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PAVING ASPHALTS

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1 Claim. (Cl. 196—152)

1

This invention relates to novel bituminous compositions for hot and cold applications which are especially adapted to withstand weathering and aging and adhere more firmly to mineral aggregate, metals and other materials.

This application is a division of U. S. 708,793, filed November 8, 1946, now abandoned.

Mineral aggregate when used in the construction of bituminous pavements is bonded together by means of a bitumen, that is, each rock of the mineral aggregate is first provided with a coating of bitumen and the coated mineral aggregate is then laid and compacted.

The finished bituminous pavement must have a certain bearing strength to carry the traffic and must withstand cracking due to load stresses and thermal stresses. Since the mineral aggregates are solid bodies, any stress induced in a bituminous pavement can relax only through flow of the asphalt present. The asphalt used must possess sufficient adherence to hold the mineral aggregate, must withstand hardening through aging and must have flow characteristics in thin films of such a nature as to allow the relaxation of stresses.

Asphalts are a dispersion of asphaltenes in asphaltic resins and oily constituents. The asphaltenes in a given asphalt are not a single compound but represent a group of compounds of similar physical properties with different molecular weights and varying carbon-hydrogen ratios. At temperatures of approximately 250° F. and higher, the asphaltenes in a paving asphalt are dispersed as molecules. With decreasing temperature the asphaltenes aggregate into larger particles of varying size. This process further continues with time at temperatures where the asphalt is in a semi-solid state and is accompanied by an increase in consistency and degree of plasticity. Thus if an asphalt of given penetration is allowed to age under conditions which eliminate oxidation, it will be observed that the penetration decreases as a function of time. On reheating to 300° F. the original penetration and flow properties will be restored. These structural changes also take place in bituminous pavements, and it was found that the asphaltenes can aggregate into particles of such a size that they add frictional effects to the asphalt film and prevent the motion of the mineral particles past each other. As a result of this, pavement under stress behaves like an elastic body, and the stress cannot dissipate and if sufficiently high will cause cracking. The structural changes taking place in an asphalt

2

are therefore detrimental to the stability and durability of pavements.

Further investigation showed that the fraction of the asphaltenes with the highest carbon-hydrogen ratio is most responsible for the formation of structures, the increase in consistency and degree of plasticity in asphalts during aging. The properties of asphalts as a binder are therefore improved by treatment with paraffinic hydrocarbons of low boiling point or solvents of similar effect in such quantities and under such conditions as to precipitate only that fraction of the asphaltenes with the highest carbon-hydrogen ratio. As an example, the effect of this treatment upon a reduced asphalt prepared from cracking coil tar may be given which readily forms a thixotropic structure and more so after aging. This asphalt had the following penetrations at 77° F. under a load of 100 grams:

Penetration	104	149	183	211	235
Time in Seconds	5	10	15	20	25

d log Pen/d log t=0.53. (In this formula the symbol d is the calculus symbol indicating a differential.)

After 120 days of aging, this asphalt had the following penetrations:

Penetration	73.5	107	135.5	158	180
Time in Seconds	5	10	15	20	25

d log Pen/d log t=0.558.

This asphalt was dissolved in two parts by volume of benzene, and the asphaltenes were partially precipitated by the addition of four parts by volume of A. S. T. M. naphtha having a boiling range of 122° to 266° F. The mixture was filtered, distilled and finally blown with CO_2 at 400° F. to remove the last traces of solvents. The treated asphalt had a somewhat lower penetration apparently due to losses of the oily constituents. The treatment reduced the naphtha-insoluble material from 15.6 to 12.7%. The penetrations of this asphalt at 77° F. were as follows:

Penetration	95	134.5	164.5	190	212.5
Time in Seconds	5	10	15	20	25

d log Pen/d log t=0.5.

After 120 days of aging the penetrations of the treated asphalt were as follows:

Penetration	94.25	133.5	163.25	188.5	211
Time in Seconds	5	10	15	20	25

d log Pen/d log t=0.5.

As further examples of the effect of the treatment the following data may be given:

BEFORE AGING

Asphalt	S. P. in °F.	Pen. 100 gms. at 77° F.	d log Pen/d log t	n
Mexican	124	71½	0.447	1.23
Mexican treated	123½	72	0.465	1.15
Mid-Continent	126	64	0.400	1.50
Mid-Continent treated	126	65	0.452	1.21
AFTER AGING 4 MONTHS				
Mexican		58	0.405	1.47
Mexican treated		70	0.460	1.17
Mid-Continent		51	0.308	2.05
Mid-Continent treated		62	0.440	1.28

where n=degree of plasticity=$(1/d \log P/d \log t)-1$.

The results show that the elimination of asphaltenes of low solubility results in a product, the consistency and flow property of which are not changed by aging.

The desired elimination of asphaltenes may be obtained by the precipitation of about 5 to 20% of the total asphaltenes. These precipitated asphaltenes are the highest carbon-hydrogen ratio asphaltenes.

In order to eliminate the use of benzene as a solvent for the asphalt, the process can be also carried out by heating the asphalt to a temperature high enough, so that it can be easily mixed with naphtha under pressure if necessary. The naphtha may be substituted by propane, butane or pentane or by naphtha of higher boiling range such as kerosene.

What is claimed is:

A stable asphalt of improved aging properties produced by adding to an original asphalt a paraffinic hydrocarbon solvent at a temperature and pressure suitable to precipitate 5 to 20% of the total asphaltenes present, which precipitated asphaltenes are those having the highest carbon-hydrogen ratio, separating the precipitated asphaltenes, evaporating the solvent, and obtaining a final asphalt product characterized by properties providing a value of about 0.5 in the formula d log Pen/d log t, and having substantially the same softening point as the original asphalt, in the said formula the symbol d being the calculus symbol indicating a differential, the abbreviation "Pen" indicating the penetration at 77° F. under a load of 100 grams, and the symbol t indicating the time in seconds.

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