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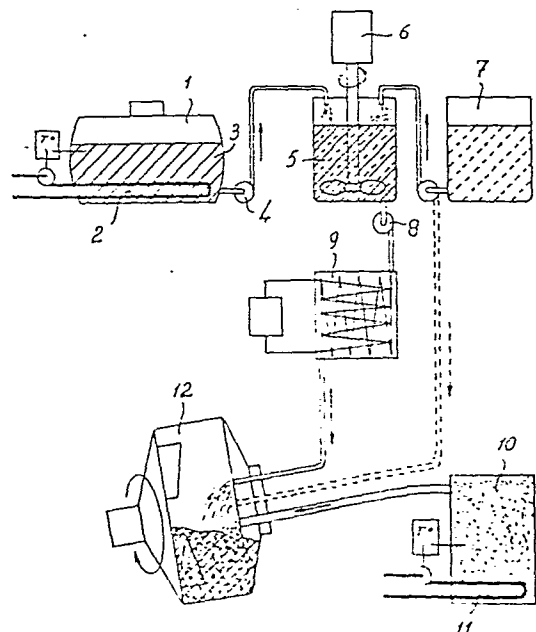
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(54) Composition of a road surfacing mass.

(57) A method of manufacturing and a use of a compression resistance and high stable surfacing mass for heavy loaded surfaces, especially for strong traffic and heavily loaded street and road sections and mainly comprising a stone material which is bound by an asphalt mass. The surfacing mass is manufactured by heating asphalt at least to the recommended temperature for mixing asphalt with a stone material, and before or after the admixing of asphalt with the stone material a fibre material is added, especially a mineral fibre having an average fibre diameter of between 1 μm and 5 μm in an amount of about 0.5-20% of weight in relation to the asphalt weight, and the fibre material is mixed homogeneously so as to throughout provide substantially separate fibres in the asphalt phase. When admixing the fibre material before adhesion of the asphalt to the stone material the temperature of the asphalt is preferably increased to 20-40°C above the temperature for mixing the asphalt mass into the stone material, and after a homogenous mixing of asphalt and fibre the asphalt mass is cooled to the said admixing temperature, whereupon the asphalt-fibre mass is mixed homogeneously with the stone material.



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ROCKWOOL AKTIEBOLAGET and AKTIEBOLAGET SKÅNSKA CEMENTGJUTERIET

Composition of Material II

The present invention relates to a method of manufacturing and the use of a compression resistance and high stable surfacing mass for heavy loaded surfaces, especially for high traffic and heavy loaded parts of streets and roads, and the surfacing mass mainly comprises a stone material which is bound by an asphalt mass.

The progress of the traffic in streets and roads, both as concerns the traffic intensity and the weight of the individual vehicles, has caused great demands on the stability of the road surfaces. This is to a special degree the case for exposed places like in front of traffic lights, at cross roads, at roundabouts etc., where surfaces masses comprising a stone material having asphalt as a binder often show to have insufficient instability.

A lack of stability in the surfacing mass comes to the effect that the mass is deformed especially due to the fact that the vehicle wheels depending on where unpacking of the surfacing mass provides lowered wheel tracks in the road way which necessitate an expensive maintenance. On the said exposed places the maintenance work further is difficult to carry out and causes traffic disturbances to a higher degree than normal road maintenance.

Attempts have been made to solve the problem involved in lack of stability by using so called skeleton masses i.e. masses in which the grain size in the stone material is graded, so that the load mainly is transferred over coarse stone grains which support each other. Thereby it has been possible to reduce the risk for settlements or packings, since the stone particles of the stone material have less possibility of re-grouping the fewer stones take part in the transfer of load.

The demands on the properties of the binder, however, increases correspondingly, and in practise the character of the binder has become the most important factor for the stability of the surfacing mass. Thus it is important that the binder locks the stone particles effectively in their taken positions and prevents displacements or re-groupings of the stone particles. The binding capacity may be increased by adding an increasing amount of binder in relation to the amount of stone material. In such case, however, there may be problems with so called asphalt run-off, what means that the hot asphalt during the mixing of asphalt with the stone material runs off the stone particles, what both counteracts the intension of increasing the amount of binder, and also causes problems at storing and transport. The stability of the surfacing masses is not substantially increased, possibly depending on the so called cold flow of the asphalt.

Attempts have been made to solve these problems by adding a fine grain filler material, but the result does not seem to have been satisfactory. Obviously the skeleton principle partly gets lost when adding a fine grain filling material.

Attempts have been made to solve the problem by adding asbestos-fibres, but asbestos-fibres do not seem to give the skeleton masses sufficient increase of stability for the amounts which can be used technically. The reason for this probably is the tendency of the asbestos-fibres to hook to each other thereby forming larger aggregates. The knowledge of the health risk with asbestos-fibres further makes it out of question to use asbestos for road covering.

In the Swedish patent 211,163 a surfacing material is described which comprises mineral fibres having a diameter off between 5 and 15 μm . also the suggested coarse mineral fibres have proved not to be useful. Probably such fibres tend to orientate parallelly to the stone surfaces of the asphalt-stone mass and thereby to the plane of the binder film. Therefore they hardly contribute to the stability of the skeleton mass. None of the suggested methods has come to any substantial practical use.

Surprisingly it has now shown that an addition of a mineral fibre material having a small fibre diameter, preferably a fibre material having an average diameter which is less than 5 μm and in which the particles are even distributed in the asphalt mainly as separate fibres strongly reduces or eliminates the above mentioned cold flow problem of the binder or the asphalt. Thereby a binder phase is obtained giving the ready surfacing mass substantially increased stability as compared with previously known surfacing masses without giving a too high viscosity at mixing temperatures for a quick and careful mixing. The increased stability depends on an increased strenght of the binder which probably depends both on the increased thickness of the binder film around the stone grains and also that the added fibre material, which is evenly distributed as separate fibres in the asphalt, as a reinforcing action.

As fibres may be used many different types of material provided that the fibres do not melt in the asphalt which during the mixing with the stone material is kept at a temperature of 140-170°C or preferably 150-160°C and also supposing that the fibres are sufficiently stiff and maintains at least a substantial stiffness in the hot asphalt. It has shown that a particularly suitable material is mineral fibres, for instance stone fibres, viz. fibres manufactured by melting stone like diabas and a subsequent fibrating of the melted stone.

As mentioned above the average fibre diameter should be less than 5 μm . When the average fibre diameter is less than 1 μm the favourable effect of the fibres is obviously reduced, probably in that the thin fibres irrevocably are shortened substantially during the mixing operation. The average fibre diameter consequently should be between 1 μm and 5 μm . For giving the intended effect the fibres should be added in an amount by weight of 0.5 and 20% as calculated on the weight of asphalt, what corresponds to about 0.03-1.2% by weight of the ready surfacing mass.

It is important that the fibres are not present in the form of tots or other baked together aggregates. This can be avoided

by a correct admixing techniques. For facilitating the distribution of the fibres and for avoiding formation of tots and for providing an optimum wetting of the fibre surfaces with asphalt it may be advantageous to treat the surfaces of the fibres with some suitable substance. For this purpose all kinds of non-polar compounds can be used, or instance wetting agents like catjonic tensides in the form of tertiary or quartery ammonium compounds.

It is also advantageous that the fibres are as dry as possible when being admixed in the asphalt, and for obtaining an effect similar to the above mentioned treatment with a wetting agent it may be advantageous to dry the fibres before mixing the fibres into the asphalt or surfacing masses so the main part of the water molecules normally absorbed to the surfaces of the fibres are removed.

The admixing of the fibres may be made by adding the fibres to the stone material before the asphalt is admixed therein or the fibres may be admixed into the ready asphalt-stone mass. An especially good effect, however, is obtained if the fibres are mixed with the asphalt mass before adding said mass to the stone material. This facilitates the mixing and the equilizing of the fibres, and the mixing of the fibre material and the asphalt material can be made indulgently to the fibres so that the fibres are not broken.

Uneven and tot free distribution of the fibres in the asphalt is further favourized if the asphalt in connection to the admixing of the asphalt is heated, for instance to 20-40°C over the temperature of about 150-160°C which the asphalt material and the stone material are mixed, whereupon the asphalt-fibre mixture is cooled to said temperature and is admixed in the stone material. The temperature increase reduces the viscosity of the asphalt and thereby facilitates a homogenous and indulgent admixing of the fibre material, and further the wetting of the fibre surfaces is facilitated at the said increased temperature, and the dispersing of the fibres in the asphalt is made quickly and effectively.

For estimating the effect of the admixing of the fibre material on the stability of the asphalt surfacing a number of fibre masses were made according to three different methods and within each group with different amounts of admixed fibre material.

EXAMPLE 1

In a mixing apparatus for asphalt masses was introduced 1,100 kg of a stone material having a predetermined distribution of the average grain size. The stone material was heated to 160°C, and to the stone material was added 5,8 kg of a mineral fibre material named "INORPHIL 057" by the manufacturer Rockwool AB which material has an average fibre diameter of 3 μm and in which the main parts of the fibres are within the area of between 1 and 5 μm .

For characterizing the fibre length there are no acceptable direct method. Therefore preferably the so called thickening number (n_f) is defined, which is calculated by the formula

$$n_f = \frac{\bar{\eta} - \eta_0}{\eta_0}$$

in which $\bar{\eta}$ is the viscosity of a slurry of 1.5 g dry fibre in 200 ml ethyleneglycol at 20°C and in which η_0 is the viscosity of the same ethyleneglycol without fibres likewise at 20°C and measured with the same equipment, viz. a Brookfield viscosimeter having a spindle LV1 or corresponding. For "INORPHIL 057" the thickening number is 1.0-5.0.

To the mixture of stone material and fibre material was admixed 195 kg asphalt. After finished mixing the mass was taken out and the stability and postpacking tendency was measured. This is made according to the following method:

A predetermined amount of the surfacing mass is put into a frame of angle iron 80 x 80 mm. The frame has a length of 2,000 mm and a width of 400 mm and is lying on a concrete floor. The surfacing mass is isolated from the concrete floor by an aluminum foil.

After two days (48 hours) at about 18°C the height position for eight different points along the center line of the frame is measured in relation to the frame. The mutual distance between the points is 200 mm. The measuring points are provided by a circular disc having a diameter of 20 mm which is put on the measuring point.

Thereafter a cylindric roll having a length of 100 mm and a diameter of 350 mm and loaded by 200 kg is rolled five times in both directions over the mass along the center line. The height of the above mentioned measuring points are once again noted and the difference to the original height is utilized as a measurement on the post-packing of the mass. The values are compared with corresponding values of post-packing of a normal mass, whereby the following value bases are used:

"Normal", 0.8-1.2 times the deformation of the normal mass;

"Slight postpacking" 1.2-1.6 times the deformation of the normal mass;

"Obvious postpacking", more than 1.6 times the deformation of the normal mass.

In example 1 the mass had an obvious postpacking tendency.

EXAMPLES 2-6

Example 1 was repeated with the same type of mineral fibre but of different length for the admixed fibre. The amount of admixed fibres and the results are made account for in the following table.

EXAMPLES 7-9

In these examples the mineral fibre material was admixed in the hot asphalt before the asphalt-mineral fibre mixture was added to the stone material and was mixed therewith. The results are shown in the table.

EXAMPLES 10-12

In these examples the asphalt was heated to 190°C, whereupon the mineral fibre material was admixed in the asphalt, the asphalt-mineral fibre mixture was cooled to 160°C and was admixed in the stone material. The results are shown in the table.

EXAMPLE 13

In this example was used a comparative mineral fibre having an average diameter of 6-8 μ m, but for the rest the method according to example 1 above was repeated.

EXAMPLE 14

In this case was used the same type of mineral fibre as in examples 1-12 above, but in order to determine the effect of the fibre length, the fibre material was ground, whereby the fibre material obtained a thickening number of 0.2.

TABLE

Example	Type of fibre	Kg fibres	% of the asphalt	Post-packing
1	INORPHIL 057	0.6	0.3	Obvious
2	"-	1.2	0.6	Slight
3	"-	3.9	2.0	Normal
4	"-	13.6	7.0	Normal
5	"-	39.0	20.0	Normal
6	"-	58.5	30.0	Normal
7	INORPHIL 057	0.6	0.3	Slight
8	"-	1.2	0.6	Slight
9	"-	3.9	2.0	Slight
10	INORPHIL 057	0.6	0.3	Slight
11	"-	1.2	0.6	Normal
12	"-	3.9	2.0	Normal
13	Coarse 6-8 μ m	13.6	7.0	Obvious
14	INORPHIL ground	13.6	7.0	Slight/obvious

From the above table it is evident that even the least amount of admixed fibre has a substantially effect on the stability and the post-packing tendency of the material. When adding 0.3 % by weight of the fibre material of the indicted type there is an obvious post-packing tendency according to example 1, and according to example 7 there is a slight post-packning tendency. In case that about 0.5 or a higher percentage of mineral fibre is admixed a normal post-packing is obtained. This is especially the case when the admixing follows according to examples 7-9 and 10-12 respectively. The table also shows that coarse fibre according to example 13 gives an obvious post-packning tendency and that also fibres having an average diameter of less than 5 μ m give substantially better property than the coarser fibres. The table also shows that the fibre length has some effect in that the ground fibre material as used

in example 14 gives an obvious postpackning tendency.

In the accompanying drawing is diagrammatically shown an apparatus for manufacture of a surfacing mass according to the invention. In a tank 1 having heating coils 2 an asphalt mass 3 is heated to normal mixing temperature or, as mentioned above, to a temperature which is 20-40°C above said mixing temperature. By means of a pump 4 the hot asphalt is batchwise pumped over to a mixing container 5 which is formed with a stirring device 6, and to which mineral fibres are batchwise added from a container 7. After stirring to provide a homogenous mixture the asphalt fibre mass is pumped through a heat exchanger 9 by means of a pump 8, in which heat exchanger the temperature of the asphalt fibre mixture is adjusted to correct temperature for being mixed with the stone mass. In case the mixture of asphalt and mineral fibre is made at elevated temperature the mass is cooled, and if the mixture is made at the normal admixing temperature at for instance 150-160°C and some cooling may have occurred during the handling of the mass some adjustment for increasing the temperature may be necessary.

The stone material is heated in a container 10 having heating means 11 and from there the stone material is batchwise transferred to a rotating mixer drum 12. The mass coming from the mixing container 5 for asphalt and mineral fibre is likewise pumped batchwise through the heat exchanger 9 to the mixer drum 12 and is mixed with a stone material with the same temperature for the two phases.

As previously mentioned the mineral fibre material can be supplied directly from the mineral fibre container 7 to the mixer drum 12 for asphalt and stone material, and in this case, of course, the asphalt is also pumped directly from the asphalt tank 1 to the mixture drum 12.

It is to be understood that the above specification and the apparatus illustrated in the drawings are only illustrating examples, and that many different modifications may be presented within the scope of the appended claims.

CLAIMS

1. Method of manufacturing a compression resistance and high stable surfacing mass for heavy loaded surfaces and mainly comprising a stone material which is bound by an asphalt mass, in which the asphalt (3) is heated to a temperature at least corresponding to the recommended temperature for mixing the asphalt with the stone material, and concurrently herewith the stone material is heated to the recommended mixing temperature, the heated asphalt and the heated stone material are mixed to a homogenous mixture in the proportions 15-25 parts by weight of stone material per part by weight of asphalt, c h a r a c t e r i z e d in that an amount of 0.5-20 percents by weight of a fibre material calculated on the amount of asphalt and having an average fibre diameter of between $1\text{ }\mu\text{m}$ och $5\text{ }\mu\text{m}$ and of a type which is not solved or softens to a substantial degree in the hot mass is added during the handling of the surfacing mass.

2. Method according to claim 1, c h a r a c t e r i z e d in that the fibre material is a mineral fibre, and in that the fibre material is added to the heated asphalt and is mixed to a homogenous mass of fibres dispersed in the asphalt before the asphalt-fibre mass is admixed in the stone material.

3. Method according to claim 2, c h a r a c t e r i z e d in that the asphalt is heated to a temperature about 20-40°C above the recommended mixing temperature for the asphalt-stone mass before the fibre material is added to the asphalt or before the mixture of asphalt and fibre material is added to the stone material.

4. Method according to any of claims 1, 2 or 3, c h a r a c t e r i z e d in that the fibre material is treated with a wetting agent like a catjonic tenside before the fibre material is added to the asphalt.

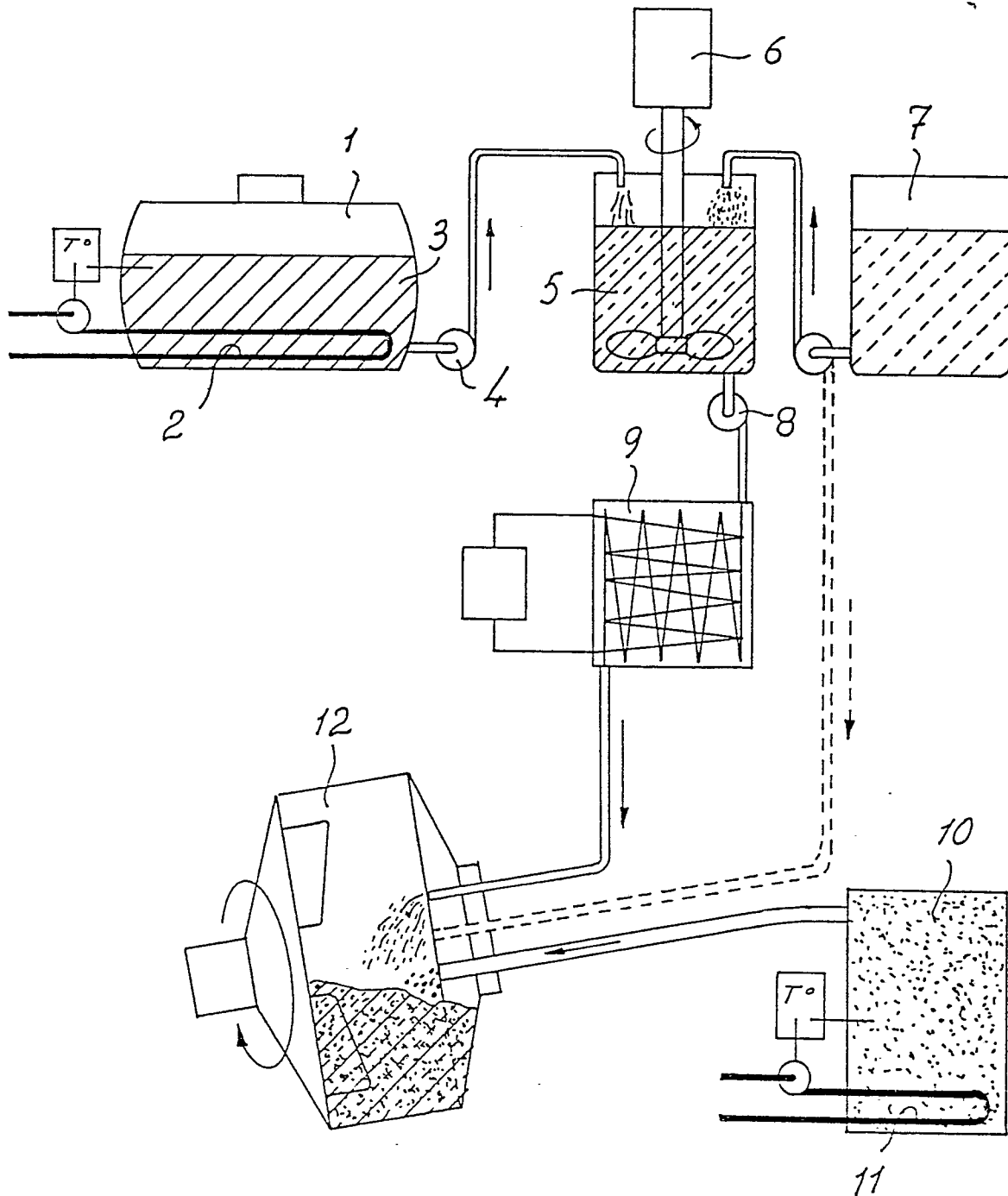
5. Method according to any of claims 1, 2 or 3, c h a r a c t e r i z e d in that the fibre material is dried completely before the addition thereof to the asphalt material.

6. Method according to any of claims 2-5, c h a r a c t e r i z e d in that the asphalt fibre mixture is cooled to the recommended admixing temperature before mixing the asphalt-fibre mass with the stone material.

7. Method according to any of the preceding claims, c h a r a c t e r i z e d in that the added fibre material is chosen among a group of material having a thickening number according to a given definition of between 1.0 and 5.0.

8. The use of a surfacing mass manufactured according to any of claims 1-7 as a surfacing for streets and roads, especially a surfacing at cross streets, in front of stop lights, in traffic round aways and other strongly frequented traffic points.

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European Patent
Office

EUROPEAN SEARCH REPORT

0058290

Application number

EP 81 85 0237.9

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
Y	DE - A1 - 2 809 059 (OWENS-CORNING FIBER-GLASS CORP.) * page 19, line 21 to page 20, line 14 * --	1,2,7,8	E 01 C 7/26 E 01 C 11/16
Y	CH - A - 495 467 (W. DE COUET STRASSEN-BAU UND TIEFBAU) * column 2, line 32 to column 3, line 11 * --	1,2,8	
A	DE - A1 - 3 002 484 (AMIANBUS AG) --		TECHNICAL FIELDS SEARCHED (Int.Cl. 3)
A	WO - A1 - 80/01179 (KIBAG AG BAGGEREI-UNTERNEHMUNGEN & KIESWERKE AM ZÜRICHSEE) ----		C 04 B 25/00 C 04 B 31/00 C 08 L 95/00 E 01 C 7/00 E 01 C 11/00
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: earlier patent document, but published on or after the filing date D: document cited in the application L: document cited for other reasons
			3: member of the same patent family, corresponding document
X The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
Berlin	18-02-1982	PAETZEL	