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FLUX OIL AND METHOD OF REVIVIFYING ASPHALT ROADS THEREWITH

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This invention relates to a method for revivifying or reconditioning asphalt roads, and particularly to a flux oil particularly suitable for such uses.

Asphalt roads have been found to harden gradually over a period of years due to losses of volatile materials from the asphalt and due to oxidation of the asphalt, or due to other unexplained phenomena, which result in cracking, raveling, and general deterioration of the road so that it becomes unsatisfactory for further use. At this stage of deterioration the asphalt extractable by the Abson method (American Society for Testing Materials (ASTM) Proceedings vol. 33, 1933, Part II, p. 704) is found to have a penetration of about 15 or less at 77° F. by the ASTM method (ASTM Standards, part III, pages 220–221, Method D5–25 using the 100 gm. wt. for five seconds). It has become brittle and unsatisfactory as a binder. It is customary at this stage either to apply an additional increment of new road over the old road, tacking the two together with liquid asphalt or road oil, or to tear up a part or all of the old road, applying a refreshing or revivifying coating of liquid asphalt or road oil, and spread and compact the resulting material. In either type of operation the oil which is normally used is a liquid asphalt, road oil or fuel oil which is paraffinic or relatively non-aromatic in nature, and is a residual oil which contains its normal content such as about 10% to 40% of asphaltenes, which are black infusible bodies which are insoluble in light hydrocarbons such as propane, butane, or pentane or the like. Such oils can not dissolve much more asphaltenes than they already contain and are rather poor solvents for asphalt in general, and are particularly poor solvents for the residual non-volatile asphalt in the deteriorated road. Consequently, they have little tendency to revivify the old asphalt by softening it, and do not tend to bind the asphalt and aggregate particles as tightly as might be desired, and this results in relatively rapid deterioration of the reconditioned road.

I have discovered a method of revivifying roads which have deteriorated as above described, which method involves use of a flux oil of suitable viscosity and of highly aromatic nature. Preferably this highly aromatic flux oil should be relatively free from asphaltenes and should have a viscosity within a definite range which insures proper penetration and revivification of the old asphalt. Such flux oils may be readily prepared for example, by blending a heavy oil having a viscosity greater than about 8000 seconds Saybolt

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Universal (SSU) at 100° F., such as an extract from the solvent refining of a viscous lubricating oil with a light oil having a viscosity below about 200 SSU at 100° F., such as a spray oil extract or the like to obtain a flux oil having a viscosity within the range of about 300 to 8000 SSU at 100° F., a viscosity gravity constant greater than about 0.92, and containing not over about 1% of asphaltenes.

By employing a flux oil such as above, and described more fully below, the asphalt in the old road which has deteriorated, is revivified, the agglomerated lumps of the old road are more readily penetrated and can subsequently be more readily broken up, and the agglomerates are more readily coated with the flux oil so that they are very tightly bound together, and the resulting road deteriorates much less rapidly.

It is an object of this invention to provide an improved method for revivifying deteriorated asphalt roads. It is a further object to supply an improved flux oil for such purposes and similar purposes. Other objects will appear in the following description of my invention.

In revivifying a deteriorated asphalt road by the method of this invention the surface of the road is first broken up by scarifying with a harrow or like equipment, digging up the entire road if it is relatively thin or digging up about two inches to about six inches of the surface where the road is thicker. It is desired that the resulting lumps, or at least the agglomerates, by which term is meant the particles or lumps containing both aggregate and asphalt, be reduced in size to about one-half inch diameter or less. Rocks of somewhat larger size may be tolerated, but "clay balls" if present should be broken up and thoroughly mixed into the remainder of mixture. The reduction in size of the agglomerates to the specified diameter of about one-half inch or less may be accomplished simply by harrowing, or by rolling with a sheepsfoot roller, discing, or the like operations. Where the road is very seriously deteriorated, it is difficult to break it up, and the agglomerates or lumps obtained merely by harrowing may be rather large, much larger than fist size for example. In this case it has been found desirable to spray the flux oil of this invention over the roughly broken up road and allow it to soak for a day or more. This permits the flux oil to penetrate the agglomerates, making them easier to reduce to size by further discing, sheepsfoot rolling or other operation.

When the agglomerates have been reduced to the desired size by either of the above methods,

the flux oil of this invention is sprayed over them, the mixture is preferably allowed to stand for a period of at least an hour and preferably a day or more, but not over about a week, and is then leveled and amalgamated by pressure, such as by rolling with a roller. If sufficient flux oil was applied in the course of reduction of the agglomerates to size, no additional flux oil need be added thereafter. The total amount of flux oil to be used as above may be between about 1% and about 15% of the weight of the agglomerates. When employing the flux oil of this invention such revivified roads will have unusual water resistance and excellent wear characteristics.

In the second of the conventional methods of revivifying asphalt roads described above, the deteriorated road surface is not broken up, but a new increment of surface is applied over the deteriorated road surface, sealing the two together with a tack coat of liquid asphalt. It has been found that such increments of surface in the past have frequently tended to separate from the old surface and thus make such methods of revivifying unsatisfactory. I have found that this general method of revivification is greatly improved if the flux oil of this invention is employed as a tack coat to bind the old surface to the new surface instead of liquid asphalt. The new increment of surface is preferably prepared as described below, employing the flux oil of this invention, but any type of increment of surface may be employed as long as it is an asphalt containing surface. In this operation, the old surface is covered with a coating of the flux oil of this invention, and the new surface is applied thereto. Preferably the old surface is scarified somewhat before or after covering it with the tack oil. Also a coating of the flux oil may be applied to the old road surface before and after scarifying. The new surface is then applied, and the two surfaces are amalgamated through the flux oil by application of pressure, such as by rolling.

The flux oil of this invention, as stated above must be highly aromatic in nature. The aromaticity is defined for convenience by its viscosity-gravity constant (VGC) as described by Hill and Coates in the Journal of Industrial and Engineering Chemistry, vol. 20 (1928) page 641. The viscosity-gravity constant should be greater than about 0.90, and preferably greater than about 0.92. As an example of the significance of the VGC test, a typical aromatic Western lubricating oil extract will have a VGC of about 0.93 or higher, whereas a well refined paraffinic Eastern lubricating oil may have a VGC of about 0.81 or less. As stated above the preferred viscosity range for the flux oil is between about 300 and 8000 SSU at 100° F.; however, flux oils having lower viscosities such as down to about 70 SSU at 100° F. may be employed in the above revivification processes in some instances, if they are highly aromatic in nature. As stated above the flux oils are conveniently prepared by blending a high viscosity extract with a low viscosity material, although in many instances blending may be unnecessary. The high viscosity material will ordinarily have a viscosity greater than about 300 SSU at 100° F., while the low viscosity material will ordinarily have a viscosity less than about 200 SSU at 100° F. Such blended flux oils are preferred, since they insure the presence of a relatively high proportion of relatively non-volatile material in the flux oil, and thus reduce the rate of volatilization of oil or other deterioration of the revivified asphalt, and yet provide for easy handling and ready penetration. Blends containing a major proportion of the more viscous component are preferred. Blends containing about 5% to about 40% of the lighter component are generally suitable. The asphaltene content of the flux oil should also be low, since the deteriorated asphalt generally contains an overabundance of asphaltenes. When the lubricating oil extracts prepared by solvent extraction of lubricating oil distillates are employed, the asphaltene content of such extracts is suitably low. The viscosity indices of the flux oils of this invention are extremely low, in agreement with their aromatic nature. Usually they are well below zero. The flash point of the flux oil as measured by the Cleveland Cup Method is preferably greater than 300° F. Lubricating oil extracts will generally have flash points above 400° or even above 500° F., whereas the flash points of the lighter extracts may be about 300° F. or lower. The API gravities of the flux oils of this invention generally will be very low, such as below about 15, and frequently below 10, i. e., the oils may be heavier than water in many instances. The olefin content of the flux oils should be relatively low, since it is well known that oils containing large proportions of olefins, such as cracked distillates, fuel oils, gas oils, etc., are not desirably stable to oxidation. Thus the presence of cracked materials in the flux oils tends to increase the rate of deterioration.

As specific examples of flux oils of this invention the following materials are described:

	Viscosity, SSU, at 100° F.	Gravity, API	VGC [1]	Flash [2] ° F.
Heavy Oils:				
SAE 30–40 Lubricating Oil Extract (1H)	[3] 60,000	10.4	0.939	510
SAE 20–30 Lubricating Oil Extract (2H)	8,000	11.0	0.941	450
Lubricating Oil Extract (3H)	[3] 100,000	5.3	0.973	475
Light Oils:				
Spray Oil Extract (1L)	110	14.5	0.945	310
Transformer Oil Extract (2L)	70	16.0	0.939	280
Kerosene Extract (3L)	31	26.0	[3] 0.93	142
Blended Flux Oils:				
20% 1L and 80% 1H above	8,000	11.2	0.938	450
10% 3L and 90% 1H above	5,000	12.0	0.934	430
30% 2L and 70% 2H above	1,000	12.5	0.943	370
30% 2L and 70% 3H above	3,000	9.1	0.970	360

[1] Viscosity-gravity constant.
[2] Cleveland Open Cup.
[3] Extrapolated.

Although only a few specific blends are shown above, similar flux oils having the characteristics described previously may be employed in the processes of this invention. The heavy extracts described above are prepared by solvent extraction of lubricating oil distillates from paraffinic

base and naphthene base Western crude oils, using phenol as the selective solvent. The light extracts are prepared by solvent extraction of spray oil and transformer oil distillates, using sulfur dioxide as the selective solvent. Similar extracts may be prepared by using other selective solvents such as furfural, cresol, aniline, or the like. The flux oils may also be prepared by other methods, as long as they have the above characteristics.

It has also been found that the preferred flux oil of this invention is a marked improvement over prior flux oils in the building of new roads, whether complete new roads or increments of new surface for old roads as described above. As examples of the prior art in this field, a cold laying method is described in U. S. Patent 1,655,240 (reissued as Re. No. 17,985) which involves coating a stone aggregate with a flux oil, adding a powdered asphalt, mixing and laying the mixture, and amalgamating by application of pressure. The flux oil here was a fuel oil or semi-liquid asphalt. A later U. S. Patent 2,220,670 describes an improvement in this process, in which the flux oil is a heavy lubricating oil extract. I have now found that the flux oil of the present invention is a marked improvement over any of the oils described in the prior art, since it has the advantage not only of high aromatic content, but of proper fluidity and penetration ability. Thus, for building new roads according to this invention an aggregate and a powdered asphalt having a melting point above about 175° F. are mixed with the flux oil of this invention so that the particles become coated thereby, and the resulting substantially homogeneous composite mixture is applied to the road bed and amalgamated by the application of pressure. The preferred flux oil of the present invention is particularly suitable for this process because it so readily coats the aggregate and the asphalt particles, and allows sufficient penetration of the asphalt so that amalgamation takes place more readily and more completely, and the stability of the road is increased.

Although the asphalt, aggregate and flux oil may be mixed simultaneously or the asphalt and flux oil may be mixed first, in the preferred mode of operation, the aggregate is first mixed with the flux oil, allowing the flux oil to coat and/or penetrate the aggregate, and thereafter the solid asphalt is mixed in, using a concrete mixer or any similar mixing apparatus in these operations. The asphalt generally becomes coated with flux oil and adheres to the coated aggregate particles to form a further coating without as yet amalgamating therewith. The coated particles move freely with respect to each other and are readily spread uniformly over the roadbed. The asphalt amalgamates with the flux oil when cold only under applied pressure to form a substantially homogeneous composite binder, which in turn serves to amalgamate the coated aggregate. Thus the coated aggregate and asphalt particles are amalgamated in position by application of pressure as by rolling. It appears that flux oil is absorbed into the pores of the aggregate, and is gradually liberated therefrom to the asphalt, thus acting as a continuous revivifier as the road ages. This may be one reason for the exceptionally long life of such roads, especially when the preferred flux oils of this invention are employed.

As described above the preferred flux oils used in this new road construction are those having viscosities between about 300 and 8000 SSU at

100° F. and VGC's greater than about 0.92, and are composed of a blend containing a major proportion of heavy aromatic material having viscosity above 300 and preferably above about 8000 SSU at 100° F. and a VGC above about 0.92, and a minor proportion of a light oil having a viscosity lower than about 200 SSU at 100° F. Preferably this flux oil should be relatively free from asphaltenes and olefins or cracked hydrocarbons as described above, and should have a flash point above about 300° F.

The aggregate to be used in making new roads may be stone or sand or even soil, as employed in conventional road construction practice. The asphalt should be a relatively brittle material having high melting point, above about 175° F. Its penetration should be less than about 20 at 77° F. An asphalt which is prepared by precipitation from an asphaltic oil, using a precipitant such as propane or the like is particularly suitable. Such asphalts and their preparation are thoroughly described in the above U. S. Patent 2,220,670. Other suitable asphalts may be made by steam blowing or by air blowing. Air blowing of highly aromatic heavy oils such as the heavy lubricating oil extracts described above or extract fractions from solvent extraction of residual oils yields asphalts of especially desirable character. The proportions of aggregate, asphalt, and flux oil to be employed in road building are about as follows: The asphalt may be between about 1 and about 10 per cent by weight of the aggregate, preferably between about 2 and 5%, and the flux oil may be between about 1 and 15%, preferably between about 2 and 6% of the aggregate. It is desirable that the asphalt in the finished road have a penetration at 77° F. of about 30 to 300. As an example of a suitable mixture, an aggregate comprising rock and sand is mixed with about 4% of a flux oil consisting of about 80% of the heavy lubricating oil extract (1H) and 20% of the spray oil extract (1L) described in the table above; and about 3% of a powdered asphalt having a melting point of about 250° F. When spread evenly on a roadbed and amalgamated by rolling, an excellent road is made.

Modifications of this invention which would occur to one skilled in the art are to be included in the scope of the invention as defined in the following claims.

I claim:

1. A method for revivifying deteriorated asphalt roads which comprises breaking up the surface of the deteriorated road to form lumps; applying to said lumps without removal from the road bed a coating of a highly aromatic petroleum extract oil having a viscosity between about 70 and about 8000 SSU at 100° F., a viscosity-gravity constant greater than about 0.90, and a flash point above about 300° F., and consisting essentially of aromatic-type hydrocarbons substantially free from asphaltenes, olefines, and cracked hydrocarbons, said extract having been prepared by a process involving contacting a straight run fraction from an aromatic hydrocarbon-containing crude petroleum with a liquid solvent selective in its action toward aromatic hydrocarbons so as to physically dissolve therein the desired aromatic hydrocarbons without dissolving the undesired non-aromatic hydrocarbons; allowing the coated lumps to stand for at least one hour; and thereafter amalgamating the coated lumps by the application of pressure.

2. A method for revivifying deteriorated asphalt roads which comprises breaking up the

surface of the deteriorated road to form agglomerates having a maximum diameter of about one-half inch; applying to said lumps without removal from the road bed a coating of a highly aromatic petroleum extract oil having a viscosity between about 300 and about 8000 SSU at 100° F., a viscosity-gravity constant greater than about 0.92, a flash point above about 300° F., and consisting essentially of aromatic-type hydrocarbons substantially free from asphaltenes, olefines, and cracked hydrocarbons, said extract having been prepared by a process involving contacting a straight run fraction from an aromatic hydrocarbon-containing crude petroleum with a liquid solvent selective in its action toward aromatic hydrocarbons so as to physically dissolve therein the desired aromatic hydrocarbons without dissolving the undesired non-aromatic hydrocarbons; allowing the coated lumps to stand for at least one hour; and thereafter amalgamating the coated lumps by the application of pressure.

3. The method of claim 2, wherein the highly aromatic petroleum oil comprises between about 60 and about 95 per cent by weight of a petroleum lubricating oil extract having a viscosity above about 8000 SSU at 100° F. and a viscosity-gravity constant greater than about 0.92, and between about 5 and about 40 per cent by weight of a light petroleum oil extract having a viscosity below about 200 SSU at 100° F.

4. A method for revivifying deteriorated asphalt roads which comprises applying to the surface of the deteriorated road a coating of a highly aromatic petroleum extract oil having a viscosity between about 70 and about 8000 SSU at 100° F., a viscosity-gravity constant greater than about 0.90, and a flash point above about 300° F., and consisting essentially of aromatic-type hydrocarbons substantially free from asphaltenes, olefines and cracked hydrocarbons, said extract having been prepared by a process involving contacting a straight run fraction from an aromatic hydrocarbon-containing crude petroleum with a liquid solvent selective in its action toward aromatic hydrocarbons so as to physically dissolve therein the desired aromatic hydrocarbons without dissolving the undesired non-aromatic hydrocarbons; applying to the coated road an increment of new asphalt paving;

and amalgamating said increment with the old road by the application of pressure.

5. A flux oil for asphalt roads comprising between about 60 and about 95 percent by weight of a petroleum lubricating oil extract having a viscosity above about 8000 SSU at 100° F. and a viscosity-gravity constant greater than about 0.92, and between about 5 and about 40 per cent by weight of a light petroleum oil extract having a viscosity below about 200 SSU at 100° F., said flux oil having a viscosity between about 300 and about 8000 SSU at 100° F., a viscosity-gravity constant greater than about 0.90 a flash point above about 300° F., both of said extracts consisting essentially of aromatic-type hydrocarbons substantially free from asphaltenes, olefines, and cracked hydrocarbons, and both of said extracts having been prepared by a process involving contacting a straight run fraction from an aromatic hydrocarbon-containing crude petroleum with a liquid solvent so as to physically dissolve therein the desired aromatic hydrocarbons without dissolving the undesired non-aromatic hydrocarbons.

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