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TREATMENT OF OILS TO REDUCE VISCOSITY AND SULFUR CONTENT

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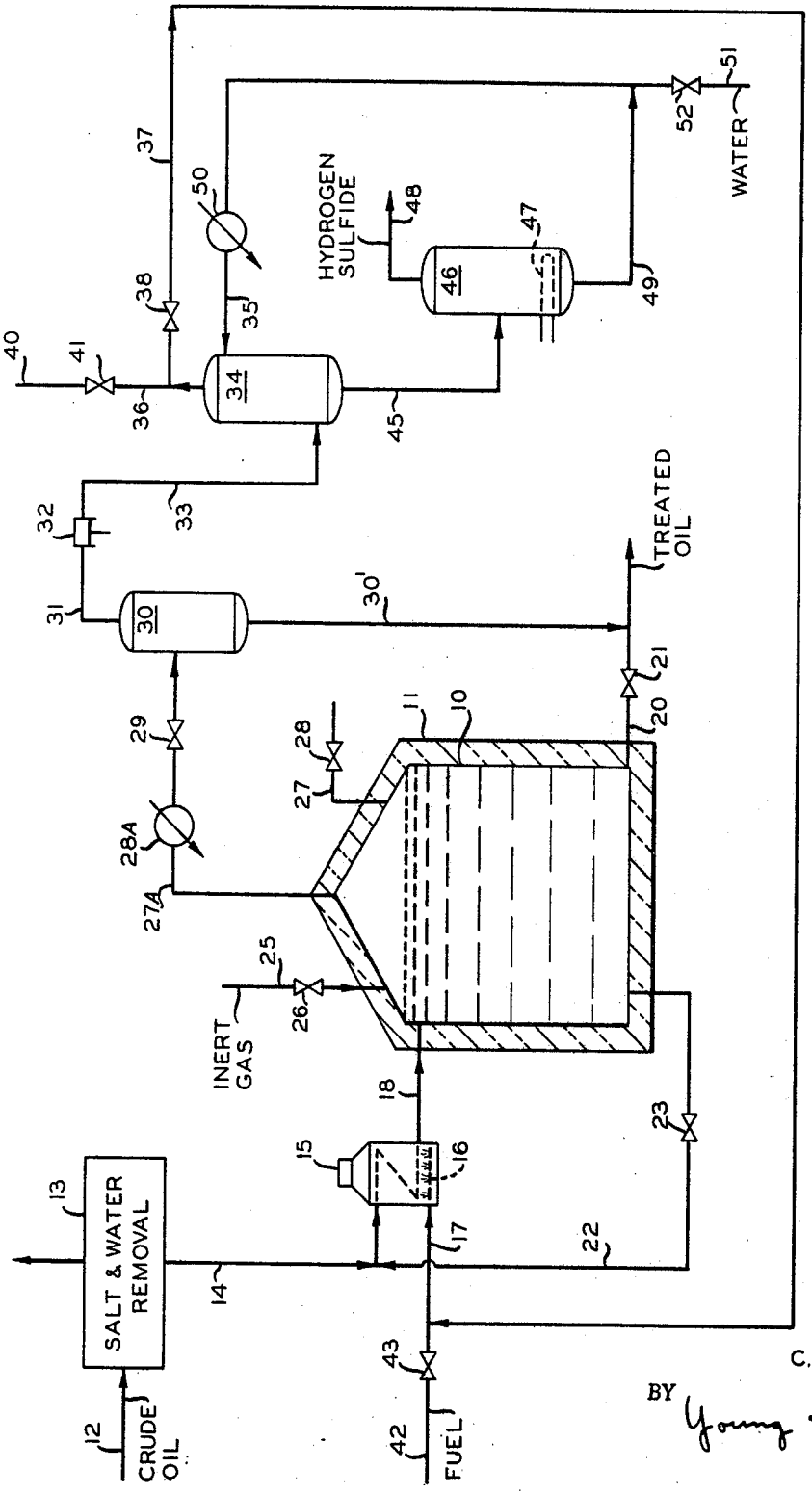

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TREATMENT OF OILS TO REDUCE VISCOSITY AND SULFUR CONTENT

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ABSTRACT OF THE DISCLOSURE

The viscosity and sulfur content of an oil is reduced by maintaining the oil at an elevated temperature for an extended period of time. Gases evolved from the oil are separated, the lighter portion being used as fuel to heat the oil and the heavier portion being blended with the treated oil for further viscosity reduction.

This invention relates to the treatment of oils to reduce the viscosity and the sulfur content thereof.

A number of oil fields have been discovered which contain oils having high viscosities. The transportation of these oils is often quite difficult, particularly when the oils are found in remote locations. In order to transport the oils through pipelines, it has often been necessary to blend in substantial quantities of lighter oils or to resort to refining operations adjacent the oil producing fields. These methods have substantially increased the cost of recovering the oils and have not always been entirely satisfactory. In addition, many of the viscous crude oils have an undesirably high sulfur content. This is particularly serious when the oils are to be used for fuel purposes in populated areas. In order to meet customer specifications and governmental regulations, it is often necessary to install rather expensive treating facilities to reduce the sulfur content.

In accordance with the present invention, a simple, inexpensive method is provided for reducing the viscosity of oils and for lowering the sulfur content. This is accomplished by heating the oil to a temperature in the general range of 500 to 700° F. and maintaining the oil at such a temperature for a period of at least 24 hours, preferably longer. The gases evolved during this heating step are cooled and separated to produce fuel gas and condensate. The latter is blended with the heated oil to reduce its viscosity still further and provide a material that can be transported more readily. The fuel gas is utilized to heat the oil to be treated, thereby eliminating or substantially reducing the fuel requirements of the treating process and utilizing the gases which are evolved from the treating step.

Accordingly, it is an object of this invention to provide an improved method for reducing the viscosity of oil and for simultaneously reducing the sulfur content.

Another object is to provide novel apparatus for use in treating oil.

Other objects, advantages and features of the invention should become apparent from the following detailed description, taken in conjunction with the accompanying drawing which is a schematic representation of apparatus employed to carry out the method of this invention.

Referring now to the drawing in detail, there is shown a relatively large storage vessel **10** which is provided with a heat insulated jacket **11**. A crude oil to be treated is introduced through a conduit **12** which communicates with the inlet of salt and water removal apparatus **13**. This apparatus, which can be of the type described in U.S. Patent 3,165,466, for example, can be employed when the crude oil contains excessive amounts of salt. The treated oil removed from apparatus **13** is conveyed through a conduit **14** to the inlet of a heater **15**. Heater

15 is provided with burners **16** which receive fuel from a conduit **17**. The heated oil is removed from heater **15** through a conduit **18** and introduced into vessel **10**. Oil is subsequently removed from vessel **10** through an outlet conduit **20** which has a control valve **21** therein.

Heater **15** is designed to elevate the temperature of oil to a valve in the general range of 500 to 700° F. Vessel **10** is of sufficient size to produce a desired average residence time of the oil therein. This average residence time is at least 24 hours, and generally will not be more than about 3 weeks. For example, if oil is supplied through conduit **42** at a rate of 10,000 barrels per day and an average residence time of ten days is desired, vessel **10** should have a volume of 100,000 barrels. It is preferred that the oil be maintained in vessel **10** for an average residence time of the order of one to two weeks. The oil should be maintained in the temperature range of 500 to 700° F. during the time that it is retained in vessel **10**. If necessary to maintain the desired temperature, a portion of the oil can be removed through a conduit **22**, which has a control valve **23** therein, and recirculated to the inlet of heater **15**. If desired, heater **15** can be an integral part of storage vessel **10** to supply heat directly to the stored oil. The treated oil removed through outlet conduit **20** has a substantially lower viscosity than the inlet oil, and has a lower sulfur content. It is desirable to maintain an inert atmosphere in the vapor space above the oil in vessel **10**. This can be accomplished by introducing an inert gas through a conduit **25**, which has a control valve **26** therein. The inert gas can be circulated through the vapor space and removed through an outlet conduit **27** which has a control valve **28** therein. This inert gas can be introduced in sufficient volume to elevate the pressure within the treating vessel. In normal operation, valves **26** and **28** can be closed after an initial purge has taken place.

A substantial volume of gas is evolved from the oil during the treating operation. This gas is conveyed through a conduit **27A**, which has a condenser **28A** and an expansion valve **29** therein, to the inlet of a flash chamber **30**. The lighter gases are removed as vapor from the top of the flash chamber through a conduit **31** which communicates with the inlet of a compressor **32**. The higher boiling constituents, which normally are C_4 and heavier hydrocarbons, are removed through a conduit **30'** which communicates with oil outlet conduit **20**. These heavier hydrocarbons are thus blended with the treated oil to reduce further the viscosity of the treated oil.

The compressed gases from compressor **32** are conveyed by a conduit **33** to the inlet of a scrubber **34**, which can be a column having packing material therein. An aqueous absorbing agent, such as water, is introduced into the top of scrubber **34** through a conduit **35** to remove hydrogen sulfide which may be contained in the gas stream. The effluent gas from scrubber **34** is removed through a conduit **36**. A conduit **37**, which has a control valve **38** therein, communicates between conduit **36** and conduit **17** to direct effluent gas from scrubber **34** to heater **15**. In the event that a greater quantity of gas is produced than is needed in heater **15**, excess gas can be removed through a conduit **40** which has a control valve **41** therein. In the event that the volume of recovered gas is not sufficient to supply the heat required to elevate the oil to the desired temperature, additional fuel can be introduced through a conduit **42** which has a control valve **43** therein. If heater **15** is provided with burners of proper configuration, a portion of the crude oil can be utilized as additional fuel, if required.

The water having hydrogen sulfide dissolved therein is removed from scrubber **34** through a conduit **45** which communicates with a stripper **46**. Stripper **46** is provided with a heater **47** to elevate the temperature and thereby strip out the entrained hydrogen sulfide which is removed

through an overhead conduit **48**. Water is removed from stripper **46** through a conduit **49** which communicates with conduit **35**, the latter having a cooler **50** therein. Make-up water is introduced, as required, through a conduit **51** which has a control valve **52** therein. The hydrogen sulfide removed from stripper **46** can be conveyed to a sulfur producing unit.

The illustrated apparatus has been shown schematically to simplify the drawing and explanation of the invention. For this reason, various pumps and control elements normally employed have been omitted.

Operating features of this invention are demonstrated by the following runs which were conducted on samples of crude oil obtained from the Morichal Field, Monagas, Venezuela. Two samples were employed which had the following properties:

Sample No.	122° F. cp. viscosity	Gravity, ° API	Weight percent sulfur
1	632	12.9	2.08
2	8,850	9.2	4.1

Samples of these oils containing specified amounts of water were heated in vessels, some of which were maintained under elevated pressure by the use of nitrogen. Gases evolved from the heating were collected and analyzed. The following table describes the properties of the oils after the heating step.

Run No.	1	2	3	4	5	6	7	8	9	10
Charge:										
Sample No.	1	1	2	2	2	2	2	2	2	2
Oil, g.	386	369	1,940	1,940	1,940	1,940	1,940	1,940	1,940	339
Water, g.	60	50	60	60	60	60	60	60	60	10
Reaction conditions:										
Time, hours	336	336	25.5	49.5	73.5	121.5	169.5	217.5	313	336
Temperature, ° F-average	543	605	604	598	602	600	595	595	597	605
Average pressure, p.s.i.	1,780	2,100	1,270	725	690	610	610	610	590	14.7
Produced oil properties:										
Gravity, ° API	14	15.3	9.5	10.4	10.0	10.5	10.9	11.7	12.2	10.8
122° F. viscosity, cp.	360	93	4,320	2,955	1,940	885	614	446	236	505
Sulfur, weight percent	1.6	1.7	4.1	4.0	3.9	3.9	3.7	3.5	3.0	3.1
Sulfur, removed, percent	23	19	0	2.5	5.0	5.0	10.0	15.0	25.0	24.5
Produced gas, N_2, free basis: Volume produced, cc., NTP	134	2,710								6,720

The compositions of the produced gases were as follows (the total produced gas from Runs 3 to 9 being 6650 cc.):

Component	Run No. (volume percent) 1	2	3-9 (total)	10
H_2	19	5.7	5.7	5.1
CH_4	55	68	38.0	32.3
C_2H_4		8.8		0.4
C_2H_6			13.5	13.2
C_3H_6		0.03	0.7	1.2
C_3H_8	5	3.5	8.8	8.0
C_4H_8		0.6	0.3	6.4
C_4H_{10}			3.2	6.3
i-C_4H_{10}		0.6	2.6	
C_5 plus		1.5	1.9	10.7
CO_2	21	11.9	8.1	1.2
O_2	071	0.1		0.7
H_2S			17.3	14.1
COS				0.3

From an inspection of the foregoing data it can readily be seen that the heat treating step substantially reduces the viscosity of the oil and in most instances substantially reduces the surfur content. Runs 3 to 9 demonstrate that increasing the time of treatment is beneficial. Run 10 demonstrates that increased pressures are not essential.

While this invention has been described in conjunction with presently preferred embodiments, it obviously is not limited thereto.

What is claimed is:

1. The method of treating an oil to reduce its viscosity and its sulfur content comprising:

heating said oil to a temperature in the range of 500 to 700° F.;

maintaining said oil at a temperature in said range in a storage zone for an average residence time of from about 24 hours to about 3 weeks;

removing gases evolved from said oil in said storage zone;

separating said gases into a first portion comprising hydrocarbons having about four or more carbon atoms per molecule and a second portion comprising gases having boiling points which are lower than the boiling points of said hydrocarbons;

removing said oil from said storage, and combining said first portion with said oil removed from said storage zone.

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