PROCESS FOR EXTRACTING AND PURIFYING BITUMEN

Filed Oct. 14, 1946

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This invention relates to a process and apparatus for extracting bitumen from rock asphalt. The primary object of this invention is to provide for the dissolution of bitumen, or substantially pure asphaltum, from the aggregate of finely crushed or comminuted rock, sand, and the like earthen matter in which it naturally occurs, one example of which is a natural deposit being found near Brownsville, Kentucky. Heretofore, attempts have been made to extract and purify bitumen from its aggregate simply by flowing a solvent for the bitumen directly through a body of crushed rock asphalt and subsequently boiling off the solvent, and while small amounts have been so obtained, the major portion of the bitumen collected in definite, impermeable layers or hardpan in the aggregate. The material forming the hardpan was not only lost to the desired product, but the hardpan blocked further flow of the solvent therefrom, so that once the hardpan formed, further attempts to continue the process were useless. Further, it was found that if a confined body of rock asphalt was saturated with a solvent, not one but several hardpans formed in well defined, vertically spaced horizontal strata. The object here is to provide an apparatus and process for flowing solvent through a mass of rock asphalt in such manner that the tendency of stratification is substantially overcome and so that whatever hardpan starts to form is both rendered harmless and automatically eliminated at its very inception.

In the physical embodiment of the invention, it is proposed to provide a chamber for receiving an undistributed mass of natural but crushed rock asphalt, and a fluid system for flowing solvent into the chamber at its top and for elucent or the solvent and dissolved bitumen at the chamber bottom, the chamber thus forming a primary vertical passage for the fluid. The particular inventive feature concerns the provision of a plurality of relatively short secondary vertical passages disposed at spaced vertical and angular intervals around the exterior of the chamber, the length and vertical placement of the secondary passages being such as to bridge at least part of the vertical section which, for them would, in the process, soon be occupied entirely by hardpan.

These and other objects will be apparent from the following specification and drawings, in which:

Fig. 1 is an elevation, broken away in parts, illustrating the extracting chamber; and,

Fig. 2 is a diagram illustrating fluid flow in the system utilizing the extracting chamber.

Referring now to the drawing, in which like reference numerals denote similar elements, the extracting and purifying chamber, indicated generally at 2, is provided with a removable top 4 having a solvent inlet 6 coupled at 8 with a solvent supply pipe 10.

Chamber 2, having a cylindrical side wall 12 and a perforated bottom 14, rests at the top of a cylindrical reservoir 16 which, in turn, has suitable structural supports (not shown) and an outlet pipe 18, it being understood that chamber 2 is removable, by conventional but not illustrated lifting rings or the like, from reservoir 16 so that an aggregate of crushed rock asphalt 20 may be loaded in or dumped from the chamber.

The operation of the apparatus thus far described is as follows: after chamber 2 has been filled with the aggregate 20 of crushed rock asphalt, a solvent is introduced through inlet 6. The preferred solvent is casing head gasoline enriched with a relatively small percentage of a higher boiling solvent, such as one gallon of any one of a number of commercial hydrocarbon paint thinners to each fifty gallons of gasoline (assuming this example that chamber 2 contains 850 pounds of finely crushed Kentucky rock asphalt). The solvent passes downwardly through aggregate 20 to pick up and carry with it the bitumen from the aggregate, through perforated bottom 14, to reservoir 16. This action continues for a short time until layers of hardpan 22 form in the aggregate.

These hardpans, in the absence of the inventive apparatus, would block further flow of the solvent and thus terminate the process.

One characteristic of the hardpan, formed of starshaped granules of crushed rock, or sand closely compacted with bitumen, is that it is extremely hard and crusty on top, as indicated at 24, and that it tapers off somewhat in consistency towards the bottom of the layer. Another characteristic is that it is to form in several distinct horizontal strata with substantially constant vertical spacing, evidently proportional to the bitumen content of the aggregate which, near Brownsville, Kentucky, averages about 6 per cent by weight. While the sand between the formed hardpans is then relatively light in bitumen content, attempts to force solvent through the sands and hardpans only impacts the crust of the first hardpan encountered.

In accordance with the invention, a number of secondary passages 26 are arranged around...
chamber 2, these passages being defined by C-shaped pipes 28 having their ends connected into openings 30 inside wall 12. It should be noted particularly that vertically spaced sets of pipes 28 are arranged with the C-shaped pipes 28 forming each set disposed with their upper ends communicating through openings 30 with the interior of chamber 2 just above the level at which the crust 24 of a hardpan 22 tends to form, while the lower ends of pipes 28 enter the chamber to the side of, but near the bottom of, a hardpan.

The function of secondary passages 26 is as follows: as the solvent flows downwardly through aggregate 20 in chamber 2, which may be considered the primary passage, and dissolves bitumen from the sands, the solution thereby becomes thicker and tends to stratify to form hardpan 22. In the example now described, however, hardpan 22 never do form completely since, as they start to form, the resistance to downward flow of the solvent is increased so that, at the top of an incipient hardpan, the relatively clear solvent flows off to the side, into the upper ends of pipes 28 and through the pipe-defined secondary passages 26 from which it is introduced back into the lower portion of the thickening strata. Upon introduction of the solvent into the lower portion of the vadose hardpan, the strata of the thickened solution of bitumen and solvent are undercut by the relatively clear solvent flowing around from the top so that the strata, in effect, destroy themselves before they encrust and form complete hardpan.

The action of the secondary passages 26 may be observed by forming some of pipes 28 as glass gauges. In the course of a typical run, cloudy liquid, i.e., the solvent and bitumen, may be observed flowing downwardly through the several gauges until, after a few minutes, the liquid clarifies, thereby indicating that the formation of the strata has commenced and that the solvent is flowing sidewise off the top of the strata without picking up appreciable amounts of bitumen. After clear liquid flows in the gauges 28a and pipes 28 for a few minutes, it again becomes occluded and flows less rapidly through the gauges, thereby denoting that the strata have been broken up and that the fluid flow is primarily downward through chamber 2. These phases may repeat many times in a typical five hour run.

It has been observed that the strata to form closer together towards the bottom of the chamber, and that those strata near the bottom are of greater consistency. Accordingly, the several sets of pipes 28 should be closer spaced towards the bottom and there should be more pipes per set in the lower sets. To prescribe against an occasional dephasing of the strata, a few long secondary pipes 28 and gauges 28a' are disposed at more widely spaced vertical and horizontal intervals. If, desired, suitable perforate guards may be placed over the upper-inner ends of pipes 28 to prevent clogging, although such clogging has not yet been recognized as a problem.

As diagrammed in Fig. 2, the system further includes an outlet valve 34 in outlet pipe 36, a pipe 36 leading from valve 34 to an evaporator 38, a gas heater 40 under evaporator 38, a vapor return pipe 42 leading from evaporator 38 to a condenser 44 and the solvents inlet pipe from condenser 44 to this top of chamber 2 so that a continuous process re-using the solvent may be carried on, as will be apparent to those skilled in the art.

At the end of a run as described above, outlet valve 34 may be closed and burner 40 left on sufficiently long to drive off most of the solvent through vapor return pipe 42, condenser 44, supply pipe 18, chamber 2, and collected in reservoir 16 after which burner 40 may be extinguished and substantially pure bitumen drawn from evaporator 38 through tap 48. With the ingredients as set forth however, about 20 gallons of highly watery bituminous paint containing about 40% bitumen and 60% solvent has been obtained by eliminating the solvent recovery step outlined above. If desired, the solvent remaining after a run in the cleansed sands may be recovered by known methods and apparatus.

While a successfully proved method and apparatus has been detailed for purposes of illustrating the concept, it is to be understood that the invention is not limited to the specific apparatus and steps disclosed, but is intended to embrace all modifications, substitutions and equivalents within the scope of the following claims.

I claim:

1. In the process for extracting and purifying bitumen from an aggregate of bitumen-bearing crushed ore, the steps which comprise flowing a solvent for the bitumen through the body of the aggregate until bitumen stratifies horizontally to form at least one hardpan in the body, withdrawing solvent off the top of the hardpan, and introducing the withdrawn solvent into the hardpan near the bottom thereof.

2. In the process for extracting and purifying bitumen from an aggregate of bitumen-bearing ore, the steps which comprise flowing a solvent for the bitumen generally vertically through a body of the aggregate until the bitumen stratifies to form at least one hardpan in the body, withdrawing solvent off the top of the hardpan, introducing the withdrawn solvent into the hardpan near the bottom thereof until the hardpan is undercut, and flowing solvent generally vertically through the undercut hardpan.

3. In the process for extracting and purifying bitumen from an aggregate of bitumen-bearing ore, the steps which comprise flowing a solvent for the bitumen generally downwardly through a body of the aggregate until the bitumen stratifies to form a plurality of hardpans in the body, draining off solvent into the lower portion of the hardpans, and introducing the drained-off solvent into the lower portion of the hardpans near the bottom thereof.

4. In the process for extracting and purifying bitumen from an aggregate of bitumen-bearing ore, the steps which comprise flowing a solvent for the bitumen generally downwardly through a body of the aggregate until the bitumen stratifies to form at least one hardpan, collecting solvent on the top of the hardpan, draining off a portion of the collected solvent, and introducing said portion generally horizontally into the lower portion of said hardpan to undercut the hardpan until the solvent thereafter breaks downwardly through.

5. In the process for extracting and purifying bitumen from an aggregate of bitumen-bearing ore, the steps which comprise flowing a solvent for the bitumen generally downwardly through a body of the aggregate until the bitumen stratifies to form a plurality of vertically spaced horizontally extending hardpans, and simultaneously introducing said solvent substantially laterally into the hardpans near the bottom thereof to undercut the same.
6. In the process for extracting and purifying bitumen from an aggregate of bitumen-bearing ore, the steps which comprise flowing a solvent for the bitumen generally downwardly through a body of the aggregate until the bitumen stratifies to form at least one hardpan, collecting solvent on the top of the hardpan, withdrawing a portion of the collected solvent, and introducing the withdrawn solvent into the hardpan near the bottom thereof until the hardpan is undercut and until the remaining solvent collected above the hardpan breaks downwardly therethrough.

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The following references are of record in the file of this patent:

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