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Titus

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[54] **PIPELINE TRANSPORTATION OF WAXY PRODUCTS**

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[52] **U.S. Cl.** **137/13,** 252/8.3, 302/66, 208/24

[51] **Int. Cl.** **F17d 1/16,** B65g 53/04

[58] **Field of Search** ..... 252/8.3, 8.55 R; 302/66; 137/13

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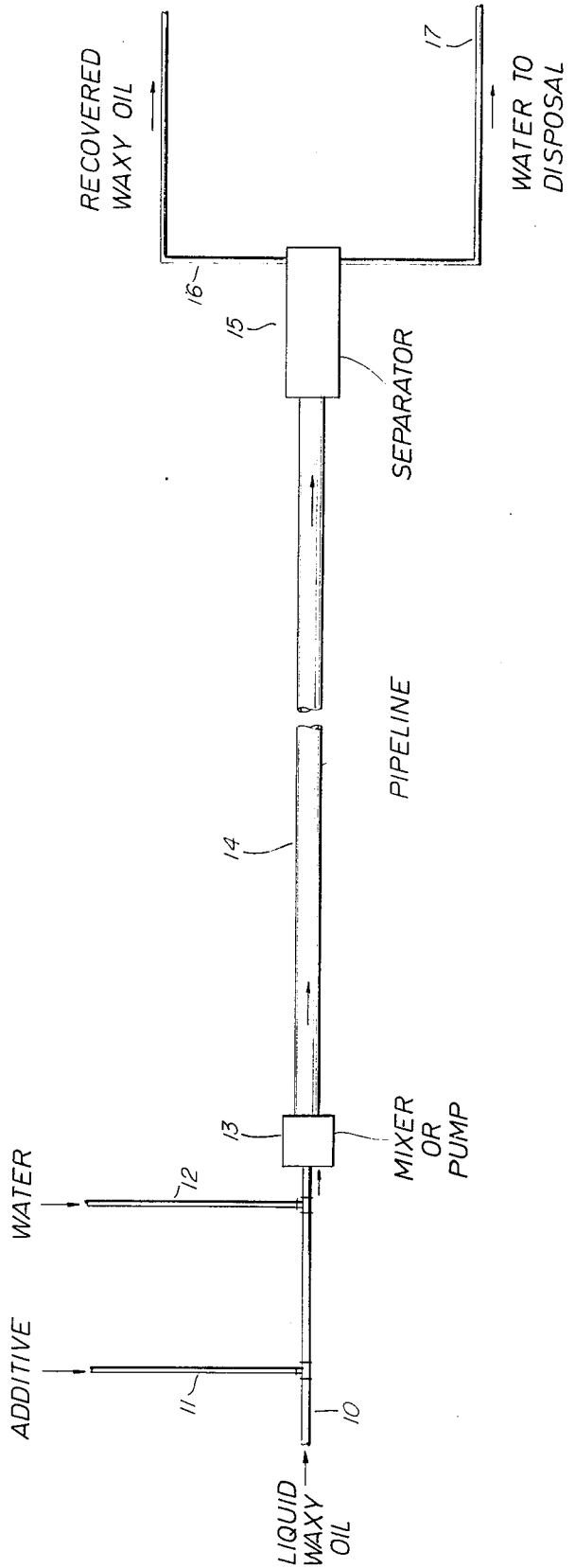
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[57] **ABSTRACT**

An improved method of pipeline transporting highly waxy crude oil in pumpable slurry form with the aid of a particular class of non-ionic surfactants.

4 Claims, 1 Drawing Figure


RECOVERED WAXY OIL
17
WATER TO DISPOSAL
16
15
SEPARATOR
PIPELINE
14
13
MIXER OR PUMP
WATER
12
ADDITIVE
11
10
LIQUID WAXY OIL

PIPELINE TRANSPORTATION OF WAXY PRODUCTS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to an improved process of pipeline transporting highly waxy crude oil and fractions thereof, which under normal conditions are difficult or impossible to pump through a pipeline primarily because of the tendency of such crudes to plug and clog the pipeline with wax deposits, by treating said waxy crude oil with an oil-soluble non-ionic surfactant containing hydrophobic-hydrophilic constituents capable of fragmenting the wax constituents in the molecule in the crude into small particles on being contacted with an aqueous liquid such as water and forming an easy to handle pumpable slurry.

2. Description of the Prior Art

Various methods have been proposed for transporting waxy crude oil and fractions thereof as evidenced by reference to U. S. Pats. 2,533,878, 2,927,978, 3,067,134, 3,076,757, 3,096,777, 3,244,188 and 3,249,535. A serious defect of these methods of handling and transporting such materials is their short effectiveness life, the tendency of the treating or improving composition to form emulsions causing viscosity increase resulting in increased pumping cost and handling, separation difficulties, and the general ineffectiveness of such methods to solve the problems under discussion when handling highly waxy hydrocarbon liquids. The method of the present invention overcomes these defects and results in a process which prevents, inhibits, and solves in general the problem of accumulation of waxy hydrocarbon materials on contacting surfaces.

To summarize present conventional methods used to modify waxy materials for pipeline transport include: (1) diluting the material with a low-viscosity, low pour point oil, (2) thermally treating the material to alter composition (visbreak, etc.), (3) addition of materials to lower the pour point (pour point depressants), and/or (4) heating the pipeline to maintain the temperature above the pour point. These steps, while technically feasible, are uneconomical or the value of the product is depreciated and the material cannot be fully utilized.

OBJECTS OF THE INVENTION

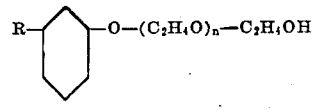
It is an object of this invention to prevent and inhibit the formation, deposition and accumulation of hydrocarbonaceous materials on interior surfaces of pipelines having waxy hydrocarbons by treating said hydrocarbons with a novel non-ionic surfactant and slurrying said treated hydrocarbons with an aqueous liquid.

Still another object of the present invention is to facilitate the handling and transportation of waxy crude oil and fractions thereof through pipelines by treating the oil with a hydrophobic-hydrophilic containing non-ionic surfactant and slurrying said treated waxy crude oil with water.

Still another object of this invention is to provide an improved method of handling and transporting highly waxy crude oil at low pumping costs and under reduced friction conditions.

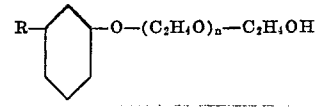
Other objects will be apparent from the following description and claims.

Now, in accordance with this invention, it has been found that waxy crude oil and fractions thereof can be effectively and efficiently transported through pipelines over great distances without the danger of clogging, plugging or shutdown by treating or modifying waxy hydrocarbons such as waxy crude oil with an oil-soluble non-ionic surfactant having hydrophobic-hydrophilic constituents in the molecule and having the formula



wherein R is an alkyl radical having from four to 20 carbon atoms and *n* is an integer of from 2 to 7, which treated oil on being contacted with an aqueous liquid such as water effects fragmentation of waxy components into small particles of from about 10 to about 10,000 microns, resulting in a slurry formation of waxy particles in hydrocarbon dispersed in an aqueous liquid which is easily pumpable and transportable in pipelines over long distances without causing plugging or clogging of the lines which lines can be readily restarted after shutdown.

The oil-soluble non-ionic surfactant used in fragmenting and dispersing wax into small particles which are readily slurried in an aqueous liquid such as water is an alkyl phenol-ethylene oxide reaction product in which the final product contains from 3 to 8, preferably 4–7, ethylene oxide units in the molecule and can be represented by the formula:



where *n* is an integer of 2 to 7 and R is an alkyl radical having from four to 20 carbon atoms preferably six-10 carbon atoms. Surfactants of this class are available under the trade names of Triton X-45, Triton N-57 (Rohm-Haas); Tergitol NP-14 (Union Carbide) or Igepal CO430 or 530 (GAF Corporation) of which preferred is Triton X-45 or nonylphenoxytetraethyleneoxyethanol. The amount of this class of surfactant which is added to a waxy hydrocarbon or wax per se can vary from about 0.1 percent to about 10 percent by weight.

A typical waxy hydrocarbon which is extremely difficult to transport through pipelines or through tubing string of well bores used in oil recovery of such crudes and which on treatment by the process of this invention are easily pumped and transferred are Unitah crudes which are high gravity, waxy oils described in the October 1970 issue of World Oil, pages 113–117 and a typical Unitah crude has the following properties:

TABLE I

Crude Properties		Value
API GRAVITY		38.6
RE ID VAPOR PRESS, PSI	Z	.0
FLASH POINT, COC, °F	Z	0.
SULFUR CONTENT, PCT W		.05
WATER, BY DIST, PCT V		.0
BS-W, BY CENTRIFUGE, PCT V		.0
SALT, LBS PER 1000 BBLS		2.0
COLOR		2.
SQUALANE NUMBER	Z	.0
POUR POINT, °F		120.
VISC, SSU AT 40°F	Z	.0
VISC, SSU AT 100°F	Z	.0

VISC, SSU AT 140°F	51.8
VISC, SSU AT 210°F	33.7

These crudes pose a special problem in that below a particular temperature (pour point, or melting point) these crudes become solid, or semi-solid and are difficult to handle and pump. When this temperature occurs above the normal ambient temperature of the pipeline, these crudes cannot be readily transported as such alone, but must be modified in some manner to reduce the high pressure drops associated with the pumping of a viscous semi-solid.

PREFERRED EMBODIMENT OF THE INVENTION

The invention is directed to a method for modifying waxy-containing hydrocarbons so as to put it in a form of low viscosity, easily movable, water-continuous slurry as illustrated by the attached FIG. **1.** This is accomplished by adding to or admixing with certain types or classes of non-ionic oil-soluble surfactants to the waxy material (when liquid) and then combining the liquid wax (or wax cooled to the semi-solid state) with an aqueous liquid such as water, brine, etc., to form the slurry. The most effective surfactant is an alkylaryl polyether alcohol containing 5 ethylene oxide groups such as Triton X-45 (Rohm and Haas Company). This material when added to Unitah crude (about 0.2%v) causes the waxy crude to form a pumpable slurry when combined with 1–40% water.

Thus, from the figure, the invention is practical as follows:

waxy crude **10** such as Unitah crude oil recovered from an underground formation is contacted with about 0.2–0.5%v of Triton X-45 via **11** and thereafter water is added (1–60%, preferably between 20% and 40%v) via **12** to form a slurry mixture which is pumped through pump or mixer **13** into a pipeline **14** for transportation to a terminal station where it is conduced into a separator **15** such as a filter, settler, cyclone, etc., where the oil is recovered in pipe **16** for further handling and the water disposed or recycled through line **17.** Thus, at the pipeline terminal the waxy hydrocarbon can be readily separated from the water phase of the slurry by filtering or heating and settling.

The essence of the invention is that it causes the formation of a modified waxy material that can be easily transported by pipeline, and not be degraded as a result of the process. The additive is easy to mix with the waxy material, and the mix is easy to slurry in an aqueous liquid carrier such as a water carrier. The resultant slurry is readily separated at the terminus either by filtration or heating and settling. Since the surfactant is not water soluble, the recovered water does not become a disposal problem.

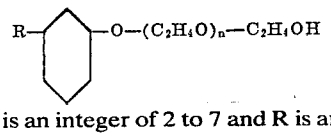
In addition to waxy hydrocarbons such as waxy crude oil, waxes per se can be fragmented into small particles by the process of this invention for easy handling, packaging, molding, etc. In such cases the wax, e.g., petroleum wax is diluted with or dissolved in a low boiling point hydrocarbon or polar solvent such as cyclohexane, hexane, benzene; ketones, ethers, etc., and a small amount (0.1–5%v) of surfactant such as Triton X-45 or Tergitol NP-14 added thereto. Water is then added in amount (5–40%) sufficient to form a slurry. Wax particles (1–1,000 microns) are recovered by separating the water phase from the wax particles-solvent phase by filtering and the solvent removed by flashing it off leaving behind non-agglomerating wax particles.

The foregoing description of the invention is merely intended to be explanatory thereof. Various changes in the details of the described method may be made, within the scope of the appended claims, without departing from the spirit of the invention.

We claim as our invention:

1. A method of pipeline transporting waxy crude oil without causing plugging or clogging of the pipeline, the steps comprising:

a. adding to the waxy crude oil from about 0.1%v to about 5%v of an oil-soluble, water insoluble non-ionic surfactant having the formula



wherein *n* is an integer of 2 to 7 and R is an alkyl radical having from four to 20 carbon atoms;

b. adding an aqueous liquid to (a) to form a slurry of the oil-soluble non-ionic surfactant containing waxy crude oil with the aqueous liquid; and

c. injecting slurry (b) into a pipeline.

2. The method of claim **1** wherein the aqueous liquid is water.

3. The method of claim **2** wherein the surfactant is nonylphenoxytetraethyleneoxyethanol.

4. The method of claim **3** wherein the amount of water used to form the slurry is between 5 and 40 percent.

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