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ASPHALT BLENDING

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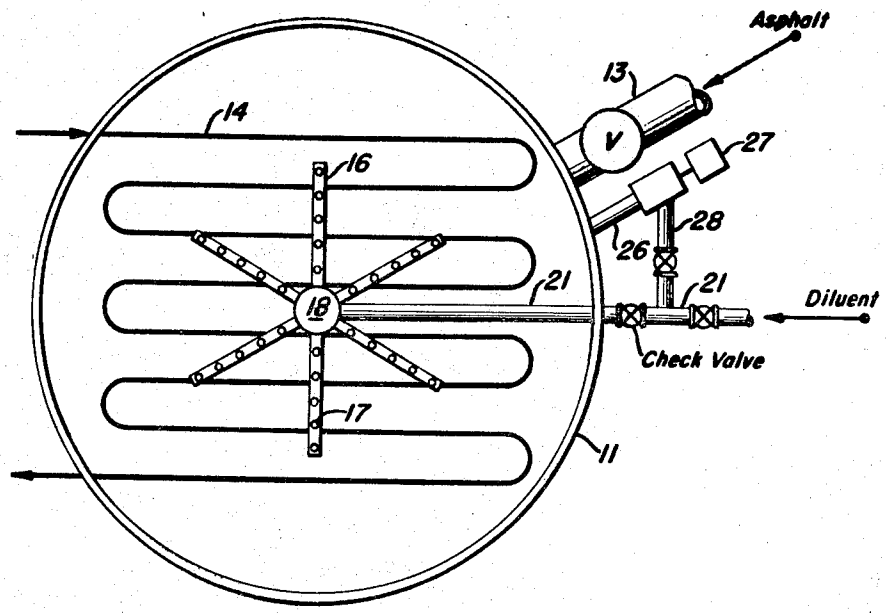


Fig. 2

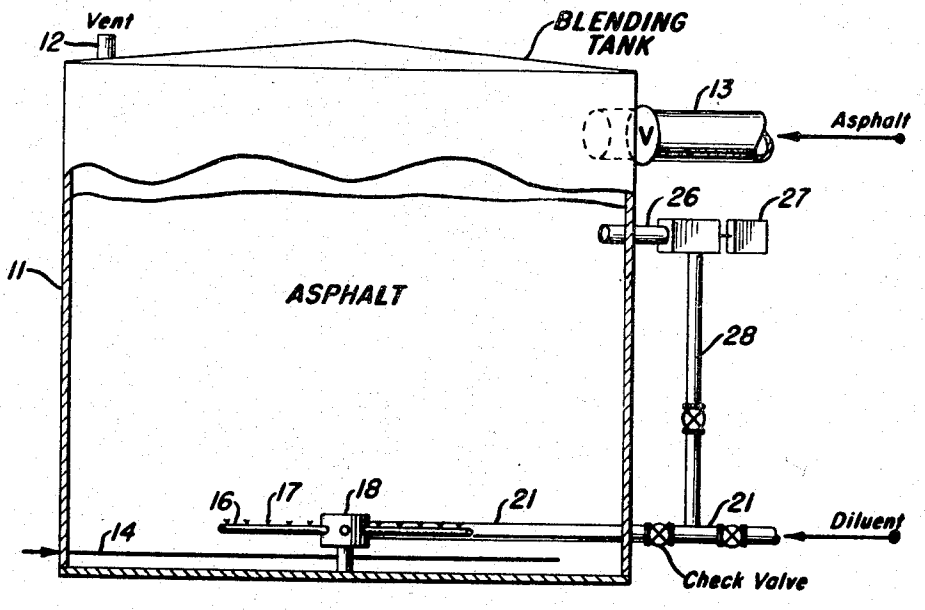


Fig. 1

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ASPHALT BLENDING

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This invention relates to the blending of very viscous hydrocarbonaceous materials and low viscosity hydrocarbon oils. Particularly the invention relates to the preparation of cut back asphalts.

A common problem to the refining of hydrocarbons and the use of viscous hydrocarbons lies in control of viscosity. More usually it is desired to take a viscous hydrocarbon, such as a petroleum residuum or an asphalt and blend it with a low viscosity oil to permit easy handling of the asphalt or residuum. For example, in road coating, the so-called cut back asphalts are used wherein a very viscous hydrocarbon is diluted or blended with a relatively low boiling hydrocarbon in order to make it easy to spray the blend onto the road surface, or more readily coat the surface of aggregate with subsequent vaporizing the diluent oil, leaving only the asphaltic material to do the actual binding.

The blending of a very viscous material such as an asphalt or a residuum with a low boiling hydrocarbon is not a simple task. Simply dumping the two materials into a tank and circulating the contents by pump requires frequently hours of circulation. The more usual method involves heating the viscous material to a temperature at which it is fairly fluid, adding the low boiling, low viscosity hydrocarbon to the tank and then agitating the contents with air until a material of substantially uniform viscosity throughout the tank is obtained. (A criterion of good blending is the substantially same viscosity of samples taken from different portions of the tank after agitation of the contents.) In view of the higher temperatures involved and the presence of free oxygen, a real fire hazard exists during such an air-blowing operation.

An object of the invention is the blending of a "solid or semi-solid" hydrocarbonaceous material and a low viscosity hydrocarbon oil in a simple and safe manner. Another object is a simple and safe procedure for preparation of cut back asphalts. Other objects will become apparent in the course of the detailed description of the invention.

The blending method of the instant invention comprises introducing a material selected from the class consisting of semi-solid and solid hydrocarbonaceous materials at a temperature such that the Saybolt Furol viscosity of said material is not more than about 3000 seconds, said temperature being between about 150° F. and about 350° F. into a tank provided with distributor means positioned substantially at the bottom of said tank, said distributor means being provided with a multiplicity of substantially uniformly spaced orifices, said orifices being between about ¼ and ¾ inch in diameter and being positioned so that fluid leaving said orifices is directed upward substantially perpendicularly to the bottom of said tank, and introducing through said distributor means a low viscosity hydrocarbon oil at a rate such that by the time all of said hydrocarbon oil has been introduced, the entire contents of said tank are substantially uniformly intermingled.

The hydrocarbonaceous material of high viscosity which is to be reduced in viscosity by admixture with a low viscosity hydrocarbon oil is a semi-solid or solid hydrocarbonaceous material such as a petroleum residuum (residual crude), residual asphalt, cracked tar, or blown asphalt. In addition to these products from the distillation of crude oil or hydrocarbon conversion operations, the method of the invention is applicable to native asphalts and asphaltites. It is to be understood that the terminology with respect to these high viscosity materials conforms to that of Abraham, Asphalts and Allied Substances, fourth edition. The method herein is applicable to any hydrocarbonaceous material which has a viscosity according to the Saybolt Furol scale of nor more than about 3000 seconds at a temperature not in excess of about 350° F. 350° F. is generally considered as about the maximum temperature at which cut back asphalts can be prepared.

The operating temperatures in general range between about 150° F. and 350° F., the temperature being adjusted so that the viscosity of the "base," i.e., the above-defined viscous material does not exceed about 3000 Saybolt Seconds Furol. When preparing cut back asphalts utilizing either petroleum residuums or asphalts as the base, in general it is preferred to use a temperature between about 175° F. and 250° F.

The low viscosity hydrocarbon oil utilized in the method herein may be any one of the oils commonly used in the preparation of cut back asphalts or in reducing the viscosity of very viscous hydrocarbon oils. In general, the diluent is a petroleum product boiling in the range between about 250° F. and 700° F. The diluent, for example, may be a virgin or cracked heavy naphtha, i.e., oil boiling over the range of about 250° F. to 450° F.; or, the diluent may be a kerosene or a light gas oil, either virgin, thermally cracked, or catalytically cracked, i.e., an oil boiling over the range of about 350° F. and 550° F. or a heavy gas oil which boils from about 500° F. to about 700° F. may be used.

The amount of diluent utilized is naturally dependent upon the viscosity of the particular base and the viscosity of the particular diluent and the viscosity desired for the blend. In the preparation of cut back asphalts, in general the final blend will contain from about 5 volume percent to as much as 60 volume percent of the diluent. Or, in other words, from about 5 volumes to about 150 volumes of diluent will be used per 100 volumes of the base.

The method of this invention is described in detail in connection with the annexed figures which set out one illustrative embodiment of the invention.

Figure 1 shows a side view of a tank adapted for utilization of the invention in the preparation of a cut back asphalt.

Figure 2 shows a top view of the interior of the tank of Figure 1.

Blending tank 11 is a conventional cone-roofed tank provided with conventional vent 12; any type of tank which is suitable for storage of hydrocarbon materials having the characteristics of the final blend is suitable for

use in this blending technique. Tank **11** is provided with a valved conduit **13** positioned near the top of the tank **11** for the introduction of the high viscosity base. Herein an asphalt is introduced, which asphalt has a softening point ASTM of 110° F., a penetration at 77° F. of 110 and a viscosity at 300° F. SSF of 65 and of 3100 SSF at 184° F.

Positioned at the bottom of the tank is a steam coil **14**. Immediately above steam coil **14** is set out a distributor means **16**. The distributor means **16** is positioned substantially at the bottom of the tank. In this instance, distributor means **16** is about 18 inches above the bottom of the tank with the steam coil being positioned about 9 inches above the bottom of the tank **11**. The distributor means **16** is provided with a multiplicity of orifices **17**, etc. These orifices are substantially uniformly spaced relative to each other. Distributor means and its orifices are set out over the horizontal cross-section of tank **11** so that "dead spaces" are virtually eliminated when the contents of the tank are agitated by the introduction of the diluent. Orifices **17**, etc. are positioned on the distributor means so that fluid emerging or leaving the orifices is directed upward substantially perpendicularly to the bottom of tank **11**, i.e., the orifices are on the upper surface of distributor means **16**.

In this embodiment, distributor means **16** is a conventional spider such as is used in introduction of air for the agitation of contents of a tank when using air for the blending of cut back asphalt. In this instance, a six-armed spider is used. The diameter of the spider is about one-half the diameter of the tank **11**. Orifices **17**, etc. are spaced uniformly on the arms of the spider **16**. The arms radiate from a central manifold **18**.

It is to be understood that the invention is not limited to the use of a spider having this number of arms—for example, 3 and 4 arms may be adequate—or even to the use of a spider. The distributor means may consist of one or more ring-like tubes positioned concentrically within tank **11**, for example, 2 or 3 rings may be positioned about the vertical axis of tank **11** so that fluid emerging from the orifices positioned on the top of the ring-like tubing will produce the necessary agitation. Still another arrangement may be the use of parallel tubing manifolded to a common header to provide the necessary distribution of orifices.

The size of the orifices will be determined in part by the tank, the material to be used, the pump pressure which may be developed by the diluent pump, etc. Usually the orifices will have a diameter between about one-quarter and three-quarters inch. It is to be understood that smaller or larger diameters may be used, depending on the circumstances and the invention is not to be limited to this precise range of diameters.

Diluent hydrocarbon is introduced by way of line **21** which is joined to manifold **18**. Line **21** is provided with a valve and also a check valve which prevents the contents of the tank from passing back through line **21**.

In carrying out blending according to the method of this invention, the asphalt is introduced into the tank **11** by way of line **13** to the desired amount. Diluent is then pumped through line **21**, manifold **18**, distributor means **16**, and emerges into the tank through orifices **17** etc. The diluent is introduced at a rate such that the jetting fluid, emerging from the orifices, causes violent agitation of the contents of the tank and rapid intermingling of the diluent and the asphalt. In general, the rate of introduction of diluent is such that the fluid emerging from the orifices will reach to about the top of the body of asphalt within the tank. A particularly suitable rate is such that the streams from said orifices have about ten feet of head above the distributor when the tank does not contain the hydrocarbonaceous material, i.e., is empty. By controlling the rate of diluent addition and meeting the above defined requirements of hydrocarbonaceous material viscosity, it is possible to produce an intermingled diluent-base blend at the end of the diluent introduction period, which blend is substantially completely intermingled. By the term "substantially completely intermingled" it is understood that samples taken from various portions of the tank will have substantially the same viscosity.

In some cases, either due to impracticality of controlling the addition rate, or the need for using a very small amount of diluent with respect to a particular asphalt, substantially uniform intermingling is not obtainable during the time that the diluent is being added. Or, for some reason, it may be desirable to add the diluent at such a rate that free diluent appears above the asphalt layer in the tank resulting in a two-layer situation of diluent and particularly blended asphalt. When this occurs, it is possible to rapidly produce a uniform blend by circulating the contents of the tank by way of line **26**, pump **27** and valve line **28** back through line **21**, manifold **18**, distributor means **16**, and orifices **17**, etc. Thus the invention is usable not only for obtaining rapid intermingling of a diluent and a very viscous material without circulation of the tank contents through an external system, but is also useful for obtaining complete intermingling of a tank which contains material having non-uniform viscosity due to improper blending or other operational difficulties. For example, for some reason it may be desirable to introduce material through line **13**, both with respect to the asphalt and with respect to the diluent, thus temporarily forming a two-layer condition. Then the contents of the tank will be agitated by circulation through lines **26**, **28** and **21**. It is necessary when doing this that line **26** draw on diluent material in order to start the blending operation.

The effectiveness of the blending method of this invention is illustrated by the following working examples. It is to be understood that these working examples are merely typical and do not limit the scope of the claimed invention.

Test 1

This test was carried out in a cone-roof tank. The tank was 20 feet internal diameter and had a straight height of 30 feet. Steam coils were positioned about one foot above the bottom. An X-shaped spider was positioned just above the air coils. The diameter of the spider was 6 feet. The spider was provided with orifices ranging from one-quarter to one-half inch in diameter and spaced about six inches apart. The tank was provided with thermocouples at various points and sample points were provided to permit removal of material at various points in the tank. It was found in the tests that temperature gradient in the tank was an excellent measure of the degree of mixing of the hot base and the diluent.

The base used in this test had a softening point of 111° F., a penetration at 77° F. of 110 and had an SSF viscosity of 3100 at 184° F. The diluent was a gas oil derived from catalytic cracking operation. The diluent had a 28° API gravity, an ASTM boiling range of 350° F. to 620° F., and a Saybolt Universal viscosity of 34 seconds at 100° F.

17,550 gallons of the base at a temperature of 243° F. were pumped into the tank; this represents 7.5 feet of tank height. 12,300 gallons of the diluent at about 70° F. were pumped into the tank through the spider over a period of 75 minutes. This represents a rate of 164 gallons per minute. At the end of the diluent delivery, the temperature of the contents of the tank was 164° F. and the S.S.F. viscosity at 77° F. was 124.

In order to check on the uniformity of the mixture in the tank, air was introduced through the distributor for 30 minutes in the normal type of blending operation. At the end of this time, a sample of material was taken from the tank and its S.S.F. viscosity at 77° F. was 125. This shows that at the completion of the diluent injection

through the distributor orifices the contents of the tank were uniformly mixed.

Test 2

In this test, the same tank as used in Test 1 was utilized. 17,250 gallons of the base used in Test 1 was pumped into the tank at a temperature of 255° F. The diluent in an amount of 12,750 gallons was introduced through the distributor orifices at 70° F. over a period of 87 minutes; this was at a rate of 147 gallons per minute. At the completion of the diluent introduction the temperature distribution in the tank was uniform at 173° F. A sample of the tank contents had an S.S.F. viscosity at 77° F. of 192. The contents of the tank were then circulated by means of a gear pump at a rate of 15,000 gallons per minute for 4 hours. At the end of the circulation, a sample of the tank had an S.S.F. viscosity at 77° F. of 196. This shows that the contents of the tank were uniformly intermingled at the completion of the diluent introduction through the orifices.

Test 3

In this test, 24,700 gallons of the base used in Test 1 were introduced into the same tank as used in Test 1. In order to determine mixing on a lower diluent content blend, only 4,780 gallons of the diluent of Test 1 were added through the distributor orifices. The diluent was added at a rate of 120 gallons per minute over a period of 40 minutes. At the end of the diluent distribution, the temperature distribution in the tank was uniform at 200° F. The viscosity of the blend was 559 S.S.F. at 140° F. Circulation of the tank contents for 3 hours with the gear pump as described in Test 2 did not significantly change the viscosity of the contents.

Test 4

In this test, the conventional procedure was used to mix a blend in the tank of the previous three tests. 23,400 gallons of the base was introduced into the tank at 211° F. 6,450 gallons of the diluent at 70° F. were introduced into the tank through an ordinary line. The contents of the tank were then circulated at 15,000 gallons per minute through a gear pump for 23 hours. The temperature distribution throughout the tank indicated that uniformity of mix had not yet been attained. At this time the viscosity of a sample drawn from the normal discharge line was 444 S.S.F. at 140° F.

At this time air was introduced through the distributor and continued for 15 minutes. After the air blow, temperature distribution indicated that the contents of the tank were now substantially completely mixed and the viscosity of a sample of the blend was 351 S.S.F. at 140° F.

Test 5

In this test, 143,000 gallons of the base utilized in the previous test was introduced into a tank having a 40 foot internal diameter. This tank was provided with an internal distributor having an X-shape of about 12 feet in diameter, similar in construction to that utilized in Tests 1 through 3. The base had a temperature of 184° F. at the start of the operation. Over a period of 5½ hours, at a rate of 76 gallons per minute, 25,000 gallons of the diluent utilized in the previous test was introduced into the tank. The viscosity showed that at the completion of the diluent introduction time the contents of the tank were uniformly mixed. The S.S.F. viscosity of the final blend at 140° F. was 1017.

The above tests show that the procedure of the instant invention is beyond comparison better than the pump circulation method of blending of cut back asphalts and is as effective, when considering the time needed to introduce the diluent into the tank, as is the conventional procedure of air blowing after the introduction of the asphalt and the diluent, and completely avoids the fire and explosion hazard of the presence of free oxygen at these elevated temperatures.

Thus having described the invention, what is claimed is:

1. In the method of preparing a cutback asphalt from a material selected from the class consisting of semi-solid and solid hydrocarbonaceous materials and a low viscosity hydrocarbon oil which method utilizes a tank provided with distributor means positioned substantially at the bottom of said tank, said distributor means being provided with a multiplicity of substantially uniformly spaced orifices, said orifices being between about ¼ and ¾ inch in diameter and being positioned so that fluid leaving said orifices is directed upwardly in a direction, substantially perpendicular to the bottom of said tank, said orifices being ordinarily utilized for the introduction of gaseous fluid to afford agitation of the contents of said tank to produce the cutback asphalt, the improvement which comprises introducing said hydrocarbonaceous materials into said tank, maintaining said materials at a temperature between about 150° F. and about 350° to afford a Saybolt Furol viscosity of not more than about 3000 seconds, and introducing said low viscosity hydrocarbon oil through said distributor means at a rate causing violent agitation of the contents of said tank such that by the time all of said hydrocarbon oil has been introduced into said tank the entire contents of said tank are substantially completely intermingled to form the cutback asphalt.

2. In the method of preparing a cutback asphalt from a material selected from the class consisting of semi-solid and solid hydrocarbonaceous materials and a low viscosity hydrocarbon oil which method utilizes a tank provided with distributor means positioned substantially at the bottom of said tank, said distributor means being provided with a multiplicity of substantially uniformly spaced orifices, said orifices being between about ¼ and ¾ inch in diameter and being positioned so that fluid leaving said orifices is directed upwardly in a direction, substantially perpendicular to the bottom of said tank, said orifices being ordinarily utilized for the introduction of gaseous fluid to afford agitation of the contents of said tank to produce the cutback asphalt, the improvement which comprises introducing said hydrocarbonaceous materials into said tank, maintaining said materials at a temperature between about 150° F. and about 350° to afford a Saybolt Furol viscosity of not more than about 3000 seconds, and introducing said low viscosity hydrocarbon oil through said distributor means at a rate such that substantial uniformity of viscosity of contents of such tank is not attained during the entry of said oil and circulating the contents of said tank through said distributor means by way of said orifices until the viscosity of the contents of said tank has become substantially uniform.

3. The process of claim 1 wherein said hydrocarbonaceous materials are selected from the class consisting of residual oil, resdiual asphalt, cracked tar, blown asphalt, native asphalt and asphaltite.

4. The method of claim 1 wherein said low viscosity hydrocarbon oil is a petroleum oil boiling within the range of about 250° F. and 700° F.

5. The method of blending a low viscosity hydrocarbon oil diluent with a material selected from the class consisting of semi-solid and solid hydrocarbonaceous materials to obtain a cutback asphalt, which method consists essentially of forming a body of said material in a blending zone, maintaining said body at a temperature between about 150° F. and about 350° F. to afford a Saybolt Furol viscosity of not more than about 3000 seconds, and introducing said diluent into said zone in the form of a multiplicity of jet-streams directed substantially perpendicularly upward into said body, at a rate causing violent agitation of the contents of said zone, such that a substantially completely intermingled blend of said material and said diluent is obtained when all of said diluent has been introduced into said zone.

6. The method of blending a low viscosity hydrocarbon oil diluent with a material selected from the class con-

sisting of semi-solid and solid hydrocarbonaceous materials to obtain a cutback asphalt, which method consists essentially of forming a body of said material in a blending zone, maintaining said body at a temperature between about 150° F. and about 350° F. to afford a Saybolt Furol viscosity of not more than about 3000 seconds, and introducing said diluent into said zone in the form of a multiplicity of jet-streams directed substantially perpendicularly upward into said body, at a rate causing agitation of the contents of said zone, such that a substantially complete intermingling of said material and said diluent has not been obtained when all of said diluent has been introduced into said zone, and thereafter circulating the contents of said zone in the form of aforesaid jet-streams

until a substantially completely intermingled blend of said material and said diluent has been obtained.

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