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PRODUCTION OF MATERIAL TO BE USED IN THE FORMATION OF ROADWAYS AND THE LIKE

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This invention relates to improvements in the production of material to be used in the formation of roadways, footpaths, floors, damp courses and the like.

The material produced by this invention is capable of application to many industrial uses, such as in the formation of roadways, foot-paths, floors, roofing, damp courses, insulators and the like and it will be understood that it is not intended that the invention is confined to any particular use to which the material may be applied and that the word or term "roadway" will include all such uses to which the material is applicable.

The invention relates to the production of a mixture of bitumen and sand, broken stone, gravel, slag and other like material usually employed in conjunction with bitumen, with or without a filler and in this specification the term "aggregates" will include any material capable of being associated with bitumen for the purpose of producing a coherent mass suitable for the purposes required.

In the formation of roadways as hitherto practiced it has usually been the custom to either treat the aggregates with bitumen in a heated condition in such manner that the individual particles of the aggregates become coated with the bitumen and then depositing the same in the situation where the formation is required and subjecting it to repeated rollings, or the dry aggregates may be treated whilst being consolidated into a roadway with either molten, emulsified, or "cut back" bitumen by the penetration or other well-known methods.

Hitherto the use of hot coated aggregates which have been allowed to cool has not proved successful because, firstly the reheating of this material without burning the same is a difficult operation, and secondly because of the sticky and adherent condition of the cold material.

Now in formations constructed as above it is customary in order to obtain a complete coating of bitumen on the aggregates, to use a greater quantity of bitumen than is required to secure adequate adhesion and permanency in a roadway, so that there is often an excess of bitumen located in the interstices between the particles of the aggregates which causes a certain amount of plasticity in the structure with a consequent decrease of its load-carrying capacities. Furthermore when the aggregates are treated with bitumen in this way it is not practicable to store the same or to transport it conveniently to distances by reason of the fact that it is sticky and adhesive, contaminating vehicles and receptacles within which it is transported.

Now the object of this invention is to provide a certain method of treating bitumen with which aggregates are mixed whereby the individual particles are completely coated with a surface layer of the minimum amount of bitumen required for the subsequent adhesion of the particles to each other to form a consolidated mass. The aggregates when treated according to this invention may be transported while still hot for laying or may be stored for relatively long periods in a cold condition and can be transported in this condition without contaminating the vehicles and transport casings and used in roadway formations after being reheated. Or alternatively the material treated with bitumen in accordance with this invention may be used with the usual penetration method (that is when spread on the roadways) either with hot bitumen or bitumen treated in any known way to render it liquid when cold, requiring a considerably smaller quantity of bitumen than heretofore.

I accomplish the object of this invention by subjecting the bitumen whilst hot to treatment with a solution or an emulsion of a substance which has the effect of aiding in an ebullition and formation of gaseous bubbles throughout the mass, and mixing the aggregates with bitumen treated in this way.

I have discovered that if bitumen is first heated and treated with a suitable substance which has the effect of aiding in an ebullition and formation of gaseous bubbles therein and is then vigorously agitated, a substantial increase in volume in the bitumen is temporarily effected, thereby affording increased covering power and that if aggregates be treated with the bitumen whilst in this condition a considerably greater quantity of

aggregates can be effectively covered with the same amount of bitumen, or put in another way a considerably less quantity of bitumen is required for effectively covering a given quantity of aggregates.

The temperature at which the bitumen is first heated is between 220° F. and 350° F. and is determined by its hardness as determined by a penetrometer for example if bitumen of 100 to 120 penetration is used a suitable temperature will be found to be between 220° F. and 275° F., whereas if bitumen of from 40 to 50 penetration, then a suitable temperature will be between 275° F. to 350° F.

With regard to the substances to be employed, I have found that those substances which lower or change the surface tension between bitumen and steam, and which are soluble in or can be emulsified in water, are suitable for the purposes of this invention. Substances which promote bitumen-water emulsions are more or less effective but not necessarily in the same degree, such as: oleate or stearate of an alkali metal (alkali soaps) certain nitrogenous substances as casein, gluten (and their decomposition products with alkali) peptone, starch, sulphonated oils, glycerine alcohol and generally those substances which affect the bitumen water and steam inter-facial tension so as to promote emulsification. And by the term "emulsifying and foam assisting agent" I mean to include the above mentioned substances and their equivalents, all such substances showing first the property of emulsifying bitumen in water and second, the property of assisting in, and stabilizing to a greater or lesser extent, the formation of a foam.

As bitumen is the residual part of varying natural products after treatment by different processes it follows that it differs widely in its physico-chemical properties, and in its response to any of the solutions of a chemical substance as defined in this specification. With a view to ascertaining whether a particular substance is suitable for the purposes of this invention the following simple test may be applied:

(*a*) First test whether the solution will emulsify with bitumen at 212° F.

(*b*) If so then add 2-lbs. of the bitumen heated to the temperature required by its hardness as indicated by a penetration test (such as about 325° F. for a bitumen of from 40 to 50 penetration) to 3 cubic centimeters of the solution being tested then agitate and if the resulting froth causes an increase in the volume of 2 to 3 times that of the original bitumen it may be assumed that the solution is suitable.

In carrying this invention into practical effect I take a certain quantity of bitumen and heat the same in a suitable receptacle to the requisite temperature, that is from 220-350° F. I then take a certain quantity of solution which will have the effect of aiding in an ebullition and formation of gaseous bubbles in the bitumen such as a solution of an oleate or stearate of an alkali metal formed by dissolving one ounce of the said oleate or stearate in one gallon of water and place the same in a separate receptacle.

A small quantity of a solution of this substance is placed in the bottom of a separate receptacle, such as for example the measuring vessel used for the hot bitumen and a charge of the bitumen whilst hot is then tipped bodily into this measuring vessel containing the aforesaid solution. By way of an example I may mention that I have found that 8 c. c. (=½ cu. in.) of a solution of soft soap formed as above (i. e. one ounce to the gallon of water) to 10 lbs. of bitumen will answer the purpose of this invention. This action creates an intense ebullition of minute bubbles of gas and steam throughout the whole mass, the soap aiding in the formation of small bubbles. It may be said that, in the absence of the soap, or other equivalent substance, small bubbles are not formed. Immediately after the formation of the bubbles there is an appearance of cessation of ebullition, and as a rule just before ebullition ceases, the charge is tipped into a mixer and incorporated with the aggregates in the usual way whilst hot. The action of the agitator of the mixer causes a more or less temporary increase in the volume of the bitumen by forming therein a substantial volume of small bubbles, agitation forming a sort of dense froth or foam. This increased volume of the bitumen results in a larger surface of aggregates being coated with the same amount of bitumen than would suffice in the ordinary way so that in effect an increased quantity of aggregates can be coated with the bitumen. In effect the surface layer of bitumen on the particles is so much thinner than obtains with the methods as hitherto employed that a considerable economy in the amount of bitumen required is effected. The aggregates mixed with the bitumen in this condition may be transported whilst hot direct to the roadway to be laid, rolled and consolidated in the usual way, or they may be allowed to cool and when cold they are not sticky or adhesive as hitherto and may be handled with convenience and stored or transported to considerable distances without contamination of the transport vehicles and may be reheated and rolled whilst hot or the usual methods as hitherto practised may be employed. Where a lean mixture has been made additional bitumen may be supplied either by subjecting the mixture to treatment just before laying and rolling, with either hot bitumen or diluted bitumen (such as "cut back" liquid bitumen) or the lean

mixture may be subjected to penetration during laying and rolling, by either hot bitumen or diluted bitumen.

By means of this invention I am able to effect a considerable economy and saving in the quantity of bitumen required in the construction of roadways and the like, the completed formation being without excess bitumen only sufficient being used to ensure adequate adhesion of the particles to each other so that subsequent plasticity or mobility or "creeping" is avoided.

In the formation of floors, roofing and such like structures fine aggregates such as sand are usually employed the material being mixed with the treated bitumen and spread out in layers upon the foundations already provided.

Bitumen treated with a solution or emulsion of a suitable substance in accordance with this invention may be used for top dressing by pouring or spreading the same over the surface of the roadway (such as wood blocks, or concrete or the like) and then covered with binding material, with the result that the top dressing will adhere to the surface and be less subject to "bleeding" than heretofore and moreover give a more permanent surface and involve the use of less bitumen. Similarly bitumen treated with a solution or an emulsion of a suitable substance in accordance with this invention may be used for the ordinary penetration system obtaining a greater covering area and a better percolation into the mass.

I claim:

1. A method of treating bitumen for use in the formation of roadways and the like consisting in heating the bitumen and subjecting it to the action of a solution of an emulsifying and foam assisting agent to effect an ebullition of bubbles throughout the whole mass of the bitumen and subsequently agitating or disturbing the mass to substantially increase the volume of the effervescent bitumen, said emulsifying agent consisting of a solution of soap and water having approximately the proportions of 1 oz. of soap to 1 gallon of water.

2. A method of treating bitumen for use in the formation of roadways and the like consisting in heating the bitumen and subjecting it to the action of a solution of an emulsifying and foam assisting agent consisting of 1 oz. of soap to 1 gallon of water, to effect an ebullition of bubbles throughout the whole mass of the bitumen and subsequently agitating or disturbing the mass to substantially increase the volume of the effervescent bitumen, said emulsifying agent being applied in the approximate proportions of ½ cu. in. of the soap solution to every 10 lbs. of bitumen.

3. A method of treating bitumen for use in the formation of roadways and the like consisting in heating the bitumen to a temperature between 220° to 350° F. and subjecting it to the action of a solution of an emulsifying and foam assisting agent consisting of 1 oz. of soap to 1 gallon of water, to effect an ebullition of bubbles throughout the whole mass of the bitumen and subsequently agitating or disturbing the mass to substantially increase the volume of the effervescent bitumen, said emulsifying agent being applied in the approximate proportions of ½ cu. in. of said solution to every 10 lbs. of bitumen.

In witness whereof I hereunto affix my signature.

ERNEST BARTON HACK.