(19) Octrooicentrum Nederland

(11) 2012307

(12) C OCTROOI

(21) Aanvraagnummer: **2012307**

(22) Aanvraag ingediend: **21.02.2014**

(51) Int.Cl.:
C09D 195/00 (2006.01) ***C09J 195/00*** (2006.01)
E01C 7/18 (2006.01) ***E01C 9/00*** (2006.01)
E01C 11/00 (2006.01) ***E01C 19/00*** (2006.01)
C08L 95/00 (2006.01)

(43) Aanvraag gepubliceerd:
-

(47) Octrooi verleend:
25.08.2015

(45) Octrooischrift uitgegeven:
02.09.2015

(73) Octrooihouder(s):
Koninklijke BAM Groep N.V. te Bunnik.

(72) Uitvinder(s):
Marinus Huurman te Utrecht.
Cornelis M.A. van den Beemt te Utrecht.
Milliyon Fekade Woldekidan te Utrecht.

(74) Gemachtigde:
ir. H.V. Mertens c.s. te Rijswijk.

(54) **Asphalt composition and process for preparing such a composition.**

(57) An asphalt composition comprises a bituminous binder material and solid particles composed of aggregates and elastic particles, having a maximum particle size of at most 2.8 mm, and which solid particles are gap-graded, wherein the upper limit of the gap is bigger than the maximum particle size of the elastic particles, and wherein the aggregates include particles with particle sizes above the upper limit of the gap. It can be prepared in a process wherein the bituminous binder material is heated to an elevated temperature;
the heated bituminous binder material at elevated temperature is passed to an expansion chamber;
water is passed to the expansion chamber to contact the heated bituminous binder material to form steam, thereby forming foamed bitumen; and
the foamed bitumen is combined with the gap-graded solid particles yielding an asphalt composition.

NL C 2012307

ASPHALT COMPOSITION AND PROCESS FOR PREPARING SUCH A COMPOSITION

The present invention relates to an asphalt composition and a process for preparing such a composition. The invention also relates to a mastic composition that can be used in the preparation of the asphalt composition and to a road surface comprising such an asphalt composition.

Asphalt compositions, sometimes also called asphalt concrete, comprise bitumen-containing bituminous binder material and aggregates. The binder material can be bitumen, but it may also contain polymers and other organic material to provide a good adhesion of the binder material to the aggregates. The aggregates are typically mineral aggregates, such as fine filler, sand, gravel or optionally ground stones. The asphalt compositions are commonly used in the preparation of road surfaces.

Bitumen is a dark-coloured solid or viscous liquid that occurs in nature or is obtained as a residue in petroleum refining. It is a mixture of paraffinic and aromatic hydrocarbons and heterocyclic compounds containing sulphur, nitrogen and oxygen. It tends to be soluble in carbon disulfide and trichloroethylene. It softens when it is heated. With filler and aggregates it forms asphalt. Bitumen may be modified to alter its properties. Polymers may be used to modify bitumen. Known polymers that are used for this purpose include natural rubber, styrene-butadiene rubber (SBR), styrene-butadiene-styrene block copolymer (SBS) and ethylene vinyl acetate copolymer (EVA). Also crumb rubber, i.e. recycled rubber from automotive and truck scrap tires, may be used to modify the properties of bitumen. When filler, i.e. aggregates with a particle size of smaller than about 63 μm, is combined with bitumen, mortar is obtained. When sand, i.e. aggregates with a particle size ranging from about 63 μm to about 2 mm, is added to bitumen mortar mastic, or in short mastic, is obtained.

Asphalt compositions for road applications are to fulfil a number of requirements. Evidently, the road surface should have a satisfactory durability or life expectancy. One of the requirements that has a growing interest is the noise performance of the road surface. Dense asphalt concrete is frequently used as road surface. The traffic noise on this type of road surfaces have become a subject of study in view of the unacceptable level of noise, especially in densely populated areas. Dense asphalt concrete tends to be very durable. In a dense asphalt concrete aggregates with a variety of particle sizes are present such that the resulting construction of aggregates and bituminous binder have a low amount of voids.
In porous asphalt compositions, the proportion of relatively large aggregates is higher so that the voids are less filled by small aggregates. The porous asphalt compositions have as advantage the excellent drainage performance for rain. Further, the obtained voids absorb traffic noise well. The highest noise reduction is obtained when road surfaces are porous,

flexible and have a fine surface texture. Porosity can be obtained by use of a gap-graded mineral fraction, implying that mineral particles, i.e. aggregates or fillers, with a certain size are largely absent. The mineral particles having sizes that are above the gap will form a granular skeleton. This skeleton provides stability to the mixture. The minerals with particles sizes that are below the gap, have a larger specific surface than the minerals in the skeleton. As a result, when minerals are mixed with the bituminous binder most of the binder will adhere to the particles that are below the gap, to form mastic. The mastic in these mixtures will bind the particles in the skeleton to form porous asphalt. The surface texture is controlled by selection of the mineral grading.

In an alternative investigation it was found that when a bituminous binder material was modified with a polymer, the bitumen properties could be altered, and the life expectancy could be prolonged. Therefore, several studies were undertaken to investigate whether the addition of polymers to the bituminous binder would have an effect on the life expectancy of road surfaces that have a good noise reducing performance. Polymer-modified bitumen is used as the binder for producing porous open-textured asphalt. The polymer can be a rubber, for example styrene butadiene rubbers or ground tire rubber. In the preparation of this polymer-modified bitumen small droplets or particles of polymer material are mixed with the heated bitumen under severe stirring such that the polymer melts in the heated bitumen and a completely homogeneous mixture is obtained.

An example of the preparation of a polymer-modified bitumen is provided by WO 2011/074003. This document discloses a modified bitumen composition that comprises bitumen, a minor amount of crumb rubber, a small amount of FCC spent catalyst and optionally another low-value polymer. The ingredients are mixed at elevated temperature whilst homogenizing, to yield a modified bituminous binder. The polymer-modified bitumen tends to be very cohesive and relatively flexible.

The use of polymer-modified bitumen enables the design of a very porous asphalt mixture with a high effective void percentage. The resulting road surface shows a reasonably good acoustic performance.

An alternative method for obtaining good noise performance can be obtained by using layered porous asphalt. In this case a porous asphalt composition with relatively uniform but large aggregates is used as the lower layer, providing large voids for excellent drainage performance. On top of the layer with large aggregates, a layer of smaller aggregates with a uniform particle size is placed. The resulting road surface with these two layers yield an improved noise reduction, that is mainly due to the fine texture of the upper layer which incurs less noise caused by tires etc., and the increased thickness of the two layers which provide a better noise absorption.

So-called Poro-Elastic Road Surfaces (PERS) show very good noise reducing properties. In PERS mineral aggregates are completely or partially replaced by much softer particles, often obtained from scrap tires. The binder in PERS mixtures is a synthetic polymer binder, such as polyurethane. An example of such a road pavement is described in US 2004/0044104. According to this US patent application, waste rubber particles with a size of 2 to 8 mm were mixed with an epoxy or urethane binder material and with stone aggregates having particles sizes in the range of less than 0.5 mm to about 30 mm. The resulting mixture was used as elastic top coat on a pavement surface. The specification teaches that when the size of the waste rubber particles is below 1 mm, the elasticity is insufficient and the noise reduction is unsatisfactory. When the particle sizes are 10 mm or bigger, the durability of the pavement is too low.

In addition to the high costs of such a pavement due to the use of expensive binder material, the workability of the mixture is also short. Owing to the curing time of the polyurethane or epoxy polymers, the workability time is limited, say in the order of 10 to 30 minutes. This is often regarded as too short for road surface manufacture. Further, it appeared that such pavements have a very short life expectancy.

Another proposed solution to obtain a high level of noise reduction on pavements is described in JP 2007-154539. According to this application an elastic paving material, comprising bitumen and an ethylene vinyl acetate copolymer as binder, aggregate, and rubber chips or rubber powder, is used to fill the voids of a porous pavement. However, by filling the voids, the drainage performance is reduced and thereby the reduction of the voids content tends to increase the noise level. Hence, this solution is also unsatisfactory and does not add any advantage over the teachings of US 2004/0044104.

Further it has been found that the life expectancy of PERS remains too short for practical application. Failure mechanisms that are reported for current day PERS focus on:

- durability, i.e. disintegration of the material under the influence of weather and traffic;
- delaminating, i.e. the adhesion between the PERS and the bituminous asphalt underlying structure is lost; and
- skid resistance, i.e. especially in wet conditions the rubber particles of PERS provides limited skid resistance.

Therefore, it is an objective of the present invention to obtain an asphalt composition having a proper balance between the noise-reducing performance on the one hand and not having the delamination and disintegration properties of PERS. It has now surprisingly been found that such a proper balance can be obtained when the asphalt composition contains a bituminous binder and gap-graded solid particles composed of elastic particles and aggregates.

Accordingly, the present invention provides an asphalt composition comprising a bituminous binder material and solid particles composed of mineral aggregates and elastic particles, which asphalt composition comprises elastic particles having a maximum particle size of at most 2.8 mm, and which solid particles are gap-graded, wherein the upper limit of the gap is bigger than the maximum particle size of the elastic particles, and wherein the aggregates include particles with particle sizes above the upper limit of the gap.

Due to the gap-graded solid particles and to the aggregates with sizes above the upper limit of the gap, porosity is introduced into the road surface that is produced from the asphalt composition. This has a positive effect on the noise performance of such road surface. The aggregates are bound to each other by means of the mastic that comprises the bituminous binder material and the fine particles, i.e. aggregates with a size of 2.8 mm or less and the elastic particles.

The elastic particles introduce elasticity into the mastic. Elasticity is the tendency of solid materials to substantially return to their original shape after being deformed. Solid objects will deform when forces are applied on them. If the material is elastic, the object will return to its initial shape and size when these forces are removed. Hereto the solid fraction with sizes below the gap comprise softer particles as a complete or partial replacement for mineral aggregates. These softer particles may act as bumper material that is present between the skeleton formed by the larger aggregates. As a result the PERS related problems with respect to skid resistance are overcome. This is because the fraction above the gap is formed by mineral aggregate particles as applied in existing porous asphalt.

Due to the use of a bituminous binder the delamination and disintegration properties of PERS using polyurethane or epoxy polymers do not occur. This has a positive effect on the durability and life expectancy of the resulting road surface.

The elastic particles may be formed from any material that has a lower stiffness than the mineral aggregates, stiffness being the extent to which a body resists deformation in response to an applied force. The elastic particles in the present invention are in the form of distinct particles, suitably having a particle size of 2 μm to 2.8 mm, more preferably from 63 μm to 2 mm. Suitably, the solid particles do not contain elastic particles with a size above the upper limit of the gap. Preferably, the elastic particles are elastic polymer particles that comprise an elastomer material.

It is emphasized that the elastic polymer particles that are preferably present in the asphalt composition of the present invention, are present in a different shape from the polymers that are present in polymer-modified bitumen compositions. In the latter compositions, polymers are heated and homogenised so that a homogeneous mixture of polymer and bitumen is obtained. The polymer chains form a matrix for the bitumen molecules and in this way alter the properties of the bitumen binder. In contrast therewith, the elastic polymer particles in the present invention are in the form of distinct particles, suitably having a particle size of 2 μm to 2.8 mm, more preferably from 63 μm to 2 mm. The skilled person will understand what is meant by gap-graded solid particles. This term refers to solid particles having a particle size distribution that is characterized by gap-grading, gap-grading being defined as particle size distribution for the solid particles wherein particles of certain sizes are substantially absent. The particle sizes that are absent, form the gap, and the gap is characterized by a lower and an upper limit. For the present invention the upper limit of the gap is bigger than the maximum size of the polymer particles, which thus may be bigger than 2.8 mm. By increasing the difference between the upper limit of the gap and the maximum size of the polymer particles the voids become larger, so that the drainage performance of the asphalt composition and its noise-reduction performance improve. Therefore, the upper limit of the gap and the maximum particle size of the polymer particles is selected such that their difference is preferably from 1 to 5 mm, more preferably, from 2 to 4 mm. Also included are embodiments wherein the lower limit of the gap is bigger than the maximum size of the elastic particles, e.g. at least one millimetre bigger. More preferably, the grading is such that the lower limit of the gap is at least equal to the maximum size of the elastic particles. In this way, the resulting asphalt composition lacks a certain grade of aggregates which facilitates the formation of voids and at the same time the elastic particles can easily be taken up in the bituminous binder and provide the mastic to bind the larger aggregates that form a skeleton, as described above.

The asphalt composition according to the present invention yields a road surface comprising the asphalt composition according to the present invention, wherein the aggregates are bound by means of the bituminous binder material into which the relatively small elastic, preferably elastic polymer, particles have been incorporated. Since the solid particles are gap-graded, they provide for a level of voids, which is beneficial for the noise reduction. Moreover, since the bituminous binder material contains small elastic particles, these particles function as bumper material that prevents direct contact between the aggregates and at the same time, due to their elasticity, provides resilience between the aggregates. In this way the stiffness and also the mechanical impedance of the road surface is reduced, which has a beneficial effect on the reduction of the noise level. Since a bituminous binder is used and since no use is made of an additional polymer such as a polyurethane, there is no risk of undue disintegration or delamination. The present invention therefore also provides road with such surfaces.

The preferred elastic polymer particles comprise an elastomer material. This material may be similar to those that are known to be included in polymer-modified bitumen compositions. The latter materials may suitably be selected from a variety of rubber types. These rubber types may also be used in the composition according to the present invention. These rubber types include natural rubber, which comprises a polymer of isoprene. Synthetic rubbers include polybutadiene and polychloroprene. Copolymers of conjugated dienes and aromatic vinyl compounds are also suitable. These types include especially block copolymers of styrene and butadiene or styrene and isoprene. Other types of synthetic rubber materials include acrylonitrile-butadiene copolymers (‘nitrile rubber’), copolymers of isoprene and isobutylene (‘butyl rubber’), polysiloxane (‘silicone rubber’), ethylene-propylene-diene (EPDM) rubber, polysulphide rubber. Polyolefins and polyurethanes may also be given elastomer properties. Other elastomer materials may also be used. Examples thereof include polyvinylchloride and poly(meth)acrylates. All these materials may be used in the asphalt composition of the present invention. Some polymers have some preference. Accordingly, the asphalt composition according to the present invention preferably comprises polymer particles comprising an elastomer material, selected from the group consisting of natural rubber, styrene-butadiene copolymers, polychloroprene, nitrile rubber, butyl rubber, polysulphide rubber, polyisoprene, EPDM rubber, silicone rubber, polyurethane rubber, polyolefins rubber, and mixtures thereof.

Although natural rubber and the above-mentioned synthetic polymers are preferred, it is also feasible to use other natural polymeric material. A suitable example is provided by cork particles. These particles are buoyant, elastic and fire resistant. Cork comprises suberin, a rubbery material that consists of a polyaromatic and a polyaliphatic domain. Aromatic monomers include hydroxycinnamic acid and derivatives, and the aliphatic monomers include unsaturated α-hydroxyacids and α,ω-diacids having 18 carbon atoms. Cork is used in concrete and may be used in asphalt compositions according to the present invention.

To give the elastic polymer particles greater durability the elastic polymer particles preferably comprise an elastomer material that has been subjected to crosslinking. The crosslinking may be effected in a variety of ways, dependent on the type of the elastomer. It is well known to crosslink rubber-type materials by vulcanization with sulphur. The vulcanization is especially suitable for elastomer material that has been obtained from the polymerization with at least one diene. Vulcanization of natural rubber, polyisoprene, polybutadiene, styrene butadiene rubber, styrene isoprene copolymers and chloroprene may suitably be effected with sulphur. Suitably, the elastomer material comprises vulcanized natural rubber. For other polymers different crosslinking agents may be used, such as peroxides, metal oxides, quinones or nitrobenzene compounds.

The elastic polymer particles may comprise additional components in order to increase their durability. Such additional components may comprise polymer fibres providing reinforcement to the particles. Carbon, chlorine compounds and metal compounds may also be added to provide additional wear resistance. It is advantageous to employ crumb rubber as polymer particles in the present invention. By crumb rubber is understood ground car and lorry tires, in particular used car and lorry tires. The use thereof has the advantages that the ground tires comprise vulcanized rubber. Tires have commonly been reinforced by means of carbon and fibres. Thus the resulting particles have also a good wear resistance. Moreover, by applying crumb rubber in the present invention, the invention provides a useful destination for waste material.

The bituminous binder material that is used in the asphalt composition according to the present invention comprises bitumen. The bitumen can be selected from a variety of bitumen types. Dependent on the ultimate purpose of the asphalt composition, the skilled person may opt for the selection of a rather soft bitumen, i.e. a bitumen with a high penetration, or a relatively hard bitumen, i.e. a bitumen with a low penetration. Suitable bitumen types include those with a penetration up to 220 dmm, e.g. from 40 to 220 dmm, measured in accordance with EN 1426. When selecting the type of bitumen the skilled person will ensure that the bitumen will allow a relatively low processing temperature. The temperature at which the bitumen will be processed is preferably such that it is below the melting temperature of the elastomer material in the elastic polymer particles. If the temperature would be higher, the elastic polymer particles will be homogenised and more or less be dissolved in the bitumen. The result will be that the eventual asphalt composition will not contain polymer particles, but polymer-modified bitumen binder.

In this context it is observed that the skilled person may also select a polymer-modified bitumen as bituminous binder material, i.e. a binder material that material contains bitumen and, in addition, a polymer that has been homogenized in the binder material. In such a case the bitumen has been modified by the addition of one or more polymers separately from any addition of polymer particles. Such polymers may be elastomers as described above, including styrene butadiene rubber, styrene butadiene block copolymers, linear or star-shaped; styrene isoprene block copolymers, linear or star-shaped, and EPDM rubber. Alternatively thermoplasts may be added, such as, polyvinylchloride, ethylene vinyl acetate; copolymers of ethylene and methyl or butylene (meth)acrylate, polyethylene or atactic polypropylene.

The bituminous binder material may comprise further other materials that are also known in conventional bituminous binders. Such compounds include waxes, heavy oil fractions and plasticizing compounds, such as fatty oils, tallow oil etc. The addition of such compounds may have the purpose of adjusting the resilience properties or thermal properties of the bituminous binder material.

The aggregates in the asphalt composition according to the present invention can be selected from any known mineral aggregates that are known in the art. The aggregates tend to be granular and have a variety of sizes, and thus a variety of diameters. The aggregates may be subdivided in at least three groups; one first group with a diameter of at least 2.8 mm; one second group with a diameter ranging from at most 2.8 mm to 63 μm and a third group having granular particles with a diameter of at most 63 μm. Suitably, the aggregates may be subdivided in three groups; one first group with a diameter of at least 2 mm; one second group with a diameter ranging from at most 2 mm to 63 μm and a third group having granular particles with a diameter of at most 63 μm. The same subdivision may be applied to all solid particles, including the elastic particles. The finer filling material, e.g. having a maximum diameter of 63 μm, may be defined as a formally dosed artificial fines or as a separate form of aggregate. The maximum diameter of the particle size of the aggregates in the first group generally does not exceed 32 mm. Asphalt compositions typically contain aggregates from all three groups. In the asphalt compositions according to the present invention the solid particles are gap-graded. That typically may result in the absence of aggregates with intermediate particle sizes. Suitably, the gap is 1 to 5 mm, preferably 2 to 4 mm. That may result in an asphalt composition that for instance substantially lacks particles within a particle size range of about 2 to about 7 mm, preferably from about 2 to about 2 to 5 or 6 mm. It is emphasised that the lower limit of the gap may be lower, e.g. 1 mm, so that aggregates with a particle size in the range of about 1 to about 5 mm, preferably about 1 to about 4 mm, are substantially absent in the composition according to the present invention. By substantially absent is typically understood that the relative proportion of the substantially absent fraction is present in an amount of at most 10 %vol, preferably 5 %vol, more preferably less than 0.5 vol%, based on the volume of the total aggregates and elastic particles. Such is obtained by employing the sieves for particle selection in accordance with a standard that is customary employed in the field of road pavements. Suitably, aggregates comprise mineral material selected from sand, gravel, crushed stone, slag and ground concrete.

In this context it is observed that the particle sizes in aggregates and thus also for the elastic particles or elastic polymer particles are determined in accordance with the standard that is typically applied in field of road pavements, i.e. EN 12697-2. This standard defines the sieves and the procedures to be used for the various fractions of aggregates.

It is not necessary to use fresh virgin aggregates. From an environmental point of view it is advantageous to use reclaimed asphalt aggregates. In US 3999743 a process for the recycling of reclaimed asphalt aggregates is described wherein reclaimed asphalt lumps are crushed and separated into coarse particles and fine particles, the coarse particles are heated in a hot temperature zone of a drying and heating drum, and the fine particles are heated in a cooler temperature zone of the same drum. The heated coarse and fine particles are combined and may be used in the production of an asphalt composition. A similar process is described in US 4096588. Preferably, the present asphalt composition also contains at least partly reclaimed asphalt aggregates.

In addition to particulate aggregates, the asphalt composition according to the present invention also comprises elastic particles with a maximum particle size of 2.8 mm. That means that at least part of the aggregates of the second and third group has been replaced by elastic particles. It is possible to replace all these aggregates by elastic particles. However, it is not necessary to replace all aggregates of the second and/or third group by elastic particles. The elastic particles are suitably selected from the sizes of the second group only, suitably having a particle size within the range of 63 μm to 2.8 mm. If the elastic particles are smaller than this lower limit, the contribution of the elasticity of the elastic particles is diminished. Suitably, the asphalt composition contains aggregates in all sizes in addition to the polymer particles, with the exception of sizes within the gap. The amount of elastic particles in the present asphalt composition is preferably in the range of 3 to 18 %vol, based on the volume of the bituminous binder material, aggregates and elastic particles. The amount of aggregates is advantageously in the range of 90 to 70 %vol, based on the volume of the bituminous binder material, aggregates and elastic particles. The aggregates suitably include aggregates from all three groups. The relative distribution of the aggregates from these three groups can be determined by the skilled person, i.a. dependent on the desired porosity of the resulting road pavement. As indicated above, the skilled person may choose for the use of rather uniform coarse aggregates if an open porous road surface is desired. Typically, the asphalt composition according to the invention comprises solid particles, composed of mineral aggregates and elastic particles, in the range of 70 to 85 %vol of the first group, 2.5 to 10 %vol of the second group and 2.5 to 7 %vol of the third group, based on the volume of the aggregates and elastic particles, wherein the groups represent the aggregates and elastic particles with a particle size of ≥ 2.8 mm, of 63 μm to 2.8 mm, and of <63 μm, respectively. At least a part of the solid particles in the second group consists of elastic particles. Suitably, the elastic particles comprise 50 to 100 %vol of the second group, based on the volume of the second group. It is also possible to replace mineral aggregates in the third group by elastic particles. Such replacement may also be for 50 to 100 %vol, based on the volume of the third group. It is particularly advantageous to ensure that the second group consist for substantially 100 %vol of elastic particles. The amount of bituminous binder material in the present asphalt composition is preferably in the range of 9 to 17.5 %vol, based on the volume of the bituminous binder material, aggregates and elastic particles.

The present asphalt composition may be prepared in a conventional way.

It is, however, advantageous if the processing temperature is kept relatively low especially when elastic polymer particles are used in order not to melt the elastomer material in the elastic polymer particles. Methods for preparing asphalt compositions at relatively low temperatures are known in the art.

Thus, the aggregates, optionally after drying and heating, may be mixed with heated bitumen and the elastic particles. It is to be ensured that the resultant temperature of the mixture is such that the physical shape of the polymer particles is at least to an extent retained. Therefore the temperature is suitably at most 150 ºC, more preferably in the range from 100 to 145 ºC.

A suitable example of a process for preparing the composition according to the invention is taught in EP 1767581. This patent describes a method for preparing an asphalt mix wherein at a temperature in the range of 75 to 110 ºC foamed bitumen and aggregate material are contacted and mixed, wherein the moisture content of the aggregate material when it is contacted with the foamed bitumen is less than 0.5%wt, based on the mass of the aggregate material. A variation of this method can be applied when the skilled person also adds polymer particles to the aggregate material that is being contacted with the foamed bitumen. Since elastomer material generally will not melt at a temperature in the range of 75 to 110 ºC, this known method can be used for the preparation of the present asphalt composition, also when elastic polymer particles are used. Foamed bitumen may be obtained by the method described in GB 1325916. According to this method water is injected into hot bitumen to obtain a desired open structure and low viscosity.

Thus, a preferred method for producing the asphalt composition according to the present invention uses foamed bitumen. Accordingly, the present invention provides a process for preparing an asphalt composition comprising a bituminous binder material and solid particles composed of aggregates and elastic particles which elastic particles have a maximum particle size of at most 2.8 mm, and which solid particles are gap-graded, wherein the upper limit of the gap is bigger than the maximum particle size of the elastic particles,

in which process the bituminous binder material is heated to an elevated temperature;

the heated bituminous binder material at elevated temperature is passed to an expansion chamber;

water is passed to the expansion chamber to contact the heated bituminous binder material to form steam, thereby forming foamed bitumen; and

the foamed bitumen is combined with the gap-graded solid particles, yielding an asphalt composition.

The bituminous binder material is heated to an elevated temperature. The temperature is selected such that at the prevailing conditions water will evaporate to form steam and thus cause the foaming of the bitumen. Whereas the process is suitably carried out at ambient pressure, the temperature of the bituminous binder material is suitably above the standard boiling point of water. Preferably, the bituminous binder material is heated to a temperature in the range of 125 to 230 ºC, preferably from 150 to 190 ºC.

Although it is possible to heat the water also, it is most cost effective to pass the water to the expansion chamber at ambient temperature, i.e. typically in the range of 15 to 25ºC. The amount of water that is passed to the expansion chamber is suitably such that foaming of the bituminous binder material will be accomplished whereas the remaining amount of water in the foamed bitumen does not get too high. Suitably, the amount of water is in the range of 2 to 4, more preferably from 2.5 to 3%wt, based on the combination of bituminous binder material and water.

The aggregates may comprise material from all three groups, i.e. the aggregates with a particle size of ≥ 2.8 mm, of 63 µm to 2.8 mm, and of <63 µm, respectively. Preferably, the subdivision of the aggregates is according to the particles size of ≥ 2 mm, of 63 µm to 2 mm, and of <63 µm, respectively. The aggregates having a particle size of at least 2.8 mm is suitably heated to a temperature in the range of 100 to 180 ºC. This will allow an easy mixing process when it is brought into contact with the foamed bitumen, which may have a temperature in the range of 60 to 145 ºC, preferably from 75 to 110 ºC. Moreover, this will ensure that the aggregates will be essentially dry so that no additional water is added to the foamed bitumen. The finest fraction may also be heated to the temperature of the more coarse aggregates. However, suitably the finest fraction, i.e. aggregates with a particle size of less than 63 μm, has ambient temperature when it is combined with the foamed bitumen.

The amount of mineral aggregates with a particle size of 63 μm to 2.8 mm, may be small or even be zero. At least a significant part thereof will suitably be taken by the elastic particles. If such mineral aggregates are being used, they may also be heated in the same or similar way like the more coarse aggregates.

The elastic particles are typically not heated. They are suitably at ambient temperature, i.e. at 15 to 25 ºC, combined with the mineral aggregates and foamed bitumen by mixing in an asphalt mixer. Since the temperature of the asphalt mixer will be relatively low, in general not exceeding 145 ºC, the elastic particles essentially retain their shape.

In the process described above, the aggregates are suitably heated. Suitable temperatures of the aggregates are in the range of 100 to 170 ºC. These temperatures ensure that the bituminous binder material can conveniently be mixed with the aggregates.

In the step wherein the foamed bituminous binder material is combined with the solid particles, additional binder material may be added. Such binder material may include additional bitumen or other such as heavy oils, waxes, resinous polymers, fatty oils etc. Especially when the aggregates contain reclaimed aggregates it may be advantageous to add a rejuvenating agent. There is a myriad of products that are presently being used and marketed as rejuvenating agents for recycled road pavement. Such products are generally classified as flux oils, viscosity graded asphalt and a large variety of proprietary formulations. A potential rejuvenating agent is a shale oil modifier. Commonly used are crude oil fractions, preferably having a viscosity of at least 200 cSt at 60 °C, animal oils, vegetable oils and mixtures thereof. The viscosity is determined in accordance with NEN-EN 12595. The use of relatively light crude oil fractions has an environmental drawback in that it evaporates and thus produces hydrocarbonaceous vapours that are undesirable from an environmental point of view. Therefore, the rejuvenating agent is preferably a vegetable oil, more preferably selected from soybean oil, sunflower oil, rapeseed oil, corn oil, peanut oil, olive oil, coconut oil, palm oil, palm kernel oil and mixtures thereof, more preferably palm oil or palm kernel oil. The use of such oils is more sustainable and also shows a low volatility and thus has an long-lasting effect on the bitumen. The present invention also enables the skilled person to prepare the starting suspension of bituminous binder material and elastic particles. Therefore, the present invention also provides a mastic composition, comprising a bituminous binder material and elastic particles, which comprises a suspension of elastic particles having a maximum particle size of 2.8 mm, preferably 2 mm, in the bituminous binder material. Preferably the elastic particles are elastic polymer particles, wherein the polymer particles comprise an elastomer material. This mastic composition differs from known conventional mastic compositions in that it is in the form of a suspension of elastic polymer particles in a bituminous binder. Also when the elastic particles are elastic polymer particles, it is different from a polymer-modified bituminous binder composition in that the polymer-modified bituminous composition comprises homogenized polymer, whereas the mastic composition according to the present invention contains identifiable particles, e.g. polymer particles, in a matrix of bituminous binder. The mastic composition according to the present invention may comprise aggregates in addition to the elastic particles. These aggregates advantageously also have a maximum particle size of at most 2.8 mm, preferably 2 mm. Suitably, the mastic composition comprises a proportion of the polymer particles in the total volume of aggregates and elastic particles in the range of 28 to 65 %vol, based on the volume of the elastic particles, aggregates and bituminous binder. In this way the mastic composition can be used as if it were a conventional mastic composition, whereas the elastic particles will provide the desired elasticity and thus noise reduction, to the eventual road surface.

The amount of bituminous binder material in the mastic composition is preferably from 30 to 75 %vol, based on the volume of the bituminous binder material, elastic particles and, optionally, aggregates. The mastic composition is different from the asphalt composition according to the present invention at least in that the aggregates have a maximum particle size of at most 2.8 mm. Moreover, the mastic composition suitably has a different viscosity from that of the asphalt composition. Suitably, the mastic composition has a viscosity of at least 140 mm^2/s, preferably in the range of 150 to 200 mm^2/s, determined at 20°C according to NEN-EN 12595. The shear modulus determined by means of a dynamic shear rheometer of the mastic composition at 10 ºC is suitably in the range of at most 350 MPa, preferably 100 to 200 MPa at a loading frequency of 100 Hz.

The invention will be further elucidated by means of the following examples.

EXAMPLE

In order to show that the mastic of the asphalt composition according to the invention has a lower stiffness than a similar mastic wherein no elastic material is present, two mastic compositions were prepared. The first mastic composition ("Mastic 1") consists of 22.0 %vol of dust, i.e. mineral aggregates having a particle size below 63 µm, 23.4 %vol of sand, i.e. sand mineral aggregates having a particle size of 63 µm to 2 mm, and 54.6 %vol of a standard penetration grade bitumen, having a penetration of 70/100. The second mastic composition ("Mastic 2") contained the same levels of dust and bitumen but contained 23.4 %vol of recycled rubber crumbs from scrap tires, having a particle size of 63 µm to 2 mm instead of sand.

The shear modulus of the two mastic compositions was determined in a dynamic shear rheometer (DSR). The complex shear modulus is an indicator of the stiffness or resistance of asphalt binder to deformation under load. The tests were carried out at a cylindrical sample having a diameter of 6 mm and a height of 20 mm. These specimens end in 4 mm high steel rings. The steel rings allow the specimens to be clamped into the DSR and effectively reduce the specimen height to 12mm. The cylindrical test sample was put upright and an oscillating torsion load was applied. Hereto the specimen is clamped and fixed at the bottom and loaded by torque applied via the upper ring. Tests are done in the linear visco-elastic range of the material. The shear strain and applied torque was measured. The number of load cycles per second is called the loading frequency. For each loading frequency, the ratio between the applied shear load and the measured shear strain provides the shear modulus of the material. The tests are done at various temperature and frequencies and on the basis of the obtained data a stiffness master curve is constructed which provides a stiffness fingerprint of the tested mastic. At 10 ºC the shear stiffness as listed in table 1 are obtained.

For bituminous materials a higher shear modulus is typically obtained at high loading frequency and at a low loading frequency a lower shear modulus is obtained.

The results of the determinations is shown in Table 1 below.

Table 1

Frequency, Hz	Shear modulus, MPa	
	Mastic 1	Mastic 2
100	719.9	142.3
10	373.7	61.5
1	173.0	22.9

The results show that the shear modulus for Mastic 2 is considerably lower than that of Mastic 1. This provides proof that the mastic composition according to the invention is significantly less stiff than the typical mastic composition. Since the mastic composition provides a binder layer between aggregates in a road surface, the less stiff binder according to the invention shall better absorb the noise that is created by traffic.

CONCLUSIES

1. Asfaltsamenstelling omvattende een bitumineus bindmiddel en vaste deeltjes, samengesteld uit minerale aggregaten en elastische deeltjes, welke asfaltsamenstelling elastische deeltjes met een maximale deeltjesgrootte van ten hoogste 2,8 mm bevat, en welke vaste deeltjes discontinu gegradeerd (gap-graded) zijn, waarbij de bovengrens van de discontinuïteit groter is dan de maximale deeltjesgrootte van de polymeerdeeltjes en waarbij de aggregaten deeltjes met deeltjesgrootte boven de bovengrens van de discontinuïteit omvatten.

2. Asfaltsamenstelling volgens conclusie 1, waarbij de bovengrens van de discontinuïteit en de maximale deeltjesgrootte van de elastische deeltjes zodanig worden gekozen dat het verschil tenminste 1 mm bedraagt.

3. Asfaltsamenstelling volgens conclusie 2, waarbij de ondergrens van de discontinuïteit ten minste gelijk is aan de maximale grootte van de elastische deeltjes.

4. Asfaltsamenstelling volgens een der conclusies 1 tot 3, waarbij de elastische deeltjes elastisch polymeerdeeltjes zijn die een elastomeer materiaal omvatten.

5. Asfaltsamenstelling volgens conclusie 4, waarbij de elastische polymeerdeeltjes een elastomeer materiaal omvatten, gekozen uit de groep bestaande uit natuurrubber , styreen-butadieen copolymeren, polychloropreen, nitrilrubber, butylrubber, polysulfide rubber, polyisopreen, EPDM rubber, siliconen rubber, polyurethaan rubber, polyolefinen rubber en mengsels daarvan .

6. Asfaltsamenstelling volgens conclusie 5, waarbij het elastomeer materiaal gevulkaniseerd natuurlijke rubber omvat.

7. Asfaltsamenstelling volgens een der conclusies 4 tot 6, waarbij de elastische polymeerdeeltjes gemalen rubber omvatten.

8. Asfaltsamenstelling volgens een der conclusies 1 tot 7, waarbij het bitumineuze bindmiddel bitumen met een penetratie van 40 tot 220 dmm, bepaald volgens EN 1426, bevat.

9. Asfaltsamenstelling volgens een der conclusies 1 tot 8, waarbij het bitumineuze bindmiddel bitumen en bovendien een polymeer dat in het bindmiddel gehomogeniseerd is, bevat.

10. Asfaltsamenstelling volgens een der conclusies 1 tot 9, die vaste deeltjes omvat die bestaan uit minerale aggregaten en elastisch deeltjes in het gebied van 70 tot 95 vol% van de eerste groep die vaste deeltjes met een deeltjesgrootte van ≥2,8 mm vertegenwoordigt, van 2,5 tot 15 vol % van de tweede groep die vaste deeltjes met een deeltjesgrootte van 63 µm tot 2 mm vertegenwoordigt, en 2,5 tot 10 vol% van de derde groep die vaste deeltjes met een deeltjesgrootte van <63 µm vertegenwoordigt, waarbij de percentages gebaseerd zijn op het volume van de aggregaten en elastische deeltjes.

11. Asfaltsamenstelling volgens een der conclusies 1 tot 10, waarbij de aggregaten mineraal materiaal gekozen uit zand, grind, steenslag, slakken en gemalen beton, omvatten.

12. Asfaltsamenstelling volgens een der conclusies 1 tot 11, waarbij de aggregaten teruggewonnen asfaltaggregaten omvatten.

13 . Asfaltsamenstelling volgens een der conclusies 1 tot 12, waarbij de hoeveelheid elastische deeltjes in het gebied van 3 tot 18 vol%, betrokken op het volume van het bitumineuze bindmiddel, aggregaten en elastische deeltjes, ligt.

14. Asfaltsamenstelling volgens een der conclusies 1 tot 13, waarbij de hoeveelheid aggregaten in het gebied van 90 tot 70 vol%, betrokken op het volume van het bitumineuze bindmiddel, aggregaten en elastische deeltjes, ligt .

15. Asfaltsamenstelling volgens een der conclusies 1 tot 14, waarbij de hoeveelheid bitumineus bindmiddel in het gebied van 9 tot 17,5 vol %, betrokken op het volume van het bitumineuze bindmiddel, aggregaten en elastische deeltjes, ligt.

16. Werkwijze voor het bereiden van een asfaltsamenstelling die een bitumineus bindmiddel en vaste deeltjes, bestaande uit aggregaten en elastische deeltjes, omvat, welke elastische deeltjes een maximale deeltjesgrootte van ten hoogste 2,8 mm hebben, en welke vaste deeltjes discontinu gegradeerd (gap graded) zijn, waarbij de bovengrens van de discontinuïteit groter is dan de maximale deeltjesgrootte van de elastische deeltjes , en waarbij de aggregaten deeltjes met deeltjesgrootte boven de bovengrens van de discontinuïteit omvatten, in welke werkwijze

het bitumineuze bindmiddel wordt verwarmd tot een verhoogde temperatuur;

het verwarmde bitumineuze bindmiddel bij verhoogde temperatuur naar een expansiekamer wordt geleid;

water naar de expansiekamer wordt geleid om in contact te worden gebracht met het verwarmde bitumineuze bindmiddel om stoom te vormen, waarbij geschuimd bitumen wordt gevormd; en

het geschuimde bitumen wordt gecombineerd met de discontinu gegradeerde vaste deeltjes, waardoor een asfaltsamenstelling wordt verkregen.

17. Werkwijze volgens conclusie 16, waarbij het bitumineuze bindmiddel wordt verwarmd tot een temperatuur van 150 tot 190 °C.

18 . Mastieksamenstelling, omvattende een bitumineus bindmiddel en elastische deeltjes, die een suspensie van elastische deeltjes met een maximale deeltjesgrootte van ten hoogste 2,8 mm in het bitumineuze bindmiddel omvat .

19. Mastieksamenstelling volgens conclusie 18, waarbij de elastische deeltjes elastische polymeerdeeltjes zijn die een elastomeer materiaal omvatten.

20. Mastieksamenstelling volgens conclusie 18 of 19, waarbij de hoeveelheid bitumineus bindmiddel in het gebied van 35 tot 75 vol%, betrokken op het volume van het bitumineuze bindmiddel, elastische deeltjes en aggregaten, indien aanwezig, ligt.

21. Mastieksamenstelling volgens een der conclusies 18 tot 20, die een afschuifmodulus in het gebied van 100 tot 200 MPa heeft, bepaald bij 10 °C in een Dynamic Shear Rheometer bij een belastingsfrequentie van 100 Hz.

22. Wegdek omvattende de asfaltsamenstelling volgens een der conclusies 1 tot 15, waarbij de aggregaten zijn gebonden door middel van het bitumineuze bindmiddel waarin de elastische deeltjes zijn verwerkt.

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	P31811NL00/AZE
Nederlands aanvraag nr. **2012307**	Indieningsdatum **21-02-2014**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **Koninklijke BAM Groep N.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **12-04-2014**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN61797**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

C09D195/00;C09J195/00;E01C7/18;E01C9/00;E01C11/00;E01C19/00;C08L95/00

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC	**C09D;C09J;E01C;C08L**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III.	☐	**GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV.	☐	**GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2012307

A. CLASSIFICATIE VAN HET ONDERWERP
INV. C09D195/00 C09J195/00 E01C7/18 E01C9/00 E01C11/00
E01C19/10 C08L95/00
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
C09D C09J E01C C08L

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)

EPO-Internal, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
T	Feipeng Xiao ET AL: "Laboratory Investigation of Dimensional Changes of Crumb Rubber Reacting with Asphalt Binder", Road Materials and Pavement Design. Volume X - No. X/2006, 1 januari 2006 (2006-01-01), bladzijden 1-21, XP055056634, Gevonden op het Internet: URL:http://www.clemson.edu/ces/arts/Dimensional Changes of Crumb Rubber Binder.pdf [gevonden op 2013-03-14] * figuur 3 * * het gehele document * ----- -/--	

[X] Verdere documenten worden vermeld in het vervolg van vak C.

[X] Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid

13 augustus 2014

Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type

Naam en adres van de instantie

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

1

De bevoegde ambtenaar

olde Scheper, Bernd

Formulier PCT/ISA/201 (tweede blad) (Januari 2004)

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
T	Mark S. Buncher: "Evaluating the Effects of the Wet and Dry Process for Inclusding Crumb Rubber Modifier in Hot Mix Asphalt", Dissertation, 30 augustus 1995 (1995-08-30), bladzijden 1-186, XP055034600, Auburn, Alabama, USA Gevonden op het Internet: URL:http://asphaltrubber.org/ARTIC/RPA_A1059.pdf [gevonden op 2012-08-03] * het gehele document * -----	
T	TONGSHENG ZHANG ET AL: "A new gap-graded particle size distribution and resulting consequences on properties of blended cement", CEMENT AND CONCRETE COMPOSITES, deel 33, nr. 5, 1 mei 2011 (2011-05-01), bladzijden 543-550, XP055064277, ISSN: 0958-9465, DOI: 10.1016/j.cemconcomp.2011.02.013 * figuur 1 * -----	
T	Anonymous: "Aggregate Gradation", Student handout, 11 juni 2014 (2014-06-11), bladzijden 1-31, XP055134130, Gevonden op het Internet: URL:http://www.ce.memphis.edu/3137/Powerpoint Handouts/2 - Aggregate Gradation and Sampling.pdf [gevonden op 2014-08-11] * bladzijde 145 - bladzijde 17 * -----	
T	SHEN D H ET AL: "Properties of gap-aggregate gradation asphalt mixture and permanent deformation", CONSTRUCTION AND BUILDING MATERIALS, ELSEVIER, NETHERLANDS, deel 19, nr. 2, 1 maart 2005 (2005-03-01), bladzijden 147-153, XP027787782, ISSN: 0950-0618 [gevonden op 2005-03-01] * figuren 2,3,4 * ----- -/--	

1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2012307

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	Ulf Sandberg ET AL: "The Poroelastic Road Surface - Results of an Experiment in Stockholm", ForumAcusticum 2005, 1 januari 2005 (2005-01-01), bladzijden 1205-1210, XP055134355, Gevonden op het Internet: URL:http://www.conforg.fr/acoustics2008/cdrom/data/fa2005-budapest/paper/834-0.pdf [gevonden op 2014-08-12]	1-22
Y	* het gehele document *	1-22

X	Ulf Sandberg ET AL: "Tyre/road noise reduction of poroelastic road surface tested in a laboratory", Proceedings of Acoustics 2013 - Victor Harbor, Australia, 20 november 2013 (2013-11-20), bladzijden 1-8, XP055134357, Gevonden op het Internet: URL:http://www.acoustics.asn.au/conference_proceedings/AAS2013/papers/p98.pdf [gevonden op 2014-08-12]	1-22
Y	* het gehele document *	1-22

X	R Go?ebiewski ET AL: "Traffic noise reduction due to the porous road surface", Applied Acoustics 64 (2003) 481-494, 1 januari 2003 (2003-01-01), bladzijden 481-494, XP055134360, Gevonden op het Internet: URL:http://www.sciencedirect.com/science/article/pii/S0003682X0200124X/pdf?md5=dacacc1018615f7c7aae2fa31eb276ac&pid=1-s2.0-S0003682X0200124X-main.pdf [gevonden op 2014-08-12]	1-22
Y	* het gehele document *	1-22

X	A. Von Meier ET AL: "A noise-absorbing road surface made of poroelastic asphaltic concrete (GB-HR-35-01)", , 1 januari 1986 (1986-01-01), bladzijden 1-114, XP055134362, Gevonden op het Internet: URL:http://www.asphaltrubber.org/ARTIC/International/RPA_A1148.pdf [gevonden op 2014-08-12]	1-22
Y	* alinea [4.3.3.1]; tabel 4.8 * * het gehele document *	1-22

X,D	US 2004/044104 A1 (MAEDA MITSUAKI [JP] ET AL) 4 maart 2004 (2004-03-04) in de aanvraag genoemd	1-22
Y	* het gehele document *	1-22

	-/--	

1

Formulier PCT/ISA/201 (vervolg tweede blad) (Januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2012307

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X,D	EP 1 767 581 A1 (KONINK BAM GROEP NV [NL]) 28 maart 2007 (2007-03-28) in de aanvraag genoemd	1-22
Y	* het gehele document *	1-22
X	JENKINS K J: "Mix design considerations for cold and half-warm bituminous mixes with emphasis on foamed bitumen", DISSERTATION SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING, FACULTY OF ENGINEERING, UNIVERSITY OF STELLENBOSCH IN FULFILLMENT FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (ENGINEERING), , 1 september 2000 (2000-09-01), bladzijden I-XVII,1, XP008125845, Gevonden op het Internet: URL:http://www.tudelft.nl/live/ServeBinary?id=f3ab4a9e-2345-4fe9-874f-0e92b59eb89b&binary=/doc/Jerkins+-+Complete+PhD+Jenkins.pdf	1-22
Y	* het gehele document *	1-22
X	F. Olard ET AL: "LOW EMISSION & LOW ENERGY ASPHALTS FOR SUSTAINABLE ROAD CONSTRUCTION: THE EUROPEAN EXPERIENCE OF LEA PROCESS", , 1 januari 2011 (2011-01-01), bladzijden 1-10, XP055078773, Gevonden op het Internet: URL:http://www.aapaq.org/q/2011st/CAPSA2011/FA1_05_107_1111.pdf [gevonden op 2013-09-11]	1-22
Y	* het gehele document *	1-22
X	PASQUINI E ET AL: "Performance evaluation of gap graded Asphalt Rubber mixtures", CONSTRUCTION AND BUILDING MATERIALS, ELSEVIER, NETHERLANDS, deel 25, nr. 4, 1 april 2011 (2011-04-01), bladzijden 2014-2022, XP027581632, ISSN: 0950-0618 [gevonden op 2010-12-31]	1-22
Y	* tabellen 1,2 * * het gehele document *	1-22
X,D	WO 2011/074003 A2 (BHARAT PETROLEUM CORP LTD [IN]; SAHA BISWANATH [IN]; MAHESHWARI SONAL) 23 juni 2011 (2011-06-23) in de aanvraag genoemd	18-22
Y	* het gehele document *	1-22

-/--

1

Formulier PCT/ISA/201 (vervolg tweede blad) (Januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2012307

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
T	Julien Buisson ET AL: "The Mastic Asphalt Industry - A Global Perspective The Mastic Asphalt Industry - A Global Perspective", , 1 november 2010 (2010-11-01), bladzijden 1-29, XP055117933, Gevonden op het Internet: URL:http://www.mastic-asphalt.eu/fileadmin/user_upload/pdf/Health___Safety/EMAA_global_perspective_mastic_asphalt.pdf [gevonden op 2014-05-14]	
	* bladzijde 3 *	

X	Nils Ulmgren ET AL: "Quiet City Transport, Vehicle/Infrastructure interface related noise, Refine and optimize the road surface, D3.18 Studies of poroelastic road surfaces in a lab-scale. (TIP4-CT-2005-516420)", Project funded by the European Community under the SIXTH FRAMEWORK PROGRAMME PRIORITY 6 Sustainable development, global change & ecosystems, 15 februari 2006 (2006-02-15), bladzijden 1-64, XP055134373, Gevonden op het Internet: URL:http://www.qcity.org/downloads/SP3/D3-18_NCC_12M.pdf [gevonden op 2014-08-12]	1-22
Y	* het gehele document *	1-22

X	BAOSHAN HUANG ET AL: "Louisiana Experience with Crumb Rubber-Modified Hot-Mix Asphalt Pavement", TRANSPORTATION RESEARCH RECORD, deel 1789, nr. 1, 1 januari 2002 (2002-01-01), bladzijden 1-13, XP055134402, ISSN: 0361-1981, DOI: 10.3141/1789-01	1-22
Y	* het gehele document *	1-22

X	Anonymous: "Crumb Rubber Modifier, Workshop Notes", , 1 januari 1993 (1993-01-01), bladzijden 1-295, XP055031446, Gevonden op het Internet: URL:http://isddc.dot.gov/OLPFiles/FHWA/013377.pdf [gevonden op 2012-07-02]	1-22
Y	* het gehele document *	1-22

	-/--	

1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2012307

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	Anonymous: "The Double Barrel Aggregate Dryer/Drum Mixer", , 12 augustus 2010 (2010-08-12), bladzijden 1-20, XP055134416, Gevonden op het Internet: URL:http://www.astecinc.com/images/file/literature/Astec_Double_Barrel.pdf [gevonden op 2014-08-12]	18-21
Y	* bladzijden 7,15 *	1-22

1

Formulier PCT/ISA/201 (vervolg tweede blad) (Januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2012307

In het rapport genoemd octrooigeschrift		Datum van publicatie	Overeenkomend(e) geschrift(en)			Datum van publicatie
US 2004044104	A1	04-03-2004	US	2004044104	A1	04-03-2004
			WO	02053839	A1	11-07-2002
EP 1767581	A1	28-03-2007	AT	541897	T	15-02-2012
			DK	1767581	T3	07-05-2012
			EP	1767581	A1	28-03-2007
			NL	1030039	C2	27-03-2007
			PL	1767581	T3	31-07-2012
WO 2011074003	A2	23-06-2011	GEEN			

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN61797	21.02.2014		NL2012307

International Patent Classification (IPC)
INV. C09D195/00 C09J195/00 E01C7/18 E01C9/00 E01C11/00 E01C19/10 C08L95/00
Applicant
Koninklijke BAM Groep N.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I — Basis of the opinion
- ☐ Box No. II — Priority
- ☐ Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV — Lack of unity of invention
- ☒ Box No. V — Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI — Certain documents cited
- ☐ Box No. VII — Certain defects in the application
- ☒ Box No. VIII — Certain observations on the application

	Examiner
	olde Scheper, Bernd

Form NL237A (Dekblad) (July 2006)

Application number
NL2012307

WRITTEN OPINION

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   - ☐ a sequence listing
   - ☐ table(s) related to the sequence listing

   b. format of material:

   - ☐ on paper
   - ☐ in electronic form

   c. time of filing/furnishing:

   - ☐ contained in the application as filed.
   - ☐ filed together with the application in electronic form.
   - ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	16, 17
	No:	Claims	1-15, 18-22
Inventive step	Yes:	Claims	
	No:	Claims	1-22
Industrial applicability	Yes:	Claims	1-22
	No:	Claims	

2. Citations and explanations

   see separate sheet

WRITTEN OPINION

Box No. VIII Certain observations on the application

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1 Feipeng Xiao ET AL: "Laboratory Investigation of Dimensional Changes of Crumb Rubber Reacting with Asphalt Binder",
Road Materials and Pavement Design. Volume X - No. X/2006, 1 januari 2006 (2006-01-01), bladzijden 1-21, XP055056634,
Gevonden op het Internet:
URL:http://www.clemson.edu/ces/arts/Dimensional Changes of Crumb Rubber Binder.pdf
[gevonden op 2013-03-14]

D2 Mark S. Buncher: "Evaluating the Effects of the Wet and Dry Process for Inclusding Crumb Rubber Modifier in Hot Mix Asphalt",
Dissertation, 30 augustus 1995 (1995-08-30), bladzijden 1-186, XP055034600,
Auburn, Alabama, USA
Gevonden op het Internet:
URL:http://asphaltrubber.org/ARTIC/RPA_A1059.pdf
[gevonden op 2012-08-03]

D3 TONGSHENG ZHANG ET AL: "A new gap-graded particle size distribution and resulting consequences on properties of blended cement",
CEMENT AND CONCRETE COMPOSITES,
deel 33, nr. 5, 1 mei 2011 (2011-05-01), bladzijden 543-550, XP055064277,
ISSN: 0958-9465, DOI: 10.1016/j.cemconcomp.2011.02.013

D4 Anonymous: "Aggregate Gradation",
Student handout, 11 juni 2014 (2014-06-11), bladzijden 1-31, XP055134130,
Gevonden op het Internet:
URL:http://www.ce.memphis.edu/3137/Powerpoint Handouts/2 - Aggregate Gradation and Sampling.pdf
[gevonden op 2014-08-11]

D5 SHEN D H ET AL: "Properties of gap-aggregate gradation asphalt mixture and permanent deformation",
CONSTRUCTION AND BUILDING MATERIALS, ELSEVIER,

NETHERLANDS,
deel 19, nr. 2, 1 maart 2005 (2005-03-01), bladzijden 147-153,
XP027787782,
ISSN: 0950-0618
[gevonden op 2005-03-01]

D6 Ulf Sandberg ET AL: "The Poroelastic Road Surface - Results of an Experiment in Stockholm",
ForumAcusticum 2005, 1 januari 2005 (2005-01-01), bladzijden 1205-1210, XP055134355,
Gevonden op het Internet:
URL:http://www.conforg.fr/acoustics2008/cdrom/data/fa2005-budapest/paper/834-0.pdf
[gevonden op 2014-08-12]

D7 Ulf Sandberg ET AL: "Tyre/road noise reduction of poroelastic road surface tested in a laboratory",
Proceedings of Acoustics 2013 - Victor Harbor, Australia, 20 november 2013 (2013-11-20), bladzijden 1-8, XP055134357,
Gevonden op het Internet:
URL:http://www.acoustics.asn.au/conference_proceedings/AAS2013/papers/p98.pdf
[gevonden op 2014-08-12]

D8 R Go?ebiewski ET AL: "Traffic noise reduction due to the porous road surface",
Applied Acoustics 64 (2003) 481-494, 1 januari 2003 (2003-01-01), bladzijden 481-494, XP055134360,
Gevonden op het Internet:
URL:http://www.sciencedirect.com/science/article/pii/S0003682X0200124X/pdf?md5=dacacc1018615f7c7aae2fa31eb276ac&pid=1-s2.0-S0003682X0200124X-main.pdf
[gevonden op 2014-08-12]

D9 A. Von Meier ET AL: "A noise-absorbing road surface made of poroelastic asphaltic concrete (GB-HR-35-01)",
, 1 januari 1986 (1986-01-01), bladzijden 1-114, XP055134362,
Gevonden op het Internet:
URL:http://www.asphaltrubber.org/ARTIC/International/RPA_A1148.pdf
[gevonden op 2014-08-12]

D10 US 2004/044104 A1 (MAEDA MITSUAKI [JP] ET AL) 4 maart 2004 (2004-03-04)in de aanvraag genoemd

D11 EP 1 767 581 A1 (KONINK BAM GROEP NV [NL]) 28 maart 2007 (2007-03-28)in de aanvraag genoemd

D12 JENKINS K J: "Mix design considerations for cold and half-warm bituminous mixes with emphasis on foamed bitumen",
DISSERTATION SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING, FACULTY OF ENGINEERING, UNIVERSITY OF STELLENBOSCH IN FULFILLMENT FOR THE DEGREE OF DOCTOR OF PHILOSOPHY (ENGINEERING),
, 1 september 2000 (2000-09-01), bladzijden I-XVII,1, XP008125845,
Gevonden op het Internet:
URL:http://www.tudelft.nl/live/ServeBinary?id=f3ab4a9e-2345-4fe9-874f-0e92b59eb89b&binary=/doc/Jerkins+-+Complete+PhD+Jenkins.pdf

D13 F. Olard ET AL: "LOW EMISSION & LOW ENERGY ASPHALTS FOR SUSTAINABLE ROAD CONSTRUCTION: THE EUROPEAN EXPERIENCE OF LEA PROCESS",
, 1 januari 2011 (2011-01-01), bladzijden 1-10, XP055078773,
Gevonden op het Internet:
URL:http://www.aapaq.org/q/2011st/CAPSA2011/FA1_05_107_1111.pdf
[gevonden op 2013-09-11]

D14 PASQUINI E ET AL: "Performance evaluation of gap graded Asphalt Rubber mixtures",
CONSTRUCTION AND BUILDING MATERIALS, ELSEVIER, NETHERLANDS,
deel 25, nr. 4, 1 april 2011 (2011-04-01), bladzijden 2014-2022, XP027581632,
ISSN: 0950-0618
[gevonden op 2010-12-31]

D15 WO 2011/074003 A2 (BHARAT PETROLEUM CORP LTD [IN]; SAHA BISWANATH [IN]; MAHESHWARI SONAL) 23 juni 2011 (2011-06-23)in de aanvraag genoemd

D16 Julien Buisson ET AL: "The Mastic Asphalt Industry - A Global Perspective The Mastic Asphalt Industry - A Global Perspective", , 1 november 2010 (2010-11-01), bladzijden 1-29, XP055117933,
Gevonden op het Internet:
URL:http://www.mastic-asphalt.eu/fileadmin/user_upload/pdf/Health___Safety/EMAA_global_perspective_mastic_asphalt.pdf
[gevonden op 2014-05-14]

D17 Nils Ulmgren ET AL: "Quiet City Transport, Vehicle/Infrastructure interface related noise, Refine and optimize the road surface, D3.18 Studies of poroelastic road surfaces in a lab-scale. (TIP4-CT-2005-516420)", Project funded by the European Community under the SIXTH FRAMEWORK PROGRAMME PRIORITY 6 Sustainable development, global change & ecosystems, 15 februari 2006 (2006-02-15), bladzijden 1-64, XP055134373,
Gevonden op het Internet:
URL:http://www.qcity.org/downloads/SP3/D3-18_NCC_12M.pdf
[gevonden op 2014-08-12]

D18 BAOSHAN HUANG ET AL: "Louisiana Experience with Crumb Rubber-Modified Hot-Mix Asphalt Pavement",
TRANSPORTATION RESEARCH RECORD,
deel 1789, nr. 1, 1 januari 2002 (2002-01-01), bladzijden 1-13, XP055134402,
ISSN: 0361-1981, DOI: 10.3141/1789-01

D19 Anonymous: "Crumb Rubber Modifier, Workshop Notes", , 1 januari 1993 (1993-01-01), bladzijden 1-295, XP055031446,
Gevonden op het Internet:
URL:http://isddc.dot.gov/OLPFiles/FHWA/013377.pdf
[gevonden op 2012-07-02]

D20 Anonymous: "The Double Barrel Aggregate Dryer/Drum Mixer", , 12 augustus 2010 (2010-08-12), bladzijden 1-20, XP055134416,
Gevonden op het Internet:
URL:http://www.astecinc.com/images/file/literature/Astec_Double_Barrel.pdf
[gevonden op 2014-08-12]

Explicit reference is made to Item VIII below.

1 The present application relates to:

1.1 an asphalt composition (see claims 1-15),

1.2 a method for the preparation of an asphalt composition (see claims 15-17),

1.3 a mastic composition (see claims 18-21), and

1.4 a road surface comprising an asphalt composition according to claims 1-15 (see claim 22).

The present application encompasses therefore 4 independent claims, i.e. claims 1, 16, 18 and 22.

2 It is not apparent what the applicant believes to be his invention. The present application lacks unity, clarity, disclosure and support in the description, apart from lack of novelty and inventive step. The skilled worker is therefore not in the position to appreciate the claimed invention and put it into context of the prior art.

3 On page 3, lines 29-34 an object has been defined which also refers to the previous paragraph (i.e. lines 22-28). The application as filed does not contain any indication or pointers that said object is somehow achieved (1) at all, or (2) in relation with one or more features identified in the claims.

4 The examples of the present application are not helpful either, on the contrary, they merely teach what the skilled worker already knows:

4.1 First of all it must be noted that no indication is provided how the mastic compositions are obtained; i.e. according to which process?

4.2 Stiff, hard particles (i.e. sand) are replaced by elastic particles (i.e. crumb rubber). Based upon basic common knowledge on dynamic shear measurements, the skilled worker would expect a dramatic drop in shear modulus, since 23.4 vol.%(!) of sand is replaced by 23.4 vol.% of rubber.

In addition:

4.3 The interactions of crumb rubber with asphalt/bitumen is well known and published in readily available patent and scientific literature of which D1 and D2 are mere examples.

These documents teach clearly various aspects, like dimensions, grading, grap-grading, mixing conditions and mixing time. Said aspects have an influence on the shear modulus measurement and consequently on the obtained result.

4.4 Grading and gap-grading in relation to asphalt pavements containing crumb rubber is disclosed in for instance D18 and D19.

4.5 The application as filed does not contain any indications or pointers what the technical meaning is of the maximum particle size, the influence of particles being gap-graded and how strict (i.e the "upper-limit" requirements) said gap-grading should be, etc.

It is to be noted that said indicated features are mandatory features of the claimed invention.

4.6 Independent claim 18 defines a "suspension" of elastic particles, which suggests that there is no interaction between the elastic particles and the asphalt/bitumen.

5 Clarity and interpretation of the claims

5.1 Independent claim 1 defines "solid particles" as a mixture of mineral aggregates and elastic particles". However, the maximum particle size of 2,8 mm is related to the asphalt composition ("...welke asphaltsamenstelling....") and not to the elastic particles. This suggests that the asphalt composition contains other "elastic particles", rendering the claims unclear.

5.2 Said claim also defines that the solid particles are gap-graded. The description suggest that the skilled person understands gap-grading (see page 4, lines 35-36).

5.2.1 Document D3 indicates gap-grading and shows in Figure 1 horizontal lines indicating gaps. It appears from this disclosure that the skilled person would be in the position to identify a maximum particle size for a certain particle range as well as the width of the gap.

5.2.2 Document D4 shows another picture in the graphs on pages 15 and 16. There is only a reduced "flattening" visible without identifiable begin and end points.

5.2.3 Document D5 shows that identifiable "gaps" (i.e "horizontal" lines) can be obtained if sieve sizes are omitted (see Figures 2-4). This is definitely neither disclosed in the description nor in the claims.

5.2.4 Dependent claims 2-4 and 10 are obscure and unclear as a direct consequence.

5.2.5 It is not apparent from the application what the skilled person should understand (see page 4, lines 35-36).

5.2.6 The description is completely obscure (see page 4, line 35 to page 5, line 15 and page 8, lines 2-15) and the applicant should clarify how this translates into embodiments the skilled worker could repeat.

5.3 Claim 1 also defines that the upper limit of the discontinuity is larger than the maximum particle size of the polymeric particles.

5.3.1 The question to be answered is now: which upper limit of which discontinuity. And further, what is the maximum particle size of the elastic particles? Is it absolute value or does the "substantially absent" definition also apply?

5.3.2 The same applies to the aggregate having particle sizes above the upper limit of the discontinuity.

5.3.3 Further the claim defines elastic particles, not polymeric particles.

5.4 Comparable objections apply to independent claims 16 and 22.

6 Poro-Elastic Road Surfaces (PERS)

6.1 As indicated on page 2, line 37 to page 3, line 9, good noise reduction can be obtained with special road surfaces. The combination of binder, rubber particles and (gap)-graded aggregates for that purpose is well known (see for instance D6-D10).

6.2 With respect to D10 it must be noted that D10 indicates clearly in paragraph [0015] that asphalt is an alternative binder to be used in the disclosure. Moreover, the application as filed does not contain any support that the indicated draw backs (insufficient elasticity and noise reduction being unsatisfactory, see application page 3, lines 6-9) are some solved. It must be further noted that apparently in the range > 1mm and 2.8 mm (see claims of present application) there is no problem with elasticity and noise reduction with the compositions of D10.

7 Foamed bitumen/asphalt preparation

7.1 As indicated on page 9, line 32 to page 10, line 5, processes for obtaining asphalt or bitumen compositions by using foamed bitumen are well known (see for instance D11-D13 or D20).

7.2 Document D17 discloses the preparation of a bitumen/rubber particle mixture in which the rubber particles are treated with foamed bitumen.

8 Lack of unity

8.1 This Authority considers that the application does not meet the requirements of unity of invention and that there are 3 inventions covered by the claims indicated as follows:

Invention 1: claims 1-15 and 22

Invention 2: claims 16-17

Invention 3: claim 18-21

The reasons for which the inventions are not so linked as to form a single general inventive concept are as follows:

8.2 Lack of corresponding inventive concepts:

8.2.1 Inventions 1 and 2 relate to an asphalt composition whereas invention 3 relates to a mastic composition. A mastic composition is, in composition and function, clearly distinguishable from an asphalt composition. From this it follows that the properties and requirements for all possible applications of a mastic composition are fundamentally different from those of an asphalt composition.

8.2.2 Even though a mastic composition is known to be used in some asphalt applications, like stone mastic asphalt (SMA) and very open-graded asphalt pavement, the overlap between the two technical areas is small and the properties of an asphalt pavement are highly influenced by the (large amount of the) course aggregate. The inventive concept of Inventions 1 and 2 is not linked over the whole range with that of Invention 3.

8.2.3 Mastic compositions are characterised by the absence of voids. Asphalt compositions and especially the (gap)-graded asphalt compositions are characterised by the presence of voids. What a corresponding inventive concept would be between a material which is virtually void-free and a material which is characterised by voids is unknown.

8.2.4 The mixture of bituminous binder and solid particles as defined in Inventions 1 and 2 may encompass mixtures that can be identified as a mastic composition. However, mastic compositions are only a small part of the large range of bituminous compositions as defined in Inventions 1 and 2.

8.2.5 With respect to the inventive concept which would link Inventions 1 (product) and Invention 2 (process) it must be noted that the process of Invention 2 is just mere possibility for obtaining a product (covered by claim 1) of Invention 1. Issues associated with a process for obtaining a product may be very different with issues associated with the use and/or application of a product.

8.2.6 Due to the absence of corresponding inventive concept the required condition for unity is absent.

8.3 Lack of corresponding special technical features

8.3.1 As explained before, the scope of Independent claim 18 (Invention 3) covers a wide range of materials outside the scope of Independent claims 1 and 22 (Invention 1) and and 16 (Invention 2).

8.3.2 The only technical feature which would link independent claims 1, 16, 18 and 22 is the presence of elastic particles exhibiting a maximum particle size of 2,8 mm (in the bituminous binder). The presence of said elastic particles in a bituminous binder is well known, see for instance prior art documents D1 and D2.

8.3.3 Thus, subject matter of independent claims 1, 16 and 22 lacks unity with that of independent claim 18.

8.3.4 The technical feature which would link independent claims 1 and 22 (product claim) with independent claim 18 (process claim) is the presence of gap-graded aggregate in combination with elastic particles exhibiting a maximum particle size of 2,8 mm (in the bituminous binder).

Said combination is well known (see for instance D18 and D19).

8.4 Thus, subject matter of independent claims 1 and 22 lacks unity with that of independent claim 16.

8.5 Due to the absence of corresponding special technical features the required condition for unity is absent.

9 Novelty

9.1 Document D14 discloses (see Tables 1 and 2) a bituminous mastic composition containing 20 wt-% crumb rubber, which crumb rubber exhibits a maximum particle size of 0.85 mm, which mastic is used to obtain gap graded asphalt compositions which asphalt compositions are clearly identified in the disclosure to obtain road surfaces.

Thus, the subject matter of independent claims 1, 18 and 22 lacks novelty.

9.2 Document D15 discloses a mastic composition (see definition on page 3 of D8). based upon crumb rubber particles exhibiting a particle size of at most 2 mm.

It appears that the feature "suspension" cannot be used to distinguish independent claim 18 from D15, since it is known from D1, D2 and D9 that the crumb rubber particles can still be separated from the surrounding bitumen up until the moment that they are fully "digested".

Thus, the subject matter of independent claims 18 lacks novelty.

9.3 Document D9 also discloses the subject matter of at least independent claims 1, 18 and 22. D9 discloses in paragraph 4.3.3.1 and Table 4.8 open textured (i.e. open graded) asphalt compositions containing bitumen which comprises rubber filler. It is common knowledge that a "filler" donates particles having a sieve size below 0.063 mm.

10 Independent claim 16

10.1 The essence of independent claim 16 is the fact that solid particles (mixture of aggregate and elastic particles) are mixed with bitumen using the bitumen foam technology.

10.2 The subject matter of independent claim 16 lacks an inventive step in view of the vast available documentation on bitumen foam technology (i.e. common knowledge) since the application as filed is silent with respect to any effect, let alone any beneficial, synergistic, surprising or unexpected effect, originating from adding elastic particles to (gap)-graded aggregate in the various known bitumen foaming processes.

10.3 Document D17 discloses a process and composition in which crumb rubber is mixed with foamed bitumen. The subject matter of independent claim 16 lacks an inventive step in view of D17, since the application as filed is silent with respect to any effect, let alone any beneficial, synergistic, surprising or unexpected effect, originating from adding some aggregate in said known bitumen foaming processes.

10.4 Document D20 discloses a process in which crumb rubber is mixed with aggregates after which said mixture is mixed with foamed bitumen (see page 7 in combination with page 15). The subject matter of independent claim 16 lacks an inventive step in view of D20, since the application as filed is silent with respect to any effect, let alone any beneficial, synergistic, surprising or unexpected effect, originating from adding aggregate in (gap)-graded form with crumb rubber with a maximum size of 2.8 mm in said known bitumen foaming processes.

11 Dependent claims 2-15, 17 and 19-21 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of patentability in respect of novelty and/or inventive step, the reasons being as follows:

the subject matter of said independent claims appears to be either known from or directly derivable from the available prior art, or the application as filed appears not to contain any beneficial, synergistic, surprising or unexpected results originating from any distinguishing feature which would support any inventive activity.

12 It is not apparent what part of the application can form the basis for an allowable claim.

Re Item VIII

Certain observations on the application

1 Definition of asphalt/bitumen

It is to be noted that within the confines of the present application (see page 1, lines 6-15), the feature "asphalt" is used within the context of EN 12597 ("a mixture of mineral aggregate and a bituminous binder"; European definition) and not within the context of ASTM D8-02 ("asphalt is a dark brown to black cementitious material in which the predominating constituents are bitumens which occur in nature or are obtained in petroleum processing"; US definition).

2 It should be noted that due to the feature "comprising" the claims on file are by no means restricted to the mandatory features expressed in said claims. Additional components or process steps may present to an unlimited extent.

3 The clarity of the claims is of the **utmost importance** (emphasis added) in view of their function in defining the matter for which protection is sought.

4 It should be noted that the applicant cannot rely on an unclear term to distinguish the claimed invention from the prior art.