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SOLVENT EXTRACTION PROCESS

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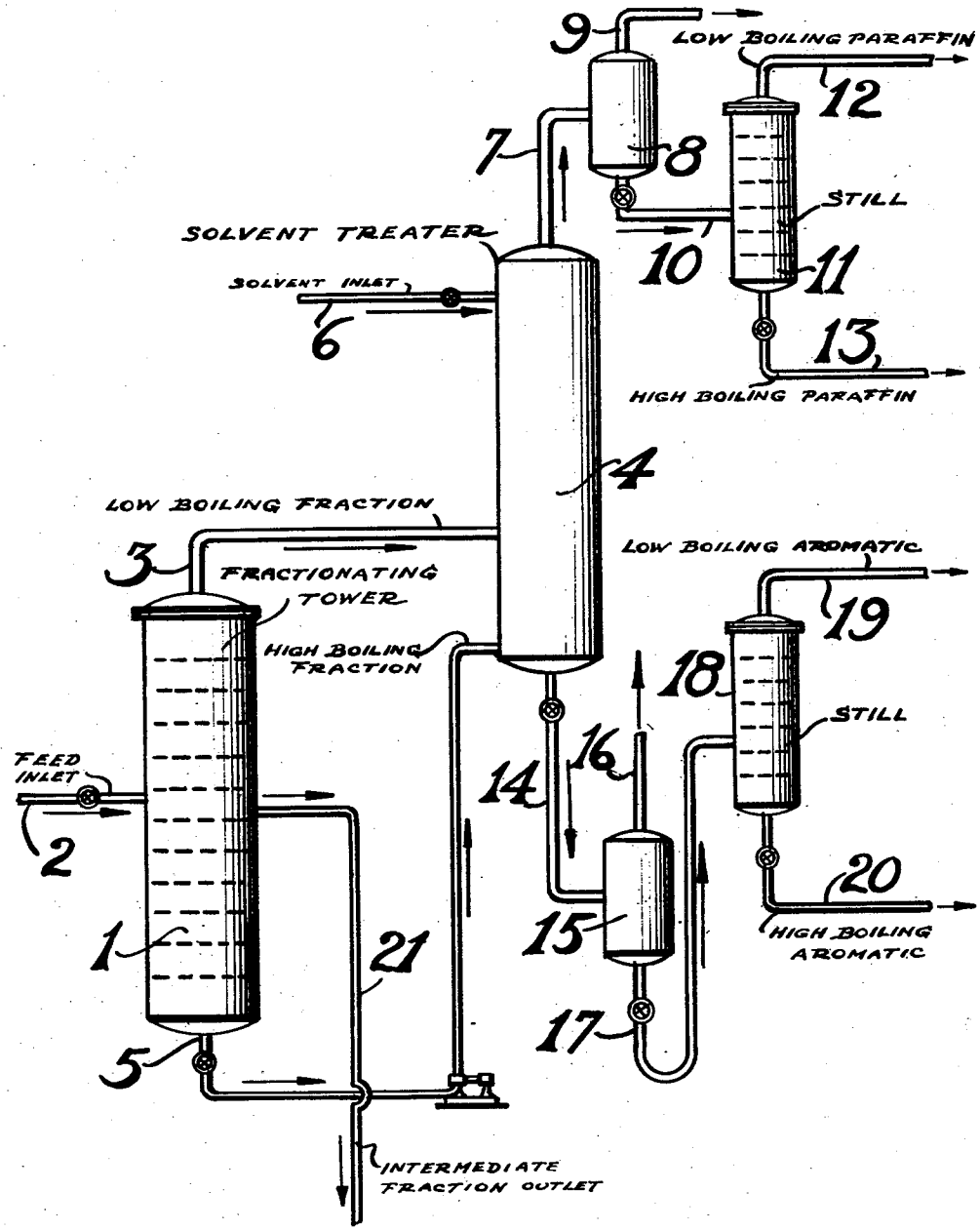

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SOLVENT EXTRACTION PROCESS

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The present invention relates to the art of solvent treating mineral oils. It is particularly concerned with an improved process of solvent treating petroleum oils; as for example, lubricating oils, heating oils, and the like, and is particularly adapted for treating petroleum oils boiling in the naphtha, kerosene and gas oil ranges. The process of the present invention separates the feed oil into at least two fractions of different boiling ranges, introduces the respective fractions at different points in solvent treating equipment, then separates the raffinate phase from the solvent extract phase and removes the solvent from the respective phases. The desolventized raffinate and extract phases may be further fractionated to secure narrow boiling cuts of highly aromatic and of highly paraffinic character.

It is well known in the art to treat mineral oils, particularly petroleum lubricating oils, with solvents which have the ability to segregate the relatively more aromatic fractions from the relatively more paraffinic fractions. In these processes it is usual to employ solvents which have a preferential selectivity for the more aromatic type compounds, as for example, solvents of the class of phenol, cresol, aniline, nitro benzene, beta beta dichlor diethyl ether, furfural, and the like. Solvent mixtures of these substances are employed as well as mixtures containing materials of the class of liquefied normally gaseous hydrocarbons. Solvent modifying agents of the class of water, alcohols and glycols are also used.

In these processes it is the usual procedure to introduce the oil; as for example, the lubricating oil into the bottom of a solvent treating tower, since it is usually lighter than the solvent, and to introduce the solvent into the top of the tower. The oil being the lighter phase flows upwardly through the tower, intimately contacting the downflowing solvent. A raffinate phase completely saturated with solvent is removed from the upper part of the tower and a solvent extract phase is removed from the lower part of the tower. It is, of course, desirable to secure a raffinate and extract phase having as high a concentration as possible of the paraffinic materials and aromatic materials respectively. The process of my invention is a distinct improvement over the known processes in the art in that it is possible to secure a more concentrated aromatic fraction and a more concentrated paraffinic fraction than has heretofore been possible by known methods of operation. My invention is particularly applicable in the treatment of low boiling hydrocarbons for the production of highly aromatic fractions suitable for use as solvents and for high octane number fuels. The process of my invention at the same time produces a highly paraffinic material suitable for the production of superior Diesel fuels and high quality kerosene.

The process of my invention may be readily understood by reference to the attached drawing showing one modification of the same. For the purpose of illustrating the invention, it is assumed that the feed oil is a petroleum oil boiling in the naphtha and gas oil range and that the solvent is of the class having a preferential selectivity for the more aromatic type compounds, and having suitable characteristics so that the solvent may be readily separated from the oil. The feed oil is introduced into fractionating tower 1 by means of feed line 2. The oil is separated into a low boiling fraction which is taken overhead by means of line 3 and introduced into tower 4. The higher boiling fraction is withdrawn from tower 1 by means of line 5 and introduced into tower 4 at a point somewhat below the point of introduction of the low boiling fraction. The respective fractions flow upwardly through tower 4 contacting downflowing solvent which is introduced into tower 4 by means of feed solvent inlet line 6. A raffinate phase saturated with solvent is removed from tower 4 by means of line 7 and introduced into solvent separator 8. The solvent is removed from solvent separator 8 by means of line 9 and the stripped raffinate is removed by means of line 10 and subsequently introduced into still 11. A low boiling highly concentrated paraffinic fraction is taken overhead from still 11 by means of line 12 and a relatively high boiling, highly concentrated paraffinic fraction removed from still 11 by means of line 13. The solvent extract phase from tower 4 is removed by means of line 14 and introduced into solvent separator 15. Solvent is removed from solvent separator 15 by means of line 16 and stripped extract is removed from solvent separator 15 by means of line 17. The stripped extract is introduced into still 18 from which a low boiling, highly concentrated aromatic cut is removed by means of line 19 and a high boiling highly aromatic cut removed from still 18 by means of line 20.

The process of my invention may vary widely. It is applicable in the treatment of any mineral oil, but it is particularly preferable in the treatment of petroleum oil boiling below about 700° F. The feed material may be fractionated into different boiling range fractions in any suitable manner. In general it is preferred to separate

the feed material into fractions in which the final boiling point of the lighter boiling fraction and the initial boiling point of the higher boiling fraction approximate the temperature of the mid-boiling point of the feed material. These conditions may be varied and in certain instances it may be desirable to separate the feed material into three fractions and to remove an intermediate boiling fraction from the system. In an operation of this character the quantity of intermediate fraction should preferably never exceed 20% of the feed material. In general it is preferred to separate the feed material into two fractions of approximately equal volume and to feed these respective fractions into the counter-current treating tower. The low boiling fraction is introduced into the countercurrent treating tower at a point intermediate the fresh solvent feed inlet and the point of introduction of the high boiling fraction. The high boiling fraction is preferably introduced into the bottom of the solvent treater and the low boiling fraction introduced at a point somewhat near the center of the solvent treater.

Any particular solvent may be used and will depend upon the feed material being treated and the quality and type of products desired. The solvent necessarily must have characteristics so that it may be readily separated from the oil by suitable means, as for example, by washing or by distillation. In general it is preferred to use solvents having boiling points substantially different from the boiling ranges of the feed material being treated in order to facilitate separation of the same. If a heavy gas oil is being treated, phenol, for example, would be entirely suitable as well as other solvents of this class having suitable boiling points. Particularly desirable solvents in the treatment of petroleum oils, boiling in the range from 250° to 600° F. are those solvents which are normally solid at normal temperatures and pressures, as for example, esters of phthalic acids, as for example, dimethyl phthalate, dibenzyl phthalate and the like. Other solvents, as for example, sulfur dioxide, the ethylene glycols, particularly phenoxy alcohols, as for example, beta phenoxy ethyl alcohol, are also suitable.

If a solvent having a boiling point substantially different from the feed material being treated is utilized, it may be desirable, for example, to eliminate the solvent recovery units 8 and 18 and to recover a low boiling paraffinic fraction as the overhead in still 11, the high boiling paraffinic fraction as a side stream in still 11 and to remove the solvent as a bottom stream in still 11. This procedure could similarly be followed in regard to still 18.

The quantity of solvent used per volume of oil will, of course, depend upon the particular solvent or solvent mixture being used, the feed oil being treated and the quality of products desired. In general it is preferred to use from about 0.5 to 4 volumes of solvent per volume of oil being treated. It is preferred to solvent extract the materials under atmospheric pressure, although other pressures may be employed. The temperature of extraction will, of course, depend upon the solvent being used, the feed material being treated and will, of course, be below the complete miscibility temperature between the solvent and the oil. In general when treating low boiling petroleum oils, it is preferred to maintain a relatively low temperature somewhat above the solidification point of the particular solvent or solvent mixture being used. In general it is preferred to separate the solvent from the respective phases by means of distillation, provided the respective boiling points are satisfactory. However, other means, as for example, re-extraction or washing may be also employed. The solvent free highly paraffinic and highly aromatic raffinate and extract phases respectively may be fractionated into any suitable close cut boiling fractions by any suitable means, as for example, by distillation.

In order to further illustrate the invention, the following example is given which is not to be construed as limiting the invention in any manner whatsoever.

Example

A petroleum naphtha boiling in the range from about 200° to 650° F. may be separated into a low boiling fraction having an initial of about 200° F. and a final of about 400° F. and a high boiling fraction having an initial of about 400° F. and a final of about 650° F. These fractions are introduced into a solvent treater in a manner in which the low boiling fraction is introduced into said treater between the point of introduction of the high boiling fraction and the point of introduction of the solvent. The respective fractions flow upwardly through the tower, intimately contacting downflowing solvent having preferential selectivity for the more aromatic type compounds which is introduced into the top of the tower. A raffinate phase and an extract phase are removed from the tower and the respective phases desolventized. By the process described it is found that the extract phase removed from the bottom of the tower is more aromatic and that the raffinate phase, removed from the top of said tower, is more paraffinic than if the feed material had been introduced directly into said tower.

The process of the present invention is not to be limited by any theory or mode of operation, but only by the following claims in which it is intended to claim all novelty insofar as the prior art permits.

I claim:

1. Process of producing from a particular mineral oil a more highly aromatic fraction and a more highly paraffinic fraction, comprising separating said mineral feed oil into a low boiling fraction and into a high boiling fraction without effecting substantial segregation of the relatively more aromatic constituents from the relatively more paraffinic constituents, directly introducing said fractions into different portions of a solvent treating tower in a manner that said low boiling fraction is introduced into said tower at a point intermediate the point of introduction of the solvent and the point of introduction of said high boiling fraction and in which said fractions are extracted with a selective solvent, removing a raffinate and extract phase, separating the solvent from the respective phases to produce said highly more aromatic and more paraffinic fraction.

2. Process in accordance with claim 1 in which said mineral oil is a petroleum oil boiling in the range from about 100° to 700° F.

3. Process in accordance with claim 1 in which which said mineral oil is a petroleum oil boiling in the range from 100° to 700° F. and in which said solvent is a solvent having a boiling point substantially different from the boiling point of the respective fractions.

4. Process of solvent treating a petroleum oil

boiling in the gasoline and gas oil ranges comprising separating said petroleum oil into at least three boiling range fractions without effecting substantial segregation of the relatively more aromatic constituents from the relatively more paraffinic constituents, discarding the intermediate boiling fraction, directly introducing the low boiling fraction and high boiling fraction into a solvent treating tower at different points in a manner in which said low boiling fraction is introduced into said tower at a point intermediate the point of introduction of the solvent and the point of introduction of said high boiling fraction, contacting said fractions with a selective solvent having a preferential selectivity for the more aromatic type compounds, removing a raffinate phase and a solvent extract phase, then separating the solvent from the respective phases.

5. Process in accordance with claim 1 in which said selective solvent is phenol.

6. Improved process for the segregation of a petroleum oil boiling in the range from about 200° F. to 650° F. into its relatively more aromatic and into its relatively more paraffinic constituents, comprising distilling said petroleum oil under conditions adapted to segregate said oil into a relatively lower boiling fraction boiling in the range from about 200° F. to 400° F. and into a relatively higher boiling fraction boiling in the range from about 400° F. to 650° F. without effecting substantial segregation of the relatively more aromatic constituents from the relatively more paraffinic constituents, directly introducing said low boiling fraction in the center section of a countercurrent treating tower, directly introducing said relatively high boiling fraction into the bottom section of said countercurrent treating tower, introducing a solvent selected from the class of solvents having a preferential selectivity for the more aromatic constituents as compared to the more paraffinic constituents into the top of said countercurrent treating tower, regulating conditions adapted to secure countercurrent flow between the oil and said solvent and adapted to produce a highly paraffinic raffinate phase and a highly aromatic solvent extract phase, separating the respective phases and removing the solvent therefrom.

7. Process in accordance with claim 6 in which said solvent is a phenol.

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