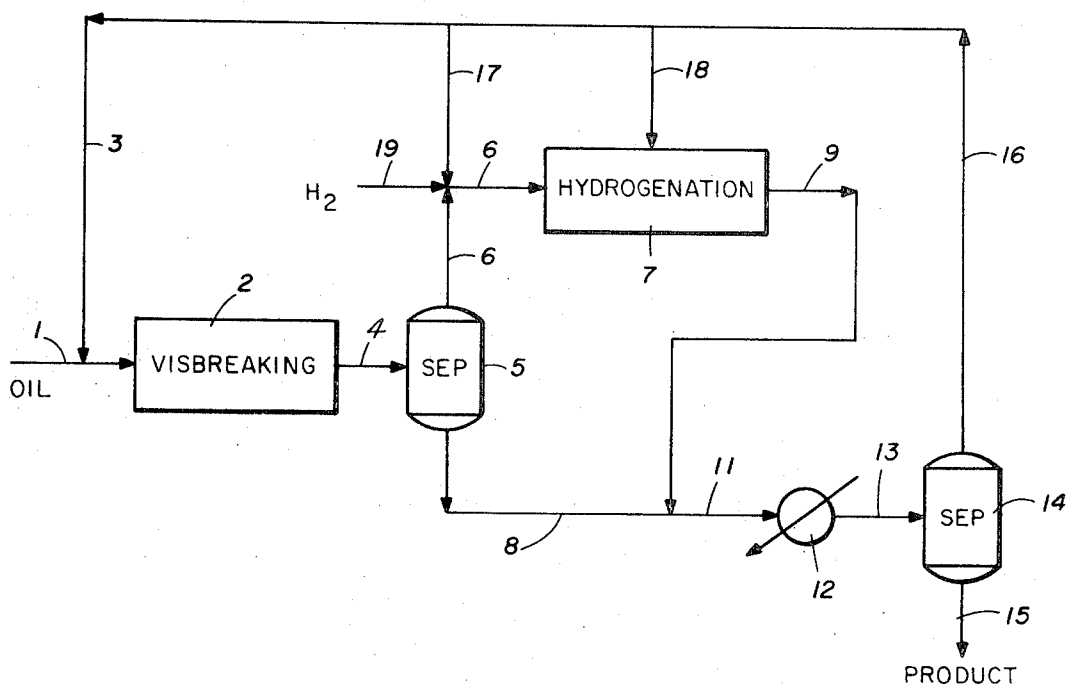


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METHOD FOR TREATING SYNTHETIC CRUDE
OIL FOR POUR POINT REDUCTION
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METHOD FOR TREATING SYNTHETIC CRUDE OIL FOR POUR POINT REDUCTION

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3 Claims

ABSTRACT OF THE DISCLOSURE

A method is provided for treating synthetic crude oil to reduce its pour point and to stabilize the reduced pour point by visbreaking the crude oil in the presence of hydrogen so that from about 50 to about 200 s.c.f. of hydrogen is consumed per barrel of oil treated, separating vapors from the visbroken oil under conditions of temperature and pressure which are not substantially different from the conditions of the visbreaking operation, hydrogenating the vaporized portion of the visbroken oil, and combining at least part of the unvaporized oil with at least part of the hydrogenated vaporized visbroken oil to provide an oil product suitable for conventional storage, transportation, and the like.

BACKGROUND OF THE INVENTION

Heretofore it has been taught to reduce the pour point of shale oil by visbreaking the shale oil in the absence of hydrogen followed by fractionation of the visbroken oil in a distillation column. This is fully and completely disclosed in U.S. Pat. 3,523,071, the disclosure of which is incorporated herein by reference.

Hydro-visbreaking of shale oil using widely varying amounts of hydrogen has been taught in U.S. Pat. 3,532,618, the disclosure of which is incorporated herein by reference.

SUMMARY OF THE INVENTION

It has now been found that visbreaking of synthetic crude oil in the presence of hydrogen while utilizing controlled hydrogen consumption rates helps stabilize the reduced pour point of an oil product obtained by combining visbroken oil with visbroken and hydrogenated oil. The resulting combination of oils is a product of reduced pour point which is suitable for storage, transportation such as in a pipeline or tanker, and the like, without concern about the product becoming so viscous that is cannot be pumped or otherwise conventionally handled.

Further by this invention, after visbreaking of the oil in the presence of hydrogen according to this invention a major portion of the oil can be separated by a holding type of separation treatment instead of the distillation taught in the prior art. By this discovery suitable separation conditions can be achieved while keeping the temperature and pressure substantially the same as the visbreaking conditions. In this manner the elevated temperature and pressure of visbreaking can be substantially maintained in the separation step. This was not possible with distillation. This is helpful because the vaporized oil removed by the separation step can then be subjected to hydrogenation without substantial loss of heat or pressure between the visbreaking and hydrogenating steps. This conservation of heat and pressure is a significant process advantage.

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Accordingly, it is an object of this invention to provide a new and improved process for treating synthetic crude oil. It is another object to provide a new and improved method for providing a pour point depressed and stabilized synthetic crude oil product suitable for conventional storage, transportation, and the like.

Other aspects, objects, and advantages of this invention will be apparent to those skilled in the art from this disclosure and the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

The drawing shows schematically a flow scheme according to this invention.

More specifically, the drawing shows synthetic crude oil in pipe 1 passing into visbreaking zone 2. Hydrogen is added to the oil by way of pipe 3 so that hydrogen is present when the oil is subjected to the elevated temperatures and pressures maintained in zone 2.

The visbroken oil is removed from zone 2 by way of pipe 4 and passed to and held in first separation zone 5 wherein the temperature and pressure conditions are maintained close to those of visbreaking zone 2 except for normal temperature and pressure drops due to pipe 4. During the holding in zone 5 separation occurs of vapors which can constitute a major portion (i.e., at least about 50 weight percent based on the total weight of the liquid oil in pipe 1) of the liquid feed oil. The oil vapors in first separation zone 5 are removed by way of pipe 6 and passed into hydrogenation zone 7.

The unvaporized visbroken oil present in zone 5 is removed substantially in the liquid state by way of pipe 8. The liquid in pipe 4 has a pour point at least 20° F. below that of the oil in pipe 1 and preferably has a pour point below 0° F. In addition, the pour point of the liquid in pipe 4 is stabilized so that it will not increase significantly upon long standing or handling at ambient atmospheric temperatures or even at more elevated temperatures.

The amount of vaporized hydrocarbon or oil removed in pipe 6 can be controlled by the amount of hydrogen added by way of pipe 3. Generally, the more hydrogen added by way of pipe 3, the more hydrocarbon or oil vapor removed by pipe 6.

The hydrogenated vaporized oil is removed from zone 7 by way of pipe 9 and all or part can be combined with all or part of the material in pipe 8. The combined materials in pipe 11 are a pour point depressed and stabilized oil.

The combined materials in pipe 11 are at an elevated temperature which is lowered by way of cooling means 12. The combined materials, after cooling, are still at an elevated pressure when passed by way of pipe 13 to a second separation zone 14. In zone 14 the temperature and pressure are maintained substantially the same and gas such as hydrogen gas allowed to separate from the liquid oil to degasify the liquid oil product. The product is removed by way of pipe 15. Recovered hydrogen gas is returned by way of pipe 16 to the process. The hydrogen gas in pipe 16 is reused in pipe 1 by way of pipe 3 and/or in pipe 6 by way of pipe 17 and/or as a cooling or quenching gas for zone 7 by way of pipe 18. Makeup hydrogen can be added as necessary by way of pipe 19.

The product in pipe 15 is a liquid oil product suitable for storage, transportation, further refining, and the like, since the product is readily flowable due to the hydrogenation step and since the pour point is depressed in a

stable manner so that the reduced pour point will remain as such during subsequent handling. Heretofore it has been found that the pour point of visbroken oil could increase with time, but visbreaking with controlled hydrogen consumption according to this invention reduces and stabilizes the pour point of the oil in pipe 15 so that the pour point will not substantially increase thereafter.

By the use of zone 5 in accordance with this invention, the temperature and pressure conditions in zone 5 can be maintained substantially the same as the conditions in zone 2. Thus, a maximum amount of heat and pressure is conserved while still separating the material to be hydrogenated from the liquid in pipe 8. This is to be distinguished from the situation where a conventional distillation zone is utilized. With the use of a distillation zone the temperature and pressure is decreased substantially from that of visbreaking zone 2. Therefore, a substantial loss of heat and pressure results whereas with the use of separation zone 5 maximum conservation of heat and pressure for hydrogenation zone 7 is achieved while still achieving separation of the oil desired for hydrogenation.

The synthetic crude oil employed in this invention can be any crude oil other than naturally occurring crude oil, e.g., oil obtained from oil shale, tar sands, coal, and the like. This invention applies to the full range of synthetic crude oils, from residuals or bottoms, fractions to overhead fractions obtained by retorting, and the like.

The visbreaking conditions for this invention are a temperature of from about 600 to about 1000° F., preferably from about 650 to about 850° F.; a pressure of at least about 500 p.s.i.g., preferably from about 500 to about 1500 p.s.i.g.; and a time of at least about 3 minutes, preferably from about 3 to about 30 minutes.

The amount of hydrogen necessarily consumed during visbreaking in order to obtain a stabilized reduced pour point is from about 50 to about 200 standard cubic feet (s.c.f.) per barrel of oil being visbroken.

The vaporized oil in pipe 6 is at an elevated temperature and pressure closely approximating those of visbreaking zone 2 when it reaches hydrogenation zone 7. The oil in pipe 6 is, therefore, heated and pressured sufficiently so that only hydrogen need be added to obtain the desired degree of hydrogenation. Reheating and/or repressuring of the vaporized oil for hydrogenation zone 7 is eliminated. This is an advantage over the use of a distillation zone since repressuring and/or reheating would be necessary with such a fractionation zone.

The hydrogenation operation 7 is carried out in a conventional manner. For example, the zone can contain known hydrogenation catalysts such as a combination of a Group VI metal (e.g., chromium, molybdenum, and/or tungsten) with a Group VIII metal (such as iron, nickel, and/or cobalt). A suitable catalyst is cobalt molybdate. Hydrogenation is carried out at a temperature of at least about 650° F., preferably from about 650 to about 900° F., a pressure of at least about 1000 p.s.i.g., preferably from about 1000 to about 3000 p.s.i.g., a liquid hourly space velocity from about 0.1 to about 2 volume per hour per volume, and a molecular hydrogen addition rate of at least about 2000, preferably from about 2000 to about 10,000 s.c.f. per barrel of oil to be hydrogenated.

All or part of the pour point depressant in pipe 8 can be combined with all or part of the hydrogenated oil of pipe 10. The combination of materials in pipe 11 are at least partially liquefied by cooling substantially to ambient temperature by cooling means 12. The cooled liquid oil in pipe 13 is then passed to second separation zone 14 wherein at least hydrogen gas and/or hydrogen containing gases are allowed to separate from the liquid thereby stabilizing the liquid by having degasified same and at the same time recovering hydrogen or hydrogen containing gas for reuse in one or more of zones 2, 5, and 7.

The product in pipe 15 has a pour point at least about

20° F. below the pour point of the feed oil in pipe 1. The reduced pour point will remain stable during subsequent handling, etc. so that one purchasing this product can rely upon the pour point of the product as purchased remaining substantially unchanged.

Example

A full range shale oil obtained by retorting Colorado oil shale was fractionated and the 380° F.+ (including bottoms) fraction was tested as the feed oil. The feed oil had a pour point of +80° F.

Two visbreaking runs were made, one utilizing hydrogen according to this invention and the other utilizing nitrogen so that the conditions of the second run could be kept comparable to the first (hydrogen) run.

In the first run the visbreaking temperature and pressure were 825° F. and 1000 p.s.i.g. The visbreaking time was 10 minutes and the amount of hydrogen consumed during visbreaking was 50 s.c.f. per barrel of feed oil. The pour point of the visbroken oil from the first run was -45° F.

The second run was carried out in the absence of added hydrogen utilizing an 825° F. temperature, a 1000 p.s.i.g. total pressure maintained by the addition of nitrogen, and a 10 minute visbreaking time. The visbroken oil had a pour point of -30° F.

Samples of visbroken oils from both the first and second runs were aged 9 months in a sealed container at room temperature (about 80° F.) and the pour point of the samples then remeasured. The pour point of the sample from the first (hydrogen) run remained the same at -45° F. whereas the pour point of the sample from the second run had increased a total of 35° F. to +5° F.

It can be seen from the above that by carrying out the visbreaking step with controlled hydrogen consumption in accordance with this invention, pour point reduction is stabilized so that the reduced pour point remains substantially unchanged.

After separation and catalytic hydrogenation of the vaporized oil over cobalt molybdate catalyst, the unvaporized liquid oil from flash zone 5 and the hydrogenated vaporized oil from zone 7 were recombined and had a pour point 30° F. below the pour point of the original feed oil.

Reasonable variations and modifications are possible within the scope of this disclosure without departing from the spirit and scope of this invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a method for reducing and stabilizing the pour point of shale oil wherein the shale oil is visbroken to reduce its pour point, the improvement comprising carrying out said visbreaking in the presence of hydrogen so that the hydrogen consumption during visbreaking is from about 50 to about 200 s.c.f. of hydrogen per barrel of oil being visbroken, subjecting said visbroken oil to first separation conditions such that the temperature and pressure of separation is not substantially different from the temperature and pressure of visbreaking, recovering the unvaporized portion of said visbroken oil, hydrogenating the vaporized portion of the visbroken oil, and combining at least part of said hydrogenated portion with at least part of said unvaporized portion to provide an oil product of reduced and stabilized pour point.

2. A method according to claim 1 wherein said combined portions are cooled to substantially completely liquefy same, subjecting the cooled liquid to second separation conditions to remove at least hydrogen gas from said liquid, and using said removed hydrogen gas in at least one of said visbreaking and said hydrogenating steps.

3. A method according to claim 1 wherein said visbreaking reduces said pour point by at least about 20° F. using conditions of a temperature of from about 600

to about 1000° F., a pressure of at least about 500 p.s.i.g.,
and a time of at least about 3 minutes.

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