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(54) **Title:** BINDER COMPOSITION WHICH CAN BE COLOURED

(57) **Abstract:** A binder composition which can be coloured is disclosed. The binder composition comprises a petroleum solvent-extracted oil, a petroleum resin, hydrogenated thermoplastic elastomer and a detachment preventing agent. The binder compositions can be used at low temperatures and retain the strength needed in coloured paving.



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BINDER COMPOSITION WHICH CAN BE COLOURED

Field of the Invention

The present invention relates to binder compositions which can be coloured by adding a pigment, etc., and more particularly it relates to binder compositions which can be coloured and are ideal for coloured paving used in public parks and walkways.

Background of the Invention

In general, when coloured paving is used in public parks and walkways, a binder product which can be coloured by adding a pigment can be employed. Such binder compositions for coloured paving include, for example, compositions which include a petroleum resin and/or a thermoplastic elastomer and a petroleum softening agent in given proportions, if necessary with the addition of an antioxidant.

Binder compositions for coloured paving are ordinarily exposed outdoors for long periods, and may suffer from deterioration due to moisture, heat, oil components and/or UV radiation. Accordingly, in the prior art, in order to raise weather resistance, binder compositions for coloured paving using as a petroleum resin and a thermoplastic elastomer a hydrogenated petroleum resin and a hydrogenated thermoplastic elastomer, in which double bonds in the respective molecules have been decreased by adding hydrogen, have been proposed (see, for example, JP 2001-172469 A and JP 2001-329117 A). In addition, binder compositions for coloured paving have also been proposed in which, in addition to employing an aforementioned hydrogenated petroleum resin and hydrogenated thermoplastic elastomer,

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the softening agent has been changed from a petroleum solvent-extracted oil to a petroleum lubricating oil-based oil which has little aromatic component and has few double bonds (see, for example, JP 2002-206047 A).

5 On the other hand, there are also binder compositions for coloured paving which take into account the effects on the environment and the human body (see, for example, JP 2003-301111 A and JP 2005-256450 A). In the binder compositions disclosed in JP 2003-301111 A, a
10 petroleum heavy oil with polycyclic aromatic hydrocarbon content decreased to no more than 3 wt% and the aromatic component decreased to no more than 15 wt% is employed as the softening agent. Similarly, in the binder compositions disclosed in JP 2005-256450 A, a petroleum
15 aromatic hydrocarbon oil with a polycyclic aromatic compound content decreased to less than 3 wt% is employed as the softening agent.

 In a paving mixture the essential constituents of which are a binder such as asphalt and aggregate, the
20 binder needs to be melted, and made to cover the aggregate. Consequently, from the point of view of the need for melting of the binder, heating to quite a high temperature is needed for the manufacture and installation thereof. Especially with coloured paving
25 using a binder composition which can be coloured with an added improving agent such as a thermoplastic elastomer, the mixing temperature during production generally requires heating to about 170°C, and compaction temperature during installation is also a temperature of
30 at least 130°C. Consequently, a large quantity of energy is required for heating the binder during production and installation, and there is also the problem that

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greenhouse gas typified by carbon dioxide is produced in the process.

The present invention is a response to the problem above and the object thereof is to offer binder compositions which can be coloured with which there is no adverse effect at low temperatures on production of a mixture or ease of working when compacting during actual use, and which retain the strength needed in coloured paving (rutting stability: DS value).

In order to solve the problem above, the present inventors have carried out concerted studies focusing on lowering the viscosity of binder compositions which can be coloured, and obtaining the strength needed in coloured paving (rutting resistance: DS value), by optimizing the hydrogenated thermoplastic elastomer added as an essential constituent to the binder, as such. The present inventors have found that the viscosity of the binder is lowered and the strength needed in coloured paving (rutting resistance: DS value) is obtained by mixing a first hydrogenated thermoplastic elastomer which has a 10% toluene solution viscosity at 25°C in the range 1000-2500 mPa.s and a second hydrogenated thermoplastic elastomer which has a 10% toluene solution viscosity at 25°C in the range 5-50 mPa.s, in specified proportions, giving an invention of polymer-improved asphalt compositions which can solve the problems of the prior art described above.

Summary of the Invention

Accordingly, the present invention provides a binder composition which can be coloured characterized in that it comprises a petroleum solvent-extracted oil, a petroleum resin, from 4 to 8wt% hydrogenated thermoplastic elastomer formed by mixing a first

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hydrogenated thermoplastic elastomer which has a 10% toluene solution viscosity at 25°C in the range 1000-2500 mPa.s and a second hydrogenated thermoplastic elastomer which has a 10% toluene solution viscosity at 25°C in the range 5-50 mPa.s, and from 0.3 to 2wt% of a detachment preventing agent, wherein the content of the first hydrogenated thermoplastic elastomer is from 34 to 49 wt% in the hydrogenated thermoplastic elastomer.

With the present invention, constituted as described above, the viscosity of the binder can be lowered while maintaining a high rutting resistance (DS value), by mixing a first hydrogenated thermoplastic elastomer which has a 10% toluene solution viscosity at 25°C in the range 1000-2500 mPa.s and a second hydrogenated thermoplastic elastomer which has a 10% toluene solution viscosity at 25°C in the range 5-50 mPa.s, in specified proportions. Consequently, it becomes possible to offer binder compositions which can be coloured with which, by contrast with prior binders for coloured paving, production and installation are possible under low temperature conditions of 30°C or less, and it is further possible to obtain the strength needed in coloured paving.

Detailed Description of the Invention

Embodiments of binder compositions which can be coloured applying the present invention are described in detail below.

Polymer-improved asphalt compositions applying the present invention comprise a petroleum solvent-extracted oil, a petroleum resin, from 4 to 8wt% hydrogenated thermoplastic elastomer formed by mixing a first hydrogenated thermoplastic elastomer which has a 10% toluene solution viscosity at 25°C in the range 1000-2500

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mPa.s and a second hydrogenated thermoplastic elastomer which has a 10% toluene solution viscosity at 25°C in the range 5-50 mPa.s, and from 0.3 to 2wt% of a detachment preventing agent. In a preferred embodiment the composition consists essentially of the petroleum solvent-extracted oil, the petroleum resin, the hydrogenated thermoplastic elastomer and the detachment preventing agent.

The content of first hydrogenated thermoplastic elastomer is from 34 to 49% of the entire hydrogenated thermoplastic elastomer.

Below, the detailed requirements of each of the constituents of polymer-improved asphalt compositions applying the present invention are described and the reasons for limiting the numerical values are explained.

A Petroleum Solvent-Extracted Oil

Petroleum solvent-extracted oil is disclosed in "Sekiyu Seihin Dekiru Made [Deriving Petroleum Products]", page 101, fig. 6-1, "Ippan-na jinkatsuyuseizou koutei [General lubricating oil production processes]" published by The Petroleum Association of Japan 30 November 1971. It is an oily substance rich in aromatic and naphthene fractions, obtained by solvent extraction in the process of producing lubricating oil from crude oil, and it generally has a boiling point (at atmospheric pressure) of at least 350°C, a viscosity of 5-100 cSt/100°C, and preferably 30-100 cSt/100°C, penetration (JIS K2207) of at least 1000, and a softening point (JIS K2207) of no more than 20°C. A product with a total quantity of aromatic and naphthene fractions of at least 45 wt% (by ring analysis), and a flash point of 240°C or more is preferred.

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A Petroleum Resin

Petroleum resin is a product of polymerization of cracking products during producing ethylene or propylene, etc., by thermolysis of naphtha; products with a large content of cyclopentadiene (CPD) or dicyclopentadiene (DCPD) have a high softening point. It is a transparent to pale yellow resin with molecular weight ca.200-2000, and generally 1000-1500, and softening point 100-150°C.

Hydrogenated Thermoplastic Elastomer

Hydrogenated thermoplastic elastomer is produced by addition of hydrogen to the double bonds in diene blocks in the molecule of an unhydrogenated thermoplastic elastomer: besides acting as a structural material, this constituent confers softness on the binder composition.

The hydrogenated thermoplastic elastomer used in binder compositions which can be coloured according to the present invention is constituted by mixing a first hydrogenated thermoplastic elastomer and a second hydrogenated thermoplastic elastomer stipulated below.

The first hydrogenated thermoplastic elastomer has a 10% toluene solution viscosity at 25°C in the range 1000-2500 mPa.s. Although there is no restriction as to the type of the first hydrogenated thermoplastic elastomer provided that percentage hydrogenation is 95 wt% or more, it is preferably a chain or branched block copolymer in which the terminal segments are polystyrene segments, and the rubber constituent segments are segments such as polyethylene and polybutylene, which do not include double bonds. Such hydrogenated thermoplastic elastomers include, for example, SEBS (styrene-ethylene-butylene-styrene block copolymer), and SEPS (styrene-ethylene-propylene-styrene block copolymer). Of these, block copolymers which have a molecular weight of $\geq 50,000$, MFR

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(melt flow rate) (200°C, 5 kg) of no more than 10 g/minute, a polystyrene content of 10-50 wt%, and a specific gravity of 0.9 or more are preferred.

5 By making the 10% toluene solution viscosity of the first hydrogenated thermoplastic elastomer at 25°C in the range 1000-2500 mPa.s, it has a higher molecular weight. In this connection, when the viscosity of a 10% toluene solution at 25°C of the first hydrogenated thermoplastic elastomer is smaller than 1000 mPa.s, the difference from
10 the molecular weight of the lower molecular weight second hydrogenated thermoplastic elastomer becomes small due to the fact that the molecular weight is too low. This is undesirable because as a result, there is an interaction between the first hydrogenated thermoplastic elastomer and the second hydrogenated thermoplastic elastomer, and
15 the desired quality improving effect is not obtained. On the other hand, when the viscosity of a 10% toluene solution at 25°C of the first hydrogenated thermoplastic elastomer is greater than 2500 mPa.s, the viscosity of
20 the polymer-improved asphalt composition is considerably elevated, and this is undesirable because mixing with aggregate and compacting at low temperature becomes difficult due to the fact that the molecular weight becomes too high.

25 It should be noted that the effect mentioned above can be manifested more ideally when the first hydrogenated thermoplastic elastomer is preferably given a 10% toluene solution viscosity at 25°C in the range of from 1400 to 2000 mPa.s.

30 The second hydrogenated thermoplastic elastomer has a 10% toluene solution viscosity at 25°C in the range of from 5 to 50 mPa.s. Although there is no restriction as to the type of the second hydrogenated thermoplastic

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elastomer provided that percentage hydrogenation is 95 wt% or more, it is preferably a chain or branched block copolymer in which the terminal segments are polystyrene segments, and the rubber constituent segments are segments such as polyethylene and polybutylene, which do not include double bonds. Such hydrogenated thermoplastic elastomers include, for example, SEBS (styrene-ethylene-butylene-styrene block copolymers) and SEPS (styrene-ethylene-propylene-styrene block copolymers). And of these, block copolymers of molecular weight at least 50,000, MFR (melt flow rate) (200°C, 5 kg) no more than 10 g/minute, polystyrene content 10-50 wt% and specific gravity 0.9 or more is preferred.

By making the viscosity of a 10% toluene solution of the second hydrogenated thermoplastic elastomer at 25°C from 5 to 50 mPa.s, it becomes constituted with a lower molecular weight. In this connection, when the viscosity of a 10% toluene solution at 25°C of the second hydrogenated thermoplastic elastomer is smaller than 5 mPa.s, this is undesirable because the desired quality improving effect is not obtained, due to the fact that molecular weight is too low. On the other hand, when the viscosity of a 10% toluene solution at 25°C of the second hydrogenated thermoplastic elastomer is greater than 50 mPa.s, the difference from the molecular weight of the higher molecular weight first hydrogenated thermoplastic elastomer becomes small. This is undesirable because as a result there is an interaction between the first hydrogenated thermoplastic elastomer and the second hydrogenated thermoplastic elastomer and the desired quality improving effect is not obtained.

It should be noted that the effect mentioned above can be manifested more ideally when the second

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hydrogenated thermoplastic elastomer preferably has a 10% toluene solution viscosity at 25°C in the range of from 10 to 40 mPa.s

Thus, in all embodiments of the present invention,
5 the softening point can be made lower than polymer-improved asphalt in the prior art, the overall viscosity can be lowered, and mixing with aggregate, production, and use, become possible with lower temperature conditions than with the prior art, by combining two
10 types of thermoplastic elastomer, namely a first hydrogenated thermoplastic elastomer, which is a hydrogenated thermoplastic elastomer with a high viscosity of a 10% toluene solution at 25°C and a second hydrogenated thermoplastic elastomer, which is a
15 hydrogenated thermoplastic elastomer with a low viscosity of a 10% toluene solution at 25°C. In addition to this, due to interaction between the first hydrogenated thermoplastic elastomer and the second hydrogenated thermoplastic elastomer, it is possible to get adequate
20 strength, and it becomes possible to maintain high rutting resistance (DS value).

In other words, we have discovered a formulation which gives a very satisfactory balance of contradictory performance traits, namely the low temperature properties
25 and mechanical properties of the asphalt composition.

In this connection, when the overall quantity of hydrogenated thermoplastic elastomer indicates the sum of the first hydrogenated thermoplastic elastomer and the second hydrogenated thermoplastic elastomer, the content
30 of the first hydrogenated thermoplastic elastomer needs to be from 34 to 49 wt% in the entire hydrogenated thermoplastic elastomer, and it is preferably from 37 to 46 wt%.

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In addition, if the overall quantity of hydrogenated thermoplastic elastomer is less than 4 wt% of the entire binder composition, the performance described above cannot be fully manifested. Similarly, when the overall
5 quantity of hydrogenated thermoplastic elastomer is more than 8 wt% of the entire binder composition, this produces the problem that starting material costs are greatly elevated due to an increase in the addition of expensive thermoplastic elastomer, because the
10 aforementioned effect is saturated. Thus, when added to give a content of hydrogenated thermoplastic elastomer in excess of 8 wt%, there is no marked additional improvement in the low temperature properties or the mechanical properties of the asphalt composition, and
15 instead it is disadvantageous as regards starting material costs.

Consequently, the content of thermoplastic elastomer needs to be from 4 to 8 wt% relative to the total of the polymer-improved asphalt composition. It should be noted
20 that in order to give an even better aforementioned effect, it is desirable that the content of thermoplastic elastomer is from 5 to 7 wt%.

A Detachment Preventing Agent

In the present invention, a detachment preventing
25 agent is preferably added in order to prevent detachment of the asphalt composition and the aggregate.

As a detachment preventing agent, a dimer acid is ideally employed, and this dimer acid is preferably produced by polymerizing a C18 unsaturated fatty acid
30 from plant oil starting material. By also including this dimer acid in the binder composition, when mixing with aggregate it acts in order to prevent detachment from the aggregate. Dimer acid is preferably employed in the

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present invention as a detachment preventing agent, but there is no restriction as to this.

As an alternative to a dimer acid, a resin acid can also be used as a detachment preventing agent.

5 Resin acids are C20 polycyclic diterpenes which have a carboxyl group, and are rosin substances which contain at least any one of abietic acid, dihydroabietic acid, neoabietic acid, pimaric acid, isopimaric acid, and/or palustric acid.

10 As the rosin here, gum rosin, wood rosin or tall oil rosin, etc., can be employed. Although these rosins can be classified as mentioned above as gum rosin and wood rosin, etc., in accordance with differences in the region where the starting material was produced, the starting
15 material and the harvesting method, they are obtained as a residue fraction when steam distilling at least pine resin. The constituents in this rosin are a mixture which includes abietic acid, palustric acid, neoabietic acid, dihydroabietic acid, pimaric acid, sandaracopimaric acid
20 and/or isopimaric acid. This rosin ordinarily softens at about 80°C, and melts at 90-100°C. It should be noted that rosin includes different types of resin acid such as abietic acid, dihydroabietic acid, dihydroabietic acid, tetrahydroabietic acid, palustric acid, neoabietic acid,
25 and levopimaric acid, however, these resin acids can each be employed singly in the pure form.

 This detachment preventing agent is included at from 0.3 to 2 wt% relative to the total mass of the binder composition. Should the content of this detachment
30 preventing agent be less than 0.3 wt%, detachment will be produced when mixing with aggregate, and it cannot be expected to improve the stability of the binder composition as a final product. By contrast, when the

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content of this detachment preventing agent exceeds 2 wt%, this effect in improving stability is saturated, and it produces the problem that starting material costs are considerably elevated due to the increased addition of an expensive detachment preventing agent. Thus, when added to give a content of detachment preventing agent in excess of 2 wt%, there is no marked additional improvement in stability and instead is disadvantageous as regards starting material costs.

Moreover, it is preferable that this detachment preventing agent is included in the range of from 0.3 to 1 wt% relative to the total mass of the binder composition. By making the upper limit for the content of detachment preventing agent 1 wt%, an improvement in the stability of the binder composition can be expected while keeping the elevation in starting material costs to a minimum; and cost effectiveness can be raised.

Below, the testing methods employed in the present invention, and specific examples and comparative examples are described; however, the present invention is not restricted to these examples. In the examples below, when not otherwise qualified, % indicates wt%.

As tests on samples obtained for carrying out experimental studies in order to confirm the properties of the binder in the present invention, as shown in Table 1, tests were carried out on properties consisting of the parameters penetration (25°C), softening point and viscosity (180°C). In addition, the DS value was measured as a test for confirming the mechanical strength of the mixture after mixing the binder composition with aggregate, via rutting resistance. The test methods are described in detail below.

Table 1
Contents %

	Starting material	Comp. Example 1	Example 1	Example 2	Example 3	Comp. Example 2	Comp. Example 3
Binder Formulation	Petroleum solvent- extracted oil	65.5	65.5	65.5	65.5	65.5	65.5
	Petroleum resin	28	28	28	28	28	28
	Hydrogenated thermoplastic elastomer (HTE)	3	2.75	2.5	2.25	2	1
		3	3.25	3.5	3.75	4	5
	HTE %	50	45.8	41.7	37.5	33.3	16.7
	Detachment preventing agent	0.5	0.5	0.5	0.5	0.5	0.5
Binder properties	Total	100	100	100	100	100	100
	Parameters evaluated						
	Penetration	53	51	51	52	53	55
	Softening point	68.5	65.0	62.0	60.5	58.0	54.0
	Viscosity °180°C	274	244	214	192	175	113
	D value	moulding impossible	1188	950	820	600	440

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Penetration (25°C) was measured by JIS K 2207 "Petroleum asphalt - Penetration test method". This value is preferably least 40 (0.1mm).

Softening point was measured by JIS K 2207 "Petroleum asphalt - Softening point test method".

Viscosity (180°C) was measured with the conditions in JPI-5S-54-99 "Asphalt - Viscosity test method using a rotating viscometer", with measurement temperature 180°C, spindle employment SC4-21, and spindle rotation speed suitable for the viscosity of the material measured, of 20-50 rpm.

DS value (dynamic stability) was measured in accordance with the wheel tracking method test method stipulated in "Hosou Chousa-Shikenhon Benran [Paving Inspection and Testing Handbook]" (Japan Road Association, editor,) employing test pieces in the form of sheets 30 cm long, 30 cm wide and 5 cm thick, produced by using each polymer-improved asphalt composition and aggregate with the formulation shown in Table 2, with a quantity of asphalt in the mixture of 5.0 wt%. It has been confirmed experimentally that Japanese roads reach a temperature of about 60°C in summer. When vehicles pass over the road in this state, flow deformation takes place to produce rutting, etc. The wheel tracking test is a test proposed in order to confirm experimentally the extent of this rutting, and is a test carried out in order to evaluate dynamic stability, which is an indicator of flow resistance in paving material. Specifically, a tyre was moved reciprocally for 1 hour on the specimen (test piece) in a thermostat tank held at 60°C, with a given load applied, and the resulting degree of deformation was measured.

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DS value (times/mm), is found using the quantity of deformation mm, in the 15 minutes from 45 minutes to 60 minutes after starting the test and the number of times the tyre travels (times) in the 15 minutes from 45 minutes to 60 minutes after starting the test by using this equation:

DS value (times/mm) = (the number of times the tyre travels (times) between 45 minutes and 60 minutes)/(quantity of deformation (mm) between 45 minutes and 60 minutes)

The higher this DS value, the higher the strength of the asphalt, which means that it is possible to offer paving material resistant to rutting.

Table 2

Origin

Material Name	Material	Origin
No. 6 gravel	hard sandstone	Miyama-cho, Hachioji-shi, Tokyo-to
Fine sand	washed sand	Tsuruoka, Futtsu-shi, Tokyo-to
Stone dust	limestone powder	Mizuho-cho, Nishi-tama gun, Tokyo-to

Results of Material Tests on Coarse and Fine Aggregate and Stone Dust

Type	(mm)	No. 6 gravel	Fine sand	Stone dust	Standard
Percent passing through	19	100			
	13.2	93.7			
	4.75	3.8	100		
	2.36		98.9		
	0.6		92.1	100	
	0.3		50.8	100	
	0.15		4.6	93.1	
	0.075		1.4	82.2	

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Specific gravity	surface dry	2.665	2.581	-	
	bulk	2.651	2.518	-	
	apparent	2.688	2.688	-	≥2.50
Water absorption	(%)	0.53	2.52	-	≤3.0
Abrasion loss	(%)	11.8			≤30
Wastage	(%)	4.4	2.5		≤12
Soft stone	(%)	3.7			≤5
Elongation/-flatness	(%)	4.3			≤25
Detachment surface area	(%)	8.7			≤15
Plasticity index	(%)		NP		
Moisture	(%)			0.12	

Set Formulation

No. 6 gravel	85
Fines	10
stone dust	5

Examples and comparative examples using SEBS as a hydrogenated thermoplastic elastomer as improving material, in order to verify the effect of improved asphalt composition applying the present invention are described in detail below.

Samples were prepared which comprised a petroleum solvent-extracted oil, a petroleum resin, hydrogenated thermoplastic elastomers and a detachment preventing agent, compounded in the percentages shown for Examples 1-3 and Comparative Examples 1-3 in Table 1.

The properties of the petroleum solvent-extracted oil employed in this verification were typical properties, viscosity at 100°C was 68 mPa.s, aromatic fraction was 33 wt%, the naphthene fraction was 26 wt%, and the paraffin fraction was 41 wt% and the flash point was 254°C. The properties of petroleum resin are typical properties, the softening point was 140°C, acid value stipulated by JIS K 0070 was 0.1mg KOH, bromine value

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stipulated by JIS K 2543 was 25 g, and polyethylene average molecular weight measured by GPC was ca. 1000.

In addition, 2 types of hydrogenated thermoplastic elastomers were employed in this verification:

5 hydrogenated thermoplastic elastomer 1 and hydrogenated thermoplastic elastomer 2. Hydrogenated thermoplastic elastomer 1 had a 10% toluene solution viscosity at 25°C of 1700 mPa.s, which falls within the scope of the first hydrogenated thermoplastic elastomer, and SEBS styrene/-
10 butadiene ratio was 32/68. In addition, hydrogenated thermoplastic elastomer 2 had a 10% toluene solution viscosity at 25°C of 24 mPa.s, which falls within the scope of the aforementioned second hydrogenated thermoplastic elastomer, and was SEBS with a styrene/-
15 butadiene ratio of 42/58. Thus, the ratio of styrene was higher in hydrogenated thermoplastic elastomer 2 than for hydrogenated thermoplastic elastomer 1.

Viscosity of a 10% toluene solution at 25°C can be measured by using a Brookfield (BL) viscosimeter, as
20 disclosed in JP 2008-31267.

As a detachment preventing agent in Examples 1-3 and Comparative Examples 1-3, dimer acid (C36, acid value 190-210 tall oil fatty acid dimer compounds) was employed in order to prevent detachment between the aggregate
25 materials and confer compatibility.

The petroleum solvent-extracted oil, petroleum resin and detachment preventing agent were mixed in a homomixer to give the inclusion rates shown for Examples 1-3 and Comparative Examples 1-3 in Table 1, and after holding at
30 about 195°C, and the hydrogenated thermoplastic elastomer and detachment preventing agent were added. The mixture was stirred for 3 hours at a revolution speed of 3500 rpm, in the homomixer. The quantity produced at this time

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was 1.8 kg. Then, the prepared asphalt and aggregate were mixed at 140°C, and the given test pieces were moulded (compacted) at 115°C, and submitted to testing.

5 From the examples and comparative examples the present invention was judged to offer the desired action and effect when penetration was upwards of 50 (1/10 cm), viscosity at 180°C was no more than 270 mPa.s, and DS value was at least 800.

10 In Comparative Example 1 the proportion of hydrogenated thermoplastic elastomer 1 in the hydrogenated thermoplastic elastomer as a whole was 50 wt%. With this Comparative Example 1, viscosity at 180°C was more than 270 mPa.s, and mixing was inadequate for making practical test pieces and moulding was impossible, 15 so that DS value could not be measured.

In Comparative Example 2 the proportion of hydrogenated thermoplastic elastomer 1 in the hydrogenated thermoplastic elastomer as a whole was 33.3 wt%. With this Comparative Example 2, viscosity at 180°C 20 was ideal, at no more than 270 mPa.s; however, DS value was 600 (times/mm) and, therefore, was less than 800 (times/mm).

In Comparative Example 3 the proportion of hydrogenated thermoplastic elastomer 1 in the hydrogenated thermoplastic elastomer as a whole was 16.7 wt%. With this Comparative Example 3, viscosity at 180°C 25 was ideal, at no more than 113 mPa.s; however, DS value was 440 (times/mm), and, therefore, was less than 800 (times/mm).

30 In Examples 1-3, hydrogenated thermoplastic elastomer content and the percentage content of the first hydrogenated thermoplastic elastomer in the hydrogenated thermoplastic elastomer as a whole, etc., were all

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formulated within the ranges stipulated in the present invention.

In Examples 1-3, the proportion of hydrogenated thermoplastic elastomer 1 in the hydrogenated thermoplastic elastomer as a whole decreased gradually from Example 1 to Example 3, 45.8 wt%, 41.7 wt%, 37.5 wt%. By this means, in Examples 1-3, viscosity at 180°C in all cases was no more than 270 mPa.s, and DS value in all cases was at least 800 (times/mm).

This shows that there is a marked difference in effect, especially in DS value, between Comparative example 1, in which the proportion of hydrogenated thermoplastic elastomer 1 in the hydrogenated thermoplastic elastomer as a whole is 50 wt%, and Example 1, in which the proportion of hydrogenated thermoplastic elastomer 1 in the hydrogenated thermoplastic elastomer as a whole is 45.8 wt%. This shows that it has been confirmed experimentally that making the proportion of hydrogenated thermoplastic elastomer 1 in the hydrogenated thermoplastic elastomer as a whole no more than 49 wt%, gives superior properties for both DS value and softening point.

In addition, it shows that there is a marked difference in effect, especially in DS value, between Comparative Example 2 in which the proportion of hydrogenated thermoplastic elastomer 1 in the hydrogenated thermoplastic elastomer as a whole is 33.3 wt%, and Example 3, in which the proportion of hydrogenated thermoplastic elastomer 1 in the hydrogenated thermoplastic elastomer as a whole is 37.5 wt%. This shows that it has been confirmed experimentally that making the proportion of hydrogenated thermoplastic elastomer 1 in the hydrogenated thermoplastic elastomer

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as a whole at least 34 wt% gives superior properties for both DS value and softening point.

Thus it has been possible to confirm experimentally that with the present invention, by mixing a first
5 hydrogenated thermoplastic elastomer which has a 10% toluene solution viscosity at 25°C in the range from 1000 to 2500 mPa.s and a second hydrogenated thermoplastic elastomer which has a 10% toluene solution viscosity at 25°C in the range from 5 to 50 mPa.s, in specified
10 proportions, both softening point and DS value show outstanding properties.

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C L A I M S

1. Binder composition which can be coloured,
characterized in that it comprises

a petroleum solvent-extracted oil,
a petroleum resin,

5 from 4 to 8 wt% hydrogenated thermoplastic elastomer
formed by mixing a first hydrogenated thermoplastic
elastomer which has a 10% toluene solution viscosity at
25°C in the range from 1000 to 2500 mPa.s, and a second
hydrogenated thermoplastic elastomer which has a 10%
10 toluene solution viscosity at 25°C in the range from 5 to
50 mPa.s, and

from 0.3 to 2 wt% of a detachment preventing agent,
wherein the content of the first hydrogenated
thermoplastic elastomer in the hydrogenated thermoplastic
15 elastomer is from 34 to 49 wt%.

2. Binder composition which can be coloured, according
to claim 1, characterized in that the first hydrogenated
thermoplastic elastomer has a 10% toluene solution
viscosity at 25°C in the range from 1400 to 20000 mPa.s,
20 the second hydrogenated thermoplastic elastomer has a 10%
toluene solution viscosity at 25°C in the range from 10
to 40 mPa.s, and the content of the first hydrogenated
thermoplastic elastomer in the thermoplastic elastomer is
from 37 to 46%.

25 3. Binder composition which can be coloured, according
to claim 1 or 2, characterized in that it comprises from
5 to 7 wt% of the hydrogenated thermoplastic elastomer.

4. Binder composition which can be coloured, according
to any preceding claim, wherein the first hydrogenated
30 thermoplastic elastomer is a styrene-ethylene-butylene-

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styrene block copolymer or a styrene-ethylene-propylene-styrene block copolymer, and the second hydrogenated thermoplastic elastomer is a styrene-ethylene-butylene-styrene block copolymer or a styrene-ethylene-propylene-styrene block copolymer.

5

5. Binder composition according to any preceding claim, wherein the detachment preventing agent is a dimer acid or a resin acid.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/077533

A. CLASSIFICATION OF SUBJECT MATTER
INV. C08L95/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C08L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2004/096915 A1 (KRATON POLYMERS RES BV [NL]; TROMMELEN ERIK A T [NL]; DAMEN JAQUES W M) 11 November 2004 (2004-11-11) claims; examples paragraph [0025]	1-5
A	US 2005/107521 A1 (SASAGAWA MASAHIRO [JP] ET AL) 19 May 2005 (2005-05-19) claims; examples	1-5



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

26 May 2014

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/077533

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