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(19)(CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Composition for Coating Concrete

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Notice: The specification contained herein as filed

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A B S T R A C T:

A composition for application to concrete asphalt surface, such as highways, airfield landing strips and the like. The composition penetrates to a certain depth into the surface and results in an improved resistance to mechanical stresses and abrasion as well as against deterioration due to solar radiation. The impregnation with the novel composition also prevents to a large extent water penetration. The main ingredients of the compositions are bitumen or an equivalent, a polymerizable monomer or monomer mixture, an inert mineral filler, water and a curing agent for the monomer. It is advantageous to add a U.V. protective agent to enhance resistance to deterioration due to solar radiation.

CLAIMS:

1. A composition for application to concrete asphalt substrates so as to form an integral protective surface structure, which affords improved resistance to mechanical stresses and to oxidation, which comprises in combination a monomer or monomer mixture, bitumen, a mineral filler, water, a curing agent for the monomer and, optionally, a UV protective agent.

2. A composition according to claim 1, where the monomer is selected from methyl methacrylate, styrene, and mixtures of these.

3. A composition according to claim 1, containing water for adjusting the viscosity.

4. A composition according to claim 1, which contains as filler gravel of different size, sand, other inert minerals, or a finely pulverized mineral as filler.

5. A composition according to claim 1, which contains in addition or instead of bitumen petrolatum, coal tar, paraffin wax, ozocerite and the like .

6. A composition according to claim 1, where the monomer mixture contains in addition or instead of the monomer defined in claim 2, another polymerizable monomer of the vinyl chloride, vinyl acetate, acrylate, isopren, butadine or chloroprene type.

7. A concrete surface characterized by improved mechanical strength improved weathering resistance, which comprises a bitumen-concrete type surface layer at least 3 to 5 cm thick, to which there is applied a composition according to claim 1 at a rate of from 1 kg/m^2 to 3 kg/m^2, so as to form an essentially water-impervious surface layer, one to a few millimeters thick.

8. A concrete surface according to claim 7 , where the substrate layer contains less than 5 per cent by weight bitumen or its equivalent.

FIELD OF THE INVENTION :

The invention relates to novel formulations which are applied as protective layer on asphalt road surfaces, on runways of airfields, asphalt surfaces in industrial use, roofs and the like. The protective layers impart to the underlying structure essential impermeability to water penetration, enhanced protection against damage by solar radiation and against attack by a variety of chemicals. The protective layer also affords a considerable protection against oxidation of underlying asphalt, either by itself or as a component of various compositions.

BACKGROUND OF THE INVENTION :

Asphalt concrete compositions, especially those used under considerable mechanical and environmental stress, do not fulfill quality requirements and require extensive repairs and also periodical replacement. Research in this field concentrates on the optimization of the compositions used, in an endeavor to attain adequate protection against oxidation and mechanical deterioration. Hitherto a wide variety of additives has been proposed, but still no satisfactory compositions have come into use.

SUMMARY OF THE INVENTION :

There are provided compositions for application as protective layer on asphalt surfaces, concrete-asphalt surfaces and any similar structures based on asphalt or its equivalents. There are also provided means for impregnating the surface layer of such structures, so as to attain a protective layer of a predetermined depth, which enhances mechanical stability, reduces to a large extent oxidation, provides protection against penetration by water, such layer having certain elastic properties. The exposure of bitumen to vapors of the monomer bring about a gradual modification of the properties of the bitumen.

The protective layers remain effective over a wide range of temperatures, from about -50°C to about 80°C, without any appreciable change. The surface layer according to the invention withstands the deleterious effects of UV radiation for prolonged periods of time, reducing aging and erosion. The novel protective layer is of special importance when applied to concrete-asphalt surfaces: roads, runways, roofs, industrial structures and the like. The novel compositions can be applied to a large variety of concrete asphalt or asphalt substrates. The use on such substrates having a predetermined porosity, which will generally be in the 3 to 8 per cent range, is preferred. Generally the order of magnitude of the protective layer is about 0.7 kg/m^2 to about 2.5 kg/m^2 surface, resulting in a certain penetration into the substrate, thus forming a layer with a decreasing content of the important ingredients as a greater depth is reached. Thus there is formed a layer which affords the required protection.

The novel compositions are based on a combination of fine grain minerals with a polymeric substance, if required with monomers which also serve as solvent, polymerization initiators, UV protectors, etc.

According to a preferred embodiment of the invention the compositions contain from about 50 to 80 weight-per cent of a fine grain mineral mixture, a polymer, a suitable carboxylic acid serving as plasticizer, an agent like benzoic peroxide dimethyl aniline and as accelerator a substance like naphtha-cobalt. It is advisable to incorporate a suitable commercially available antioxidant. There may be used minerals like finely ground marble, limestone, granite, dolomite, etc. of predetermined particle size distribution.

It is a further object of the invention to provide improved structures, such as roads, runways, roofs, etc., which have improved resistance against mechanical stresses and which also afford protection of the asphalt against aging, the structure of the invention acting as a mechanical buffer system.

The noise of wheels moving on such surfaces is decreased by about 10 to 40 per cent.

Such a system comprises a substrate of increased porosity, and a protective layer applied to same. An increased porosity can be attained by a reduced asphalt content of the substrate on which the protective layer is formed, which constitutes an integral structure therewith. Generally bitumen (or asphalt) contents of the substrate of from about 3 to 5 per cent gave good results.

Compositions of the invention contain, by way of example, from about 15 to 25 weight-% bitumen, which can be used in different qualities and types;

a fine-grain mineral filler: about 55 to about 70 weight-%, a suitable monomer or monomer mixture, like methylmethacrylate of the order of 10 to about 20 weight-%; if desired with from about 0.03 to 0.1 weight-% of dimethylaniline, about 1 to 3 weight-% oleic acid, about 0.1 to about 0.8 weight-% phenol and added water to adjust the viscosity to a desired value. The use of the additives, such as dimethylaniline is optional. Instead of the above monomer there can be used a variety of other monomers, such as styrene, copolymers or terpolymers, and the like.

The compositions must be adjusted to the specific intended use.

It is clear that there may be used a wide variety of different components which are equivalents of the above.

The invention is illustrated with reference to the following examples, which are by way of illustration only :

According to a preferred technology,the bitumen is heated gradually to about 120 to 160^{o}C,mixed in a high speed mixer with the monomer and the solids and agitated for about 30 minutes to one hour. Typical compositions have a viscosity of about 250 to 350 CST at 25^{o}C.Upon addition of a hardener and catalyst the product can be applied during about 24 hours before

hardening. The compositions devoid of hardener and catalyst can be stored in a closed container for up to about one year.

Example 1: Emulsion of Micro-Polymeric Concrete Asphalt for the Impregnation of Concrete Asphalt, Ground Concrete Constructions and other Surface layers :

Bitumen (blown, 75/25)	16
Ground dolomit, about 250 mesh	60
Methylmethacrylate monomer	14
Dimethylaniline	0,04
Oleic acid	1.5
Phenol	0.3
Glycerol	0.3
Water - up to desired viscosity, about	20

The water is admixed to the mixture after cooling down.

A black liquid is obtained which serves for the formation of a surface layer ; the rate of application is about 1 kg/m^2. The layer dries in about one hour. A long-lasting protective cover is obtained,which withstands weathering over prolonged periods of time.

Example 2:

A composition was prepared according to Example 1, but without dimethyaniline and without water. A viscous substance was obtained which can be applied to any surface which is to be impregnated. The rate of application is about 1.5 kg/m^2. A weather-resistant, and wear-resistant layer is obtained.

Example 3 :

A composition was prepared according to Example 2, but with styrene monomer instead of methyl methacrylate, 17 parts. A similar composition was obtained. Similar properties were obtained.

Example 4:

A composition was prepared according to Example 3, but with the addition of 0.5 weight-% benzoyl peroxide and 0.3 weight-% cobalt naphthenate. Curing took place in one hour. A highly resistant protective layer was obtained.

Example 5 :

A composition was prepared according to Example 2, but with a 50/50 monomer mixture of methylmethacrylate and styrene. Curing took place in less than one hour. A highly resistant protective layer is obtained when applied to porous concrete asphalt or similar substrates.

Example 6 : Cold Composition for the Formation of a Road Layer, of an Airfield Runway, Parking Lot, or the like.

The following composition is applied as layer of about 3 to 5 cm thickness to a suitable substrate, which can also be a deteriorated road surface or the like, and after polymerization for about 12 hours there is obtained a long-lasting surface which has excellent mechanical properties, which is very little permeable to water and which withstands oxidation due to sunlight over prolonged periods of time. Parts are parts by weight :

Dolomite chips - 25 mm	10
Coarse dolomite gravel - 12 mm	20
Fine dolomite gravel - 9 mm	20
Crushed sand (2 to 4 mm)	38
Micro-Polymeric Concrete Asphalt according to Example 3	12

Example 7 :

A composition was prepared according to Example 3, but with the following instead of the mineral components:

Fine sand	36
Finely ground mineral	56

When applied to a suitable substrate, after curing there is obtained a highly water-impervious surface layer.

Various compositions of the invention were subjected to accelerated aging tests according to standard conditions, according to ASTM G 53. The tests were carried out for 1000 to 1300 hours with concrete substrates of varying porosity. At the end of the test a water pressure of 1000 mm was applied, for 14 days. At the end of the test period no water penetration had taken place.

The compositions of the invention can be applied to conventional asphalt road surfaces. These have generally a bitumen content of about 5 to 7 per cent. According to the invention it has been found that a novel system of substrate/protective layer gives improved results as regards resistance to vibrations, shocks, stresses by pressure. Such a system comprises an asphalt concrete, and similar composition layer of increased porosity, which contains only from about 3 to 5 weight-per cent bitumen, and which has a thickness which is generally of not less than 5 cm thickness, to which a composition of the invention, such as one of the foregoing examples is applied. The actual protective layer comprises the upper one or 2 millimeters, although a deeper penetration takes place into crevices, etc. Such a water-impervious surface layer

with the underlying structure which forms a mechanical buffer system of improved stress resistance, provides long lasting roads, runways, roofs, etc. The upper layer also affords chemical protection against aging of the asphalt and against its oxidation, thereby drastically reducing maintenance costs compared with conventional roads, runways, and the like.

The coating also reduces wheel noise on roads coated with such a composition.

The following results were obtained with a coating composition according to Example No.3 :

35 mm thick asphalt concrete cast sheets were obtained, of the type used in roads and runways.

In addition to the above a modofied bitumen was examined.

The above sheets were coated with a composition of Example 3, at approximately 1kg/m2.

The aim of the test was to determine the influence of the coating on water penetration and the changes of this property after accelerated UV ageing.

Water penetration was tested on the following types of samples:

(1) Without coating

(2) Coated with Example 3, unaged;

(3) Coated with Example 3, after exposure to 500 hours UV;

(4) Sample after 1300 hours UV radiation.

Conditions of UV radiation

Q-U.V. Panel in accordance with ASTM G-53. Cycles of 8 hours radiation at 60°C followed by 4 hours 100% humidity at 50°C.

Test Procedure

On the sheet samples an 80mm diameter funnel was placed, to which a 1000 mm high burette was fixed. The contact of the funnel to the sheet was sealed by epoxy and the setup was filled with water. The drop of the water level in the burette was recorded from time to time during 14 days.

The results are expressed in ml of water seepage.

No.of days	Sample without Coating	Sample coated with Example No.3 - unaged	Sample after 500 hrs. U.V. - aged
1	Water passed	-0.1	-0.2
2.	Immediately	-0.2	-0.3
3	Through the asphalt	-0.2	-0.35
6.	Through the asphalt	-0.2	-0.4
7.	Concrete sheet	-0.3	- 04
8		-0.4	- 0.45
9		-0.4	- 0.5
10		-0.45	- 0.55
14		-0.7	- 0.7

Sample after 1300 hours exposure to UV Radiation

Number of Days:	0	0
	4	-0.25
	5	-0.25
	6	-0.35
	7	-0.40
	12	-0.60
	13	-0.70
	14	-0.70

Conclusion :

Water penetration through the original sample and samples after 500 hours and after 1300 hours UV exposure is practically identical, i.e. UV radiation has no effect on water penetration.

At the rate of application generally used, in the order of from about 1 kg/m^2 to about 3 kg/m^2, the composition penetrates into the top layer of the concrete asphalt surface and impregnates this layer. Practically no actual layer is formed on top of the original one, and such a layer does not exceed about 0.7 to 1 mm. Concrete asphalt surfaces of roads and the like have a certain porosity, and this facilitates the penetration of the compositions of the invention into the uppermost part of such existing surface.