly reported. Chennai has agreed to test out the formula. Plastic waste like cups and carrier bags are heated only up to 170°C to form a molten paste which is then mixed with hot bitumen before it is laid. Plastic increases the road’s load bearing capacity, makes it more heat resistant and prevents rain water from seeping down.

CHENNAI CORP.
INDIA
Accession no.871694

Item 43

Rubber and Plastics News
32, No.8, 18th Nov.2002, p.26
RUBBER ON THE ROAD
Konkoly J

The blending of shredded scrap tyres into an asphalt paving mix on a 7.3-mile stretch of Interstate 80 in Nebraska already is a success when it comes to producing a smooth road surface. Time and weather will determine whether the pilot project also meets the goal of creating a longer lasting roadway. Tests on the project, which used 47,000 scrap tyres, indicate that the rubber-asphalt mix could last 15 to 20 years, double the average life of conventional asphalt.

USA
Accession no.871629

Item 44

Journal of Testing and Evaluation
30, No.2, March 2002, p.171-6
INFLUENCE OF LABORATORY AGING METHOD ON THE RHEOLOGICAL PROPERTIES OF ASPHALT BINDERS
Abbas A; Baek Cheol Choi; Masad E; Papagiannakis T
Washington State University

Results are reported of an examination of whether the Superpave prescribed sequence of asphalt binder ageing procedures, i.e. the rolling thin film oven(RTFO), followed by the pressure ageing vessel(PAV), is necessary or whether similar binder rheological properties are obtained using the PAV procedure only. Three binders were tested, an unmodified PG 64-28, an SBS polymer-modified binder of the same grade and an SBS polymer-modified PG 76-28. The low temperature and fatigue rheological properties were measured by a bending beam rheometer and a dynamic shear rheometer, respectively. The results obtained indicated that, with a few exceptions, the rheological properties measured after ageing with the RTFO followed by PAV were significantly different from those obtained after PAV ageing only. 8 refs.

USA
Accession no.870721

Item 45

Rubber Asia
THE ROAD LESS TRAVELLED

The incorporation of natural rubber in bituminous mixes used to resurface roads is briefly discussed. The cost of such incorporation is considered in relation to the extended service life of the road surface. Hot and cold processes for addition of the NR are described. The development by Revertex (Malaysia) of a charge-reversed NR cationic latex called 1497C is mentioned.

REVERTEX (MALAYSIA)SDN.BHD.
MALAYSIA
Accession no.869130

Item 46

Iranian Journal of Polymer Science and Technology
15, No.2, June-July 2002, p.103-20
Persian
IMPROVING BITUMEN PROPERTIES BY POLYMERIC MATERIALS
Sadradini M R; Yousefi A A; Kavussi A
Tarbiat Modarres,University; Iran,Polymert Institute

Details are given of the effects of different polymers, crumb rubber modifier and HVS oil on bitumen properties. Improvements in elastic and deformation recovery and low temperature brittleness by the incorporation of PE and crumb rubber modifier are discussed. 24 refs.

IRAN
Accession no.868404

Item 47

Polymers and Polymer Composites
10, No.6, 2002, p.433-40
ENHANCED PERFORMANCE OF LDPE/SBS BLEND MODIFIED ASPHALT THROUGH DYNAMIC VULCANIZATION
Gao G; Zhang Y; Zhang Y; Sun K
Shanghai,Jiao Tong University

A blend of LDPE and SBS was used to modify an asphalt, and a storage-stable modified asphalt was prepared by dynamic vulcanisation. The vulcanisation characteristics of the modified asphalt were studied using a strain-
controlled rheometer. The vulcanisation of the SBS in the blend-modified asphalt resulted in a marked increase in the torque. The physical properties of the LDPE/SBS blend-modified asphalt containing even a small amount of sulphur were shown to be improved, together with its storage stability. The rheological properties of the blend-modified asphalt before and after the addition of sulphur were characterised using a dynamic shear rheometer and a rotational viscometer. 18 refs.

CHINA
Accession no.864340

Item 48

China Synthetic Rubber Industry
25, No.4, 2002, p.253

A NEW APPROACH TO HIGH TEMPERATURE STORAGE STABILITY OF SBS MODIFIED ASPHALT
Shifeng W; Yutang Z; Yong Z; Yinxi Z
Shanghai Jiao Tong University

The effect of carbon black on the softening point, viscosity, ductility and high temperature storage stability of SBS modified asphalt was investigated. The carbon black was premixed with SBS and added to the asphalt under high-speed shearing. The properties of the carbon black modified asphalt are compared with those of the unmodified asphalt.

CHINA
Accession no.862302

Item 49

Polymer
43, No.17, 2002, p.4667-71

MISCIBILITY STUDIES ON BLENDS OF KRATON BLOCK COPOLYMER AND ASPHALT
Varma R; Takeichi H; Hall J E; Ozawa Y F; Kyy T
Akron, University; Bridgestone/Firestone Research Inc.

The miscibility of blends of styrene-butadiene-styrene (SBS) block copolymer and asphalt was investigated using cloud point measurements, from which phase diagrams were constructed. Upper critical solution temperature behaviour was observed, with a maximum at approximately 200 C, for blends containing about 20% SBS. Changes in the glass transition temperature of the butadiene segment of the SBS, for blends containing up to 60 vol% asphalt, were attributed to partial miscibility. No miscibility was observed between the PS segment and asphalt. Phase decomposition kinetics were determined for blends containing 6% SBS, using time-resolved light scattering. 18 refs.

USA
Accession no.862127

Item 50

Rubber and Plastics News 2
23, No.17, 27th May 2002, p.3

PAVING MILESTONE

An 18-mile section of Interstate 880 from Oakland to Fremont, California, is being repaved with 270,000 tonnes of asphalt rubber, keeping more than 400,000 scrap tyres out of area landfills. Jeffrey Reed, president of the Rubber Pavements Association, and RPA Deputy Director Douglas Carlson presented an outstanding achievement award to Bart Desai, deputy district director of maintenance for the California Department of Transportation, for the project, the largest single use of asphalt rubber in the USA. This abstract includes all the information contained in the original article.

USA, RUBBER PAVEMENTS ASSOCIATION
Accession no.859985

Item 51

Tire Business
20, No.2, 29th April 2002, p.13

SELLING ASPHALT RUBBER
Moore M

The Asphalt Rubber Technology Service (ARTS) at Clemson University in the USA is striving to prove the value of asphalt rubber, and to surmount the entrenched prejudices of conventional asphalt manufacturers and state road officials. This article examines the benefits of rubberised asphalt in detail.

CLEMSON, UNIVERSITY; ASPHALT RUBBER TECHNOLOGY SERVICE; SOUTH CAROLINA DEPT. OF HEALTH & ENVIRONMENTAL CONTROL; FORD MOTOR CO.; US, GOVERNMENT CANADA; EUROPE-GENERAL; USA
Accession no.859055

Item 52

Polymer Testing
21, No.6, 2002, p.633-40

IMPROVED PROPERTIES OF POLYSTYRENE-MODIFIED ASPHALT THROUGH DYNAMIC VULCANISATION
Jin H; Gao G; Zhang Y; Zhang Ysun K; Fan Y
Shanghai Jiao Tong University

Storage-stable PS-modified asphalt is prepared in the presence of linear styrene-butadiene-styrene triblock copolymer (SBS) through dynamic vulcanisation. The vulcanisation characteristics of the blends are studied using a strain-controlled rheometer. At temperatures from 140 to 180 deg.C, the rate of the blends increases significantly with increasing temperature. A suitable processing temperature is between 170 and 180 deg.C for the sake of good mechanical and thermal stability properties. The physical properties, including softening point penetration,
and ductility at low temperature of the modified asphalt through dynamic vulcanisation, are compared to that of modified asphalt without sulphur. The storage stability of the PS-modified asphalt is effectively improved in the presence of SBS through dynamic vulcanisation. The morphology and rheological properties of the modified asphalt are also investigated using an optical microscope and a dynamic shear rheometer, respectively. The morphology is compared between the pure PS-modified asphalt, the PS/SBS/sulphur-modified asphalt, and the PS/SBS/sulphur-modified asphalt, which indicates that the compatibility and storage stability of the PS-modified asphalt are improved significantly in the presence of SBS through dynamic vulcanisation. 15 refs.

CHINA
Accession no.854773

Item 55

Rubber India
RUBBERISATION OF ROADS

Rubberisation of roads in the country can effect a substantial saving in cost, as well as creating additional demand for NR, thus ensuring a remunerative price for farmers. Experts participating at a seminar on Road Rubberisation with Natural Rubber Modified Bitumen, jointly organised by the Institution of Engineers India’s (IEI) local centre and the Indian Rubber Board, said that it was highly cost-effective besides extending significant socioeconomic benefits. Expressing the hope that some positive decisions on rubberisation of the roads might emanate soon from the Surface Transport Ministry, Mr. S. M. Desalphine, Chairman, Rubber Board, said that discussions were going on regarding this issue at various levels at the Centre. Details are given.

INSTITUTION OF ENGINEERS INDIA;
INDIA,RUBBER BOARD
INDIA

Accession no.851907

Item 56

Polymers and Polymer Composites
IMPROVED STORAGE STABILITY OF LDPE/SBS BLENDS MODIFIED ASPHALTS

Gao G; Zhang Y; Zhang Y; Sun K; Fan Y
Shanghai, Jiao Tong University

Phase separation has been a major obstacle to the widespread use of polymer-modified asphalt in road surfacing, and to provide a solution to the problem of storage-stable polymer modified asphalts, blends of SBS and LDPE are mixed under high shear stress, and added with sulphur to the asphalt under high speed mixing. Compared to the asphalts modified by LDPE and SBS added directly, the blend modified asphalts showed better storage stability in the presence of sulphur at high temperature, with no visible phase separation or evidence of coalescence. The rheological properties of the asphalts were also improved by the addition of polymers in all cases. 18 refs.

CHINA
Accession no.850545
The fracture resistance of chemically modified crumb rubber asphalt (CRA) pavement was evaluated based on the J-integral concept and the results were compared with that of crumb rubber asphalt (CRA) and control asphalt pavement. Four semi-circular core specimens were cut from each gyratory compacted cylinder for the fracture resistance tests. Notches with different depth to radius ratios were introduced at the middle of the flat surface of each specimen. Three point bend loading was used to allow the separation of the two surfaces due to tensile stresses at the crack tip. It was found that the CMCRA pavement had the highest residual strength at all notch depths tested. The fracture resistance of the CMCRA pavement, based on Jc, was found to be about twice that of the CRA and control pavements. The CRA pavement was found to have a slightly higher fracture resistance than that of the control pavement. SEM examination of the fracture surface of each mixture revealed the microstructural origin of the improved fracture resistance of the CMCRA pavement in comparison with the control pavement. 28 refs.

CHINA
Accession no.847574

Item 60
Polymer Testing
RHEOLOGICAL CHARACTERISATION OF STORAGE-STABLE SBS-MODIFIED ASPHALTS
Wen G; Zhang Y; Zhang Y; Sun K; Fan Y
Shanghai, Jiao Tong University

The storage stability of styrene-butadiene-styrene triblock copolymer (SBS) modified asphalt can be improved significantly with the addition of elemental sulphur. The dynamic mechanical properties of SBS-modified asphalts before adding sulphur are characterised using dynamic shear rheometry. The addition of sulphur to SBS-modified asphalt results in the formation of a chemically vulcanised SBS network structure in the modified binders, and the high-temperature performance of the binders is improved and their temperature susceptibility reduced to an extent. The SBS content has a great effect on the rheological properties of the asphalts. The rheological properties of SBS modified asphalts depend strongly on the sulphur level. Increasing sulphur levels lead to increasing crosslink density in the modified binders, and consequently the rheological properties of SBS-modified asphalt is improved. A comparison is made among the properties of the asphalts modified by three different SBS structures. The SBS structure affects the compatibility and storage stability of SBS-modified asphalts, which are improved by the addition of sulphur. As determined by a rotational viscometer, the increase in asphalt viscosity is not directly proportional to the SBS content before and after adding sulphur. The morphology of SBS-modified asphalts, characterised by optical microscopy, shows that the compatibility and storage stability of SBS modified asphalt are improved by the addition of sulphur. 15 refs.

CHINA
Accession no.844970

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Rubber Asia
ROAD RUBBERISATION, CAN IT BOOST OFFTAKE OF NATURAL RUBBER?
Natural rubber is the best medium for road rubberisation, but the more credible of calculations suggest that this application cannot mean any substantial offtake of rubber. Of the estimated 25 lakh km of roads in India, only 48% is surfaced. Of these, only 45% are surfaced with bitumen, the effective service life of which is only 2 to 4 years. At present, Kochi Refineries has a capacity to produce 15,000 t/y of NR-modified bitumen (NRMB). The Kerala Public Works Minister has stated that the state would need 65,000 tonnes of NRMB every year to rubberise all the roads. However, as the rubber content in NRMB is just 2% of the total volume, the total rubber required for road rubberisation in Kerala comes to only about 1,300 tonnes.

INDIA
Accession no.849585

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Journal of Materials Science
FRACTURE RESISTANCE CHARACTERIZATION OF CHEMICALLY MODIFIED CRUMB RUBBER ASPHALT PAVEMENT
Mull M A; Stuart K; Yehia A
Technology Resources Inc.; US, Federal Highway Administration; Egypt, National Research Centre

The fracture resistance of chemically modified crumb rubber asphalt (CMCRA) pavement was evaluated based...
Item 61

Rubber and Plastics News
31, No.6, 15th Oct.2001, p.29

RUBBERISED CEMENT REDUCES CRACKING, WEIGHT
Moore M

Han Zhu, a researcher and assistant professor at Arizona State University, has experimented with crumb rubber as an additive to Portland concrete cement. Besides guarding against cracking, crumb rubber in concrete can reduce thermal expansion and contraction, drying shrinkage, ride noise, freeze-thaw damage, brittleness and weight. If 20 pounds of crumb rubber per cubic yard of fresh PCC were added, all 5 million tyres scrapped annually in Arizona could be consumed, it is claimed.

ARIZONA, STATE UNIVERSITY
USA

Accession no.833244

Item 62

Kottayam, Rubber Research Institute of India, 2001, pp.52; 30cm, 62(12)

RUBBERIZED BITUMEN AND ITS APPLICATIONS AN ANNOTATED BIBLIOGRAPHY
Latha N; Korah A C; Jose M
India, Rubber Research Institute

A report is presented containing the abstracts and bibliographic data of 81 published articles on the subject of rubberised bitumen and its applications in road surfacing, construction, and related areas. The dates of the articles range from 1931 to 2000. The entries include journal articles, reports and conference presentations.

AUSTRALIA; CANADA; EUROPEAN COMMUNITY; EUROPEAN UNION; INDIA; MALAYSIA; NEW ZEALAND; UK; USA; WESTERN EUROPE

Accession no.832954

Item 63

Journal of Applied Polymer Science
82, No.4, 24th Oct. 2001, p.989-96

VULCANIZATION CHARACTERISTICS OF ASPHALT/SBS BLENDS IN THE PRESENCE OF SULFUR
Guian Wen; Yong Zhang; Yinxi Zhang; Kang Sun; Zhiyong Chen
Shanghai, Jiao Tong University

The vulcanisation of asphalt/SBS blends in the presence of sulphur was followed with a strain-controlled rheometer. The blends cured at temperatures greater than 140C. The cure rate increased significantly with increasing temperature from 150 to 180C and the apparent activation energy of vulcanisation was 45.2 kJ/mol. A suitable processing temperature for good mechanical properties and thermal stability was 170-180C. The structure of SBS and the sulphur level affected the vulcanisation of the blends. 17 refs.

CHINA

Accession no.833244

Item 64

Analytica Chimica Acta

DIRECT AND CONTINUOUS METHODOLOGICAL APPROACH TO STUDY THE AGEING OF FOSSIL ORGANIC MATERIAL BY INFRARED MICROSCOPOMETRY IMAGING. APPLICATION TO POLYMER MODIFIED BITUMEN
Lamontagne J; Durrieu F; Planche J-P; Mouillet V; Kister J
CNRS

Details are given of the development of a new simulation method for studying the ageing of polymer modified bitumens. An ageing cell was fitted to an FTIR microscope to continually and directly study the oxidation of polymer modified bitumens by FTIR microscopy imaging. The method was applied to an SBR modified bitumen. 31 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE

Accession no.832954

Item 65

Elastomery
5, No.4, 2001, p.8-16
Polish

APPLICATIONS OF WASTE TYRE RUBBER GRANULATE TO MODIFICATION OF ASPHALTS USED IN ROAD BUILDING
Radziszewski P; Kalabinska M; Pilat J
Warsaw, Polytechnic; Bialystok, Technical University

The ecological use of crumb rubber from used car tyres to bitumen modification, which is utilised for road pavement construction, is examined. An overview is presented of the state-of-the-art of the asphalt-rubber production technology, and factors influencing bitumen properties are discussed. Laboratory test methods of modified binder characterisation are described, together with required values for the USA and the Republic of South Africa guidelines, countries leading in the technology of bitumen modification with crumb rubber addition. Basing on chosen research results there is proven favourable viscoelastic behaviour of asphalt rubber compared with non-modified bitumen. 5 refs.

EASTERN EUROPE; POLAND

Accession no.831212
**Item 66**

*Scrap Tire News*


**LITTLE TIKES INTRODUCES SAFETY SURFACING**

This month, Little Tikes Commercial Play Systems is unveiling its “Little Tikes Surfacing Just Pour N Play” pre-packaged pour-in-place surfacing product made from recycled tyre rubber. The technology utilises recycled tyre rubber combined with pre-mixed PU to produce a soft, pliable, energy-absorbing rubber surface for playgrounds and other recreational surfaces. The base course or shock pad is primarily intended for an underlay or base course over compacted gravel, concrete or asphalt. It uses a large crumb rubber particle and is primarily black in colour. The wear course uses a 100% recycled SBR with a 1-3mm particle size and is manufacturing using coloured urethane and colour-pigmented crumb rubber.

LITTLE TIKES CO.

USA

Accession no.829820

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**Item 67**

*China Synthetic Rubber Industry*

24, No.3, 2001, p.176

**STORAGE STABLE SBS/PE BLEND MODIFIED ASPHALTS**

Gao Guangtao; Zhang Yong; Zhang Yinxi

Shanghai, Jiao Tong University

The modification of asphalt by such polymers as SBS triblock copolymer, PE for reduced road deterioration (e. g. rutting, cracking) has been developed for many years. However, due to the difference in solubility parameters between the base asphalt and the polymers, the storage stability of the polymer modified asphalts (PMAs) at high temperature is usually poor, which leads to separation of polymeric and bituminous phase and inconsistent binder quality. An attempt is made to prepare a storage stable PMA. 3 refs.

CHINA

Accession no.829116

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**Item 68**

*China Synthetic Rubber Industry*

24, No.5, 2001, p.274-7

Chinese

**DYNAMIC MECHANICAL PROPERTIES OF STORAGE STABLE SBS MODIFIED ASPHALTS**

Gu’ian W; Yong Z; Xinzhong C; Yinxi Z; Kang S; Zhiyong C

Shanghai, Jiao Tong University

Dynamic mechanical properties of storage stable SBS modified-asphalts are studied. With the addition of stabiliser, due to the formation of elastic network formation in modified binders, the elasticity of SBS asphalt increases and the temperature of asphaltic material decreases significantly. The amounts of SBS and stabiliser have great effect on the dynamic mechanical properties of SBS-modified asphalt. The complex modulus of modified binders increases with increase in amounts of SBS and stabiliser, and tan delta trend to be low and unchanged at high temperature. By comparing the PS content of SBS, 30% and 40% (mass), there is little effect on properties of SBS modified asphalt within the given PS contents. 4 refs.

CHINA

Accession no.827848

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**Item 69**

*Polymer Engineering and Science*

41, No.7, July 2001, p.1251-64

**BLENDS OF BITUMEN WITH POLYMERS HAVING A STYRENE COMPONENT**

Fawcett A H; McNally T

Belfast, Queen’s University

The properties of a 100 penetration grade bitumen were significantly modified by addition of 10 to 40 pph of a homopolystyrene and graft, block and random copolymers of styrene with butadiene and acrylonitrile. At low temps., some blends showed similar stiffness to or even lower stiffness than the bitumen, but generally the blends...
were more than one order of magnitude stiffer, even when a rubber was added. Contrasting behaviour was exhibited by a PS and a high-impact PS, about 3 to 4% of grafted rubber on the latter being sufficient to cause the enhancement, even at the 10 ppm level, by two different random styrene-butadiene copolymers, and also by blends consisting of different amounts of SBS block copolymer. Some polymers apparently triggered a Hartley inversion of the micellar structure of the asphaltene micelles. High low temp. stiffness correlated roughly with a lower Tg, as measured by the peak maximum in the loss modulus plots of the DMTA and by the steps in the DSC curves at temps. below 0°C. Tan delta maxima and DSC traces detected the Tg in the continuous phase and in the dispersed phases, but none of these amorphous polymers formed a crystalline phase, though the DSC traces of the PS and the SBS blends suggested that the polymer-rich phases underwent an ageing/ordering process on cooling. 41 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no.827268

Item 71
Polymer Journal (Japan)
33, No.3, 2001, p.209-13
COMJATIBILIZER ROLE OF STYRENE-BUTADIENE-STYRENE TRIBLOCK COPOLYMER IN ASPHALT
Kamiya S; Tasaka S; Zhang X; Dong D; Inagaki N
Shizuoka,University

Mixtures of triblock copolymer poly(styrene-butadiene-styrene) (SBS) and asphalt were used to prepare polymer modified asphalt (PMA). Differential scanning calorimetry, needle penetration and softening point methods and tensile strength measurements were used to characterise physical and mechanical properties. When the fraction of asphalt varied from 0-97 %, the glass transition temperatures of both blocks of SBS changed, indicating that the system is at least partially miscible. The soluble fraction extracted from the asphalt by n-heptane, maltene, was found to interact preferentially with the polybutadiene unit of SBS, whereas the insoluble fraction, asphaltene, interacted predominantly with the poly styrene unit. The fraction dependence of viscosity, penetration and tensile strength of the mixtures showed the threshold at low SBS concentration to increase markedly. The small amount of SBS in PMA seem to act as compatibilizer and emulsify the two components of asphalt to make a mechanically stable network. 20 refs.

JAPAN
Accession no.826617

Item 72
Patent Number: US 6186700 B1 20010213
PAVEMENT METHOD AND COMPOSITION WITH REDUCED ASPHALT ROOFING WASTE
Omann J S

A method of manufacturing and applying a novel pavement and patch material for roadways, driveways, walkways, patch for potholes and like surfaces, including the steps of reducing recycled asphalt roof waste to granules, adding aggregate and other solid recyclable materials to the granules, adding rejuvenating oil, adding emulsifier, adding asphalt concrete oil, adding anti-strip additives, adding liquid silicone, mixing the composition, heating the composition, applying the composition to the roadway or the like and compacting a new paving material.

USA
Accession no.822085

Item 73
Patent Number: US 6184294 B1 20010206
BLENDS OF ALPHA.-OLEFIN/VINYLIDENE AROMATIC MONOMER OR HINDERED ALIPHATIC VINYLIDENE MONOMER
Park C P; Thoen J; Broos R; Guest M J; Cheung Y W;
Chaudhary B I; Gathers J J; Hood L S
Dow Chemical Co.

A fabricated article other than a film comprising a thermoplastic blend prepared from polymeric materials consisting of; (A) from 1 to 99 weight percent of at least one interpolymer made from monomer components comprising (1) from 0.5 to 65 mole percent of (a) at least one aromatic vinylidene monomer, or (b) at least one hindered aliphatic or cycloaliphatic vinylidene monomer, or (c) a combination of at least one aromatic vinylidene monomer and at least one hindered aliphatic or cycloaliphatic vinylidene monomer, and (2) from 99.5 to 35 mole percent of at least one aliphatic alpha-olefin having from 2 to 20 carbon atoms; and (B) from 99 to 1 weight percent of at least one polymer made from monomer components comprising at least one aliphatic alpha-olefin having from 2 to 20 carbon atoms. These articles possess improved properties when compared to the properties of articles derived from the individual polymers comprising the blend. These articles are useful in the preparation of injection moulded parts, bitumen and asphalt modification, hot melt and pressure sensitive adhesive systems.

USA
Accession no.817459

Item 74
Patent Number: US 6180697 B1 20010130
METHOD FOR PREPARATION OF STABLE BITUMEN POLYMER COMPOSITIONS
Kelly K P; Butler J R
Fina Technology Inc.

This involves heating an asphalt cut in a stirred tank to a temperature sufficient to allow the stirring of the asphalt in the tank. A thermoplastic elastomer or rubber is added to the asphalt while continuing to stir the asphalt. The mixture is stirred at a speed and for a period of time sufficient to increase the distribution of the elastomer into the asphalt.
The stirring speed is reduced and the temperature is increased to add an oil dispersion of crosslinking agents to the tank. Stirring is continued for a period of time sufficient to improve the distribution of the crosslinking agent dispersion in the asphalt.

USA
Accession no.816374

Item 75
Rheologica Acta
40, No.2, March 2001, p.135-41
RHEOLOGY AND MICROSTRUCTURE OF ASPHALT BINDERS
Martinez-Boza F; Partal P; Navarro F J; Gallegos C
Huelva,Universidad

The viscous and linear viscoelastic properties of different asphalt binders are analysed. Thus, an unmodified bitumen, a polymer-modified (SBS) bitumen, a commercial synthetic binder and two model synthetic binders with different SBS concentrations are studied. The mechanical spectra of these binders are quite different, mainly influenced by SBS concentration. Thus, up to three regions may be observed for a synthetic binder with high polymer concentration. The temperature dependence of the zero shear-rate-limiting viscosity is described by an Arrhenius-like equation in a temperature range that depends on binder composition. These results are discussed taking into account the development of a polymer-rich phase in SBS modified bitumen and model synthetic binders. 25 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; SPAIN; WESTERN EUROPE
Accession no.811159

Item 76
Colloid and Polymer Science
CHEMICAL DESTABILIZATION OF CRUDE OIL BASED EMULSIONS AND ASPHALTENE STABILIZED EMULSIONS
Djuve J; Yang X; Fjellanger I J; Sjoblom J; Pelizzetti E
Bergen,University; Statoil AS; Torino,Universita

A comparison of low and high molec.wt. demulsifiers was conducted and their effect on both crude oil and asphaltene-based water-in-oil emulsions was studied. The high molec. wt. compounds included complex block polymers, phenolic resin alkoxylates, polyester and polyol diepoxide reaction product. Physical characteristics were examined for crude and for the chemicals. These parameters were then correlated with the demulsifier performance. Results indicated that a significant lowering of interfacial tension was required, but not sufficient for an efficient demulsification. Addition of the chemicals directly to the oil phase prior to emulsification, i.e. as inhibitors, increased the performance of the chemicals significantly. 16 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; NORWAY; SCANDINAVIA; WESTERN EUROPE
Accession no.810656

Item 77
Macromolecular Materials and Engineering
STUDIES ON BLENDS OF ACETATE AND ACRYLIC FUNCTIONAL POLYMERS WITH BITUMEN
Fawcett A H; McNally T
Belfast,Queen’s University

Five commercial polar polymers were blended with bitumen and examined by fluorescence optical microscopy, DSC and DMTA in order to reveal developments in the performance of the resulting colloidal composites. The polymers were ethylene-acrylic acid, ethylene-vinyl acetate (9 and 28% vinyl acetate content) and ethylene-methacrylic acid copolymers and PMMA. In each case, the low-temp. stiffness of the bitumen was enhanced by two orders of magnitude, but the addition of an ionomer was more effective at low concentration, indicating a specific self-organisation of the asphaltenes. 30 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.810581

Item 78
Journal of Materials Science
LOW TEMPERATURE FRACTURE PROPERTIES OF POLYMER-MODIFIED ASPHALTS RELATIONSHIPS WITH THE MORPHOLOGY
Champion L; Gerard J F; Planche J P; Martin D; Anderson D
Institute Nationale des Sciences Appliquees; Elf-Solaize,Centre de Recherche; Pennsylvania,State University

A methodology for studying the relationships between fracture behaviour and morphology of polymer-modified asphalts used as binders is developed by using the linear elastic fracture mechanics (LEFIVI) method and confocal laser scanning and environmental and cryo-scanning electron microscopies. Different types of polymers are used as modifiers: copolymers from ethylene and methyl acrylate (EMA), butyl acrylate (EBA) or vinyl acetate (EVA); diblock or star-shape triblock styrene-butadiene copolymers (SB or SBS). The 4 to 6 wt.% blends display a heterogeneous structure with a polymer-rich dispersed phase based on the initial polymer swollen by the aromatic fractions of the asphalt. The fracture toughness of the blends is higher than for the neat asphalt even if Klc of blends remains low compared to usual polymer blends due to the brittleness of the asphalt matrix. The fracture behaviour, which is strongly dependent on the nature of the polymer, is discussed from the toughening mechanisms given for the filled polymers and the polymer blends. The EBA, SB and SBS-based blends compared to the EMA and EVA-based ones display a higher Klc due to the elastomeric behaviour of the polymer phase, leading to a
more efficient energy dissipation during crack propagation. The sample prepared with 4% crosslinked SIB (Styrelf) and the corresponding physical blend (non-crosslinked) display the better fracture properties. 36 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; USA; WESTERN EUROPE
Accession no.810182

Item 79
Kobunshi Ronbunshu
58, No.2, 2001, p.66-72
Japanese
MECHANICAL PROPERTIES OF THE PHYSICAL GEL OF SEMI-CRYSTALLINE HYDROGENATED STYRENE-BUTADIENE RUBBER AND STRAIGHT ASPHALT - POTENTIALITY AS VIBRATION DAMPERS
Mashita N; Fukahori Y
Bridgestone Corp.

The results of the study revealed that the gels exhibited a rubber-like stress-strain relationship attributed to the polymer network phase and large tan deltas at small and large deformations due to the asphalt phase. The semi-crystalline network structure of the polymer controlled flow and asphalt bleeding and the bicontinuous phase structure exhibited large damping. 10 refs.

JAPAN
Accession no.809562

Item 80
Patent Number: US 6156828 A1 20001205
RUBBER BASE ASPHALT EMULSION METHOD
Wickett S R

A gel-like emulsion containing natural rubber and crumb rubber from used vehicle tyres may be added to an asphalt paving emulsion at ambient temperature for chip coating, slurry sealing, microsurfacing, soil stabilisation or pavement recycling.

USA
Accession no.809278

Item 81
SULFUR-IN-OIL IN ASPHALT AND POLYMER COMPOSITION AND PROCESS
Hayner R E
Marathon Ashland Petroleum LLC

A sulphur in oil in asphalt and polymer blend is disclosed. An asphalt and polymer blend is first prepared and then a slurry of solid sulphur in liquid oil added. Addition of a slurry of solid sulphur in oil or oil containing sulphur compounds, permits rapid and effective uniform dispersion of the sulphur component in the asphalt/polymer blend. Uneven mixing, which can occur when sulphur is separately added as a solid to the asphalt blend, is avoided. Polymer use is optimised because polymer matrix development (digestion/swelling) can be completed before crosslinking occurs. The method is safer because formation of explosive clouds of sulphur dust is avoided.

USA
Accession no.809064

Item 82
Patent Number: US 6136899 A1 20001024
SBR FOR ASPHALT CEMENT MODIFICATION
Lewandowski L H; Klemmensen D F
Goodyear Tire & Rubber Co.

It has been determined that a specific type of emulsion SBR can be used to modify asphalt cement to greatly enhance the resistance to shoving, rutting and low temperature cracking of asphalt concretes made therewith. It has further been determined that this emulsion SBR is compatible with virtually all types of asphalt and that modified asphalt cements made therewith have extremely high levels of force ductility, tenacity and toughness. The SBR used to modify asphalt cement in the practice of this invention is a blend of (i) a high molecular weight styrene-butadiene rubber having a weight average molecular weight of at least about 300,000 and (ii) a low molecular weight styrene-butadiene rubber having a weight average molecular weight of less than about 280,000; wherein the ratio of the high molecular weight styrene-butadiene rubber to the low molecular weight styrene-butadiene rubber is within the range of about 80:20 to about 25:75; and wherein the bound styrene content of the high molecular weight styrene-butadiene rubber differs from the bound styrene content of the low molecular weight styrene-butadiene rubber by at least 5 percentage points. These SBR compositions are comprised of repeat units which are derived from styrene and 1,3-butadiene, wherein the styrene-butadiene rubber composition has a number average molecular weight as determined by field flow fractionation which is within the range of about 50,000 to 150,000 and wherein the styrene-butadiene rubber has a light scattering to refractive index ratio which is within the range of 1.8 to 3.9.

USA
Accession no.808974

Item 83
Patent Number: US 6136898 A1 20001024
UNBLOWN ETHYLENE-VINYL ACETATE COPOLYMER TREATED ASPHALT AND ITS METHOD OF PREPARATION
Loza R; Dammann L G; Hayner R E; Doolin P K
Marathon Ashland Petroleum LLC; Ashland Inc.

A method is provided for improving high temperature performance grade properties of unblown asphalt by i) heating an asphalt cement to 200 deg F to 500 deg F (93 deg C to 260 degree C), ii) adding 0.1 wt.% to 10 wt.% ethylene-vinyl acetate copolymer based on weight of said asphalt cement to the heated asphalt cement, iii)

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adding 0.05 wt % to 1.0 wt.% phosphorus-containing acid, e.g. polyphosphoric acid, based on weight of said asphalt cement and iv) mixing the resulting blend, thereby providing an unblown asphalt composition of greater useful temperature index (UTI). The invention further relates to asphalt compositions thus made and paving compositions containing these asphalt compositions.

USA
Accession no.808973

**Item 84**

*Journal of Applied Polymer Science*
79, No.6, 7th Feb.2001, p.1034-41

**RAPID FTIR METHOD FOR QUANTIFICATION OF STYRENE-BUTADIENE TYPE COPOLYMERS IN BITUMEN**

Masson J F; Pelletier L; Collins P
National Research Council of Canada

A method for determining the polymer content of polymer modified bitumen (PMB), where the polymer is either styrene-butadiene (SB) or styrene-butadiene-styrene block copolymer (SBS), is proposed using fourier transform infrared analysis of the styrene and butadiene peaks. The method was tested on 24 different blends of bitumen and SB copolymers, using two different bitumens and five different copolymers at different weight percent concentrations. The method was shown to be better than plus/minus 0.4 percent accurate on the polymer content expected, and it is proposed that this method could therefore be used to quantify unknown blends of PMB where the polymer is either SB or SBS, or could be used to study the effects of weathering or other ageing processes on the polymer content of PMB. Degradation pathways are proposed in an appendix. 22 refs

CANADA
Accession no.808778

**Item 85**

*China Synthetic Rubber Industry*
24, No.2, 2001, p.113

**IMPROVED DISPERSION AND STORAGE STABILITY OF POLYSTYRENE MODIFIED BITUMEN**

Hailong J; Gui’an W; Yong Z; Yinxi Z
Shanghai,Jiao Tong University

Problems relating to the incorporation of polystyrene into bitumen for the polymer modification of the latter are briefly discussed, and the used is proposed of a reactive agent such as sulphur for the blending of styrene-butadiene triblock copolymer (SBS) together with polystyrene to improve the dispersion of the polystyrene phase in bitumen to acquire a stable polystyrene-modified bitumen.

CHINA
Accession no.808757

**Item 86**

Patent Number: US 6130276 A1 20001010

**METHOD OF REDUCING FUMES FROM A VESSEL OF MOLTEN ASPHALT**

Vermilion D R; Franzen M R; Janicki R T; Trumbore D C; Keating J W; Marzari J A
Owens Corning Fiberglas Technology Inc.

From 0.2 to 6 weight percent of a polymer is added to the asphalt to reduce the visual opacity of the fumes by at least 25% over the same asphalt without the polymer. In another embodiment, the total emissions of benzene soluble suspended particulates is reduced by at least 15% over the same asphalt without the polymer. Preferably, the added polymer has a melt flow index of from 15 to 95 grams/10 minutes. The added polymer reduces the visual opacity of the fumes by forming a skim on the upper surface of the molten asphalt.

USA
Accession no.806338

**Item 87**

Patent Number: EP 1063263 A2 20001227

**METHOD OF PREPARING HEATING TYPE PAVING MATERIAL AND COMPOSITION USED THEREFOR**

Ando S; Goto T; Hagiwara S; Miyauchi H
Toho Chemical Industry Co.Ltd.

Disclosed is a composition, which is a blend of a condensate obtained by reacting polyalkylenepolyamine with a fatty acid and a modified polyolefin resin having carboxyl groups in a specified proportion. It is added to bitumen in an amount of 0.05 to 5.0 wt.% to provide a paving material with superior peel resistance between the bitumen and aggregate.

EUROPEAN COMMUNITY; EUROPEAN UNION; JAPAN; WESTERN EUROPE-GENERAL
Accession no.806222

**Item 88**

Patent Number: EP 1072646 A1 20010131

**ASPHALT MODIFIER**

Maeda M; Izumoto R
Bridgestone Corp.

This includes 3 to 80 parts by weight of carbon black with a particle size of 75 micrometers or less and 10 to 100 parts by weight of an oil, per 100 parts by weight of thermoplastic elastomer. It is made by kneading carbon black and an oil with a thermoplastic elastomer at 80 to 200°C. The kneading time is from 1 to 30 minutes, the shear rate during kneading is from 50 to 800 (sec-1) and the shear energy acting per cu.cm. of carbon black during kneading is from 200 to 3000 (J/cu.cm.).

EUROPEAN COMMUNITY; EUROPEAN UNION; JAPAN; WESTERN EUROPE-GENERAL
Accession no.805866
**Item 89**

**Patent Number:** US 6117926 A1 20000912  
**ACID-REACTION POLYMER-MODIFIED ASPHALT COMPOSITIONS AND PREPARATION THEREOF**  
Engber S L; Reinke G H  
Mathy Construction Co.

An acid-reacted polymer-modified asphalt composition including (i) 80 weight percent asphalt, (ii) 0.2 to 15 weight percent polymer containing available epoxy groups, and (iii) an acid effective for promoting chemical bonding between the asphalt and the polymer, wherein the composition exhibits substantially improved Dynamic Shear Rheometer stiffness values, without an appreciable loss in the G” viscous component of the complex modulus, low temperature creep stiffness and “m” values of the composition.

**USA**  
**Accession no.802950**

**Item 90**  
**Composites Part B: Engineering**  
32B, No.1, 2001, p.57-66  
**INNOVATIVE TECHNIQUE FOR USING POLYMER COMPOSITES IN AIRPORT PAVEMENT REHABILITATION**  
Ramsamoop D V  
California, State University

A new design of a GRP composite overlay with a granite riding surface to eliminate reflective cracking on jointed rigid airport pavements is presented, together with an analytical solution for the stresses and deflection in the overlay. The stresses and deflection were obtained from fracture mechanics using the relationship between the deflection and the stress intensity factor for a crack or joint. The thermal, bending and shear stresses together with the number of cycles of repeated loading for the occurrence of the first sign of reflective cracking are presented. 16 refs.

**USA**  
**Accession no.804087**

**Item 91**

**Patent Number:** US 6127461 A1 20000905  
**CO-AGGLOMERATION OF RANDOM VINYL SUBSTITUTED AROMATIC/CONJUGATED DIOLEFIN POLYMER WITH SULFUR TO IMPROVE HOMOGENEITY OF POLYMER/ASPHALT ADMIXTURES**  
Takamura K; Velasco P; Blanpain P; Cheng J; Plaumann H; Liu R; Milician W; Baughman B  
BASF Corp.

The coagglomerate is storage stable and easily blended with asphalt under a variety of mixing conditions. Polymer/asphalt blends prepared with the sulphur coagglomerated polymers show improved storage stability against phase separation.

**USA**  
**Accession no.801675**

**Item 92**

**RECYCLING OF POLYMER MODIFIED ASPHALT PAVEMENT**  
Daly W H; Negulescu I I; Mohammad L N; Yeh P H  
Louisiana, State University (ACS, Div. of Polymeric Materials Science & Engng.)

The objective is to evaluate the fundamental properties of recycled asphalt pavements containing polymer modified asphalt cement (PMAC). To achieve this goal, the composition and engineering (rheological) properties of an industrial PMAC and of blends containing PMAC and different amounts of aged PMAC are evaluated using analytical methods and Superpave binder tests. The results give a practical guide to design hot asphalt mixtures that utilise the optimum amount of polymer modified recycled asphalt pavements. 3 refs.

**USA**  
**Accession no.802795**

**Item 93**

**BioCycle Journal of Composting and Recycling**  
41, No.12, Dec. 2000, p.46-7  
**WASTE TIRES CUT COSTS OF BUILDING NEW HIGHWAYS**  
Amirkhanian S

The South Carolina Department of Health and Environmental Control has awarded the city of Clemson in conjunction with Clemson University, a 6 million US dollar grant to establish a program, the Asphalt Rubber Technology Service (ARTS). The program involves the implementation of a 2 US dollar feed paid on each new tyre sold in South Carolina, 44 cents of which is placed in this Trust Fund. The newly developed ARTS will provide technical assistance in the promotion, design and testing
of rubberised asphalt and other crumb rubber in civil infrastructure applications for public works agencies in local governments across the state. To date, S.C. DOT has constructed five rubberised projects around the state, summaries of three of which are included.

SOUTH CAROLINA DEPT. OF HEALTH & ENVIRONMENTAL CONTROL; CLEMSON UNIVERSITY
USA
Accession no. 801410

**Item 95**
Patent Number: US 6113978 A1 20000905
METHODS AND COMPOSITIONS TO PROTECT ASPHALTIC MATERIALS
Ornstein I N; Christ G C
Asphaltic materials are provided with increased resistance to damage from water, oil and weather by treatment with an aqueous composition containing (A) from about 0.1 to 4% by weight, on a 100% solids basis, of an aqueous solution or self-dispersed emulsion or dispersion of a copolymer, which is the reaction product of monomers containing fluorinated groups, cationic groups and non-ionic groups, optionally (B) an effective amount of a penetration assistant, and (C) water to make up 100%.
USA
Accession no. 801258

**Item 96**
Patent Number: US 6011095 A 20000104
METHOD FOR PREPARING BITUMEN/POLYMER COMPOSITIONS AND USE THEREOF
Planche J P; Turello P; Lacour C
Elf Antar France
Bitumen/polymer compositions are produced by stirring together, at 100-230°C, a bitumen or bitumen mixture, a sulphur-curable elastomer and a polymeric additive consisting of at least one functionalised olefin copolymer and a sulphur-donating coupling agent. The bitumen-polymer compositions may be used directly or in dilute form to make bituminous binders for road surfaces, coated materials and sealing coatings.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no. 800938

**Item 97**
Patent Number: US 6011094 A1 20000822
ASPHALT MODIFIED WITH OLEFIN/VINYLDENE AROMATIC MONOMER INTERPOLYMERS
Stevens J C; Timmers F J; Gatzeke A L; Bredeweg C J; McKay K W; Gros W A; Diehl C F
Dow Chemical Co.
Bitumens can be blended with interpolymers prepared from at least one olefin and at least one vinyl or vinyldiene aromatic monomer and, optionally, at least one diene. When the interpolymers prepared from monomers containing a diene are blended with a bitumen, the blends are crosslinkable.
USA
Accession no. 800030

**Item 98**
Patent Number: US 6107373 A1 20000822
CONSUMABLE ASPHALT CONTAINERS AND METHOD OF REDUCING FUMES FROM A KETTLE OF MOLTEN ASPHALT
Janicki R T; Vermilion D R; Gallagher K P; Ponn F H; Franzen M R; Marzari J A; Keating J W; Trumbore D C; Harris S G; Mirra E
Owens-Corning Fiberglas Technology Inc.
A consumable container is moulded from a composition comprising 40 to 90 wt.% of an asphalt and 10 to 60 wt.% of a polymer material, which can include a first polymer, such as PP, which imparts heat resistance, and a second polymer, such as EVA, which imparts toughness and impact resistance. This moulded asphalt/polymer material preferably has an unnotched Izod impact strength of at least 2 joules. The container can be melted along with roofing asphalt held in the container without adversely affecting the properties of the asphalt and without requiring undue mixing. The composition also can be used to reduce fumes
normally emitted from a kettle of molten asphalt, e.g. as measured by a reduction of the visual opacity of the fumes by at least 25%, a reduction of hydrocarbon emissions of the fumes by at least 20% or a reduction of the total suspended particulates emissions of the fumes by at least 15%. The container may be used, e.g. to hold roofing or paving asphalt or a recyclable petroleum-derived material, such as used motor oil. The container composition may include one or more ingredients to improve the quality of paving-grade asphalt.

USA

Accession no.800029

Item 100

China Synthetic Rubber Industry
23,No.3,2000,p.196-9
Chinese

MODIFICATION OF ASPHALT WITH RUBBERS FOR PAVEMENT AND THEIR MICROSTRUCTURE
Lin Xianfu; Wu Qi; Lu Deshui; Chen Zhichun
Hangzhou,Zhejiang University

Asphalt modified with three kinds of rubbers, such as reclaim rubber, synthetic or natural rubbers, block copolymers (SBS), and its use as a pavement material are reviewed. Rubber modification can significantly improve the performance of asphalt for pavements. Four kinds of modification mechanisms are presented and compared. 18 refs.

CHINA

Accession no.799136

Item 101

Patent Number: US 6100317 A1 200000808
STABILIZED BITUMEN COMPOSITIONS
Liang Z-Z; Woodhams R T; Smith J W
Polyphalt LLC

Two or more different polymeric materials are stably incorporated into bitumen by effecting steric stabilisation of a polyolefin, such as polyethylene, and by dispersing the other polymer, such as a styrene-butadiene-styrene copolymer, an ethylene-vinyl acetate copolymer or an EPDM copolymer in the stabilised polyethylene-bitumen composition. The ability to incorporate different polymeric materials in bitumen permits desirable modifications to the properties of the composition to be effected. In addition, different properties can be attained by modifying processing parameters.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; USA; WESTERN EUROPE

Accession no.797953

Item 102

Patent Number: US 6103783 A1 20000815
ELASTIC WATER-PERMEABLE CONCRETE COMPOSITION, FORMULATION METHOD THEREFOR, ELASTIC WATER-PERMEABLE CONCRETE STRUCTURE FORMED OF THE COMPOSITION, AND METHOD FOR CONSTRUCTING THE STRUCTURE
Hong Y-K

An elastic water-permeable polymeric concrete composition is disclosed, together with a formulation method therefor, an elastic water-permeable polymeric concrete structure using the composition and a method for constructing the structure. The polymeric concrete composition is formulated by integrating a rubber powder ground from waste tyres or waste rubber and an aggregate using a polymeric binder, and if required, by adding a pigment and aromatic capsules capable of providing remedial and psychological effects. The polymeric concrete structure manufactured using such a polymeric concrete composition has appropriate elasticity, water permeability, strength and a pleasant aroma. Thus, the polymeric concrete composition is useful for paving a footpath, a roadway, a bikeway, a railway crossing, a parking lot, a stadium, a racing track, a landing strip, etc., and as a material for civil engineering and constructions such as blocks, tile sound-absorbing plates, soundproofing plates, soundproofing walls and retaining walls.

KOREA; USA

Accession no.797905

Item 103

Patent Number: US 6106604 A1 20000822
BITUMEN EMULSION, PROCESS OF PRODUCING A BITUMEN EMULSION AND PROCESS OF PRODUCING A BITUMINOUS EMULSION FOR THE CONSTRUCTION OR MAINTENANCE OF PAVEMENTS
Durand G; Poirier J-E; Chappat M
Colas

A bitumen emulsion is disclosed, including a bituminous phase having one of pure bitumen, fluxed bitumen, and modified bitumen. The bitumen emulsion also includes an aqueous phase including water and an emulsifying agent. The bitumen emulsion further includes a breaking agent encapsulated in capsules allowing control of breaking of the bitumen emulsion, the control involving rupture of the capsules from a mechanical effect by a mechanical action produced on the bitumen emulsion. Processes for producing a bitumen emulsion and processes for controlling the breaking of a bituminous emulsion are disclosed.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; USA; WESTERN EUROPE

Accession no.795624

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Effect of Dispersion Agents on Properties of SBS Modified Asphalt

Shifeng W; Dizhen W
South China, University of Technology

The effect is examined of dispersing agents on the properties of SBS used as a modifier for asphalt. The two dispersing agents tested are a terpene hydrocarbon and an aromatic petroleum resin. It is found that both have a positive influence on the dispersibility of SBS without lowering its softness point as is the case when oils are used to accelerate the dispersibility of SBS. 2 refs.

China
Accession no. 794763

Industrial Trial of SBR Latex for Paving

Jihong Z; Jiming X
Qilu Petrochemical Co. Ltd.

SBR latex for paving with a 45% solids content was prepared by the vacuum concentration process using a viscosity depressant and outside circulation heating. The industrial trial determined the optimum conditions for temperature, vacuum and dehydrating amounts. The effects of the additions of an alkaline agent and viscosity depressant were examined.

China
Accession no. 794755

Modification of Road Bitumens with Thermoplastic Polymers

Xiaohu Lu; Isacsson U
Sweden, Institute of Technology

Polymer-modified bitumens were prepared by blending bitumens with different thermoplastics polymers (styrene-butadiene-styrene(SBS), styrene-ethylene-butylene-styrene(SEBS), EVA and ethylene-butyl acrylate(EBA) copolymers). The basic properties, e.g. morphology, rheology and ageing, of the modified binders were studied using fluorescence microscopy, dynamic mechanical analysis, creep testing and GPC. The results obtained indicated that the morphology and rheological properties of the modified binders were influenced by characteristics and content of the polymer and nature of the bitumen. When a continuous polymer phase was formed at a sufficiently high polymer content, the rheological properties of the binders were significantly improved. At a given polymer content, the modified binders containing SBS and SEBS differed widely from those containing EVA and EBA in their rheological behaviour. The ageing properties of the binders were also strongly dependent on types of polymer. In most cases, the rheological changes during ageing were related to oxidation of bitumen and/or degradation of polymer. 22 refs.

Europe; Scandinavia; Sweden; Western Europe
Accession no. 792600

Enhancing Load Bearing Characteristics of Compacted Soil

Doyle M P
Vinzoyl Technical Services LLC
Methods are disclosed for preparation of chemically-stabilised emulsions of tall oil in water. Temperature and pH are controlled during preparation of the emulsions so as to prevent saponification and neutralisation of acids in the tall oil component. The final emulsions have pHs in the range of from about 3.0 to 5.0 and remain phase stable for extended periods of time. Methods are disclosed for using the emulsions for soil treatment to improve soil stabilisation and load bearing capacity for roadbed use, for treatment of reclaimed asphalt pavement for reuse as a stabilised base course for roadway construction and for remediation of heavy metal contaminated soil.

USA
Accession no.790660

Item 110
International Polymer Science and Technology
27, No.8, 2000, p.T/13-4
CERTAIN RHEOLOGICAL PROPERTIES OF SEALING/BONDING COMPOSITES BASED ON BUTADIENE-STYRENE RUBBERS
Shutilin Y F; Smirnykh A A; Krasovitskii Y V
Voronezh, State Technological Academy

Polymer-bitumen composites for use as sealing/bonding materials are examined with reference to their rheological properties. Composites based on whiting-filled butadiene-styrene rubber containing bitumen and transformer oil were studied, with varying compositions of components to determine the temperature dependence of effective viscosity of composites with rubber contents of 12 wt.%, 18 wt.%, 24 wt.% and 29 wt.%. It is demonstrated that the production of sealing/bonding composites based thereon, must be carried out at a temperature of no more than 393 K with the aim of preventing undesirable structure formation of the viscous-flow material. 4 refs. Translation of Kauchuk i Rezina, No.1, 2000, p.11.

RUSSIA
Accession no.790292

Item 111
Patent Number: US 6057390 A1 20000502
CROSSLINKABLE POLYMER-MODIFIED ASPHALT AND ITS METHOD OF PREPARATION
Loza R; Dammann L G; Hayner R E; Doolin P K
Ashland Inc.; Marathon Ashland Petroleum LLC

A method is provided for improving high temperature performance grade properties of asphalt which comprises i) heating an asphalt cement to 200 to 500 F (93 to 260 deg C), ii) adding 1 to 10 wt. % crosslinkable polymer, e.g., styrene-butadiene-styrene triblock copolymer based on weight of said asphalt cement, iii) adding a useful temperature index (UTI) improving amount of dioxime(s) of 1,4- benzoquinone and its derivatives and optionally, free radical initiator, e.g. organic peroxide, and iv) mixing the resulting blend, thereby providing a paving asphalt having a greater useful temperature index (UTI) than a corresponding blend to which no dioxime is added. The invention further relates to asphalt compositions thus made and paving compositions containing these asphalt compositions.

USA
Accession no.784441

Item 112
Patent Number: US 5998514 A 19991207
RANDOM VINYL SUBSTITUTED AROMATIC/C4-C6 CONJUGATED DIOLEFIN POLYMER MODIFIED ASPHALT MIXTURES
Cheng J T-C; Plaumann H; Takamura K; Baughman A B
BASF Corp.

The present invention relates to random vinyl substituted aromatic/C4-C6 conjugated diolefin polymer modified asphalt mixtures wherein the modifier is a keto-containing amide such as diacetone acrylamide (DAAM), an oxazoline containing copolymer, and an ethoxylated trimethylolpropane triacrylate.

USA
Accession no.783861

Item 113
China Synthetic Rubber Industry
23, No.4, July 2000, p.242
PREPARATION OF STORAGE STABLE SBS COPOLYMER/ASPHALT BLENDS
Gui’an W; Xinzhong C; Yong Z; Yinxi Z
Shanghai, Jiao Tong University

It is well known that mechanical properties of asphalt can be improved by modification with some polymers, especially styrene-butadiene-styrene tri-block copolymer (SBS). However, due to the incompatibility between polymeric materials and asphalt, the storage stability of polymer-modified asphalt is usually poor at high temperatures. Dynamic vulcanisation, through which the compatibility and mechanical properties of polymers can be improved effectively, is widely used in polymer/polymer blends. Storage stable SBS/asphalt blends are prepared via dynamic vulcanisation.

CHINA
Accession no.783783

Item 114
Patent Number: US 6043302 A1 20000328
IMPACT ABSORBING MACADAM
Spendlove P D

This comprises 10 to 75% (preferably 25 to 45%) of a particulate rubber having a particle size of up to 40 mm, 25 to 90% (preferably 45 to 65%) of an aggregate having a particle size of up to 40 mm and from 5 to 9% of a polymer modified bituminous binder. Typically such a macadam has a void volume, interconnected or unconnected, of from 5 to 25%. The polymer, which modifies the bituminous binder,
is preferably an unbranched styrene butadiene styrene block copolymer forming about 7% of the modified binder. The macadam is suitable as a base for sports pitches and athletic tracks without a rubber shock pad overlay.

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

References and Abstracts

**Item 115**

**Patent Number:** US 6027558 A1 20000222

**HYDRATED LIME ADDED DIRECTLY TO ASPHALT CEMENT AS A MULTI-FUNCTIONAL MODIFIER FOR ASPHALT MIXTURES**

Little D N; Graves R E; Huege F R

Chemical Lime Co.

A hot mix asphalt composition and method are shown in which hydrated lime is added directly to the asphalt binder prior to the addition of the asphalt binder to the mineral aggregate constituent of the composition. The lime-asphalt mixture is then added to the mineral aggregate. The lime component is added to the asphalt binder in an amount which exceeds about 10% by weight, based upon the total weight of asphalt binder in the composition.

USA

**Accession no.780969**

**Item 116**

**Patent Number:** US 6013681 A 20000111

**PRODUCTION OF BITUMINOUS EMULSION AND LIQUID AMINE EMULSIFIER THEREFOR**

Asamori K; Tamaki R; Funada H; Taniguchi T; Juarez F C; Ortiz C A; Muniz A G; Hernandez H R

Kao Corp.

A liquid amine compound is disclosed which can be applied to various uses such as emulsification for bitumens, since it has as high surface activity as those of solid amines and is more excellent in workability as compared with the solid amines, and an emulsifier for bitumens produced by using the amine compound. Furthermore, a process is disclosed for producing an emulsifier for a bituminous emulsion by reacting an aliphatic amine having at least one hydrocarbon group having not less than 8 carbon atoms with a carbonyl compound and adding an acid thereto to adjust the pH of the amine compound so as to be not more than 5, and a process for producing a bituminous emulsion composition by using the amine compound.

JAPAN

**Accession no.777023**

**Item 117**

**Elastomery**

4, No.1, 2000, p.9-14

**PAVEMENTS FROM ASPHALTS MODIFIED WITH GROUND TYRE RUBBER**

Diedrich K M; Burns B J

Degussa-Huls AG; Creanova Inc.

High quality pavements can be prepared by mixing trans-polyoctenamer (TOR) with ground tyre rubber (GTR) in asphalt. As little as 3-6% of TOR causes efficient dispersibility of fillers, compatibility and crosslinking in asphalt GTR mixtures. Mixture preparation and methods of usage are described in detail. In addition, practical examples of the cost calculations for several roads are presented. 4 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; USA; WESTERN EUROPE

**Accession no.776390**
**Item 120**  
Patent Number: US 6020404 A1 20000201  
**BITUMEN/POLYMER COMPOSITIONS WITH IMPROVED STABILITY AND THEIR APPLICATION IN CARRYING OUT SURFACING OPERATIONS**  
Planche J-P; Turello P; Lacour C  
Elf Antar France  

Bitumen/polymer compositions are provided containing a bitumen or a mixture of bitumens and, reckoned by weight of bitumen, 0.3% to 20% of at least one primary polymer selected among certain elastomers and plastomers and 0.01% to 12% of at least one olefinic polymer bearing epoxy or COOH groupings. The compositions are useful, directly or after dilution, to form bitumen/polymer binders for carrying out road surfacing, for coated materials or waterproof coatings.

**Accession no. 776239**

**Item 121**  
Patent Number: US 5973037 A 19991026  
**STYRENE ETHYLENE BUTYLENE STYRENE (SEBS) COPOLYMER RUBBER MODIFIED ASPHALT MIXTURE**  
Fields J R  

The process and composition for SEBS block copolymers modified asphalt mixtures for use in roofing, sealing, paving, and waterproofing membranes are disclosed. Powdered and pelletised SEBS is added to oxidised or unoxidised asphalt flux in high-shear processes, and is applied in hot and ambient uses such as cutbacks and emulsions, with or without added fillers, fibres, or other additives.

**USA**  
**Accession no. 776239**

**Item 122**  
**Offshore**  
60, No.4, April 2000, p.172  
**RUBBER TOUGHENED URETHANE RESISTS WEAR AND LIMITS VIBRATION**  

A unique process transforms used tyres into a solvent-free substance that can be sprayed onto almost any surface to create a layer of rubber toughened urethane that is resistant to wear, abrasion and corrosion, and reduces noise and vibration. ProCoat is suitable for deck coatings, bridge and road surfaces and the construction of fenders and rubbing strakes. The coating is naturally resistant to ice formation, but can also be applied in a thickness to contain heating elements. A less typical use was the coating of a rudder of a ferry to protect the metal against damage from cavitation.

**PROCOAT NORDIC AB**  
**EUROPEAN UNION; SCANDINAVIA; SWEDEN; WESTERN EUROPE**  
**Accession no. 770450**

**Item 123**  
Patent Number: US 5981010 A 19991109  
**POLYURETHANE-MODIFIED BITUMEN COATING COMPOSITION**  
Terry C E; Berard R A; Pinholster D F  
Interface Inc.

A polyurethane-modified bitumen coating composition of selected surface tack and fluidity is disclosed. The composition includes: bitumen; a minor modifying amount of a polyurethane prepared by the reaction of a polyisocyanate and a hydroxyl terminated polybutadiene; a tackifier; and a filler material.

**USA**  
**Accession no. 7769716**

**Item 124**  
Patent Number: US 5980664 A 19991109  
**PAVEMENT MARKING MATERIAL AND METHOD OF MARKING PAVEMENT**  
Wilson J H  

A substantially permanent pavement marking system, using a polymer modified cement material to provide a raised marking which extends above the surface of the pavement, is disclosed. The lines are formed by tapping off the desired outline shape of the marking. The pavement marking material is of such a consistency that it will set up to form a thick layer and not flow over the tape and will harden forming a raised marking.

**USA**  
**Accession no. 769674**

**Item 125**  
Patent Number: US 5986010 A 19991116  
**POLYMER FOR ASPHALT CEMENT MODIFICATION**  
Clites J S; Colvin H A; Klemmensen D F  
Goodyear Tire & Rubber Co.

This invention discloses a process for synthesising a styrene-butadiene polymer which is particularly useful for modifying asphalt to improve force ductility, elastic recovery, toughness and tenacity, by a process which comprises the steps of: (1) continuously charging 1,3-butadiene monomer, an organolithium compound, a polar modifier and an organic solvent into a first polymerisation zone, (2) allowing the 1,3-butadiene monomer to polymerise in said first polymerisation zone to a conversion of at least about 90 percent to produce a living polymer solution which is comprised of said organic solvent and living polybutadiene chains having a number average molecular weight which is within the range of about 20,000 to about 60,000, (3) continuously withdrawing said living polymer solution from said first reaction zone, (4) continuously charging styrene monomer, divinyl benzene and the living polymer solution being withdrawn from the first polymerisation zone to a conversion of at least about 90 percent to produce a living polymer solution which is comprised of said organic solvent and living polybutadiene chains having a number average molecular weight which is within the range of about 20,000 to about 60,000, (3) continuously withdrawing said living polymer solution from said first reaction zone, (4) continuously charging styrene monomer, divinyl benzene and the living polymer solution being withdrawn from the first polymerisation zone to a second polymerisation zone, (5) allowing the styrene
monomer and divinyl benzene monomer to polymerise in said second polymerisation zone to produce a solution of styrene-butadiene polymer having a number average molecular weight which is within the range of about 30,000 to about 85,000 and (6) continuously withdrawing the solution of said styrene-butadiene polymer from the second polymerisation zone.

USA

Accession no.769188

Item 126
Patent Number: EP 985703 A1 20000315
ASPHALT-ADDITIVE COMPOSITION
Isobe K; Tamaki R; Tomioka K
Kao Corp.

An additive for asphalt, which rapidly improves the anti-stripping effect of asphalt from aggregates, comprises (A) a specific acidic phosphoric acid compound and (B) at least one member, such as a mineral oil, alcohol having 8 to 18 carbon atoms, carboxylic acid having 8 to 18 carbon atoms or triglyceride thereof. The amount of (B) is 25 to 400 pbw per 100 pbw of (A).

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

Accession no.766255

Item 127
Patent Number: US 6000876 A 19991214
CONTENT AND PRODUCTION METHOD FOR SEMI-RIGID ASPHALT CONCRETE
Shen D-H; Lu C-T;

This concrete comprises cationic emulsified asphalt, type-1 cement, F-type superplasticiser, sodium-carboxymethylcellulose, calcium chloride, stone dust and aggregates. The mixing procedure is described.

TAIWAN

Accession no.764067

Item 128
Elastomery
3, No.5, 1999, p.10-7
Polish

INTERACTIONS BETWEEN RUBBER AND ASPHALT. EVALUATION OF SYSTEM STABILITY.
Baryn W; Slusarski L
Instytut Polimerow Politechniki Lodzkiej

This detailed article examines the stability of ground rubber asphalt mixes which are increasingly being used in pavement construction. It is reported that the rate of sedimentation of the rubber particles is lowered due to swelling of these particles in the asphalt melt. A similar effect is said to be possible to achieve if the asphalt viscosity is enhanced, i.e. the use of reclaimed rubber as a thickening agent.

EASTERN EUROPE; POLAND

Accession no.763085

Item 129
Patent Number: US 5990207 A 19991123
MIXTURES OF BITUMEN, OF POWDERED RUBBER WASTE AND OF POLYMER EMPLOYED AS ROAD BINDER
Perret P; Lebez J; Montignac G
Elf Atochem SA

The present invention relates to mixtures of bitumen, of powdered rubber waste and of at least one copolymer (A) of an alpha-olefin and at least one unsaturated epoxide, such that: the Brookfield viscosity at 180 deg C according to NFT Standard 76102 (27 needle) is lower than 1150 mPa.s.; the difference in absolute value of the softening points (ring and ball temperature) according to NFT 66008 between the top and bottom fractions of a mixture stored for 3 days at 180 deg C in a vertical tube is smaller than or equal to 5 deg C. These mixtures are useful as road binders.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE

Accession no.761733

Item 130
Patent Number: US 5990206 A 19991123
ASPHALT MODIFIER COMPOSITION AND ASPHALT COMPOSITION
Tanaka S; Ikenaga T
Kao Corp.

Preparation of an asphalt composition using an asphalt modifier composition comprising at least one member selected from the group consisting of rubber-base modifiers and resin-base modifiers and a phosphorous compound permits the modifier to be satisfactorily dissolved in asphalt. Further, when paving is conducted by using a composition for paving prepared with the asphalt composition, the adhesion of asphalt to an aggregate is high, and the resultant pavement has markedly improved rutting resistance and wearing resistance. The pavement therefore has a prolonged service life.

JAPAN

Accession no.761732

Item 131
Progress in Rubber and Plastics Technology
15, No.4, 1999, p.235-48

USE OF RECYCLED TYRE RUBBER FOR MODIFICATION OF ASPHALT
Gawel I; Slusarski L
Wrocławska Politechnika; Lodz,Polytechnic

An overview is presented of problems connected with the modification of asphalts with rubber crumb from tyre recycling. 45 refs.

EASTERN EUROPE; POLAND

Accession no.761199
Item 132
Patent Number: US 5961730 A 19991005
METHOD OF ASPHALT REMOVAL FROM SURFACES
Salmonson S T; Frailey M D; Proctor J J; Kranz L P; Crooks S M
Morton International Inc.
An asphalt release agent for preventing hot road asphalt, especially polymer-modified asphalt, from sticking to surfaces of delivery truck beds is provided. The release agent includes a water-based mixture of polycycloaliphatic amines and polyalkylene glycols. The release agent is applied onto the truck beds to create a slippery non-stick surface so that the road asphalt which comes in contact with such truck bed surfaces will not adhere.
USA
Accession no.761047

Item 133
Patent Number: US 5961709 A 19991005
ENVIRONMENTALLY IMPROVED ASPHALT COMPOSITIONS AND THEIR PREPARATION
Hayner R E; Doolin P K; Hoffmann J F; Wombles R H
Marathon Ashland Petroleum LLC
An environmentally improved asphalt paving composition which contains a solvent-precipitated asphaltene, such as solvent deasphalting bottoms, and a viscosity reducing amount of paraffinic fluxing component, e.g. 325 Neutral Oil, is disclosed.
USA
Accession no.761046

Item 134
Patent Number: EP 967186 A2 19991229
PARTICULAR MATERIAL SUITABLE FOR USE IN CONSTRUCTION AND METHODS OF MAKING SAME
Al-Nageim H
Liverpool, John Moores University
This particulate material, which is suitable for use in the manufacture of surfaces for roads and airfields, is composed of coated and uncoated aggregates. The aggregates may be gravel, clay, artificial aggregate or crushed rock aggregate and the coating is a set mixture of cement, paste and water. Asphalt mixtures made from the clay-made aggregates and/or coated aggregates are more stable and less prone to rutting under traffic loads.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.759899

Item 135
156th ACS Rubber Division Meeting - Fall 1999. Conference preprints.
Orlando, Fl., 21st-23rd Sept.1999, paper 108
POSSIBILITIES OF GROUND TYRE RUBBER RECYCLING WITH TRANS-POLYOCTENAMER
Diedrich K M; Burns B J
Degussa-Huls AG; Creanova Inc. (ACS, Rubber Div.)
The chemical properties of trans-polyoctenamer (TOR) facilitate the coating of the surface of ground rubber waste, i.e. ground tyre rubber (GTR), by a simple technique. A ground rubber modified in this way can be added as filler material to virgin rubber compounds and causes less deteriorated physicals of the vulcanisates than uncoated rubber waste does. Alternatively, the modified ground rubber can be directly moulded into new rubber compounds. The parameters of the rubber waste influencing the final properties of the rubber goods are discussed. A new application of TOR in connection with GTR is found in asphalt production. Every year GTR is used in greater amounts in rubberised asphalt. Small amounts of TOR result in better dispersion of the GTR and crosslinks the GTR to the asphalt. In addition, the TOR drastically reduces tackiness of the mixture caused by the GTR addition. This allows earlier compacting of the asphalt with steel and rubber rollers at higher temperatures and saves a lot of time. The ability of the TOR to crosslink the GTR to the asphalt provides a rubberised matrix in the asphalt paving that prevents premature cracking, rutting and shoving. 5 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; USA; WESTERN EUROPE
Accession no.759700

Item 136
156th ACS Rubber Division Meeting - Fall 1999. Conference preprints.
Orlando, Fl., 21st-23rd Sept.1999, paper 170
REVIEW OF THE USE OF CRUMB RUBBER IN PAVEMENT MAINTENANCE AND REHABILITATION STRATEGIES
Van Kirk J
Basic Resources Inc. (ACS, Rubber Div.)
Crumb rubber has been used in asphalt concrete pavement applications for many years. The most successful application of crumb rubber has been in the wet process asphalt rubber binder used in seal coats, interlayers and hot mix. Research based on field performance has proven that thinner sections of asphalt rubber hot mix can out perform thicker sections of conventional hot mix. This reduction in thickness when using asphalt rubber has led to the use of the binder in multi-layer systems. Field performance has shown that asphalt rubber can provide very cost-effective pavement maintenance and rehabilitation strategies. 13 refs.
USA
Accession no.759428
Item 137
Patent Number: US 5959007 A 19990928
BITUMINOUS COMPOSITIONS PREPARED WITH PROCESS TREATED VULCANIZED RUBBERS
Zhi-Zhong Liang
Polyphalt LLC

Stable rubberised bitumen concentrates are prepared by initially forming a mass comprising bitumen and crumb rubber particles in an amount of at least about 15 wt% of the mass with the crumb rubber being swollen in situ, and applying shear and temperature conditions to the mass to dissociate the vulcanisable network of the rubber particles and to incorporate the digested vulcanisate into the bitumen. The stable rubberised bitumen concentrate is stable against sedimentation of rubber particles both following storage of the concentrate at about 320 deg F for 48 hours and dilution to a lower concentration in the ASTM solubility test.

USA
Accession no.759139

Item 138
Patent Number: US 5938832 A 19990817
CRUMB RUBBER MODIFIED ASPHALT WITH ENHANCED SETTLING CHARACTERISTICS
Memon G H

This asphalt includes crumb rubber particles which have been treated to produce a greater number of carboxylic sites on the surface of the crumb rubber. These carboxylic sites interact with the functional groups in the asphalt, resulting in a homogeneous mixture having improved separation characteristics as well as the improved rheological properties due to the inclusion of the crumb rubber particles.

USA
Accession no.758913

Item 139
Patent Number: US 5827568 A 19981027
RUBBER BASE ASPHALT EMULSION ADDITIVE
Wickett S R
Rubber Resources LLC

A gel-like emulsion containing natural rubber and crumb rubber from used vehicle tyres which may be added to an asphalt paving emulsion at ambient temperature for chip coating, slurry sealing, microsurfacing, soil stabilisation or pavement recycling.

USA
Accession no.758241

Item 140
Patent Number: US 5936015 A 19990810
RUBBER-MODIFIED ASPHALT PAVING BINDER
Burns B J
Creanova Inc.

An improved rubber-modified asphalt paving binder is provided by incorporating a minor proportion of a polyoctenamer into the heated liquid asphalt cement. The binder can contain from about 80% to about 20% by weight of asphalt cement, from about 0.5% to about 20% by weight of crumb rubber, such as ground tyre rubber (GTR), and from about 0.01% to about 10% by weight of the polyoctenamer. The polyoctenamer can be of the trans- or cis- form, such as that sold under the brand name VESTENAMER. A paving concrete is provided by adding the improved asphalt binder, with mixing, to conventional aggregate materials, which materials can also contain additional crumb rubber.

USA
Accession no.753718

Item 141
International Polymer Science and Technology
26, No.2, 1999, p.97-103
USE OF RECYCLED TYRE RUBBER FOR MODIFICATION OF ASPHALT
Gawel I; Slusarski L
Wroclaw Politechnika; Lodz Polytechnic

Blending of waste rubber with asphalt used for road building enhances the road’s resistance to deformation. The rubber requires granulation prior to blending with the asphalt, and this is usually accomplished using knife disintegrators, which gives particles of irregular shape and rough surface, which of most suited to this process. Two processes are employed for blending the ground waste rubber into the asphalt. In the wet process, the rubber is mixed with the asphalt at 170-220 C, with a typical addition of 14-20%. In the dry process, the rubber replaces part of the aggregates, and is mixed with the mineral before the latter is mixed with the asphalt. The addition of rubber particles to the asphalt gives a considerable increase in viscosity, improves the elasticity of the binder and lowers its brittle point. Rubber-modified asphalts offer the considerable benefit of enhanced stiffness at elevated temperatures. The optimum rubber addition is 5%, and compositions with a contents of 15-20% are generally very stiff. Although compositions containing rubber are more expensive, the surface is more durable and it is possible to use thinner layers. Research in Poland is briefly summarised. 45 refs. Translation of Polimery, Tworzywa Wielkoczasteczkowe, No.5, 1998, p.280
EASTERN EUROPE: POLAND
Accession no.753460
Item 142

Italian Technology

TECHNOLOGICAL PROGRESS FOR MODIFIED BITUMENS

A new type of draining asphalt containing Eni Chem SBS has recently been presented at the Autodrome in Monza. With this new type of asphalt produced by Eni Group, the road blanket becomes permeable even in the case of strong rain, and thus prevents the many risks caused by spraying of water raised off wheels, as well as risks determined by water stagnation. Details are given.

ENICHEM SPA; ENI GROUP
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.753289

Item 143

High Performance Plastics
Nov.1999, p.9

STYRENE COPOLYMERS FOR MOTORWAY SURFACES

Bitumen modified with Shell’s Kraton D polymer has been used for resurfacing a 20 km stretch of a major motorway in Turkey, it is reported. Superior performance in extreme hot and cold climatic conditions were the reasons for the choice of this modifier which is one of a range of styrene-based polymers and compounds containing an unsaturated rubber midblock. Brief details are given of this application.

SHELL CHEMICALS
TURKEY
Accession no.752948

Item 144

BITUMINOUS AGGREGATE COMPOUNDS, AND PROCESS FOR ITS PRODUCTION
Biardi G; Luciani B; Pellicioli P

These road-base compounds comprise an inert stone material bonded by bitumen and include small pieces of rubber.

EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.752177

Item 145

Plastics News(USA)
11, No.35, 18th Oct.1999, p.4

PLASTIC POTHOLE REPAIR PAVING WAY TO SAVINGS
Ledson S

Using components made predominantly from recycled plastic waste, Parsec has introduced a pothole and roadway repair system for asphalt and concrete roads. A cross-laminated PE liner covers the bottom of the pothole, while a PP geogrid mesh interwoven with PVC rebar tubes is laid on top. The rebar tubes act as reinforcement rods that will allow the pothole filler to withstand vehicle impact, provide stability and prevent deterioration. The filler is then covered by traditional asphalt.

PARSEC INC.
USA
Accession no.751187

Item 146

Patent Number: US 5952412 A 19990914
PELLETIZED RUBBER
Greenberg L M; Smith J A
Green Edge Enterprises LLC

The present invention relates to rubber pellets made of an amount of vulcanised rubber and an amount of binder, with the vulcanised rubber preferably being discarded rubber. Additionally, the rubber pellets will preferably contain an amount of filler materials which are plastic or rubber or combinations thereof so that the preferred rubber pellet contains an amount of rubber equal to 50-95 wt.% of the rubber pellet, an amount of filler of 0-45 wt.% of the rubber pellet, and an amount of binder of 5-10 wt.% of the rubber pellet. The rubber pellets are used in the formation of asphalt and are desirable because they provide necessary constituents to the asphalt and allow for elimination of equipment and separate ingredient addition steps from the asphalt formation process. The present invention is also desirable because it provides for a way to dispose of waste rubber materials.

USA
Accession no.749735

Item 147

Polymer
40, No.23, 1999, p.6337-49
BLEND OF BITUMEN WITH POLYETHYLENES
Fawcett A H; McNally T; McNally G M; Andrews F; Clarke J
Belfast,Queen’s University; Dussek Campbell Ltd.

Blends of a 100 penetration grade bitumen with four different PEs having up to 40 pph or 29 wt % of polymer were prepared using a Z-blade mixer at more than 160C. The blends were studied by fluorescence optical microscopy, DSC and DMTA. The optical measurements indicated the presence of bitumen-rich and polymer-rich phases. The DSC showed that the m.p. of the crystallites was lowered and, within the polymer-rich phases, the extent of crystallinity reduced by the presence of the bitumen. Annealing made significant changes to crystallite size, indicated by raising of the m.p. of the polymer crystallites. The DMTA measurements showed that these polymers lowered the temp. at which the Tg softened the material, but raised the temp. at which the blend underwent viscous flow. When the polymer fraction was over 20 to
28%, the flow started only when the crystallites melted, so that the polymer then provided an associating junction network. 17 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.749000

Item 148
Patent Number: EP 940440 A1 19990908
BLOCK COPOLYMER COMPOSITION FOR MODIFYING ASPHALT AND ASPHALT COMPOSITION COMPRISING THE SAME
Toda K; Nakamichi Y
Japan Elastomer Co.Ltd.

The above composition comprises a mixture of (A) a block copolymer composed of at least two polymer blocks, each mainly comprising a monoalkenyl aromatic compound and at least one polymer block mainly comprising a conjugated diene compound, and (B) a block copolymer comprising at least one polymer block mainly comprising a monoalkenyl aromatic compound and at least one copolymer block mainly comprising a conjugated diene compound and having a molec. wt. equivalent to 1/3 to 2/3 of the molecular weight of A. The total bonding alkenyl aromatic compound content in the mixture is from 10 to 50 wt.% and the vinyl bond content in the conjugated diene polymer blocks is no greater than 70 wt.%. The composition has a specified bulk density and particle size distribution and a total pore volume of from 100 to 2,000 cu.mm/g.
JAPAN
Accession no.747468

Item 149
Plastics Engineering
55, No.8, Aug.1999, p.12
PLASTICS INDUSTRY IS PART OF THE SOLUTION TO SUSTAINABLE PLASTICS RECYCLING
American Plastics Council’s Technical Assistant Program works to help communities, state and local governments, teachers and businesses to understand how plastics are more energy efficient, conserve resources and benefit their lives. Recently APC partnered with the Massachusetts Department of Environmental Protection and the USEPA to demonstrate an efficient end use product for plastics recovered from electronic equipment and computers. The product is a cold patch asphalt mixture, ideal for filling potholes, that uses recovered plastics for 75% of its volume.
AMERICAN PLASTICS COUNCIL
USA
Accession no.745283

Item 150
POLYMERS FOR BITUMEN MODIFICATION
Exxon Chemical Europe Inc.

Two families of polymer modifiers for bituminous road surfacing applications from Exxon Chemical are described. They are Polybilt, a range of specially developed plastomers based on EVA copolymers, and Vector, a range of styrenic-block elastomers. Advantages of polymer-modified bitumen in road surface applications are discussed, and performance characteristics offered by the use of bitumen binders are described in applications such as drainage asphalt, thin overlays, hot rolled asphalt, and surface dressings. Typical properties are included for each product.
BELGIUM; EUROPEAN COMMUNITY; EUROPEAN UNION; WESTERN EUROPE
Accession no.742804

Item 151
Macplas
24, No.207, April 1999, p.109-10
Italian
DRAINING ASPHALTS

The use of rubber-modified asphalts for road surfaces having improved water drainage properties is discussed. Particular attention is paid to Eliflex modified bitumen developed by Agip Petroli using EniChem’s Europrene Sol T styrene-butadiene-styrene block copolymer thermoplastic elastomer.
ENI GROUP; AGIP PETROLI SPA; ENICHEM SPA
EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.742593

Item 152
Patent Number: US 5807429 A 19980915
COMPOUND BINDER, PROCESS FOR OBTAINING IT AND APPLICATION IN HIGHWAY SURFACING
Chambard R; Gaultier J; Pellion R; Perrono G
Colas SA

Compound binder comprising an aqueous emulsion of at least one hydrocarbon binder and, at least one hydraulic binder, which also contains at least one adjuvant intended to control the rate of setting of the hydraulic binder in order to obtain a liquid product with a viscosity of less than 1 Pa.s.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.740261
ITEM 153
High Performance Textiles
July 1999, p.7-8
TEMPORARY ROAD SURFACES
A woven structure that can be laid much like carpet across soft, sandy and swampy ground will help all types of vehicle to traverse such areas safely, according to US Patent 5,946,890. The fabric is portable and has a weight of about 725 gsm. When laid, the fabric will have a thickness of about 1 cm.

SOCIETE A RESPONSABILITE LIMITEE
DESHAMPS
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.739197

ITEM 154
Patent Number: US 5902852 A 19990511
ASPHALT CEMENT MODIFICATION
Schulz G O; Klemmensen D F
Goodyear Tire & Rubber Co.
A modified asphalt cement is composed of from about 90 to 99 wt.% of asphalt and from about 1 to 10 wt.% of a rubbery terpolymer, which is composed of repeat units derived from about 64 to 84.9 wt.% of a conjugated diolefin monomer, about 15 to 33 wt.% of a vinyl aromatic monomer and about 0.1 to 3 wt.% of isobutoxymethyl acrylamide, all of which are in the backbone of the rubbery terpolymer. The rubbery terpolymer, which has a Mooney viscosity in the range of about 35 to 80, greatly enhances the resistance to shoving, rutting and low temperature cracking of the asphalt concrete and preferably also contain repeat units derived from hydroxypropyl methacrylate.
USA
Accession no.738724

ITEM 155
Patent Number: EP 926191 A2 19990630
ASPHALT ADDITIVE
Tomioka K; Tamaki R; Isobe K
Kao Corp.
The additive, a formula for which is given, increases the adhesion between asphalt and aggregates and ensures the anti-stripping effect of the asphalt from the aggregates immediately after paving and over a long time.
JAPAN
Accession no.738582

ITEM 156
Patent Number: US 5811477 A 19980922
METHOD FOR PREPARING IMPROVED ASPHALT EMULSION COMPOSITIONS
Burris M V; Burris B B
A method of preparing an asphalt emulsion composition comprises mixing an aqueous asphalt emulsion, water, latex rubber, and a solids mix composition comprising reclaimed rubber particles passing through a 40 mesh U.S. series sieve and one or more solid additives selected from the group consisting of a rheological agent, gilsonite, carbon black, surface active clay and polymer fibres, and mixtures thereof. The ratio of latex rubber : rubber particles is between about 1:1 and about 1:10 by weight, respectively; the components are mixed at substantially ambient temperature.
USA
Accession no.738141

ITEM 157
Patent Number: US 5888289 A 19990330
BITUMEN COMPOSITIONS AND A PROCESS FOR THEIR PREPARATION
Hendriks H E J; Steernberg K; Terlouw T; Vonk W C
Shell Oil Co.
The present invention provides a bitumen composition comprising a bitumen component, a thermoplastic rubber in an amount of less than 8 % wt, and an ethylene-vinyl acetate copolymer in an amount of less than 5 % wt, both based on total bitumen composition, wherein the ethylene-vinyl acetate copolymer has a vinyl content in the range of from 20 to 35% wt, based on copolymer; a process for preparing such bitumen composition; and the use of such bitumen compositions in asphalt mixtures for road applications.
USA
Accession no.737670

ITEM 158
Patent Number: US 5773496 A 19980630
POLYMER ENHANCED ASPHALT
Grubba W E
Koch Industries Inc.
The present invention relates to an asphalt composition prepared from bitumen (asphalt), linear and non-linear copolymers of styrene and butadiene, and elemental sulphur. The present invention compositions are useful for industrial applications, such as hot mix asphalts used with aggregates for road paving, and repair.
USA
Accession no.737234

ITEM 159
San Francisco, Ca., Spring 1997, p.397-8. 012
CHARACTERISATION OF ASPHALT BINDERS MIXED WITH EPOXY TERMINATED ETHYLENE TERPOLYMER
Lee Y J; France L M; Hawley M C
Michigan, State University
(ACS,Div.of Polymeric Materials Science & Engng.)
Several polymers have been used to improve resistance to high temperature rutting, low temperature thermal cracking...
and fatigue cracking of asphalt pavement at various service temperatures. The thermomechanical and rheological properties of asphalt are directly related to the quantity and quality of asphaltenes which usually contribute to reacting sites. Epoxy-like reacting polymers will bond chemically to the reactive sites in the asphalt and form asphalt/polymer networks. Because of its viscoelastic nature, asphalt binder behaviour depends on both temperature and loading. At high temperatures, asphalt shows good viscous flow properties with little or no elastic behaviour. The lack of elasticity causes rutting at high temperatures. At low temperatures, asphalt becomes a brittle solid with little or no viscous properties and it results in thermal cracking usually below T_g of the asphalt binder. Within the intermediate temperature zone, asphalt usually fails by fatigue cracking, which is caused by repeated loading. Polymer modification has the potential to widen the service temperature range of good performance. Detailed characterisations of epoxy terminated ethylene terpolymer modified asphalt binders are provided to determine the suitability of the use of the binders and mixes for specific paving applications. A performance based binder specification called the Strategic Highway Research Program (SHRP) has been widely adopted to evaluate both unmodified and polymer modified binders. 9 refs.

USA
Accession no. 737104

Item 160
Patent Number: US 5883162 A 19990316
PROCESS FOR THE PREPARATION OF ELASTOMER/BITUMEN COMPOSITIONS AND THEIR APPLICATION AS ROAD SURFACINGS
Planché J-P; Germanaud L; Zins A
Elf Exploration Production

A bitumen or bitumen mixture is contacted with an elastomer, a functionalising agent and, optionally, a peroxide compound at 100 to 230°C under stirring conditions. The functionalising agent is a thiolcarboxylic acid having 3 or more carbon atoms, a thiolcarboxylic acid ester or preferably a disulphide having carboxylic groups or carboxylic esters. The compositions produced may be used either directly or in diluted form as binders for road surfaces. They have a broad plasticity range.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no. 735426

Item 161
Patent Number: US 5851430 A 19981222
BITUMINOUS EMULSIONS
Chirinos M L; Taylor A S; Taylor S E
Intevep SA

An HIPR emulsion of bitumen in water is prepared by a method which comprises directly mixing 70 to 98% by volume of bitumen having a viscosity in the range 200 to 500,000 mPa.s at the mixing temperature with 30 to 2% by volume of an aqueous solution of an emulsifying surfactant, percentages being expressed as percentages by volume of the total mixture. Mixing is effected under low shear conditions in the range 10 to 1000 reciprocal seconds in such manner that an emulsion is formed comprising highly distorted bitumen droplets having mean droplet diameters in the range 2 to 50 microns separated by thin films of water. The emulsions can be cut back to provide stable emulsions of lower bitumen content which are useful in roadmaking and in the formation of protective coatings.
VENEZUELA
Accession no. 733171

Item 162
Patent Number: US 5849819 A 19981215
VIBRATION DAMPING MATERIAL
Philipps T E; Meteer C L
Isorica Inc.

A vibration damping material is disclosed in which polyvinyl chloride (PVC) and a particle filler such as fly ash or talc are amalgamated into a matrix by combination with a small percentage by weight of blown asphalt in a heat working process, such as extrusion, for forming a product such as a sheet of the material. By use of blown asphalt as a compatibiliser and amalgamator, waste or recycled PVC, such as of electrical wire stripings, combined with a filler, has provided excellent damping characteristics.
USA
Accession no. 730207

Item 163
Patent Number: US 5863971 A 19990126
PROCESS FOR PREPARING BITUMEN COMPOSITIONS
Baanders R; Van Gooswilligen G; Steernberg K
Shell Oil Co.

Describes a process for preparing a bitumen composition which comprises mixing at an elevated temperature an oxidised bitumen having a penetration index of at least 0 with a thermoplastic rubber which is present in an amount of less than 5 per cent wt., based on total bitumen composition; bitumen compositions obtainable by such process; and the use of such bitumen compositions in asphalt mixtures for road applications.
USA
Accession no. 726101

Item 164
Tire Business
16, No.23, 1st March 1999, p.16
STATES FIND SOLUTIONS FROM RUBBER ASPHALT
Moore M

Arizona, California and Florida continue to use rubberised asphalt wherever the paving material’s longer life justifies
its double cost over conventional asphalt. Tennessee, Texas and New Mexico are also experimenting with asphalt rubber and report encouraging results. The National Highway System bill killed the quota on rubberised asphalt, although Section 1038 requirements for continuing research and technology transfer were kept in place.

USA
Accession no.725955

Item 165

_Tire Business_
16, No.24, 15th March 1999, p.26

**STATES GAIN NEW RUBBER ASPHALT OPTION**
Moore M

When choosing to use crumb-rubber-modified asphalt for road projects, US states have two processes available, but a third method is gaining popularity. The predominant technology is the “wet” process which describes any method in which crumb rubber is added to asphalt cement prior to incorporating the binder. In the “dry” process, crumb rubber is added directly to hot mix asphalt in the mixing process. In the third process, “terminal blend”, the rubber is blended into the asphalt at the refinery.

USA
Accession no.725954

Item 166

_Journal of Adhesion_

**FERRIC OXIDE ADHESION PROMOTERS FOR WATER RESISTANT ASPHALT PAVEMENTS**
Woodhams R T
Walters Consulting Corp.

Pyrex brand glass was chosen as a model substrate for silica-type aggregates to determine the effect of iron compounds on the adhesion of bitumen to glass in the presence of water. Both iron naphthenate and iron oxide were equally effective in maintaining adhesion in the presence of moisture. Two independent methods were used to measure the wet adhesion-peel testing and contact angle measurements. A boiling water test was described for assessing whether a particular asphalt mix may be susceptible to eventual loss of interfacial adhesion when exposed to water. 4 refs.

CANADA
Accession no.721346

Item 167

_Tire Business_
16, No.21, 1st Feb.1999, p.15

**COMMUNITIES FIND RUBBER ASPHALT VIABLE**
Moore M

It is claimed there is enough evidence now to demonstrate rubber-modified asphalt’s absolute value in lengthening pavement life, giving a smoother ride and dampening road noise. The rubberised asphalt experiences of a county in Canada and the state of Arizona demonstrate that contention. Since 1988, Arizona has laid about 1,100 miles of asphalt rubber pavement, using about 5.5 million tyres.

NORTH AMERICA
Accession no.721092

Item 168

_Macplas International_
Nov. 1998, p.83

**MODIFIED BITUMEN**

In order to handle the anticipated 8 million visitors to Expo 98, the World Trade Exposition in Lisbon, a new road system linking the exposition site with Lisbon and its main motorways, is using Caribit SP a bitumen modified with Kraton D-1101 for the construction of tunnels and road surfaces for the new road network. The performance benefits of polymer-modified bitumen are briefly described.

SHELL CHEMICAL CO.
EUROPEAN COMMUNITY; EUROPEAN UNION; PORTUGAL; WESTERN EUROPE
Accession no.720569

Item 169

_Magazine of Concrete Research_

**PROPERTIES OF CONCRETE INCORPORATING RUBBER TYRE PARTICLES**
Li Z; Li F; Li J S L
Hong Kong,University of Science & Technology

The properties of concrete incorporating rubber tyre particles are investigated experimentally. Rubber particles were used to replace 33% by volume of the fine aggregate, and two rubber coating methods were used to improve the bond between the rubber particles and the cement paste. Properties studied included compressive, flexural and tensile strengths as well as vibration isolation capability. Results are discussed, which indicate that the mixtures might be suitable for applications such as driveways or road constructions where strength is not a high priority, and where vibration reduction is required. 13 refs.

HONG KONG
Accession no.711750

Item 170

_Construction and Building Materials_
12, No.8, Dec.1998, p.405-14

**LOW-TEMPERATURE PROPERTIES OF STYRENE-BUTADIENE-STYRENE POLYMER MODIFIED BITUMENS**
Xiaohu L; Isacsson U; Ekblad J
Sweden,Royal Institute of Technology

Low temperature properties of modified bitumens containing styrene-butadiene-styrene copolymers were...
investigated for use as road surfacing materials. Tests were carried out on laboratory samples using conventional methods, dynamic mechanical analysis and bending beam rheometer. The effects of the characteristics of base bitumens and polymers and the proportion of the components on these properties were studied. The degree of improvement was shown to generally increase with SBS content and was slightly influenced by the SBS structure. In addition, the study showed a statistically linear relationship between different low temperature parameters. 12 refs.

SCANDINAVIA; SWEDEN; WESTERN EUROPE

Accession no.711742

Item 171
Patent Number: US 5800888 A 19980901
HEAT BONDED TYPE VIBRATION-DAMPING RESIN FOR STRUCTURAL MEMBER VIBRATION-DAMPING STRUCTURE
Yasumoto T; Okumura H; Iwai K; Tanaka T; Sasaki T; Sugimoto A; Kawashima H; Itano N; Shibata M; Nanri Y
Kobe Seiko Sho KK; Nihon Tokushu Toryo Co.Ltd.

The present invention relates to a heat-bonded type vibration-damping resin for a structural member which contains, with a view to a preferable blending rate, asphalt, synthetic rubber, petroleum resin and filler material, and further a heat-bonded type vibration-damping resin for a structural member which contains, with a view to a preferable blending rate, asphalt, filler material and blowing agent. In addition, its basic concept consists of a configuration in which the vibration-damping resin is formed into a sheet and arranged at the surface of the metallic structure used at a place where vibration and noise should be prevented so as to form the vibration-damping structure and a method for manufacturing the vibration-damping structure. The vibration-damping resin can be easily mounted on the surface of the metallic structure having an elongated shape, bonded to it by heating and has a workability in which the mounting work to the metallic plate may be facilitated. In addition, thermoplastic resin and the like can be arranged between the metallic plate and the vibration-damping resin.

JAPAN
Accession no.711303

Item 172
Patent Number: EP 885935 A1 19981223
ASPHALT COMPOSITIONS AND PROCESS FOR LOW TEMPERATURE PAVING APPLICATIONS
Puzic O; Williamson K E
Exxon Research & Engng.Co.

Disclosed are polymer modified asphalt-diluent oil binder compositions having enhanced low service temperature performance properties.

USA
Accession no.710580

Item 173
Patent Number: EP 885934 A1 19981223
LOW TEMPERATURE PAVEMENT BINDERS AND METHODS OF THEIR PREPARATION
Puzic O; Williamson K E
Exxon Research & Engng.Co.

Disclosed are sulphonated polymer modified asphalt-diluent oil binder compositions having enhanced low and high service temperature performance properties.

USA
Accession no.710579

Item 174
Patent Number: EP 881242 A2 19981202
POLYMER FOR ASPHALT CEMENT MODIFICATION
Clites J S; Colvin H A; Klemmensen D F
Goodyear Tire & Rubber Co.

A styrene-butadiene polymer is produced by (I) continuously charging 1,3-butadiene monomer, an organolithium compound, a polar modifier and an organic solvent into a first polymerisation zone, (II) allowing the butadiene to polymerise to a conversion of at least about 90% to produce a living polymer solution composed of organic solvent and living polybutadiene chains having a number-average molec.wt., which is within the range of about 20,000 to 60,000, (III) continuously withdrawing the living polymer solution from the first reaction zone, (IV) continuously charging styrene monomer, divinyl benzene and the living polymer solution being withdrawn from the first polymerisation zone into a second polymerisation zone, (V) allowing the styrene monomer and divinyl benzene monomer to polymerise in the second polymerisation zone to produce a solution of styrene-butadiene polymer having a number-average molec.wt., which is within the range of about 30,000 to 85,000 and (VI) continuously withdrawing the solution from the second polymerisation zone. The polymer is used to improve the force ductility, elastic recovery, toughness and tenacity of asphalt.

USA
Accession no.708475

Item 175
Patent Number: US 5795929 A 19980818
POLYMER ENHANCED ASPHALT EMULSION
Grubba W E
Koch Enterprises Inc.

This includes linear and non-linear copolymers of styrene and butadiene, crosslinking agents and emulsifiers. It can be used for industrial applications, such as hot-mix and emulsified asphalts with aggregates for road paving and repair.

USA
Accession no.706725
Item 176
Rubber and Plastics News
28, No.7, 2nd Nov. 1998, p.6
ASPHALT RUBBER USERS REPORT SUCCESS
Moore M

Rubber-modified asphalt works, and no longer can be labelled a ‘new’ technology, according to asphalt rubber experts. There is enough evidence now to demonstrate the product’s absolute value in lengthening pavement life, giving a smoother ride and dampening road noise, according to experts speaking at the Rubber Recycling ‘98: The North American Experience conference. The rubberised asphalt experiences of a county in Canada and the state of Arizona demonstrate that contention. Details are given.

CANADA; USA
Accession no. 705935

Item 177
Journal of Testing and Evaluation
26, No.4, July 1998, p.306-14
ASPHALT-RUBBER MIXTURE BEHAVIOR AND DESIGN (WET PROCESS)
Goulias D G; Ali A H
Brooklyn, Polytechnic University

The interaction between crumb rubber and asphalt cement was found to depend on several material- and blending-related variables. Conventional tests for binder evaluation were used in examining the asphalt-rubber binder reaction curve and the ageing/oxidation effects due to mixture preparation and lay-down operations. The quantification of ageing could be used in adjusting the blending time of the rubber-modified binder for achieving the desired in-place mixture properties. The Marshall test results indicated that the asphalt-rubber mixtures exhibited lower stability and high flow values and thus were less strong but more flexible than conventional mixtures. The Marshall results were coupled with toughness, stiffness and energy absorption values in order to improve the current method of mix design. 12 refs.

USA
Accession no. 705935

Item 178
Patent Number: US 5749953 A 19980512
HIGH SHEAR ASPHALT COMPOSITIONS
Doyle M P
Vinzoyl Technical Services LLC

A method to saponify the naturally-occurring acids found in asphalts is disclosed. The method utilises sodium hydroxide (or other strong base) added to asphalt which is then subjected to high shear mixing, at an elevated temperature. The method disclosed may be used in conjunction with polymers and other modifiers added to the asphalt to enhance the asphalt’s performance. This asphalt is used in road applications, roofing applications and numerous speciality applications which use asphalt as the base material. The asphalt can be used hot, liquefied with solvents or emulsified with water and surfactants.

USA
Accession no. 702308

Item 179
Patent Number: EP 877056 A2 19981111
COMPATIBLE BLEND CONTAINING AN EPOXY-MODIFIED BLOCK COPOLYMER, PROCESS, THERMOPLASTIC RESIN COMPOSITION, RESIN COMPOSITIONS AND ASPHALT COMPOSITION CONTAINING AN EPOXY-MODIFIED BLOCK COPOLYMER
Ohtsuka Y
Daicel Chemical Industries Ltd.

The blend comprises (a) a resin having an affinity to an aromatic vinyl polymer, (b) a resin having reactivity to an epoxy group and (c) a compatibiliser comprising an epoxy-modified aromatic vinyl-conjugated diene block copolymer in which (i) a polymer block consisting of an aromatic vinyl compound and (ii) a polymer block consisting of a compound having a conjugated double bond are included, the remaining double bonds being partially or completely epoxidised. It exhibits small particle size dispersion, as determined by SEM, and an excellent homogeneity in its outer appearance, and shows improved flow, mechanical properties, such as impact strength, compared to a compatible blend containing, as a conventional compatibiliser, an aromatic conjugated diene block copolymer or an aromatic vinyl conjugated block copolymer with epoxy groups at terminals.

JAPAN
Accession no. 701267

Item 180
Rubber and Plastics News
RUBBER-MODIFIED ASPHALT AVAILABLE IN VARIOUS FORMS
Moore M

When choosing to use crumb rubber-modified asphalt for road projects, states have two processes available, but a third method is gaining popularity. To date, the predominant technology in the asphalt rubber field is the so-called ‘wet’ process, which describes any method in which crumb rubber is added to asphalt cement prior to incorporating the binder. In this way it differs from the ‘dry’ process, in which crumb rubber is added directly to hot mix asphalt in the mixing process. Arizona and Florida use only the wet process. So does California, with the exception of an experiment with the PlusRide dry process for hot mix asphalt in the 1970s, according the Pavement Branch of CalTrans Headquarters Laboratory in Sacramento, California. The El Paso district of the Texas Department of Transportation laid some dry process
asphalt rubber in 1993; but this project did not give good results. Details are given.
USA
Accession no.699832

Item 181
Patent Number: US 5744524 A 19980428
POLYMER MODIFIED ASPHALTIC COMPOSITIONS WITH IMPROVED DISPERSION AND PRODUCTS THEREFROM
Manandhar E D; Usmani A M
Bridgestone/Firestone Inc.

An asphaltic compound according to the invention includes from about 70 to about 45 parts by weight of asphalt; from about 15 to about 25 parts by weight of a polymer modifier for said asphalt; from about 15 to about 25 parts by weight of a filler; and, from about 0.1 to about 5 parts by weight of a dispersing agent. The dispersing agent can be selected from the group consisting of stearic acid, tri(dioctyl)pyrophosphate titanate, tri(dioctyl)pyrophosphate-O, neoalkoxy tridodecylbenzenesulphonyl titanate, lecithin, aluminium stearate, maleic anhydride-modified ethylene/alpha-olefin copolymer, maleic anhydride grafted propylene-ethylene copolymer, ethoxylated alcohol, and mixtures thereof.

USA
Accession no.699644

Item 182
Patent Number: US 5718752 A 19980217
ASPHALT COMPOSITION WITH IMPROVED PROCESSABILITY
Klutz R Q
Shell Oil Co.

A bituminous composition is claimed comprising a bituminous component and a radical block copolymer of styrene and butadiene which has the generalised given formula containing a block of polybutadiene having a weight of from 2000-8000, a block polystyrene having a weight average molecular weight of 10000-30000, a block of polybutadiene having a weight average molecular weight of from 40000-100000, a multifunctional coupling agent and an integer from 3-6.

USA
Accession no.695924

Item 183
Journal of Rheology
POLYMER MODIFIED ASPHALTS AS VISCOELASTIC EMULSIONS
Lesueur D; Gerard J F; Claudy P; Letoffe J M; Martin D; Planche J P
Laboratoire des Materiaux Macromoleculaires; Laboratoire des Materiaux Organiques a Proprietes Specifiques; Laboratoire de Thermodynamique

Appliquee: Elf-Solaize, Centre de Recherche

Linear viscoelastic properties of polymer modified asphalts (PMAs) were studied at various temperatures and frequencies. The materials consisted of blends of paving grade asphalt cements and diblock poly(styrene-b-butadiene)(SB) or triblock poly(styrene-b-butadiene-b-styrene)(SBS) copolymer up to 6 wt% concentrations, which yielded heterogeneous PMAs with an emulsion-like morphology: a polymer-rich phase dispersed within an asphalt phase. In addition the 6% modified SB modified binder was studied before and after dynamic vulcanisation, i.e. in-situ crosslinking of the polymer-rich inclusions to increase the PMA stability. The rheological response of the blends was calculated using the Paliere model, knowing the mechanical properties of each phase, the volume fraction of dispersed phase and the capillary number of the dispersed droplets. 31 refs.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.697769

Item 184
Patent Number: US 5733955 A 19980331
ASPHALT CEMENT MODIFICATION
Schulz G O; Klemmensen D F
Goodyear Tire & Rubber Co.

Disclosed is a modified asphalt cement composed of from about 90 to 99 wt.% of asphalt and from about 1 to 10 wt.% of a rubbery polymer, which comprises in its backbone repeat units derived from about 64 to 84.9 wt.% of a conjugated diolefin monomer, about 15 to 33 wt.% of a vinyl aromatic monomer and about 0.1 to 3 wt.% of isobutoxymethyl acrylamide. It exhibits greatly enhanced resistance to shoving, rutting and low temperature cracking. The terpolymer has a Mooney viscosity in the range of about 35 to 80 and preferably contains repeat units derived from hydroxypropyl methacrylate.

USA
Accession no.697769

Item 185
Patent Number: US 5719216 A 19980217
PREPARATION PROCESS FOR POLYMER-MODIFIED BITUMEN
Scherner W E M; Steernberg K
Shell Oil Co.

A method for improving the storage stability of a polymer-modified bituminous composition is disclosed, which comprises using as a compatibilising agent a bis(nitroaryl) disulphide and/or nitroaryl aryl disulphide. The invention further provides a polymer-modified bituminous composition comprising such a compatibilising agent.

USA
Accession no.695924
An updated technical specification is presented for Ruberoid Synthaprufe Waterproofer, previously covered by British Board of Agrement Certificate No.88/2051. The product consists of a cold-applied bituminous emulsion containing synthetic rubber latex, and is used to form a sandwich membrane above and below ground structures of concrete, brickwork, blockwork or masonry. It may also be used as a damp-proof membrane for solid floors. Design data are given for such aspects as weathertightness, adhesion, effect of temperature extremes, resistance to mechanical damage, and durability. The results of tests on the physical properties and service performance of the membrane are tabulated and guidelines given on delivery, site handling and installation.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE

Accession no. 692157

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**Item 187**

Patent Number: US 5703148 A 19971230

**ASPHALT-POLYMER COMPOSITIONS, PROCESS FOR MAKING SAME AND USES THEREOF**

Jolivet Y; Malot M; Jamois D

Total Raffinage Distribution SA

An asphalt-polymer composition contains: (a) at least 12-97 wt.% of an asphalt, (b) at least 1-25 wt.% of a polymer, and (c) at least 2-50 wt.% of aromatic compound(s). The aromatic compound(s) is present in an amount greater than 2 wt.%, the at least one aromatic compound(s) and the polymer are present in amounts such that the ratio of amount present of aromatic compound to amount present of polymer is 0.5-10, and the composition has a FRAASS point of less than or equal to -13°C and a defined storage stability. A process for preparing such asphalt-polymer composition includes mixing the asphalt, the polymer and the aromatic compound at a temperature of 190-300°C for a period of time preferably exceeding 30 minutes. The asphalt-polymer composition can be used as a road asphalt, emulsion or surface coating.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE

Accession no. 689975

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**Item 188**

Patent Number: US 5702199 A 19971230

**PLASTIC ASPHALT PAVING MATERIAL AND METHOD OF MAKING THE SAME**

Fishback G M; Egan D M; Stelmar H

Plasphalt Project Ltd.Co.

An asphalt concrete or paving material includes from 5-20% or more of granular recycled plastic, which supplements or replaces the rock aggregate component of the mixture. The material produces a structurally superior paving material and longer lived roadbed. The paving material includes any and all residual classes of recyclable plastic, including thermosetting plastics and other plastics having little or no current widespread utility. The material produces roadbeds of higher strength with less total asphalt thickness and having greater water impermeability, and is most useful for all layers below the surface layer. The recyclable plastic component of the material is preferably a mixture of all recyclable classes 3-7, or of those materials from such classes from which potentially more valuable recyclable materials have been selectively removed. The paving product is preferably formed by a process of shredding or mechanically granulating used and industrial waste plastic to a no.4 to a half inch sieve size. The granules are then treated with a reducing flame, with a plasma flame process, to activate the surface of the granules and increase the surface tension without raising the temperature of the plastic. The activated treated granules are then added to the aggregate and mixed with the asphalt to produce the paving material.

USA

Accession no. 689453

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**Item 189**

**Journal of Elastomers and Plastics**

30, No.3, July 1998, p.245-63

**DYNAMIC SHEAR RHEOLOGICAL PROPERTIES OF POLYMER-MODIFIED ASPHALT BINDERS**

Newman J K

US, Army Engineer Waterways Experiment Station

Results are presented of an investigation of the rheological characteristics, measured using dynamic shear rheometry, of two asphalts from different crude sources modified with 5% SBR, 5.5% LDPE, 5% reactive styrene-butadiene block copolymer and a 5% crumb rubber/2% SBS mixture. 14 refs.

USA

Accession no. 689453

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**Item 190**

**Polymer Recycling**

3, No.1, 1997/98, p.17-28

**MODIFICATION OF BITUMEN WITH SCRAP TYRE PYROLYTIC CARBON BLACK. COMPARISON WITH COMMERCIAL CARBON BLACK. II. MICROSCOPIC AND SURFACE SPECTROSCOPIC INVESTIGATION**

Chebil S; Chaala A; Darmstadt H; Roy C

Sherbrooke, University; Quebec, Universite Laval; Institutt Pyrovac Inc.

The possibility of using pyrolytic carbon black (CBp), a by-product of scrap tyre pyrolysis, as a reinforcing agent in bitumen was investigated. Conventional and CBp-
modified bitumens were compared. The performance of CBp-modified mixtures was shown to be improved before and after Strategic Highway Research Program ageing tests. The CBp exhibited a high storage stability in the bitumen matrix. ESCA and secondary ion mass spectroscopic techniques revealed that some bitumen compounds were strongly adsorbed on the CBp surface, which explained the high interactions between the CBp and the bitumen matrix. It was found that the rutting potential, the effect of water and the thermal susceptibility were reduced in the concrete mixture by CBp addition. 14 refs.

CANADA
Accession no.688689

Item 191
Polymer Recycling
RHEOLOGICAL PROPERTIES OF BITUMEN MODIFIED WITH USED TYRE-DERIVED PYROLYTIC OIL RESIDUE
Chaala A; Ciochina O G; Roy C; Bousmina M
Institut Pyrovac Inc.; Quebec,Universite Laval

The use of pyrolytic residue(PR), the residual fraction of the oil obtained from vacuum pyrolysis of used tyres, for modification of bitumen was investigated. The consistency of PR was found to be similar to that of petroleum bitumen 150/200 penetration grade, while the chemical composition of the PR differed slightly from that of the petroleum bitumens. The PR had a higher aromatic character, lower sulphur content and higher amount of toluene-insoluble materials. PR exhibited a high consistency/temp. susceptibility and, therefore, reduced the thermal susceptibility of PR-bitumen mixtures and slightly improved their behaviour at low temps. as evidenced by their low Fraas point. The rheological properties of blends in terms of dynamic complex modulus, stiffness as reflected by dynamic complex modulus/sin delta and loss tan delta were examined. These properties directly affected the quality of road pavements and their service life. 23 refs.

CANADA
Accession no.688688

Item 192
Patent Number: US 5721296 A 19980224
 ASPHALT ADDITIVE AND ASPHALT COMPOSITION
Mizunuma T; Tanaka S; Tamaki R; Funada H; Taniguchi T; Sasaki H
KAO Corp.

Disclosed is an asphalt composition to which a water-soluble prepolymer, which is resinified as the reaction proceeds gradually in an aqueous solution, is added. The speed of resinification can be controlled by means of an accelerator. The asphalt compositions exhibit improved strength and can be used as road pavements, railroads, waterproofing agents and adhesives.

JAPAN
Accession no.688293

Item 193
Antec ‘98. Volume II. Conference proceedings.
Atlanta, Ga., 26th-30th April 1998, p.1720-7. 012
MICROSCOPIC MECHANICAL MODELLING OF POLYMER MODIFIED ASPHALT COMPOSITE
Li G; Zhao Y; Pang S-S
Louisiana,State University (SPE)

The high temperature rutting and low temperature cracking of asphalt pavement due to severe temperature susceptibility of asphalt cement have led to the research of polymer modified asphalt (PMA) - an alternative asphalt mixture binder. The improved high temperature deformation resistance of PMA has been generally accepted but, within the cost effective polymer concentration, a few applications demonstrated negative results as regard to low temperature cracking resistance when compared with neat asphalt. Few microscopic mechanical analyses have been addressed to solve this problem. Here, PMA is treated as a two-phase composite material with the oily fraction of base asphalt swelled polymer particles dispersed in an asphalt matrix. A two-layer, built-in model is developed to evaluate the effects of elastic modulus, coefficient of thermal expansion, volume fraction, particle size and PMA film thickness on temperature and boundary force induced interface stresses. By comparison with one single inclusion model and modified Eshelby model, it is found that this model is suitable for the evaluation of PMA. The results show that there are five factors which can be beneficial to enhancing low temperature cracking resistance of PMA: thickening PMA film in PMA mixture design; increasing polymer content within the cost effective range; reducing polymer particle size; selecting soft and asphalt compatible polymer; and incorporating polymers with the coefficient of thermal expansion smaller than that of asphalt. 19 refs.

USA
Accession no.687525

Item 194
Polymer Engineering and Science
38, No.5, May 1998, p.707-15
EFFECT OF PARTICLE MORPHOLOGY ON THE EMULSION STABILITY AND MECHANICAL PERFORMANCE OF POLYOLEFIN MODIFIED ASPHALTS
Sabbagh A B; Lesser A J
Massachusetts,University

An examination was made of how the morphology of the dispersed phase influences the phase separation of LDPE polyolefin/asphalt emulsions together with commensurate
studies on the mechanical performance of the composite binder. The effects that the particle morphology has on the mechanical behaviour, including high temperature viscoelastic performance and low temperature fracture toughness, as well as the stability of the emulsions. 19 refs.

USA
Accession no.685240

Item 195
Patent Number: US 5708061 A 19980113
IN-SITU STABILISED COMPOSITIONS
Hesp S; Liang Z; Woodhams R T
Toronto,University

Insoluble particulate materials, which may be in solid or liquid form, are dispersed in a continuous non-aqueous phase and the dispersion rendered stable and resistant to phase separation by in-situ stabilisation involving the formation of chemical bonds among the stabiliser components and dispersed phases to form a network surrounding the particles, which is compatible with the continuous phase. The compositions may be used in the manufacture of stabilised polyolefin-modified bitumen compositions for paving.

CANADA
Accession no.683443

Item 196
EFFECT OF POLYMER MODIFICATION ON THE PROPERTIES OF ASPHALT CONCRETE
Bhurke A S; Shin E E; Rozeveld S; Vallad P; Drzal L T
Michigan,State University
Edited by: Drzal L T; Schreiber H P
(US,Adhesion Society)

Polymer modified asphalts show promise in improving the properties of asphalt concrete. One of the parameters controlling the properties of asphalt concrete is the interaction between the asphalt binder and aggregates. This is characterised by the study of the interfacial adhesion between the binder and aggregate and the cohesive performance of the binder. Poor adhesive or cohesive performance leads to premature failure, cracking and poor pavement performance. The failure and fracture morphology of asphalt concrete is characterised qualitatively by studying the fracture morphology using in-situ environmental scanning electron microscopy (ESEM) tensile tests and quantitatively by low temperature fracture toughness measurements. 7 refs.

USA
Accession no.681460

Item 197
Hilton Head Island, S.C., 23rd-26th Feb.1997, p.603-5. 8(10)
POLYMER MODIFIED ASPHALT-AGGREGATE ADHESION MEASUREMENT AND CHARACTERISATION. II
Bhurke A S; Shin E E; Rozeveld S; Vallad P; Drzal L T
Michigan,State University
Edited by: Drzal L T; Schreiber H P
(US,Adhesion Society)

Polymer modified asphalts have been shown to improve the rheological and engineering properties of asphalt concrete used in pavement construction. One of the parameters determining the final properties of asphalt concrete is the adhesion between the asphalt binder and aggregates. The fundamental and systematic study of adhesion is important since premature adhesive failure between the binder and aggregate leads to poor pavement performance, especially at low temperatures. The lap shear test is used to study the interfacial binder-aggregate adhesion. Two different viscosity graded asphalt binders and one polymer modifier, SBR latex (Ultrapave UP70) are studied. The effects of polymer modification on adhesion are investigated in terms of polymer concentration and test temperature (-20 deg.C to 20 deg.C). Fracture mechanisms and binder morphology are studied using environmental scanning electron microscopy. Two different approaches for polymer modification are evaluated - blending the polymer into the asphalt binder, and coating the polymer on the aggregate. In all cases, the effect of polymer modification on adhesion shows a strong dependence on temperature, with the failure mode changing from cohesive to adhesive at some transition temperature between 0 deg. C and -10 deg.C. Different fracture surface morphologies and a natural network structure in asphalt binders are observed. In general, polymer modification improves the low temperature adhesive performance of the asphalt binders. 5 refs.

USA
Accession no.681476

Item 198
Patent Number: US 5693132 A 19971202
PHENOLIC ASPHALT BLENDS
Kluttz R Q; Blackbourn R L; Veith C A; Cushing D S; Buechele J L

The asphalt is blended with a phenolic tar, which is primarily cumyl phenol and phenolic materials having a molec.wt. of between about 300 and 1000. The tar is obtained as the bottoms product of a phenol heavy ends separation process and may also include phenol and acetophenone.

USA
Accession no.680457
Item 199
Polymer Technology for the New Millennium.
Conference proceedings.
Blue Mountains, Australia, 12th-15th Oct.1997, paper
25. 012
SCRAP RUBBER IN BITUMEN ROAD
SURFACES
Gaughan R; Swanston I
New South Wales, Roads & Traffic Authority; SAMI
Pty.Ltd.
(Australasian Plastics & Rubber Institute)
Conventional bitumen sprayed seals and asphalt have
been used successfully throughout Australia for many
years, and their use will continue. To cope with the ever-
increasing demands being placed on roads, improved
sealing and asphalt treatments are required. In addition to
the need for better quality aggregates, delivery systems
and operational techniques, a range of special purpose
bituminous binders are required for use in situations
where improved binder properties are necessary. Polymer-
modified binders (PMBs) are considered to ful-
fill this
requirement by providing prolonged or enhanced binder
performance. In Australia, the well developed bituminous
surfacing technology has been expanded to utilise polymer
modified binders and procedures have been developed
for the placement of PMB membranes as surfacing and
interlayer treatments. PMBs are also used in speciality
asphalts. The available procedures use either proprietary
polymer modified bitumen blends or scrap rubber bitumen
manufactured with scrap rubber obtained from the
processing of tyre buffings and/or conveyor belts. The
latter provides an excellent method of recycling a waste
product and improving the environment. The manufacture
of scrap rubber bitumen and its use in bituminous sprayed
sealing and asphalt works are described. 8 refs.
AUSTRALIA
Accession no.679819

Item 200
Journal of Elastomers and Plastics
30, No.2, April 1998, p.161-81
PAVEMENT JOINT SEALANT SPECIFICATIONS
- PAST, PRESENT, AND FUTURE
Lynch L N; Janssen D J
USAE Waterways Experiment Station;
Washington, University
A review is presented of the history of joint sealant
material specifications, current specifications and potential
techniques that may be included in material specifications
of the future to provide a more direct correlation between
laboratory evaluation and field performance. Typical
base materials used currently for pavement joint sealing
include asphalt-rubber, modified coal-tar, polysulphide,
PU, silicone and polychloroprene. 19 refs.
USA
Accession no.677773

Item 201
Patent Number: US 5637350 A 19970610
ENCAPSULATION OF ASPHALT PRILLS
Ross E A
Asphalt Prilling Inc.
An encapsulated asphalt prill having an impervious,
water insoluble shell, and a process for making same are
disclosed. The encapsulating materials are preferably
composed primarily of materials such as molten fatty
acids, low melt polymers, waxes, elastomers (synthetic
rubbers) or plastomers, many of which are also used as
blending agents to enhance the final use properties of the
commercial asphalt end products.
CANADA
Accession no.671770

Item 202
Patent Number: US 5637141 A 19970610
PAVEMENT BINDER AND METHOD OF
MAKING SAME (LAW441)
Puzic O; Evans L J; Williamson K E; Gorbaty M L;
Nahas N C; Lenack A L
Exxon Research & Engineering Co.
The above method involves blending a minor amount of
an unsaturated polymer (e.g. having at least one diene
monomer) with a major amount of asphalt at an elevated
temperature such that the components are sufficiently
fluid to blend, treating the asphalt-polymer blend with
a sulphonating agent, and stripping the treated asphalt-
polymer blend at an elevated temperature with sufficient
stripping gas to remove strippable sulphur moieties and to
stabilise the resulting stripped, treated blend. The invention
also provides asphaltic compositions made by this method.
The asphaltic compositions are useful as binders in road
paving applications.
USA
Accession no.671745

Item 203
Patent Number: EP 826735 A2 19980304
PAVEMENT MATERIAL
Matsushita S
Matsushita Sangyo Corp.
This comprises an asphalt and several kinds of aggregates.
At least one kind of aggregate is a slag obtained by
performing slag-formation treatment on waste material,
such as garbage incineration residues. In one embodiment,
a concrete based pavement material is derived by adding
and mixing cement, sand, water and a type of glass cullet
from which sharp and protruding portions have been
removed. The pavement material is useful for constructing
or repairing roads and the above embodiment can
additionally serve as a floor material.
JAPAN
Accession no.671728

References and Abstracts
Item 204

Gemini
No.1, 1998, p.22-3

DOES TOUGHER ASPHALT PRODUCE DANGEROUS DUST?
Dragland A

In the last few years, transport authorities and road builders in Norway have worked systematically to develop even more wear resistant and stronger wearing course for road surfaces. The reason is that 250,000 tonnes of asphalt is worn away from Norwegian roads every year. Just one single trip between Oslo and Trondheim, a distance of 540 km, results in the removal of approximately 7-8 kg of asphalt. This causes small particulate matter that produces a potential health risk when inhaled. Rutting caused by wear from tyres also has a negative effect on road safety. In addition, the total cost of road repairs caused by wear from studded tyres adds up to 250 million Norwegian kroner annually. Details are given.

NORWAY; SCANDINAVIA; WESTERN EUROPE
Accession no.670338

Item 205
Patent Number: US 5637640 A 19970610

ASPHALT CEMENT MODIFICATION
Schulz G O; Klemmensen D F
Goodyear Tire & Rubber Co.

It has been determined that rubbery terpolymers of a conjugated diolefin monomer, a vinyl aromatic monomer, and N-isobutoxymethyl acrylamide can be used to modify asphalt cement to greatly enhance its resistance to shoving, rutting, and low temperature cracking. These rubbery polymers have a Mooney viscosity within the range of 35-80. It has further been determined that these rubbery terpolymers are compatible with virtually all types of asphalt. A preferred embodiment of these rubbery polymers also contains repeat units which are derived from hydroxypropyl methacrylate. The invention more specifically relates to a modified asphalt cement comprising of 90-99 wt.% of asphalt and from 1-10 wt.% of a rubbery polymer which is comprised of repeat units which are derived from about 64-84.9 wt.% of a conjugated diolefin monomer, 15-33 wt.% of a vinyl aromatic monomer and 0.01-3 wt.% of isobutoxymethyl acrylamide.

USA
Accession no.668712

Item 206
Patent Number: EP 824136 A2 19980218

IMPROVED ANIONIC BITUMINOUS EMULSIONS
Schilling P
Westvaco Corp.

Rapid set, medium set and slow set anionic emulsions are prepared from straight bitumen or bitumen modified by incorporating polymers, solvents or polymer latices. Adhesion between the asphalt and aggregate in anionic solventless and solvent-containing bituminous emulsions is improved using adhesion promoters, which are the reaction products of styrene (alpha-methyl styrene)-acrylic (methacrylic) acid polymers with polyalkylene amines. Further improvement can be achieved by using tall oil fatty acid or fortified tall oil fatty acids as co-reactants in the production of the polyamidoamine products. The emulsifiers are alkali earth salts of tall oil fatty acids, fortified tall oil fatty acids, tall oil rosin and fortified rosin as well as combinations of kraft lignin and non-ionic emulsifiers.

USA
Accession no.666586

Item 207

Polymer Recycling
2, No.4, 1996, p.257-69

MODIFICATION OF BITUMEN WITH SCRAP TYRE PYROLYTIC CARBON BLACK. COMPARISON WITH COMMERCIAL CARBON BLACK PART I: MECHANICAL AND RHEOLOGICAL PROPERTIES
Chebil S; Chaala A; Roy C
Sherbrooke,University; Laval,University; Institut Pyrovac Inc.

This comprehensive article supplies a comparison of commercial carbon black, designated ASTM N550 and pyrolytic carbon black, a by-product of scrap tyre pyrolysis, as modifiers in two different bitumen grades. The mechanical and rheological properties of both are studied in detail. Results suggest that the addition of pyrolytic carbon black may be useful in increasing the rigidity and elasticity of binders, for warm climates. 22 refs.

CANADA
Accession no.668712

Item 208

Geosynthetics International
4, No.6, 1997, p.605-21

SYNTHESIS AND EVALUATION OF GEOSYNTHETIC-REINFORCED BASE LAYERS IN FLEXIBLE PAVEMENTS. II.
Perkins S W; Ismeik M
Montana,State University

Details are given of the use of geosynthetics to reinforce the base course layer of flexible pavements. A review is presented of existing design techniques developed for this application. Analytical studies using finite element techniques to predict roadway response and to illustrate reinforcement mechanisms are summarised. 33 refs.

USA
Accession no.666586
References and Abstracts

Item 209
Geosynthetics International
4, No.6, 1997, p.549-604
SYNTHESIS AND EVALUATION OF GEOSYNTHETIC-REINFORCED BASE LAYERS IN FLEXIBLE PAVEMENTS. I.
Perkins S W; Ismeik M
Montana, State University
Details are given of the use of geosynthetics to reinforce the base course layer of flexible pavements. Studies are described involving laboratory-scale experiments using stationary cyclic loads or moving wheel loads and field studies using controlled vehicle loads or random traffic loads. 38 refs.
USA
Accession no. 666585

Item 210
USE OF VERY HARD ASPHALT BINDER IN THE PREPARATION OF BITUMINOUS COVERING, ESPECIALLY USED IN ROAD UNDERLAYERS
Malot M; Jolivet Y
Total Raffinage Distribution SA
Bituminous coatings composed of very hard bitumen and mineral granulates are disclosed. A very hard bitumen having a penetrability (at 25°C) of 0-20 is used. The coating has a modulus rigidity greater than 24,000 MPa, and is used particularly for the formation or reinforcement of highways, in which the bitumen content of the coating is greater than 6 wt.%. Also claimed is the bituminous coating described.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no. 665790

Item 211
Rubber Asia
12, No.1, Jan.-Feb. 1998, p.97-9
NEW THRUST ON ROAD RUBBERISATION
Ouseph T
The use of rubberised asphalt in road resurfacing applications in India is suggested as a means of consuming the oversupply of natural rubber in the country. Studies have indicated that a kilometer length of road wide enough to facilitate two-line traffic would use around one tonne of rubber for modifying the bitumen, and Kerala itself has 50,000 km of asphalted roads, about half of which are in dilapidated condition. The project, in addition, would create a new market for natural rubber in India.
INDIA
Accession no. 664139

Item 212
Journal of Polymer Science : Polymer Physics Edition
MICROSTRUCTURE OF TRIBLOCK COPOLYMERS IN ASPHALT OLIGOMERS
Rong-Ming Ho; Adedeji A; Giles D W; Hajduk D A; Macosko C W; Bates F S
Minnesota, University
A model asphalt was separated into two parts, asphaltene and maltene, and separate blends of asphaltene and of maltene with styrene-(ethylene-butene)-styrene triblock copolymers were prepared over a range of compositions and then examined by TEM, small-angle X-ray scattering, dynamic mechanical analysis and DSC. Asphaltene was found to be essentially immiscible with both blocks of SEBS, while maltene was miscible with SEBS. An unusual sequence of morphological transformations of SEBS microstructure with respect to the addition of maltene was observed. A basic understanding of the interactions of the components of asphalt with SEBS gave a simple route to characterise and predict the microstructure of triblock copolymers in asphalt oligomers. 20 refs.
USA
Accession no. 663592

Item 213
Scrap Tire News
11, No.12, Dec. 1997, p.6
USING PYROLYSED CARBON BLACK AS A PAVEMENT MODIFIER
Fader J H; Faulkner B P; Unterweger R J
Svedala Pyro Systems Inc.; US, Dept. of Transportation
According to a paper given at an ACS, Rubber Division meeting, the commercial pyrolysis of scrap rubber has been unsuccessful due to the lack of market demands for the crude raw pyrosates: pyro-oil, pyro-gas, and pyro-char. The paper, which is announced here, is said to discuss ongoing tests at the Svedala Pyro Systems’ Process Research & Test Centre and the recent Joint Highway Research Project conducted by the U.S. Department of Transportation FHA, the Indiana Department of Transportation and Purdue University. Test results verify the proprietary processing of the raw pyro-char into an upgraded homogenous pyrolysed carbon black as a viable, value-added asphalt modifier.
USA
Accession no. 662768

Item 214
Journal of Elastomers and Plastics
29, No.4, Oct. 1997, p.326-42
LABORATORY PERFORMANCE OF ASR MODIFIED ASPHALT BINDERS
Dutta U; Ibadat I; Klemperer D; Keshawarz M S
Detroit, Mercy University; Hartford, University
Cars, when they are no longer useful, are flattened and shipped to an automotive shredder facility. At the shredder
facility, while they are shredded to recover the ferrous and non-ferrous metals for recycling, a huge quantity of non-metallic residue commonly called automotive shredder residue (ASR) is generated. Since ASR mostly contains plastics and rubber related materials, and addition of plastic and scrap rubber from waste tyres as a road material has been proved to be effective in solving existing pavement related problems, attempts are made to examine the feasibility of ASR as a road material additive. As part of this effort, compatibility and mechanical properties of ASR-modified asphalt are studied. The asphalt is mixed with a requisite amount of ASR for one hour at 37 deg. F glass transition temperature (Tg) and microstructure of ASR, asphalt and ASR modified asphalt are examined to determine compatibility. Mechanical properties of ASR modified asphalt are studied by performing dynamic mechanical analysis. The photomicrographs and Tg of ASR modified asphalt demonstrate some compatibility between ASR and asphalt. Dynamic mechanical analysis indicates that rutting and ageing properties of asphalt should improve with the addition of ASR. 12 refs.

USA
Accession no.660865

Item 217

**Indian Rubber Journal**

**INSIGHT INTO RUBBERISED ROADS**
Krishman K S G
India,Rubber Board

The use of rubberised asphalt and bitumen in road surfacing is discussed with reference to India. 48% of India’s roads are said to be surfaced and the remaining unsurfaced. Of the former category, bituminous pavements form the majority, but problems with cracking and wear has led to the use of rubberised compounds. The technique of rubberisation is described, and the use of laboratory techniques is discussed to establish changes in properties and how they affect the service performance, effect of type and amount and method of incorporation of rubber on the properties of the bitumen, and commercial procedures for the production and laying of road binders.

INDIA
Accession no.660850

Item 218

152nd ACS Rubber Division Meeting, Fall 1997.
Conference Preprints.

**USING PYROLYZED CARBON BLACK (CBP) FROM WASTE TIRES IN ASPHALT PAVEMENTS**
Fader J H; Faulkner B P; Unterweger R J
Svedala Industries Inc.,Pyro Div.
(ACS,Rubber Div.)

Previous attempts to commercialise processes for the pyrolysis of scrap tyres are reviewed, and results are presented of research undertaken by the Pyro Division of Svedala Industries in the processing of raw pyrolysis char into pyrolysed carbon black for use as a modifier in asphalt road surfaces. 35 refs.

AMERICAN TIRE RECLAMATION INC.; POLYMER VALLEY CHEMICALS INC.
USA
Accession no.659557
PERFORMANCE OF SCRAP TIRE RUBBER MODIFIED ASPHALT PAVING MIXES
Coomarasamy A; Hesp S A M
Ontario, Ministry of Transportation; Queen’s University at Kingston (ACS, Rubber Div.)

Rubber-modified asphalt binders were prepared by mixing 30 and 80 mesh crumb rubber from scrap tyre recycling and partially devulcanised tyre rubber with two grades of road surfacing asphalts. A thermomechanical process was used to prepare a fine colloidal dispersion of 30 mesh crumb rubber in molten asphalt. The samples were tested for low temperature fracture toughness, high and low temperature performance, rutting resistance and resistance to low temperature cracking. Significant improvements in high temperature properties were found for the thermomechanically processed sample. Mixes containing rubber-modified binders showed a moderate improvement in low temperature cracking resistance, with systems containing smaller particles showing the best performance. Rutting resistance improved with reduced crumb rubber particle size. 36 refs.

USA
Accession no.659539

PROCESS FOR RESURFACING ROADS
Fogg R; MacDonald J

A thin film of heated asphaltic material is sprayed onto the asphalt road surface and an aggregate layer is laid on the film while the film is still hot. The asphaltic material is preferably composed of from about 60 to 95 parts asphalt, about 40 to 5 parts waste oil, about 0.5 to 1.5 parts finely divided latex and about 0.5 part anti-stripping agent. The material is heated to a temperature between 220 and 250F to achieve flowability on the road surface. The process can be carried out without air pollution problems or material runoff problems and is environmentally friendly.

USA
Accession no.658508

THERMO-OXIDATIVE STABILITY OF HIGH-IMPACT POLYSTYRENE WITH ADDITIONS OF ASPHALTENE CONCENTRATES
Uglov V V; Kosheleva L A

The ability of high-molecular weight components of crude oil to retard processes of thermo-oxidative breakdown of polymers is known. In particular, this property is possessed by petroleum asphaltenes, but their practical utilisation is held back by the absence of industrial technology. Of greatest interest and promise are asphalt - the products of deasphalting of the residual part of crude oil with propane, butane, and heavier n-alkanes. By varying the type of solvent and the precipitation temperature, it is possible, on the basis of the same feedstock, to produce concentrates of high molecular weight petroleum compounds (asphalts) with different asphaltene contents. It is shown that concentrates of high-molecular weight compounds of crude oil, obtained on a Doeben deasphalting unit (BashNIINP process) and containing 18-70 wt.% asphaltenes, can be used for stabilisation of PE and PP. An attempt is made to assess the possibility of using these concentrates for the stabilisation of PS. The investigation is carried out on high-impact UPS-825 PS, and also concentrates with different asphaltene contents, obtained from tar and asphalt from propane deasphalting. The characteristics of the asphaltene concentrates (ACs) are presented. Thermal degradation of polymer specimens stabilised with ACs is studied by means of thermogravimetry. 8 refs.

RUSSIA
Accession no.657033

EFFECT OF NETWORK FORMATION ON THE RHEOLOGICAL PROPERTIES OF SBR MODIFIED ASPHALT BINDERS
Lee Y-J; France L M; Hawley M C
Michigan, State University

SBR was used to modify asphalt binders. The rheological and thermomechanical properties of the binders were investigated using rotational viscometry, dynamic shear rheometry, and thermal mechanical analysis. The optimum SBR content and mixing procedure were determined. 11 refs.

USA
Accession no.656178

CHARACTERISATION OF STYRENE-BUTADIENE-STYRENE POLYMER MODIFIED BITUMENS - COMPARISON OF CONVENTIONAL METHODS AND DYNAMIC MECHANICAL ANALYSIS
Lu X; Isacsson U
Stockholm, Royal Institute of Technology

The rheological properties of styrene-butadiene-styrene polymer (SBS) modified bitumens are studied using conventional test and dynamic mechanical analysis (DMA). The study indicates that SBS modification
improves the viscoelastic properties of bitumens, which can be demonstrated using DMA but not conventional methods. Significantly improved properties of binders include increased dynamic mechanical moduli and decreased phase angle at high temperatures, as well as reduced complex modulus and increased phase angle at low temperatures. SBS modification also causes reductions in glass transition temperature, Fraass breaking point and temperature susceptibility. The degree of improvement is observed to be influenced by bitumen source/grade and polymer content/structure. Comparison showed that certain relationships exist between parameters obtained using conventional methods and DMA, such as between penetration and complex modulus, kinematic viscosity and complex viscosity, and Fraass breaking point and glass transition temperature. However, the main conclusion of the study is that conventional test parameters such as penetration and softening point are not suitable for characterisation of rheological properties of SBS modified bitumens. 14 refs.

SCANDINAVIA; SWEDEN; WESTERN EUROPE
Accession no.653534

**References**

**Item 224**
Patent Number: US 5574095 A 19961112
**METHOD FOR PRODUCING ASPHALTS CONTAINING AN EPOXY-CONTAINING POLYMER AND POLYAMINE**
van der Werff J C
Shell Oil Co.

This involves mixing an asphalt base, an epoxy-functionalised polymer and then a polyamine and recovering the final asphalt composition.

USA
Accession no.649602

**Item 225**
Patent Number: EP 792918 A2 19970903
**ASPHALT MODIFIER COMPOSITION AND ASPHALT COMPOSITION**
Tanaka S; Ikenaga T
Kao Corp.

The asphalt modifier composition comprises at least one rubber-base modifier or resin-base modifier. A phosphorus compound permits the modifier to be satisfactorily dissolved in asphalt. Paving made from this composition has markedly improved rutting resistance and wear resistance, giving rise to a prolonged service life. Adhesion of the asphalt to aggregate is also high.

JAPAN
Accession no.649491

**Item 226**
Patent Number: US 5556900 A 19960917
**PROCESS FOR PRODUCING A POLYEPOXY POLYMER-LINKED-ASPHALT**

**THERMOPLASTIC COMPOSITION**
Goodrich J L; Statz R J
Chevron Research & Technology Co.; DuPont de Nemours E.I.,& Co.

Disclosed is a thermoplastic polymer-linked-asphalt and a process for making a thermoplastic polymer-linked asphalt. More particularly, disclosed is a reaction process for linking epoxide-containing polymers to asphalt. The improved thermoplastic polymer-linked-asphalt product is particularly useful in road paving and roofing applications.

USA
Accession no.645171

**Item 227**
Patent Number: US 5576363 A 19961126
**THERMOSETTING ASPHALT**
Gallagher K P; Vermilion D
Owens-Corning Fiberglas Technology Inc.

A thermosetting asphalt composition includes a blend of an asphalt and an epoxy-functionalised polymer, the epoxy-functionalised polymer being present in an amount within the range from about 4-30% of the combination of asphalt and epoxy-functionalised polymer.

USA
Accession no.640915

**Item 228**
Patent Number: US 5582639 A 19961210
**METHOD OF PREPARING AN EMULSION OR ASPHALT CONCRETE FOR USE AS A ROAD MATERIAL**
Hove L

A coarse stone fraction is pretreated with a rapid breaking emulsion based on a high viscid bitumen and then a low viscid binder is added thereto to produce a concrete with good shapeability and improved bonding of/in the laid out material.

DENMARK; EUROPEAN COMMUNITY; EUROPEAN UNION; SCANDINAVIA; WESTERN EUROPE
Accession no.640458

**Item 229**
Patent Number: US 5578663 A 19961126
**PAVEMENT REJUVENATOR AND DRESSING CONDITIONER WITH ELASTOMER**
McGovern E W
Paving Consultants K.A.E.,Inc.

A pavement rejuvenating and/or conditioning composition is claimed in which particular coal tar derivatives and other optional ingredients are supplemented with an elastomeric constituent. A rejuvenating or conditioning composition containing an elastomer will reliably hold in place a top layer of fine Aggregate, whereas a rejuvenating or
conditioning composition without elastomer does not, and also allows for early restoration of traffic, prompt resistance to rain, and good repair and wear resistance of and in the pavement to be maintained. The elastomer is preferably acrylonitrile-butadiene polymer although other polymers can also be substituted including natural and nitrile rubbers, polyorganosiloxane and, less preferably, styrene-butadiene, neoprene- and polybutadiene polymers.

USA
Accession no.640087

Item 230
Patent Number: US 5564856 A 19961015
HOT-MIX COMPOSITIONS FOR MAKING AND REPAIRING GEOWAYS CONTAINING POLYOLEFIN-POLYARYLATE ALLOY FIBRES
Modrak J P
Hercules Inc.

Disclosed are melt-spun polyolefin/polyarylate alloy fibres having an elevated softening point, which are useful in staple lengths for the reinforcement of synthetic geoways, such as roads and runways, especially those made from asphalt-based pavements. The improved softening point of the fibres allows their incorporation into hot-mix pavement used to make and repair such surfaces without degradation of the fibres by the elevated temperatures found in plant for making the pavements.

USA
Accession no.637093

Item 231
European Chemical News
67, No.1764, 12th-18th May 1997, p.22
ROAD TO SUCCESS
Taffe P

Shell has been involved in the polymer-modified bitumen (PMB) market for many years. In Europe bitumen modification accounts for 54% of its styrene-butadiene-styrene copolymers (SBS) output, with roofing taking 73% of the bitumen share. Only 3% of roads in Europe use PMBs, but the potential is large. Increasingly heavy traffic loads have led to premature wear through rutting and cracking of the road surface. Shell claims SBS increases the elasticity of bitumen and can double road surface life, especially under severe weather or traffic conditions.

SHELL CHEMICALS LTD.
WESTERN EUROPE-GENERAL
Accession no.636212

Item 232
151st ACS Rubber Division Meeting, Spring 1997, Conference Preprints.
Anaheim, Ca., 6th-9th May 1997, Paper 4, pp.23. 012
APPLICABILITY OF SUPERPAVE MODELS FOR DESIGN AND CONSTRUCTION OF

RUBBERIZED ASPHALT PAVEMENTS
Takallou H B; Takallou M B
TAK Consulting Engineers Inc.; Portland State University
(ACS,Rubber Div.)

Results are presented of tests performed on crumb rubber modified asphalt binders and mixtures using SuperPave mix design technology (US Strategic Highway Research Program Council), and the performance characteristics of rubberised asphalt road surfaces laid in Southern California are described. 3 refs.

US,STRATEGIC HIGHWAY RESEARCH PROGRAM COUNCIL
USA
Accession no.636018

Item 233
Patent Number: US 5596032 A 19970121
SLOW-SETTING BITUMINOUS EMULSIONS
Schilling P; Starr F S
Westvaco Corp.

This invention relates to emulsifiers for slow-setting aqueous emulsions suitable for use in applications where a high degree of chemical, mechanical, and rheological stability is required (such as in slurry seal applications and thixotropic industrial emulsion applications). In such applications, fine aggregate, clay, or polymer latex is mixed with the emulsion to obtain a homogeneous storage-stable composite which can be applied for coatings, flooring, roofings, and as a roadway sealant.

USA
Accession no.635245

Item 234
Patent Number: US 5558704 A 19960924
PAVING ASPHALT CONCRETE COMPOSITION
Masuda K; Kuriki M; Hokari K
Bridgestone Corp.; Fukuda Road Construction Co.Ltd.

This consists essentially of an oil-impregnated vulcanised rubber crumb and an asphalt-aggregate mixture. The oil-impregnated vulcanised rubber crumb consists of 99 to 60 wt.% of vulcanised rubber crumb and 1 to 40 wt.% of an extending oil.

JAPAN
Accession no.634044

Item 235
Patent Number: US 5549744 A 19960827
PAVEMENT BINDER
Puzic O; Evers L J; Williamson K E; Gorbaty M L; Nahas N C
Exxon Research & Engineering Co.

Storage stable road paving binders are made by blending a minor amount of a polymer having at least one diene
monomer with a major amount of asphalt containing at least 0.3 wt.% of total nitrogen at an elevated temperature such that the components are sufficiently fluid to blend, treating the asphalt-polymer blend using not more than 250 meq of a sulphonating agent per 100 g of asphalt-polymer blend to introduce the corresponding acid functionality into the blend, maintaining the sulphonated asphalt-polymer blend at a sufficiently elevated temperature and stripping the sulphonated blend with sufficient chemically unreactive gas to remove a major fraction of the acid functionality introduced by sulphonation.

A bituminous composition is disclosed comprising a compatible bituminous component and a completely non-tapered radial block copolymer of a conjugated diolefin and a vinyl aromatic hydrocarbon wherein the polymer has from 3-6 arms, a molecular weight of from 150000-400000, a coupling efficiency of at least 95%, and a polyvinyl aromatic hydrocarbon blockiness of at least 98.5%.

USA

Accession no.629713

Item 239
Patent Number: US 5539029 A 19960723

ASPHALT EMULSION-RUBBER PAVING COMPOSITION

Burris M V

This is formed by combining an aqueous asphalt emulsion, water, latex rubber, minus 40 size rubber particles and a thickening agent, mixing the materials at substantially ambient temperature to form a substantially homogeneous liquid composition, adding to the liquid composition between about 5 and 15 pounds of aggregate per gallon and mixing the components at substantially ambient temperature.

USA

Accession no.629339

Item 240
Patent Number: US 5525653 A 19960611

RUBBER ASPHALT MIX

Rouse M W

A rubber modified asphalt for use as a paving compound is formed by reacting very fine ground particulate rubber with paving grade asphalt and mixing the combination at 300-400F. The resulting mixture reacts fully within 25 minutes or less to form a freely pouring mixture; the reacted mixture can be held at normal asphalt working temperatures for at least 96 hours without degradation.

USA

Accession no.624977

Item 241
Patent Number: US 5519073 A 19960521

PROCESS FOR THE PREPARATION OF A PHOSPHORIC ACID-CONTAINING ASPHALT/ POLYMER MIXTURE AND RESULTING ASPHALT COMPOSITION THEREOF

van der Werff J C; Nguyen S M

Shell Oil Co.

Phosphoric acid is mixed with an asphalt base, air is blown through the resulting mixture, a terpolymer is mixed with the acid-blown asphalt composition to give a glycidyl-functionalised polymer-containing acid-asphalt composition and finally an amine anti-strip additive is mixed with the latter composition. The terpolymer is
produced by the concurrent reaction of ethylene, normal butyl acrylate and glycidyl ester, such as glycidyl acrylate or glycidyl methacrylate according to US 5306750.

USA

Accession no.619041

Item 242

International Journal of Polymer Analysis and Characterization
3, No.1, 1996, p.33-58

CHARACTERISATION OF ASPHALT BINDERS
BASED ON CHEMICAL AND PHYSICAL
PROPERTIES
Wei J B; Shull J C; Lee Y-J; Hawley M C
Lambda Technologies Inc.; Michigan State University

The chemical compositions and physical properties of unmodified and polymer-modified asphalts were studied using high-performance GPC, FTIR, dynamic mechanical analysis, thermomechanical analysis, and DSC. SBR and styrene-ethylene-butylene-styrene copolymers were used to modify the asphalts. Rheological properties were determined. 10 refs.

USA

Accession no.615624

Item 243

Polymer News
21, No.8, Aug.1996, p.283-4

CHEMISTRY AND TECHNOLOGY OF ASPHALT-
CONTAINING MATERIALS
Usmani A M
Usmani Development Co.

A report is given on a symposium on asphalt-containing materials presented at the 210th American Chemical Society Meeting in Chicago on August 20-24th 1995. Twenty-five papers were presented in five sessions, covering characterisation of asphalt, mechanical and rheological aspects, polymer modification, performance/ modification considerations, and composites and coatings.

AMERICAN CHEMICAL SOCIETY
USA

Accession no.615317

Item 244

Polymer News
21, No.8, Aug.1996, p.262-7

POLYMER MODIFICATION OF ASPHALT:
CHEMISTRY AND TECHNOLOGY
Usmani A M
Usmani Development Co.

Asphalt chemistry is described and the mechanism of polymer modification of asphalt for use in paving and roofing applications is discussed. Particular attention is paid to the use of PP and SBS polymers. Asphalt characterisation results are presented and asphalt secondary structure is considered with reference to mechanisms of inversion and reversion. 10 refs.

USA

Accession no.615309

Item 245

Geosynthetics International
3, No.4, 1996, p.537-49

FULL SCALE HIGHWAY LOAD TEST OF
FLEXIBLE PAVEMENT SYSTEMS WITH
GEOGRID REINFORCED BASE COURSES
Collin J G; Kinney T C; Fu X
Collin Group Ltd.; Alaska, University at Fairbanks

The results are discussed of tests carried out on the use of geosynthetics to improve the performance of flexible road surfaces. A full scale test research program was carried out using a 20 kN moving wheel load to determine the benefit of using a stiff biaxial geogrid between the base and the subgrade of a flexible road surface system, with the traffic benefit ratio (TBR) defined as the ratio of the number of load cycles of a stiff geogrid reinforced section to the number of load cycles of an unreinforced section for a given level of performance. 16 refs.

USA

Accession no.614803

Item 246

Patent Number: US 5496400 A 19960305

ASPHALT COMPOSITIONS WITH IMPROVED
CROSSLINKING AGENT
Doyle M P; Stevens J L
Vinzoyl Petroleum Co.

An improved, substantially anhydrous, crosslinking agent is disclosed for use in asphalt compositions of the type used for roofing and paving materials. The crosslinking agent comprises a blend of tall oil, a strong base, an anhydrous organic solvent, and fatty amines; it is substantially free of water.

USA

Accession no.610990

Item 247

Patent Number: US 5498683 A 19960312

POLYMER CONCRETE COMPOSITIONS AND
METHOD OF USE
Kim C S

Binder premix or primer compositions comprise (a) vinyl esters and/or unsaturated polyesters containing characteristic linkages, (b) monofunctional and/or polyfunctional vinyl monomers and/or monofunctional and/or polyfunctional resins which have very high group molar attraction constants. The primer or binder premix is utilised in the repair of a bridge, highway, airport runway, parking structure, or patio and similar type structures.

USA

Accession no.610888
References and Abstracts

Item 248
Manchester, 17th-21st June 1996, paper 52. 012
RECYCLING IN ROAD PAVEMENTS AND STREET FURNITURE
Van Heystraeten G
Belgium, Centre de Recherches Routieres; European Tyre Recycling Association
(Institute of Materials)
Scrap rubber tyres from cars and lorries can be used for road applications in seven main fields: as lightweight fill in embankments; for erosion control; as side slope fill and in retaining walls; in acoustic insulating devices - noise screens along roads and railways; in safety devices - culverts, inertial barriers, New Jersey barriers, speed control humps; in other functional road equipment items - roadside water guides, railway or tramway crossing pads, sign supports, interlocking, blocks and bollards; as aggregate in a bitumen-bound top layer for filter drains; as aggregate in asphalt mixes; and as rubber-bitumen (crumb rubber modifier) in hot-mix asphalts such as porous asphalt, joint and crack sealing compounds, chip seal coats, membrane interlayers. These seven fields of application are reviewed in detail. 14 refs.
BELGIUM; EUROPEAN COMMUNITY; EUROPEAN UNION; WESTERN EUROPE
Accession no.610116

Item 249
150th ACS Rubber Division Meeting. Fall 1996.
Conference Preprints.
STYRENIC THERMOPLASTIC ELASTOMERS: THE PATHWAY TO INVENTION
Holden G
Holden Polymer Consulting Inc.
(ACS, Rubber Div.)
An account is given of early research by Shell which led to the development of Kraton styrene block copolymer thermoplastic elastomers. Later developments in hydrogenated and branched block copolymers and blends of triblock and diblock copolymers, applications in rubberised asphalt and oil viscosity modifiers, and aspects of ongoing research are also reviewed. 26 refs.
SHELL DEVELOPMENT CO.; SHELL CHEMICAL CO.
USA
Accession no.609313

Item 250
Polymer Engineering and Science
36, No.12, June 1996, p.1724-33
POLYMER BLENDS FOR ENHANCED ASPHALT BINDERS
Ait-Kadi A; Brahimi B; Bousmina M
Laval, University
Straight asphalt binders were modified by the addition of both HDPE and a blend of HDPE and EPDM. The blends compositions were fixed at 90/10 HDPE/EPDM to illustrate the possibility of adapting the polymer to be added to the asphalt binder for specific end-use applications. Linear viscoelastic properties of unmodified and polymer modified asphalts at concentrations ranging from 1-5 wt% were studied before and after Thin-Film Oven Test (TFOT) ageing at a temperature range of -15 C to 60 C. Standard test such as ring-and-ball softening point, Fraas breaking point and TFOT ageing were also performed on the whole set of samples. 34 refs. Polyblends ‘95. National Research Council Canada Symposium, Montreal, 19-20 October 1995.
CANADA
Accession no.604781

Item 251
Polymer Engineering and Science
36, No.12, June 1996, p.1707-23
ASPHALT MODIFIED BY SBS TRIBLOCK COPOLYMER: STRUCTURES AND PROPERTIES
Adedeji A; Gruenfelder T; Bates F S; Macosko C W; Stroup-Gardiner M; Newcomb D E
Minnesota, University
Microstructural transformation of a SBS triblock copolymer blended with asphalt was studied as the asphalt composition was varied from 0-96 wt%. TEM, dynamic mechanical spectrometry, and DSC were used. The blends were made in batch mixers at 200 C, or by solution casting from a non-selective solvent (trichloroethane) at about 28 C. 29 refs. Polyblends ‘95. National Research Council Canada Symposium, Montreal, 19-20 October 1995.
USA
Accession no.604780

Item 252
Journal of Applied Polymer Science
61, No.9, 29th Aug. 1996, p.1493-501
RHEOLOGICAL PROPERTIES OF STYRENE-BUTADIENE COPOLYMER-REINFORCED ASPHALT
Blanco R; Rodriguez R; Garcia-Garduno M; Castano V M
Universidad Autonoma Metropolitana-Iztapalapa; Universidad Nacional Autonoma de Mexico
The rheological properties of SBR-reinforced asphalt were investigated. A percolation-type model was used to fit dynamic experimental data and a comparison was made with the Kerner-Takayanagi model. In addition, a frequency-composition-temp. correspondence principle was proposed. This correspondence principle allowed prediction of the rheological behaviour of an asphalt-based composite within a wide range of compositions, provided that a narrow composition range at different frequencies and temps. was previously known. 11 refs.
MEXICO
Accession no.604286
METHOD OF PRODUCING AN ASPHALT PRODUCT
Kuc J

This involves initially shredding scrap tyres within a shredder system where an at least partially vulcanised rubber composition is formed into particulates less than about 2.0 mm in dimension. Metal is removed from the scrap tyres and the resulting composition leaving the shredder system is mixed in particular weight percentages with a chemical composition for insertion into a masticator system, which includes a first zone, a second zone and a third zone. The masticator system heats the composition entering to a temperature of about 485°F in the first zone. The composition is then cooled to a temperature within a range of about 230 to 250°F in a second zone and then slightly reheated to a temperature within the range of 290 to 350°F in the third zone. Compounding of the composition is provided within the first zone. The non-thermoset and non-thermoplastic polymer asphalt modifier composition formed is blended with liquid asphalt binder to produce a final asphalt product, which is used in construction or road paving.

USA
Accession no.603838

PROCESS FOR LIQUEFYING TYRE RUBBER AND PRODUCT THEREOF
Flanigan T P
Neste/Wright Asphalt Products Co.

A homogeneous asphalt composition is made by introducing asphalt medium, preferably in an amount of about 80 to 90%, into a reactor vessel, introducing tyre rubber granules, preferably in an amount of about 10 to 20%, into the asphalt medium to form a mixture of the asphalt medium and the granular tyre rubber, circulating a portion of the mixture into a bottom portion of the reactor vessel through jet spray nozzles and recirculating the mixture at 500°F through the vessel until the whole tyre rubber is completely integrated into the asphalt medium and a stable, homogeneous asphalt composition is formed.

USA
Accession no.603329

METHOD AND APPARATUS FOR TREATMENT OF ASPHALT AND SYNTHETIC RESINS
Truax D A
Ultra Technologies Inc.

A low cost method for preparing foamed or aerated asphalt-rubber paving compositions is disclosed in which a flowable mixture, including respective quantities of asphalt and finally divided reclaimed rubber particles is first directed into a rocket-type reactor along with steam and/or water to subject the mixture to conditions of elevated temperature, pressure and shear. The initially reacted mixture is then passed into a pressurised, secondary reaction vessel system to complete the gelation reaction in a period of, e.g. 7 to 15 min. The preferred apparatus includes a rocket-type primary reactor presenting a confined reaction zone and asphalt-rubber and water/steam conduits communicating with the zone. The output of the primary reactor feeds directly into a pressurised tank forming a part of the downstream secondary reaction and recovery system where the gelation reaction is completed. The preferred system includes a total of 5 serially interconnected tanks housed within an insulative shell and heated by means of a burner.

USA
Accession no.603106

ENHANCED PERFORMANCE OF ASPHALT PAVEMENTS USING GEOCOMPOSITES
Austin R A; Gilchrist A J T
Netlon Ltd.

A report is presented on the development and testing of a composite combining a stiff PP geogrid with a geotextile, thus producing a material with the handling and installation benefits of a geotextile, combined with the performance advantages of a stiff geogrid. A case study detailing the use of the composite reinforcement is also presented. 4 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.599425

ASPHALT PAVEMENT IMPROVEMENTS USING UNSORTED RECYCLED PLASTIC MATERIALS
Degan D; Fishback G; Stelmar H
Plasphalt Project Ltd.

Asphalt cement, the primary paving material for roads and other traffic surfaces, has been produced for decades with some improvements being made to the material’s quality, durability and strength. Several of the recent improvements have been accomplished with the use of polymeric additives in the binders or the use of fibres. Waste products such as crumb rubber have also been incorporated in asphalt material - either as aggregate or as a polymeric additive to the asphalt binder - in numerous attempts over the past few decades to improve the service life and characteristics of the pavements while reducing the impact of tyres on landfalls. Crumb rubber is now being
used primarily by California, Arizona, Florida, Texas and a few other states to fortify asphalt for paving. Typical uses include 0.5 in. thick layer of this asphalt on a macadam or concrete base of an interstate highway and up to 2 in. thick in other areas. The use of recycled plastics in this industry, which would also reduce the need for space in landfills, has been limited to the use of well-sorted materials as admixtures in the asphalt binders. None of these efforts have provided a pavement which is sufficiently improved to justify the added cost - and in some cases the pavement has been inferior with rutting or break-up occurring.

USA

Accession no.599272

Item 258

Scrap Tire News
10, No.8, Aug.1996, p.1/18

CRM - A HIGH PERFORMANCE MATERIAL FOR TODAY'S HIGH PERFORMANCE ROADS

Crumb rubber modified asphalt pavements are reported to have advocates on two important fronts - city and county public works directors and the asphalt contracting community. In some regions of the US and Canada, both have recognised crumb rubber as a modifier rather than a waste material. It is not surprising that they are choosing rubberised asphalt pavements. It has been used in every climatic and road condition in the US, according to the California State Highway Authority, which has spent the last 17 years experimenting with the material. The authority has used asphalt rubber everywhere from the snowy high Sierras to the desert region between Sacramento and Reno - 18 snow region highway sections, eight in California's valley areas, three roads in the coastal region and two in the desert. In most applications, asphalt rubber makes roads safer and more durable; in fact, the tougher the conditions, the more advantages CRM has over conventional asphalt. It flexes in freeze and thaw conditions, it resists wear from tyre chains on vehicles, it doesn’t rut and crack as easily as conventional asphalt and it lasts much longer than many other paving materials. Details are given.

CALIFORNIA, STATE HIGHWAY AUTHORITY
USA

Accession no.598987

Item 259

Patent Number: WO 9520623 A1 19950803

PROCESS FOR PRODUCING RUBBER MODIFIED RUBBER CEMENT

Flanigan T P
Neste/Wright Asphalt Products Co.

A process for preparing a homogeneous asphalt product which is a two-member composition of distillation tower bottoms and ground tyre rubber homogenised therein includes introducing distillation tower bottoms at a temperature of about 425-470°F to a vessel through which air is flowing at about 6-15 psi pressure, introducing ground tyre rubber to the vessel and bombarding the distillation tower bottoms and ground tyre rubber with the air until the mixture is completely and stably homogenised, and recovering the homogenised asphalt composition. Alternatively, the ground tyre rubber is mixed directly with the distillation tower bottoms to form a wetted mixture which is bombarded with air at a temperature of about 350-485°F at about 6-15 psi pressure until the mixture is completely and stably homogenised. The homogenised asphalt composition is then recovered.

USA

Accession no.598792

Item 260


ASPHALT CEMENT MODIFICATION

Schulz G O; Klemmensen D F
Goodyear Tire & Rubber Co.

A modified asphalt cement is composed of from about 90 to 99 wt.% of asphalt and from about 1 to 10 wt.% of a rubbery terpolymer, which is composed of repeat units derived from about 64 to 84.9 wt.% of a conjugated diolefin monomer, about 15 to 33 wt.% of a vinyl aromatic monomer and about 0.1 to 3 wt.% of isobutoxymethyl acrylamide. The rubbery terpolymer has a Mooney viscosity within the range of about 35 to 80, is compatible with virtually all types of asphalt and preferably contains repeat units derived from hydroxypropyl methacrylate. Asphalt concretes made therewith have greatly enhanced resistance to shoving, rutting and low temperature cracking.

USA

Accession no.597935

Item 261

Patent Number: US 5476542 A 19951219

ASPHALT COMPOSITIONS WITH IMPROVED CROSSLINKING AGENT

Doyle M P; Stevens J L

The crosslinking agent comprises a blend of tall oil, a strong base, an anhydrous organic solvent, such as n-methyl fatty acid taurate, and fatty amines and is substantially free of water. The compositions are useful as roofing and paving materials.

USA

Accession no.597864

Item 262

Patent Number: US 5468795 A 19951121

METHOD FOR PRIMING WET OR DRY ROAD SURFACES

Guder H
Minnesota Mining & Mfg. Co.

Priming compositions contain a homogeneous liquid solution containing a polymeric material and at least one
water-miscible solvent in an amount sufficient to provide adhesion between wet or dry road surface materials and adhesive coated articles. The priming composition allows the marking of roadways with pressure sensitive adhesive articles even on wet or damp roadway surfaces. A method for priming roadway surfaces is also included.

USA
Accession no.596228

Item 263
Patent Number: US 5473000 A 19951205
METHOD FOR IMPROVING THE STRENGTH OF BITUMEN, ASPHALT OR A SIMILAR MATERIAL, AND A COMPOSITION OBTAINED BY THE METHOD
Pinomaa O L
Pinomaa O.,Ky

In this invention a thermoplastic or a thermoelastomer is added to the bitumen and the solubility and compatibility is improved by a third component, which is wood resin, turpentine resin, a derivative of these, tall oil, tall-oil pitch, or a constituent or mixture of these. The obtained composition of bitumen, asphalt or a similar material can be used as a binding agent in the road pavement materials.

FINLAND; SCANDINAVIA; WESTERN EUROPE
Accession no.594360

Item 264
Patent Number: US 5460649 A 19951024
FIBRE-REINFORCED RUBBER ASPHALT COMPOSITION
Strassman D R

Disclosed are a fibre-reinforced asphalt concrete composition suitable for paving applications, method of making the composition, method for converting a conventional asphalt plant to one capable of producing this composition and an apparatus for doing the same.

USA
Accession no.594299

Item 265
Patent Number: US 5462588 A 19951031
FLAME RETARDED ASPHALT COMPOSITION
Walters R B; Schmidtline P J
Schuller International Inc.

This comprises a bituminous composition, a thermoplastic elastomer, an inert filler, a halogenated flame retardant and an effective flame retardant amount of a nitrogen heterocyclic composition having at least six members and containing at least three nitrogen atoms.

USA
Accession no.593731

Item 266
Patent Number: EP 718373 A1 19960626
POLYMER MODIFIED ASPHALTIC COMPOUNDS WITH IMPROVED DISPERSION AND IMPROVED PRODUCTS THEREFROM
Manandhar E D; Usmani A M
Bridgestone/Firestone Inc.

These compounds include from about 70 to 45 pbw of asphalt, from about 15 to 25 pbw of a polymer modifier for the asphalt, from about 15 to 25 pbw of a filler and from about 0.1 to 5 pbw of a dispersing agent, such as stearic acid, tri(diocyl) pyrophosphate titanate, tri(diocyl) pyrophosphate-O, nealkoxy tridodecylbenzenesulphonyl titanate, lecithin, aluminium stearate, maleic anhydride-modified ethylene/alpha-olefin copolymer, maleic anhydride grafted propylene-ethylene copolymer, ethoxylated alcohol or mixtures thereof.

USA
Accession no.592987

Item 267
URETHANE MODIFIED ASPHALT FOR PAVEMENT OVERLAYS/WEARING COURSES FOR ROAD APPLICATIONS
Sendijarevic A; Sendijarevic V; Wang X; Haidar A; Dutta U; Klempner D; Frisch K C
Detroit, Mercy University
(SPI,Polyurethane Div.)

PU modified asphalt were prepared by reaction with polymeric MDI and a polybutadiene polyol. A self-hardening type of fly ash containing free lime was used as a filler and moisture scavenger in the preparation of modified asphalt concretes. The mechanical properties of the asphalt concretes, including hardness, stress-strain properties, compression strength, compression set and tensile set, were evaluated at -30, 25 and 70C. Thermal properties of the binders and concretes were determined by TMA and viscoelastic properties by DMA. The presence of PU improved the thermal and mechanical properties of binders and concretes prepared with fly ash. The modified asphalt binders exhibited elastomeric properties over a broad temperature range from below -40C to over 80C. 6 refs.

USA
Accession no.592102

Item 268
International Polymer Science and Technology
22, No.12, 1995, p.T/25-9
USE OF COMMUNICATED VULCANISATE IN MASTIC COMPOSITIONS BASED ON BITUMEN
Voronov V M; Solov’evo Y N; Nesiolovskaya T N; Sergeeva N L

A review of the literature on the above is presented, covering classification of rubber-bitumen mastics(RBMs),
features of mixing of bitumen with rubber crumbs, implementation of the process of RBM manufacture, structure and properties of RBMs, and composition and fields of application of RBMs. 65 refs. (Full translation of Kauch.i Rezina, No.3, 1995, p.34)

CIS; COMMONWEALTH OF INDEPENDENT STATES; RUSSIA

Accession no.590007

Item 269

Rubber and Plastics News

REPORT SCRUTINISES RUBBERISED ASPHALT
Moore M

A preliminary report by a commission of state and local government officials has condemned the use of crumb rubber in rubberised asphalt road surfacing as an experimental technology which offers no better and sometimes worse quality than conventional asphalt at a much higher cost. Brief details are given as this and other comments regarding its use.

RUBBER PAVEMENTS ASSN.
USA

Accession no.587029

Item 270

Patent Number: US 5451621 A 19950919
SBS-MODIFIED, ASPHALT-BASED MATERIAL WITH RESISTANCE TO CROSSLINKING
Usmani A M; Gorman W B; Thompson G S; Kane E G
Bridgestone/Firestone Inc.

This comprises a mixture of from about 47 to 74 pbw of asphalt, from about 7 to 15 pbw of SBS block copolymer, from about 15 to 25 pbw of a filler component and from about 1 to 5 pbw of PP. It is made by forming a mixture by admixing the asphalt, the block copolymer, filler and PP, which inhibits high temperature crosslinking of the block copolymer.

USA

Accession no.586877

Item 271

Patent Number: US 5451619 A 19950919
ASPHALT COMPOSITION CONTAINING EPOXIDISED POLYMERS
Kluttz R Q; Erickson J R
Shell Oil Co.

The epoxidised polymer consists of a conjugated diolefin and, optionally, a vinyl aromatic hydrocarbon.

USA

Accession no.586858

Item 272


STUDY OF THE BONDING BETWEEN FABRIC AND BITUMEN EMULSION IN A STRESS ABSORBING MEMBRANE INTERLAYER
Woodside A R; McIlhagger R; Woodward W D H; Clements H W
Ulster,University
(Institute of Materials)

Mechanical pull-off tests and water absorption and retention measurements were performed on PP, glass, cotton and jute fabrics to assess their bonding with bitumen emulsion in stress absorbing membrane interlayers for use in road construction. The fabric structure and the depth of emulsion tack coat were the variables which most affected the adhesive bond strength. The temperature of tack coat application had no effect. All the fabrics absorbed and retained water to a certain extent, which was considered to affect the bonding process. Samples consisting of fabrics sandwiched between asphalt cores were sheared by a direct shear mechanism and by a short beam shear test, and the results were compared. Emulsion tack coat rate and fabric type and structure had a considerable effect on shear strength, while fabric orientation had no effect. 6 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; NORTHERN IRELAND; UK; WESTERN EUROPE

Accession no.586739

Item 273

Construction and Building Materials
10, No.2, 1996, p.141-6

TENSILE REINFORCEMENT OF ASPHALT CONCRETE USING POLYMER COATING
Kim K W; Park Y C; Yeon K S
Kangwon,National University

The possibility of using a polyester resin for reinforcing flexible pavements was investigated. The application of a thin-layer coating of a polymer, an unsaturated polyester resin, on the surface of a laboratory-prepared unmodified asphalt concrete mixture was studied as a tensile reinforcement method for such a material. Selected laboratory performance tests were conducted and the results were compared with those of a normal (uncoated) asphalt concrete mixtures and a modified asphalt mixture, both mixtures being widely used in Korea. The polymer coating was found to be effective in improving Marshall stability, TS and flexural strength of asphalt concrete. These improvements could be explained as the effect of reinforcement by a thin polymer layer which was fully bonded to the specimen faces. The reinforcement was also effective in reducing the stiffness of the mixture whilst improving load-carrying capacity. This improvement in strength and reduction in stiffness resulted in a retardation of crack initiation resulting from cyclic load application and a significantly improved resistance to crack propagation.
The study showed that there was a possibility of using the polymer coating as a method of tensile reinforcement with flexible pavements. 16 refs.

SOUTH KOREA
Accession no.586639

Item 274
Waste News
1, No.26, 26th Feb.1996, p.11
BURNING UP THE ROAD - LITERALLY
Mikolajczyk S J
A chemical reaction has caused scrap tyre chips used as infill in a section of road outside Pomeroy, Wash., to ignite. The shredded tyres included nylon cords and steel belts, and it is thought that following flash flooding, the water started a chemical reaction accelerating rusting of exposed steel in the chips. The oxidation process generated heat in the pockets of air between the chips, possibly igniting them.

USA
Accession no.585530

Item 275
Patent Number: US 5441360 A 19950815
ASPHALTIC COMPOSITIONS AND USES THEREFOR
Long H W
Asphaltic concrete compounds composed of asphalt cement and aggregate have, as a substantial portion of their respective aggregates, anthracite coal particles and fines, which are added specially as a lossy microwave material. They are particularly useful when laid down as a pavement or a top layer of a pavement, which can be freed of ice by using microwave energy to debond the ice without causing any noticeable melting of the ice. They are also useful as patching materials when damaged pavement is being repaired, especially during cold weather. The coated area is treated with microwave energy, resulting in the penetration of heat into both the coating and portions of the damaged pavement, the heat ensuring their bond and also the bond of the asphaltic concrete compound, which is filled into the damaged pavement cavities. Also the top layer and/or the entire filled cavities of the originally damaged pavement, include this asphaltic concrete compound, which has the anthracite coal, added as the lossy microwave material, to thereby facilitate the penetration of heat, which in turn ensures the creation of strong bonds throughout the repaired pavement.

USA
Accession no.583937

Item 276
Cincinnati, Oh., 30th Jan-1st Feb.1995, paper 2F, 627
FLEXIBLE VINYL ESTER RESIN FOR ROAD OVERLAY
Tsuki S; Mita T; Takahashi S; McLaskey C
Dainippon Ink & Chemicals Inc.; Reichhold Chemicals Inc. (SPI,Composites Institute)
A methyl methacrylate-modified, air drying, flexible vinyl ester resin (Diover for Pavement) is described which eliminates common defects of traditional road overlay resins. Advanced features of these resins include their usability over a very wide range of ambient temperatures, good adhesion to a variety of substrates, and excellent abrasion resistance. Its advantages, compared with other materials, are described.

USA
Accession no.582931

Item 277
Patent Number: US 5436285 A 19950725
RECYCLED RUBBER IN A POLYMER MODIFIED ASPHALT AND METHOD OF MAKING SAME
Causyn D; Thys K
A paving composition includes between 89 to 93% graded aggregate, 5.76% asphalt cement, 0.24% SBR polymer and 1 to 5% graded recycled crumb rubber. The asphalt cement and SBR polymer are blended and heated to form a first mixture. The aggregates are blended and heated to form a second mixture and the two mixtures are blended together prior to the addition of the graded recycled crumb rubber.

CANADA
Accession no.581228

Item 278
Patent Number: US 5432213 A 19950711
WATER-PERMEABLE RESINOUS COMPOSITION FOR ROAD PAVING OF HIGH STRENGTH AND BLOCKS AND PAVEMENT THEREOF
Kim H-D; Lee C-S; Son J-H; Jeon S-H
Samsung General Chemicals Co.Ltd.
This composition contains 2 to 20 pbw of thermosetting resin, as a binder, per 100 pbw of granular aggregate, and 1 to 20 pbw of cellulose or 1 to 30 pbw of lignocellulose, as botanical fibre, or their derivatives, as additives per 100 pbw of the resin. Inorganic substances in an amount of 5 to 200 pbw, per 100 pbw of the resin, are also included in fine granular or fibrous form.

KOREA
Accession no.580721

Item 279
China Synthetic Rubber Industry
19, No.1, 1996, p.40-2
Chinese
PREPARATION OF LATEX FOR ROAD ASPHALT MODIFICATION USING SBR 1502 RUBBER CEMENT
Latex for rubber asphalt modification was prepared using SBR 1502 rubber cement by the concentration of agglomeration and viscosity-reducing methods. The results showed that the total solids content increased from 19-23% to 45-50%. The modified road asphalt had good service properties.

Item 280
Patent Number: US 5426140 A 19950620
TIME DELAYED THICKENING, SLUMP-RESISTANT POLYMER CONCRETE COMPOSITIONS, METHODS OF REPAIRING CONCRETE SURFACES, CONCRETE STRUCTURES REPAIRED THEREWITH AND ARTICLES OF CONSTRUCTION COMPRISING A FORMED MASS, ETC.
Fekete F; Thrash D J
Resurfacing surfaces of highways and roads to provide a skid-resistant surface is achieved using a polymer concrete composition containing a curable polymer composition consisting of an ethylenically unsaturated polymer having carbon-bonded carboxyl groups and/or hydroxyl groups and at least one reactive thickener comprising Group IIA metal oxide or hydroxide or a polyisocyanate. This mixture is mixed with aggregate, coated onto the surface, compacted, shaped and cured.
USA
Accession no.578672

Item 281
Patent Number: US 5429695 A 19950704
EMULSIFYING AGENT FOR PRODUCING CATIONIC ASPHALT EMULSIONS OF DIFFERENT SETTING TIMES, FOR ROAD CONSTRUCTION AND MAINTENANCE, METHOD OF OBTAINING THE AGENTS AND METHOD FOR ADJUSTING THE SETTING TIME OF THE EMULSIONS
Salmeri H C
The emulsifier comprises a compound obtained by the reaction between a natural wood resin, colophony resin and an amine, the reaction resulting in the liberation of water, as a by-product, and the incorporation of primary, secondary and tertiary amino groups, as substituents, to the resin molecules.
ARGENTINA
Accession no.577216

Item 282
SPI Composite Institute 49th Annual Conference.
Conference Proceedings. Cincinnati, Oh., 7th-10th Feb 1994, paper 2-B. 627
DURABILITY OF CONCRETE REINFORCED WITH PULTRUDED FIBRE REINFORCED PLASTIC GRATING
Anderson G R; Bank L L; Munley E
US,Federal Highway Administration; Washington, Catholic University (SPI, Composites Institute)
The Federal Highway Administration is currently studying the possibilities of using fibre-reinforced plastics as reinforcement in concrete bridge decks, replacing the current practice of using steel bar as reinforcement in concrete. The suitability of reinforced plastics as concrete reinforcement in chemical environments, based on the results of chemical immersion tests and concrete immersions tests, is examined. The physical changes in four commercially available glass fibre-reinforced pultruded composites, in the form of deck grating are studied. Changes in the material are observed using visual, mass change and thickness changes, as well as examination by scanning electron microscopy. Testing procedures, the data analysis and physical changes observed are discussed. The results of immersion tests are detailed and compared. Possibilities for further investigation are recommended. 9 refs.
USA
Accession no.568675

Item 283
Patent Number: WO 9504110 A1 19950209
GERMAN
RECYCLING OF VARNISH COAGULATE IN ROAD CONSTRUCTION
Herrmann K; Schlipf M
Dynamit Nobel AG; Zeller & Gmelin GmbH & Co.
This invention relates to a process for producing road toppings based on bitumen, the use of varnish coagulates as an additive to such toppings, and improved road toppings.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.568301

Item 284
Patent Number: WO 9508426 A1 19950330
PAVEMENT MARKING AND BASE SHEET
Rice E E; Hargett R A
Minnesota Mining & Mfg. Co.
A conformable pavement marking is described, comprising an upper sheet and a base sheet, in which the base layer comprises a fibrous scrim, a tie layer, and a conformance layer, the tie layer material impregnating the lower portion
of the scrim, and material of the upper sheet impregnating the upper portion of the scrim. Also described are pavement marking base sheets.

USA
Accession no.564423

Item 285
Patent Number: US 5405882 A 19950411
METHOD OF FOAMING ASPHALT AND PRODUCTS PRODUCED THEREBY
Balnpied R H
Atlas Roofing Corp.
A process of foaming asphalt comprises mixing sodium hydrogen carbonate with asphalt melted to a liquid state. The mixing yields carbon dioxide and water. The carbon dioxide gas foams the molten asphalt, and the foaming is enhanced by the boiling of the water. The rate of addition of the sodium hydrogen carbonate, and the temperature of the asphalt, are controlled in accordance with the desired specific gravity of the resultant foamed asphalt. The sodium hydrogen carbonate is added at a rate in a range of from about 2-6 wt.%. The asphalt is melted at a temperature of 212-500F. The foamed asphalt is used by depositing it on a substrate.

USA
Accession no.562423

Item 286
Patent Number: US 5399598 A 19950321
ASPHALT COMPOSITION
Peters W E
Alphaflex Industries
An asphalt composition comprises asphalt mixed with an asphalt modifier, which combines a thermoplastic elastomeric copolymer and an effective amount of a fibrillated polytetrafluoroethylene and molybdenum disulphide particles. The thermoplastic elastomeric copolymer preferably comprises two incompatible polymers forming a two-phase copolymer including a thermoplastic end block polymer, preferably a styrene polymer, and an elastomeric mid block polymer, selected from polybutadiene, polyisoprene and poly(ethylene-butylene). The asphalt modifier is made by mixing together under high shear e.g. in a twin screw extruder, particles of a thermoplastic elastomer copolymer, fibrillatable polytetrafluoroethylene and molybdenum disulphide until the PTFE is substantially fibrillated and combined with the thermoplastic elastomer copolymer. A preferred asphalt modifier comprises about 2-12 pbw of fibrillated PTFE and molybdenum disulphide particles per 100 pbw of copolymer, with the ratio of fibrillated PTFE to molybdenum disulphide being about 3 to 1 by weight.

USA
Accession no.562354

Item 287
Patent Number: US 5403117 A 19950404
PAVEMENT, A PAVING MATERIAL AND METHODS OF PRODUCING SAID PAVEMENT AND SAID PAVING MATERIAL
Okuyama H; Kojimoto T; Tanaka M
Sumitomo Rubber Industries Ltd.
A paving material in which a large quantity of aggregates are bound together by a hot melt of thermoplastic resin powder is described, together with methods of producing such a pavement and paving material. The thermoplastic resin powder is neither limited in pot life, nor influenced by working conditions and weather conditions at the time when pavement is laid at a job site. Accordingly, uniform strength can be given to the resulting pavement or paving material. Further, the resulting pavement or paving material has excellent weather resistance, elasticity and flexibility, and can used in playgrounds, parks, roads etc. It is also easy to alter after it has been laid.
JAPAN
Accession no.561935

Item 288
Patent Number: US 5405440 A 19950411
PROCESS FOR THE PREPARATION OF A COLD MIX ASPHALT PAVING COMPOSITION
Green H C; Shaw D J
Global Resource Recyclers Inc.
A method is described of preparing a cold mix asphalt paving composition by (a) separating non-asphalt impurities from an asphalt rubble obtainable from a reclaimed asphalt pavement to produce a purified asphalt rubble; (b) comminuting the purified asphalt rubble to obtain sized asphalt-aggregate mixture; (c) testing the mixture to determine the percent of asphalt present; and (d) blending an asphalt emulsion with the asphalt-aggregate mixture in an amount so as to yield a cold mix asphalt pavement composition comprising from about 4-6.5 wt.% of asphalt. The cold mix asphalt paving composition is used to coat roadway surfaces, parking lots, driveways etc. Once the cold mix asphalt paving composition has been applied to a surface, a top coat may be overcoated onto it.

USA
Accession no.561931

Item 289
Patent Number: US 5405439 A 19950411
BITUMEN EMULSION
Marchal J L
Esso SAF
A method for preparing a bitumen emulsion from bitumen, water, emulsifying agent, inorganic acid and metal salt, the metal being selected from lithium, sodium, potassium, magnesium, calcium and aluminium, is described. The
bitumen emulsion has a viscosity of at least 200 cst at 25°C. The method comprises (a) feeding the bitumen into a first static mixer at a temperature above 50°C; (b) introducing part of the water under pressure into the mixer, the pressure being sufficient to prevent vapourisation of the water; (c) introducing the emulsifying agent, inorganic acid and metal salt into the first mixer; (d) mixing the components in the first mixer, and then passing the resultant mixture into at least one other mixer in which the temperature is lower than that in the first mixer and is below the boiling point of water; (e) introducing the remainder of the water into the other mixer(s); and (f) passing the mixture through the other mixer(s) and removing the resulting bitumen emulsion.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE
Accession no.561930

Item 290
Patent Number: US 5397818 A 19950314
PROCESS FOR PRODUCING TYRE RUBBER MODIFIED ASPHALT CEMENT SYSTEMS AND PRODUCTS THEREOF
Flanigan T P
Neste/Wright Asphalt Products Co.
A process for preparing an incorporated asphalt composition includes mixing ground tyre rubber with distillation tower bottoms to form a wetted mixture of the ground tyre rubber with the distillation tower bottoms, bombarding the wetted mixture with air at a temperature of about 350-485°F at about 6-15 psi pressure until the mixture is completely incorporated, and recovering the incorporated asphalt composition. The homogenised asphalt product is a two-member composition of distillation tower bottoms having ground tyre rubber incorporated therein.
USA
Accession no.561661

Item 291
Patent Number: US 5397389 A 19950314
ASPHALTIC CONCRETE PRODUCT AND A METHOD FOR THE FIXATION OF CONTAMINATED SOILS AND HAZARDOUS MATERIALS IN THE ASPHALTIC CONCRETE
Glynn J J
American Reclamation Corp.
A composition for the fixation of hydrocarbons from contaminated oily soil and hazardous wastes is described. The hazardous waste and contaminated oily soil are components in a cold mix asphaltic concrete. The soil and hazardous materials are mixed with asphaltic roof cuttings and mineral aggregate to form the mixture. The mixture is coated with a cold mix emulsion to form an asphaltic concrete. The hydrocarbons and hazardous wastes do not leach from the set concrete.
USA
Accession no.561145

Item 292
Patent Number: US 5393819 A 19950228
ASPHALT MODIFIER
Peters W E
Alphaflex Industries
A bitumen and asphalt modifier comprises a thermoplastic elastomeric copolymer and an effective amount of a fibrillated PTFE and molybdenum disulphide particles. The copolymer comprises two incompatible polymers forming a two-phase copolymer including a thermoplastic end block polymer and an elastomeric mid block polymer. The asphalt modifier is made by mixing together, under high shear, particles of a thermoplastic elastomeric copolymer, fibrillatable PTFE and molybdenum disulphide until the fibrillatable PTFE is fibrillated and combined with the thermoplastic elastomeric copolymer.
USA
Accession no.559892

Item 293
Patent Number: US 5393811 A 19950228
COMPOSITION AND METHOD FOR IMPROVING THE STORAGE STABILITY OF POLYMER MODIFIED ASPHALTS
Moran L E; Sokol K L
Exxon Research & Engineering Co.
A storage stable improving amount of a polymerised alpha-olefin having a number-average molec.wt. of from about 500 to 5,000 and a congealing and melting point which is essentially no higher than those of the alpha-olefin from which it is prepared, is added to an asphalt containing a higher molec.wt. polymer having a number-average molec. wt. of at least about 10,000.
USA
Accession no.559877

Item 294
Patent Number: EP 669378 A1 19950830
ROAD SURFACING COMPOUNDS
Leaver R J
Excel Industries Ltd.
These compounds, e.g. bitumen-based compounds, are made by introducing into the compound during production thereof a mixture comprising a fibrous material, such as cellulose or mineral fibres, and a finely divided filler material, e.g. limestone or hydrated lime.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.558639

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Item 295
Patent Number: WO 9502014 A1 19950119
ASPHALT PAVING MIX AND METHOD FOR MAKING IT
Punkert F P
Inphalt Inc.

The mix preferably comprises a mixture of asphalt oil, preferably in the range of between about 18 and 22 wt.%, mineral wool fibre, preferably in the range of 17 to 23 wt.% and having a length of between about 0.5 and 5.0 in. and a shot content of between about 25 and 35 wt.%, and aggregate material, preferably in the range of between about 55 and 65 wt.% and having a particle size of not less than 0.060 in.

USA
Accession no.557176

Item 296
Patent Number: WO 9500591 A1 19950105
ENGINEERED MODIFIED ASPHALT CEMENT
Ostermeyer L F
McConnaughay Technologies Inc.

This comprises asphalt cement, reacted tall oil, tall oil pitch, tall oil derivatives or mixture thereof and polymers selected from block copolymers and latices, both natural and synthetic. Methods of manufacture include blending a reacted tall oil-modified asphalt cement with a polymer-modified asphalt cement to obtain the desired properties; modifying an asphalt cement with a reacted tall oil, tall oil pitch, tall oil derivatives or mixtures thereof and then adding the selected polymer(s) to this tall oil-modified asphalt cement; modifying the asphalt cement with the selected polymer(s) and then adding the tall oil, tall oil pitch, tall oil derivatives and mixtures thereof and reacting with a strong base; and adding the polymer(s), tall oil, tall oil pitch, tall oil derivatives and mixture thereof and the strong base to the asphalt cement at or nearly at the same time.

USA
Accession no.554245

Item 297
Rheologica Acta
34, No.3, May/June 1995, p.311-6
INFLUENCE OF RHEOLOGICAL PROPERTIES OF BITUMEN EMULSIONS ON THE PERFORMANCE OF SURFACE DRESSING SYSTEMS
Khalid H; Fienkeng M N
Liverpool, University

Three bitumen emulsions, used in road surface dressing construction, one conventional and two polymer modified, were tested to determine their rheological properties. A tensile load test was developed to determine the adhesive strength of surface dressing systems and was used to study the influence of temperature and curing time on the strength development of the three dressing systems. The polymers used as modifiers were an SBR copolymer and a styrene-isoprene copolymer. 10 refs.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.556167

Item 298
Patent Number: US 5371121 A 19941206
BITUMEN COMPOSITIONS CONTAINING BITUMEN, POLYMER AND SULPHUR
Bellomy R C; McGinnis E L
Chevron Research & Technology Co.

Asphalt compositions are disclosed prepared from bitumen, a triblock copolymer of styrene and butadiene, and about 0.015-0.075 wt.% of elemental sulphur. The asphalt compositions are useful in industrial applications, such as in hot mix asphalts useful in preparing aggregates for road paving.

USA
Accession no.556167

Item 299
Patent Number: US 5385401 A 19950131
PROCESS FOR ADDING RECYCLED TYRE PARTICLE TO ASPHALT
Nath R H
Cyclean Inc.

The rubber particles are saturated with an aromatic oil and do not absorb additional oils from the asphalt binder materials. The integrity of the asphalt mix is not compromised.

USA
Accession no.553848

Item 300
Patent Number: EP 658603 A2 19950621
COMPATIBLE BLEND CONTAINING AN EPOXY-MODIFIED BLOCK COPOLYMER, PROCESS, THERMOPLASTIC RESIN COMPOSITION, RESIN COMPOSITIONS AND ASPHALT COMPOSITION CONTAINING AN EPOXY-MODIFIED BLOCK COPOLYMER
Ohtsuka Y
Daicel Chemical Industries Ltd.

The blend comprises a resin having an affinity to an aromatic vinyl polymer, a resin having reactivity to an epoxy group and a compatibilising agent comprising an epoxy-modified aromatic vinyl-conjugated diene block copolymer in which a polymer block consisting of an aromatic vinyl compound and a polymer block consisting of a compound having a conjugated double bond are included, the remaining double bonds being partially or completely epoxidised. It exhibits small particle size dispersion in a scanning electron microscopic structure.
observation and excellent homogeneity in outer appearance
and improved flow properties and mechanical properties,
such as impact strength, compared to a compatible blend
having a conventional compatibilising agent, which is an
aromatic-conjugated diene block copolymer or an aromatic
vinyl-conjugated diene block copolymer having epoxy end
groups. The resin compositions comprise various resins and
a modifier or stabilizer, which is an epoxy-modified aromatic
vinyl-conjugated diene block copolymer.
JAPAN
Accession no.553806

Item 301
Patent Number: US 5382612 A 19950117
PROCESS FOR PREPARING IN AQUEOUS
EMULSION A BITUMEN/POLYMER BINDER
WITH CONTINUOUS THREE-DIMENSIONAL
POLYMERIC STRUCTURE AND APPLICATION
OF THIS BINDER TO THE PRODUCTION OF
FACINGS OR BITUMINOUS MIXES
Chaverot P; Demangeon F
Elf France
The process involves forming (a) a reaction mixture in
an emulsion formation zone by feeding to the zone (i)
a bitumen-polymer component composed of a bitumen
containing 0.5 to 15%, by wt. of the bitumen, of a
sulphur-crosslinkable elastomeric polymer, the component
having a melt viscosity of not more than 2 Pa.s at the melt
temperature, (ii) an aqueous phase containing an effective
quantity of an emulsifying system and (iii) a crosslinking
system donating sulphur in a quantity such as to provide
0.5 to 20 wt.% of sulphur relative to the weight of the
elastomeric polymer contributed by the bitumen/polymer
component and (b) maintaining the reaction mixture in the
emulsion formation zone at an appropriate temperature
until an aqueous emulsion of bitumen/polymer binder is
obtained, in which the polymer of the binder is at least
partially crosslinked to a three-dimensional structure. The
binder is useful for coating road surfaces.
EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE;
WESTERN EUROPE
Accession no.552909

Item 302
Patent Number: US 5369156 A 19941129
BLENDING BITUMEN INTO POLYISOBUTYLENE-
ETHYLENE/VINYL ACETATE MIXTURE
Lesage J
British Petroleum Co.PLC
A bituminous binder useful in road surfacing is prepared
by blending from 1 to 35 wt.% of bitumen with a mixture
of EVA and polyisobutylene having a number-average
molec.wt. of greater than 400 to less than 1,000. The ratio
of polyisobutylene:EVA is between 90:10 and 50:50.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN
EUROPE
Accession no.552191

Item 303
China Rubber Industry
42, No.5, 1995, p.274-8
Chinese
MODIFICATION OF ASPHALT FOR ROAD
CONSTRUCTION WITH CRUMB
Li H; Li R
Brief details are given of the use of crumb rubber to
modify asphalt.
CHINA
Accession no.551997

Item 304
Journal of Materials Science
30, No.10, 15th May 1995, p.2584-90
NEW LOOK AT RUBBER-MODIFIED ASPHALT
BINDERS
Morrison G R; Hesp S A M
Kingston,Queen’s University
The high temperature rheological characteristics and the
low-temperature fracture properties of asphalt binders
containing crumb and devulcanised rubber waste were
investigated. The asphalt binders were tested and compared
with an unmodified asphalt and three commercial polymer-
modified binders. 27 refs.
CANADA
Accession no.551989

Item 305
Journal of Applied Polymer Science
56, No.8, 23rd May 1995, p.947-58
INFLUENCE OF STYRENE-BUTADIENE
DIBLOCK COPOLYMER ON STYRENE-
BUTADIENE-STYRENE TRIBLOCK
COPOLYMER VISCOELASTIC PROPERTIES
AND PRODUCT PERFORMANCE
McKAY K W; Gros W A; Diehl C F
Dow Chemical Co.
The effects of the styrene-butadiene diblock copolymer
on the viscoelastic properties of styrene-butadiene-styrene
triblock copolymers (SBS) were examined in both in the
neat state, in polymer/asphalt blends, and in hot melt
assembly adhesives. The influence of the styrene-butadiene
diblock is quantitatively defined in the loss tangent and
order-disorder transition of the neat copolymer. It is then
explained how alteration in neat viscoelastic behaviour
extends into the SBS/asphalt blend and SBS adhesive
viscoelastic behaviour and, ultimately, the product
performance. 30 refs.
USA
Accession no.551590
Item 306
Patent Number: EP 655484 A1 19950531
ROAD SURFACING COMPOSITION
Kilner D N
Shell Internationale Research Mij BV

A slurry comprising aggregates of different particle size and a bituminous emulsion is suitable for use in road surfacing and by variation of the ratio of the different aggregates can achieve a wide variety of sustainable texture depths, including texture depths greater than 1.5 mm.
EUROPEAN COMMUNITY; EUROPEAN UNION; NETHERLANDS; WESTERN EUROPE
Accession no.551323

Item 307
Patent Number: US 5367007 A 19941122
MULTI-LAYER COMPOSITE BLOCK AND PROCESS FOR MANUFACTURING
Richards D C
Enviropaver Inc.

A multi-layer moulded composite paving block is described, with a first layer of reclaimed asphalt, thermoplastic or thermosetting plastic, monofilament fibre material and elastic material, and a second layer of thermoplastic such as polyethylene or thermosetting plastic, and an aggregate material. The first layer comprises about 75-95% of the block while the second layer comprises about 5-25%. The plastic constituent in each of the first and second layers at opposing surfaces thereof are heat and pressure bonded with the plastic constituent in the other layer, so as to form a securely interlocked structural interface between the two layers, forming a single integral structure.
CANADA
Accession no.550673

Item 308
Reuse/Recycle
25, No.4, April 1995, p.30-1
ROAD INSULATION - A NEW APPLICATION FOR OLD TYRES

An evaluation has been made by the US Army Corps of Engineers Cold Regions Research & Engineering Laboratories into the use of scrap tyres as an insulating layer to prevent frost damage and potholes in frost-susceptible roads. It is offered as an alternative use of scrap tyres in road surfacing applications with reference to the mandated one of rubberised asphalt in which 1000 scrap tyres would be used per mile, compared with some 100,000 in the insulation application. Brief details are given of test results.
US, ARMY CORPS OF ENGINEERS COLD REGIONS RES. & ENGNG.LABS.
USA
Accession no.549876

Item 309
Shell Chemicals Europe Magazine
No.2, March 1995, p.24-7
KEY TO THE HIGHWAY
Clark T

The use is discussed of Kraton thermoplastic elastomer modified bitumen in road surfacing projects. The action of the TPE increases the bitumen’s elasticity, enabling it to regain its shape after deformation. Results of trials carried out in road tests are discussed, including its use in porous asphalt road surfaces.
SHELL CHEMICALS EUROPE LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.549788

Item 310
Patent Number: US 5360849 A 19941101
MIXTURES OF BITUMEN AND POLYMER COMPOSITIONS SUITABLE FOR THE MODIFICATION OF BITUMENS
Braga V; Giavarini C
Himont Inc.

The polymer composition comprises: (A) 10-40 pbw of an isotactic propylene homopolymer, or a random copolymer of propylene with ethylene and/or a C4-C10 alpha-olefin; (B) 0-20 pbw of a copolymer fraction containing ethylene, which is insoluble in xylene at ambient temperature; (C) 50-80 pbw of a copolymer fraction of ethylene with propylene and/or C4-C10 alpha-olefin, said copolymer fraction being soluble in xylene at ambient temperature, having an intrinsic viscosity greater than 1.5 and up to 2.2 dl/g, and having 20-45 wt.% ethylene.
USA
Accession no.548656

Item 311
Patent Number: US 5360848 A 19941101
MODIFIED BITUMENS, PROCESSES FOR THEIR PREPARATION, THEIR USE AND SOLUBILISING AGENTS FOR PLASTICISED POLYVINYL BUTYRAL IN BITUMEN
Kuechler M; Mucha B
Hoechst AG

These modified bitumens are claimed to have improved elasticity properties and an improved low temperature flexibility. They are prepared by homogeneous mixing of plasticised polyvinyl butyral into molten bitumen at 150-300°C, simultaneously using mono-, oligo- or polyalkylene glycol dialkyl ethers as solubilising agents, if appropriate in combination with PS as solubilising co-component.
EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.548655
PAVING ASPHALTS: ENVIRONMENTAL AND FLAMMABILITY CONSIDERATIONS

Wagner J P; Mendez C L; Gidden R P
Texas A & M University; Texas, Nuclear Science Center

A report is presented on the evaluation of petroleum-based paving asphalts as a possible source of heavy metal pollution in soils and water, as well as on the determination of combustion parameters, e.g. smoke mass and particle size distribution, and sulphur dioxide and oxides of nitrogen during controlled burning. Particular attention is paid to the changes in combustion behaviour, smoke components and heavy metal content introduced by the addition of tyre rubber to the paving asphalt samples. 27 refs.

NEW POLYMER-MODIFIED FUNCTIONALISED ASPHALT COMPOSITIONS AND METHODS OF PREPARATION (C-2747)

Gorbaty M L; Peiffer D G; McHugh D J
Exxon Research & Engineering Co.

Novel road paving binder compositions are disclosed, made by combining an asphalt that contains sulphonate or sulphonic acid groups, a polymer preferably of butyl rubbers, styrene-butadiene linear diblock copolymer, styrene-butadiene-styrene linear or radial triblock polymer and EPDM that has been sulphonated, and mixtures thereof, and a basic neutralising agent. The amounts of each are effective to allow formation of one continuous phase or two interdispersed phases that do not segregate on standing at elevated temperatures associated with road paving. The amount of polymer is an amount less than 7 wt.% of total polymer-asphalt composition that is sufficient to produce an asphaltic composition having a viscosity at 135C of about 150-200 cPs or about 3000-8000 cPs. The compositions have improved viscoelasticity, softening point, and storage stability.

OXIDISED ASPHALT RUBBER SYSTEM

Trumbore D C; Franzen M R; Wilkinson C R
Owens-Corning Fiberglas Technology Inc.

Disclosed is an elastomeric asphalt composition, which does not phase separate and is compatible at high temps. It can be produced without the need for high shear milling equipment. The elastomer is preferably an SBS or SIS block copolymer.

POLYMER-MODIFIED, OXIDISED ASPHALT COMPOSITIONS AND METHODS OF PREPARATION

Gorbaty M L; Nahas N C
Exxon Research & Engng. Co.

Disclosed are road paving asphalt compositions with improved viscoelastic properties and storage stability and unexpected phase compatibility. They contain neutralised mixtures of oxidised asphalt and an acid functionalised polymer, such as sulphonated EPDM, sulphonated SBR or acrylic acid terpolymers, in an amount, which is sufficient to result in an asphalt composition having a softening point greater than about 55C and a viscosity in the range...
of from about 150 to 2000 cPs or from about 3000 to 8000 cPs at 135°C and effective to allow the formation of one continuous phase or two interdispersed phases, which do not segregate on standing at elevated temp. The basic neutralising agent used in these compositions contains cations having a valence of from +1 to +3, preferably +2. The compositions are particularly useful as binders in dense graded and open graded hot mix pavements.

USA
Accession no.545188

Item 318
Patent Number: WO 9423131 A1 19941013
German
METHOD OF PRODUCING A SYNTHETIC AGGREGATE FOR THE TOP LAYERS OF TRAFFIC SURFACES
Fuelling R; Kaemereit W
Mannesmann AG

The aggregate contains a substance, which inhibits the formation of ice, and is formed of a hardening mineral mixture, which is broken down to the required particle size and, if necessary, graded. A granular material with significantly improved stability is made from a mixture comprising a first component containing finely particulate alkaline-earth oxides and/or hydroxides and a second component containing alkaline-earth chlorides in aqueous solution, the weight ratio of the first and second components being in the range of 5:1 to 1:1.

EUROPEAN COMMUNITY; EUROPEAN UNION; GERMANY; WESTERN EUROPE
Accession no.544680

Item 319
Patent Number: US 5334641 A 19940802
RUBBER ASPHALT MIX
Rouse M W

A rubber modified asphalt for use as a paving compound is formed by reacting very fine ground particulate rubber with paving grade asphalt and mixing the combination at between 300°F and 400°F. The resulting mixture reacts fully within 25 minutes or less to form a freely pouring mixture; the reacted mixture can be held at normal asphalt working temperatures for at least 96 hours without degradation.

USA
Accession no.544424

Item 320
EVATECH H POLYMER-MODIFIED BITUMEN
Nicholls J C
Transport Research Laboratory

A test programme was developed in order to assess the properties of Evatech-H bituminous binder modified with EVA as a road surfacing material. The work carried out by the Transport Research Laboratory was commissioned by Alfred McAlpine Quarry Products Ltd. Results of tests carried out are discussed, and show an enhanced resistance to deformation, compared to the use of traditional binders.

MCALPINE A.,QUARRY PRODUCTS LTD.
EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.544009

Item 321
EVATECH H POLYMER MODIFIED BITUMEN FOR HOT ROLLED ASPHALT
Total Bitumen

The advantages are discussed of the use of Evatech H in road surfacing projects. It consists of a specially developed binder of bitumen and EVA, which produces a road surface capable of being laid in a wider range of climatic conditions, and offering more than double the resistance to permanent deformation than equivalent mixes made with unmodified bitumen.

EUROPEAN COMMUNITY; EUROPEAN UNION; UK; WESTERN EUROPE
Accession no.544007

Item 322
Patent Number: US 5330569 A 19940719
INDUSTRIAL ASPHALTS
McGinnis E L; Goodrich J E
Chevron Research & Technology Co.

These may be produced by mixing together without air-blowing (a) a feed material comprising a bituminous material having a viscosity of at least 50 centistokes at 350°F, the feed material forming a single phase when mixed with 5% of 85% phosphoric acid, and (b) from about 0.1 to 20.0 wt.% of phosphoric acid. Mixing is carried out at a temp. in the range of 351 to 600°F, giving rise to an increase of the softening point of the feed and a decrease in penetration.

USA
Accession no.542976

Item 323
Patent Number: EP 639630 A1 19950222
PROCESS FOR STABILISING BITUMEN-POLYMER BLENDS
Italia P
Agip Petroli SpA

The blends are treated in an inert environment at a temp. in the range of from 210 to 240°C and for from 1 to 4 h with a vinyl aromatic compound. The bitumen is selected from bitumens containing resins, asphaltenes,
aromatics and saturated species, which comply with the condition \( Z > 5 \), \( Z \) being defined by a specified expression.

EUROPEAN COMMUNITY; EUROPEAN UNION; ITALY; WESTERN EUROPE
Accession no.542960

Item 324
Patent Number: US 5328943 A 19940712
ASPHALT COMPOSITIONS FOR PAVEMENT
Isobe M; Aizawa Y
Nippon Oil Co.Ltd.

These comprise an asphalt of natural or petroleum origin, a thermoplastic elastomer and/or a styrene-butadiene rubber and a low molec.wt. PP. These components are premixed or plant-mixed to form a reformed asphalt, which is mixed with an aggregate to produce a road paving material having increased compression strength, increased low temperature viscosity and decreased high temperature viscosity.

JAPAN
Accession no.542865

Item 325
Patent Number: WO 9416019 A1 19940721
OXIDISED ASPHALT RUBBER SYSTEM
Trumbore D C; Franzen M R; Wilkinson C R
Owens-Corning Fiberglas Corp.

The present invention provides an elastomeric-asphalt composition which does not phase separate and which is compatible at high temperature. This material can be produced without the need to use high shear milling equipment, and is not limited by the tendency of other elastomer polymers to be incompatible with asphalt nor does the composition separate into a polymer-rich phase and an asphalt-rich phase. In a preferred embodiment, the elastomer materials are SBS and SIS block copolymers.

USA
Accession no.541745

Item 326
Patent Number: US 5324758 A 19940628
VIBRATION DAMPING MATERIAL OF ASPHALT CEMENT
Takahashi M; Soga Y; Iatagaki K; Fujita Y; Nakamura Y
Showa Shell Sekiyu KK; Shimizu Construction Co.Ltd.

The composition described comprises (a) 60-90 pbw of asphalt cement, (b) 10-30 pbw of thermoplastic rubber, and (c) 0-20 pbw of a tackifier. The total of (a), (b) and (c) is 100 pbw. Penetration of the vibration damping material falls in the range 35 to 140.

JAPAN
Accession no.541008

Item 327
Patent Number: US 5322867 A 19940621
ASPHALT AMINE FUNCTIONALISED POLYMER COMPOSITION
Kluttz R Q
Shell Oil Co.

The composition comprises a bituminous component, a polymer which comprises at least one block of a conjugated diolefin and at least one block of an acrylic monomer such as an alkyl methacrylate, and from 0.001-1 pbw of a polyfunctional amine having at least two amino groups. An acid or anhydride functionalised conjugated diene block copolymer may be used in place of the acrylic monomer polymer.

USA
Accession no.540595

Item 328
Patent Number: WO 9414896 A1 19940707
TREATMENT OF RUBBER TO FORM BITUMINOUS COMPOSITIONS
Liang Z; Woodhams R T
Toronto,University,Innovations Foundation; Polyphalt Inc.

Rubber, particularly crumb rubber from the recycling of tyres, is processed to effect partial or high levels of dissociation of rubber vulcanisate network, in particular to form bituminous compositions in which the treated rubber, carbon black and other additives released are stably dispersed. Bitumen, hydrocarbon oil and liquid rubber are used to effect penetration, swelling and compatibilisation of the rubber particles, following which thermal energy and mechanical energy are applied to initiate breakdown of the vulcanised structure of the rubber particles and the formation of at least partially dissociated rubber vulcanisate network. Such treated rubber may be further reacted and combined for employment in the production of stabilised polymer modified bitumen composition.

CANADA
Accession no.536698

Item 329
Patent Number: US 5314935 A 19940524
BITUMEN/POLYMER COMPONENT MAKING IT POSSIBLE TO OBTAIN BITUMEN/POLYMER COMPOSITIONS WITH VERY LOW THERMAL SENSITIVITY, CAPABLE OF BEING EMPLOYED FOR THE PRODUCTION OF SURFACINGS
Chaverot P; Lacour C
Elf Antar France

A bitumen/polymer component of the type consisting of a hydrocarbon matrix is provided in which a sulphur-crosslinked elastomer is distributed homogeneously in a quantity such that it represents 5 to 20 wt.% of the bitumen/polymer component. The component exhibits a penetration, determined according to NF standard T66004, and a ball-
and-ring softening temperature, determined according to NF standard T66008, such that the Pfeiffer number, which links these quantities, assumes values greater than 5 in the case of the bitumen/polymer component.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE

Accession no.536262

**Item 330**

Patent Number: US 5278207 A 19940111

**ASPHALT AMINE FUNCTIONALISED POLYMER COMPOSITION**

Klutz R Q
Shell Oil Co.

A composition is disclosed comprising a bituminous component, a polymer which comprises at least one block of a conjugated diolefin and at least one block of an acrylic monomer such as an alkyl methacrylate and from 0.001 to 1 pbw of a polyfunctional amine having at least two amino groups. An acid or anhydride functionalised conjugated diene block copolymer may be used in place of the acrylic monomer polymer.

USA

Accession no.535684

**Item 331**

Patent Number: EP 618275 A1 19941005

**POLYMER-MODIFIED SULPHONATED ASPHALT COMPOSITION AND METHOD OF PREPARATION**

Gorbaty M L; Peiffer D G; McHugh D J
Exxon Research & Engineering Co.

The composition is a blend of an asphalt which contains sulphonate or sulphonic acid groups, a sulphonated polymer, preferably butyl rubber, a styrene-butadiene linear diblock polymer, a styrene-butadiene-styrene linear or radial triblock polymer or EPDM, and a basic neutralising agent.

USA

Accession no.535394

**Item 332**

Patent Number: EP 618274 A1 19941005

**POLYMER MODIFIED ASPHALT COMPOSITION AND METHOD OF PREPARATION**

Gorbaty M L; Nahas N C
Exxon Research & Engineering Co.

The composition contains neutralised mixtures of oxidised asphalt and a sulphonated polymer, such as sulphonated EPDM, sulphonated SBR or acrylic acid terpolymer, in an amount effective to allow the formation of one continuous phase or two interdispersed phases that do not segregate on standing at elevated temperatures.

USA

Accession no.535392

**Item 333**

Patent Number: US 5308898 A 19940503

**BITUMINOUS COMPOSITIONS INCLUDING RESIDUES OF THERMOPLASTIC POLYMERS WITH POLYURETHANE FOAMS AND THERMOSET RESIN, ETC.**

Dawans F
Institut Francais du Petrole

This invention relates to bituminous compositions obtained by the incorporation of thermoplastic polymer residues, particularly sterile car waste, containing polyurethane foams and thermoset resins, as well as their preparation process. The process consists of mixing previously ground polymer residues, so as to obtain an average particle size below 10 mm with melted asphalt or bitumen. The mixture is stirred at a temperature between 150°C and 300°C, the presence of ground polyurethane foam and thermoset resin particles helping to increase the dissolving rate of the polymers. A catalyst and/or a reagent aiding a coupling reaction between the polymers and certain constituents of the bitumen or asphalt may also be added, which gives the final bituminous mixture improved properties. The bituminous compositions can be used for coating solid materials.

EUROPEAN COMMUNITY; EUROPEAN UNION; FRANCE; WESTERN EUROPE

Accession no.535354

**Item 334**

*Scrap Tire News*
8, No.11, Nov.1994, p.14

**CRYOGENICALLY GROUND RUBBER FOR ASPHALT**

It is briefly reported that the growing use of tyre rubber in asphalt applications in recent years has generated an increasing number of questions about the performance of cryogenically ground whole tyre rubber versus ambiently ground rubber. The Florida Department of Transportation has prohibited the use of cryogenically ground rubber in its specifications for use of ground tyre rubber in asphalt pavements in the state. This decision was taken partly as a result of information contained in a University of Florida report “Evaluation of Ground Tyre Rubber in Asphalt Concrete”.

FLORIDA, DEPT. OF TRANSPORTATION
USA

Accession no.534931

**Item 335**

*Tire Business*
12, No.12, 19th Sept. 1994, p.17

**ATR DEVELOPS ADDITIVE TO IMPROVE ASPHALT**

Moore M

It is reported that American Tire Reclamation Inc. of Detroit has developed an additive from carbon black and
oil, which improves the performance of modified asphalt. Full details are provided of “ATR-33”, and also of its market demand resulting from recycled tyre utilisation legislation.

AMERICAN TIRE RECLAMATION INC.; RUBBER PAVEMENTS ASSN.; NORTH CAROLINA, DEPARTMENT OF TRANSPORTATION, USA

Accession no.531383

Item 336
Rubber and Plastics News
24, No.3, 12th Sept. 1994, p.5
ROADWORK FIRM DEVELOPS ASPHALT MODIFIER
Moore M

American Tire Reclamation Inc., a Detroit tyre pyrolysis firm, is to build a new plant to produce its newly developed asphalt modification technology. The article supplies details of ATR33 - a refined version of the carbon black and oil produced by pyrolysis. Adding it to asphalt improves the material’s resistance to ageing and rutting. The technology may provide an alternative way of meeting planned legislation on the inclusion of waste tyre products in road surfaces, rather than incorporation of rubber crumb.

AMERICAN TIRE RECLAMATION INC.
USA
Accession no.531298

Item 337
MRS Bulletin
19, No.9, Sept. 1994, p.14
STRONG, EROSION-RESISTANT CONCRETE CAN USE RECYCLED POLYSTYRENE

Brief details are presented on the development of a stronger, more chemically resistant concrete by Oak Ridge National Laboratory. The concrete is reported to contain recycled PS and applications are said to include construction of sturdier, lighter weight bridges, to improve durability of road surfaces, and containment of toxic wastes. The concrete is also said to be under consideration as a protective coating for the New York City piers to protect them from erosion by seawater.

OAK RIDGE NATIONAL LABORATORY
USA
Accession no.531238

Item 338
Journal of Applied Polymer Science
54, No.2, 10th Oct. 1994, p.231-40
CHLORINATED POLYOLEFINS FOR ASPHALT BINDER MODIFICATION
Morrison G R; Lee J K; Hesp S A M
Queen’s University at Kingston

The benefits obtained from the addition of small quantities of chlorinated polyolefins to paving grade asphalt binders were investigated. A chlorinated polyethylene plastomer (Tyrin 2552), and a chlorinated olefinic elastomer (Tyrin CM0730) were added to asphalt binders at 3 and 5 wt. % and subsequently reactively processed to facilitate compatibilisation. The mixtures were analysed for rheological performance relating to fatigue and rutting as well as low-temperature fracture performance. The addition of small quantities of these polymers to the asphalt binders resulted in significant improvements over conventional modifiers at both the high and low temperature extremes. Results are included for samples containing recycled PE stretch wrap, ground rubber tyres, and commercial styrene-butadiene copolymer. 26 refs.

CANADA
Accession no.531084

Item 339
Rubber Chemistry and Technology
67, No.3, July/Aug. 1994, p.447-80
POLYMER MODIFICATION OF PAVING ASPHALT BINDERS

Lewandowski L H
Goodyear Tire & Rubber Co.

A review is given of the use of polymer modifiers in dense-graded hot-mix asphalt concrete pavement applications. Emphasis is given to methods used to characterise the compatibility, rheology, and mechanical properties of the binders. 103 refs.

USA
Accession no.530561

Item 340
Patent Number: US 5306750 A 19940426
POLYMER AND ASPHALT REACTION PROCESS AND THERMOPLASTIC EPOXIDE-CONTAINING POLYMER-LINKED ASPHALT PRODUCT

Goodrich J L; Statz R J
Chevron Research & Technology Co.; DuPont de Nemours E.I., & Co. Inc.

The above product is particularly useful in road paving and roofing applications.

USA
Accession no.530279

Item 341
Scrap Tire News
8, No.10, Oct. 1994, p.18
PAVER INCREASES ASPHALT RUBBER USE

It is reported that FnF Construction Inc. of the USA is aggressively pursuing the crumb rubber modified asphalt paving market. Recent projects are mentioned.
The company’s mixing process and units are briefly described.

**FNF CONSTRUCTION INC.: CEI ENTERPRISES USA**

Accession no. 529606

**Item 342**
*Rheologica Acta*

33, No.4, July/Aug. 1994, p. 344-54

**FRACTIONAL COMPLEX MODULUS MANIFESTED IN ASPHALTS**

Stastna J; Zanzotto L; Ho K

Novacor Research & Technology Corp.

Regular and polymer-modified asphalts were studied via fractional relaxation processes. Basic properties of this complex modulus and the forms of generated constitutive equations were studied. Relaxation times of the model were related via a pseudospectrum to the phase angle lag. 21 refs.

**CANADA**

Accession no. 528302

**Item 343**


**ASPHALT AMINE FUNCTIONALISED POLYMER COMPOSITION**

Kluttz R Q

Shell Internationale Research Mij BV

A bituminous composition comprises a bituminous component, a polymer comprising at least one block of a conjugated diolefin and at least one block of an acrylic monomer, such as an alkyl methacrylate, and from 0.001 to 1 pbw of a polyfunctional amine having at least two amino groups. An acid or anhydride functionalised conjugated diene block copolymer may be used in place of the acrylic monomer polymer.

**EUROPEAN COMMUNITY; EUROPEAN UNION; NETHERLANDS; WESTERN EUROPE**

Accession no. 527695

**Item 344**

Patent Number: US 5302638 A 19940111

**ASPHALT/O-MODIFIED PE BLEND FOR PAVING**

Ho K; Zanzotto L

Husky Oil Operations Ltd.

The blend contains PE, which has been modified by shearing action in the presence of an O-containing gas, such as oxygen or ozone, and has improved viscosity at high temps and reduced stiffness at low temperatures. Paving mixtures obtained therefrom have improved Marshall Test Value (ASTM D1559), indicating that they should have a reduced tendency to become rutted under traffic loads.

**CANADA**

Accession no. 526301

**Item 345**

Patent Number: WO 9410247 A1 19940511

**BITUMEN EMULSION, ITS PREPARATION AND USE AND BREAKING ADDITIVE FOR USE THEREIN**

Redelius P G; Uhlback P; James A D; Stewart D;

Gastmans A C C

Nynas Petroleum AB

The emulsion, which is of the anionic or cationic type, includes a breaking additive, which comprises a suspension of a breaking solid in oil. The bitumen emulsion may be used in road building, road maintenance, recycling of old asphalt pavings and construction work.

**SCANDINAVIA; SWEDEN; WESTERN EUROPE**

Accession no. 524061

**Item 346**

Patent Number: US 5277710 A 19940111

**METHOD OF PROCESSING AN ASPHALT MIXTURE**

Aho S

This invention concerns a method of processing an asphalt mixture which comprises mineral aggregate and/or recycled crushed asphalt and to which bitumen-based binding material has optionally been added. The mineral aggregate or crushed asphalt or a mixture thereof that has been disposed of in hoppers is heated by leading a heated gas that contains vapour, such as superheated water vapour, thereto.

**FINLAND; SCANDINAVIA; WESTERN EUROPE**

Accession no. 523260

**Item 347**

Angewandte Makromolekulare Chemie

Vol. 218, May 1994, p. 171-82

**KINETICS STUDIES ON THE FREE RADICAL POLYMERISATION OF STYRENE IN THE PRESENCE OF ASPHALTS**

Milczarska T; Szańko J

Warsaw, Technical University; Szczecin, Technical University

A study was made of the free radical polymerisation of styrene in bulk at 60C initiated with AIBN in the presence of hydroxystetramethylpiperidinioxy and two types of petroleum asphalts. The differences between the kinetic behaviour of asphalts in comparison with stable free radicals are discussed. 21 refs.

**EASTERN EUROPE; POLAND**

Accession no. 517598

**Item 348**

Annals of Occupational Hygiene

38, No.3, June 1994, p. 257-64

**EXPOSURE TO LOW MOLECULAR POLYMINES DURING ROAD PAVING**
Levin J O; Andersson K; Hallgren C
Sweden, National Institute of Occupational Health

Fatty amine wetting agents are used to increase adhesion in bitumen emulsion used in road paving, but commercial products are contaminated with low molecular weight polyamines and alkanol polyamines which are released from the hot bitumen during paving, causing eye and respiratory tract irritation and skin sensitisation. The exposure of road pavers to ethylene diamine, diethylene triamine, triethylene tetramine, tetraethylene pentamine, hydroxyethyl ethylene diamine, hydroxyethyl diethylene triamine, monoethanolamine and diethanolamine was studied. A highly sensitive measurement technique using naphthylisothiocyanate-coated sorbents and filters was used. 14 refs.

SCANDINAVIA; SWEDEN; WESTERN EUROPE
Accession no.517165

Item 349
Patent Number: US 5290833 A 19940301
AGGREGATE OF ASPHALT AND FILLER
Schmanski D W
Carsonite International Corp.

An asphalt pavement material comprises an aggregate mixture of asphalt, gravel, sand and a pelletised composite of recycled rubber and thermoplastic material. The composite has a uniform size, smaller than the gravel and larger than the sand and is configured to fit within interstitial voids between the gravel. Sufficient pelletised composite is added to the asphalt pavement and mineral aggregate mixture (replacing mineral aggregate of comparable size) to substantially fill void spaces between the gravel.

USA
Accession no.513170

Item 350
Colloid and Polymer Science
272, No.4, April 1994, p.375-84
ELASTIC STERIC STABILISATION OF POLYETHYLENE-ASPHALT EMULSIONS BY USING LOW MOLECULAR WEIGHT POLYBUTADIENE AND DEVULCANISED RUBBER TYRE
Morrison G R; Hedmark H; Hesp S A M
Queen’s University at Kingston

Emulsions containing 3% PE were stabilised against coalescence in an asphalt medium by low molec.wt. virgin polybutadiene and recycled styrene-butadiene stabilisers. The recycled styrene-butadiene steric stabiliser precursor was obtained as a thermomechanical devulcanised ground rubber tyre in asphalt. The low molec.wt. butadiene and styrene-butadiene rubbers were in-situ-reacted with sulphur in order to increase the compatibility of the stabiliser with the asphalt phase. Because of the high molar volume of the asphalt phase and the similarity in contact energy between stabiliser and matrix phase, it was assumed that the stabilisation was caused by entropic effects only. The fundamental aspects of elastic stabilisation of PE-asphalt emulsions were examined. The total interaction free energy profile between the PE particles showed that the efficiency of the steric stabiliser formation reaction could be improved significantly. The use of devulcanised rubber tyre as a replacement for the virgin polybutadiene precursor in the in-situ stabilisation process could significantly reduce the cost of the technology. 22 refs.

CANADA
Accession no.512937

Item 351
Chicago, Il., 19th-22nd April 1994, Paper 26, pp.19. 012
APPLICATION OF CRUMB RUBBER MODIFIERS (CRM) IN ASPHALTIC MATERIALS
Rouse M W
Rouse Rubber Industries Inc.
(ACS, Rubber Div.)

The application of crumb rubber from scrap tyres in asphalt road surfacing compositions is reviewed. Test methods for asphalt binders and mixtures are examined, and the impact of US legislation on future developments is discussed. 26 refs.

USA
Accession no.511432

Item 352
Tire Business
11, No.22, 21st Feb.1994, p.9/21
ARIZONA SOLD ON RUBBER-MODIFIED ASPHALT
Moore M

This article outlines the growth and success of the use of rubberised asphalt for roads and paving material in Arizona. Congress has cut off funding for the promotion and enforcement of a provision in a 1991 highway law that requires states to use rubberised asphalt, but Arizona plans continued use of the material. The article supplies full details of the advantages of rubberised asphalt as paving material.

INTERNATIONAL SURFACINGS INC.; FNF CONSTRUCTION
USA
Accession no.511222
Item 353
Patent Number: US 5284887 A 19940208
COMPOSITION FOR COATING CONCRETE ASPHALT SUBSTRATES, SUCH AS HIGHWAYS, LANDING STRIPS OF AIRFIELDS AND THE LIKE
Lavy A; Margulis Y
Aldema Ltd.

The composition comprises an acryl- or styrene-type monomer, bitumen, a mineral particulate filler and a UV protective agent. It forms an uppermost protective layer and penetrates to a certain small depth, resulting in improved resistance to mechanical stress and surface abrasion as well as against deterioration by solar radiation.

ISRAEL
Accession no.508287

Item 354
Photocopy (New Civil Engineer, 1994, 3 March, 16-17), pp. 2. 12ins. 9/3/94. 62(12)-6R1
RIGHT ON TARGET
Parker D

The effective use of Shell Bitumen’s Cariphalte DM as a resurfacing material in a military application is described. The polymer-modified bitumen was selected by the Royal Armoured Corps Gunnery School to resurface the firing pads which are put under severe stress from the shock of the recoil from tank guns and also scraping and abrasion from hard rubber tracks as the tanks manoeuvre into firing position. The army required a system which would be operational within 5 days and fit into a tight financial budget. Cariphalte DM contains 7% SBS, and has a pen of 90+ or -20. The benefits of its extra binder flexibility are discussed.

SHELL BITUMEN (UK) LTD.; TARMAC ROADSTONE LTD.
EUROPEAN COMMUNITY; UK; WESTERN EUROPE
Accession no.508235

Item 355
Patent Number: US 5284509 A 19940208
METHOD FOR PRODUCING SUPERIOR QUALITY PAVING ASPHALT AND PRODUCT PREPARED THEREFROM
Kamel N I; Miller L J
Exxon Research & Engineering Co.

These binders, which have reduced binder runoff and high temperature viscosity, are made by adding a copolymer of ethylene with an alkyl acrylate, preferably methyl acrylate, or vinyl acetate and a neutralised sulphonated polymer, preferably a terpolymer of ethylene, propylene and a diene, to asphalt.

USA
Accession no.507742

Item 356
Scrap Tire News
8, No.1, Jan.1994, p.4-5
RUBBERISED ASPHALT IS A WINNER FOR FLORIDA

The Florida Department of Transport’s Materials Office has been researching the addition of recycled rubber to asphalt pavements. As a result of this research, it has been determined that ground tyre rubber would have two major benefits in highway construction - in the prevention of the spread of cracking and in the improvement of durability and reduction in pavement wear. From January 1994, the Department will include ground tyre rubber specifications in its construction contracts. Details are given.

FLORIDA, DEPT. OF TRANSPORTATION
USA
Accession no.504173

Item 357
Patent Number: EP 579512 A1 19940119
STORAGE STABLE POLYMER MODIFIED ASPHALT PAVING BINDER
Bardet J G; Gorbaty M L; Nahas N C
Exxon Research & Engineering Co.

These binders, which have reduced binder runoff and high temperature viscosity, are made by adding a copolymer of ethylene with an alkyl acrylate, preferably methyl acrylate, or vinyl acetate and a neutralised sulphonated polymer, preferably a terpolymer of ethylene, propylene and a diene, to asphalt.

USA
Accession no.503089

Item 358
Patent Number: EP 578057 A2 19940112
AGGREGATE TREATMENT
Dunning R L; Schulz G O
Goodyear Tire & Rubber Co.

Aggregate that is resistant to stripping by water and is useful for making asphalt concrete is produced by mixing with latex, heating the mixture to a temp. of from 66 to 232°C and maintaining the mixture at this elevated temp. for a time to reduce the moisture content to below about 0.7 wt.% and allow the polymer in the latex to crosslink.

USA
Accession no.503014
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