United States Patent Office

3,284,336

Patented Nov. 8, 1966

3,284,336

METHOD OF TREATING OILS DERIVED BY THERMAL TREATMENT OF SOLID CARBONACEOUS MATERIALS

William J. Culbertson, Jr., and Thomas D. Nevens, Denver, and Werner D. Schnackenberg, Englewood, Colo., assignors to The Oil Shale Corporation, New York, N.Y., a corporation of Colorado

No Drawing. Filed June 10, 1965, Ser. No. 463,043
22 Claims. (Cl. 208—11)

This application is a continuation-in-part of our pending application Serial No. 106,493, filed May 1, 1961, now abandoned.

This invention relates to the production of oil from solid carbonaceous materials and more particularly to a method for economically producing oil from solid carbonaceous materials characterized by a pour point requisite to pipeline transportation.

In crude form the heavy oils derived from naturally occurring deposits, such as petroleum, oil shale, tar sand, and the like, when cooled tend to thicken and progressively lose their ability to be moved in ordinary fluid handling operations, such as pumping, pouring, and the like. The temperature at which such congelation is observed for a particular oil is commonly known as the "pour point." There is little or no relation between the pour point and the viscosity of a given oil. At temperatures slightly above the pour point of an oil, movement of the oil by ordinary, fluid handling operations often is extremely difficult and commercially impractical. At temperatures approximating or below the pour point of a oil, ordinary fluid handling of the oil is even more difficult. Therefore, hydrocarbon oils characterized by a pour point comparable to or higher than temperatures reasonably expected in the normal handling and movement of the oil generally are unsuitable unless expensive pour-point depressants and/or expensive processing are preliminarily employed. The relationship between pour point and expected temperatures in handling and movement is especially important when it is desired to transport heavy oil by pipeline over relatively long distances.

Crude oil produced by conventional recovery operations from petroleum normally is characterized by a pour point which enables such oil to be suitably transported by pipeline without special treatment at ground temperature conditions above about 40° F. On the other hand, oils produced by thermal treatment of solid carbonaceous materials and particularly shale oils usually are characterized by a pour point on the order of about 80° F. to about 100° F. Accordingly, if conventional means are employed to lower the pour point of such oils to an acceptable level, even greater expense is involved. Moreover, problems occasioned by the high pour point of oils obtained by thermally treating solid carbonaceous material are aggravated by the fact that the great preponderance of raw materials, such as oil shale, usually are removed from population centers and low-cost transportation facilities, such as navigable water. Consequently, the only commercially practical means for conveying the crude oil produced at the deposit sites to market is by pipeline transportation.

As a result of the relatively high pour point of crude shale oil or oil derived from oil-bearing sands and the like, the refining industry has been unable competitively to employ such oil despite the fact that at the deposit site the crude oils can be produced at considerably less cost than petroleum crudes.

By virtue of the significant difference in the composition of crude oil and oils derived by thermal treatment of such carbonaceous materials as oil shale and oil or tar sand, processes which are suitable for lowering the pour point of petroleum crudes are not commercially desirable. In one method which has been suggested for reducing the pour point of crude shale oil, the oil is subjected to cracking at temperatures generally in excess of about 900° F. and under elevated pressures. Under the conditions requisite in such pour point lowering treatments, the formation of heavy fuel oil constituents is undesirably accompanied by the formation of substantial amounts of light gases and coke which are economically prohibitive in terms of end product losses. Coking is per se undesirable due to its fouling of equipment and reduction effected in heat transfer. In addition, the conditions utilized in the suggested coking processes are not selective in their cracking of the heavier hydrocarbons, with the result that the treated shale oil is undesirably altered in composition by additional cracking of a substantial amount of the lighter hydrocarbons its contains.

Another method which has been suggested for reducing the pour point of crude oils produced by thermal treatment of carbonaceous materials involves the incorporation of pour point depressants as in the case of petroleum crudes. As previously indicated, a significant reduction in pour point can be realized only by incorporation of large amounts of the expensive depressants. Aside from the economics involved, it is undesirable to introduce such large amounts of a foreign material into a crude oil which subsequently must be extensively refined.

Therefore, the prior art has not provided an efficient, inexpensive method for significantly lowering the pour point of shale oil and other high pour point oils produced by thermally treating solid carbonaceous material and thus making such oils available to the industry by pipeline.

Accordingly, it is the primary object of the present invention to produce from a crude oil derived by thermally treating solid carbonaceous material an oil which is characterized by a low pour point.

A particular object of the invention is the production of a low pour point oil from an oil derived from thermal treatment of solid carbonaceous material by means which do not require appreciable cracking of the crude oil or addition of a foreign pour point depressant.

It is another object of the present invention to provide an inexpensive method for significantly lowering the pour point of shale oil as compared to processes previously suggested.

It is a further object of the present invention to provide a method for lowering the pour point of shale oil by a thermal treatment wherein the values in the light ends are preserved.

It is still another object of the present invention to provide a method for effecting a reduction in the pour point of shale oil by a thermal treatment wherein substantially no coking is obtained.

It is a particular object of the present invention to provide a method for lowering the pour point of shale oil to render the shale oil suitable for handling and pipeline transportation.

It is an additional object of the present invention to provide a shale oil suitable for pipeline transmission and economically competitive with crude oil.

Broadly described, the present invention is a method for treating a heavy fraction separated under substantially non-cracking conditions from a crude oil derived by thermal treatment of solid carbonaceous material, to produce said heavy fraction and at least one light fraction, which method comprises heat treating said separated heavy fraction alone at a temperature above about 600° F. and below the point of incipient thermal decomposition of the heavy fraction for a period of time which is inversely proportional to said temperature to produce a product which, when combined with at least part of a light fraction, results in an oil having a pour

point lower than that of the original crude oil; said heat treatment producing substantially no non-condensible hydrocarbons and substantially no elemental carbon.

A preferred embodiment of the present invention is a method for reducing the pour point of an oil derived by thermal treatment of solid carbonaceous material which comprises treating said oil under substantially non-cracking conditions to obtain at least one light fraction and an oil residue, heat treating said oil residue at a temperature above about 600° F. and below the point of incipient thermal decomposition of the residue for a period of time which is inversely proportional to said temperature to produce a product which, when combined with a light fraction results in an oil having a pour point lower than that of the original crude oil, said heat treating process producing substanially no non-condensible hydrocarbons and substantially no elemental carbon; and combining said modified oil residue product with at least a portion of a light fraction to provide an oil readily transportable by pipeline.

Also included in the invention is an oil product prepared by heat treating a separated heavy residue formed by separating said residue and a light fraction under substantially non-cracking conditions from a crude oil derived and produced by thermal treatment of solid carbonaceous material; said heat treatment of the residue being conducted at a temperature between about 600° F. and the point of incipient thermal decomposition of the residue and for a period of time which is inversely proportional to said temperature to produce a product which, upon combination with at least part of the light fraction, results in an oil having a pour point lower than that of the original crude oil.

Preferably, the heat treatment of the heavy fraction in accordance with the invention is continued for a period sufficient to produce a treated heavy fraction which, on combination with part of the light fraction, will produce an oil having a pour point at least about 10° F. below that of the original crude oil.

While the precise effect of the heat treatment of the heavy high molecular weight fraction containing the waxes, asphaltenes, and the like is not completely clear, it is theorized that some portion of the heavy fraction undergoes a molecular modification and/or rearrangement which results in a marked improvement in pour point and reduction in thixotropy after combination with lighter hydrocarbon oil fractions. The molecular weight of the heavier hydrocarbons is not appreciably affected by any such alteration in molecular structure. Moreover, the pour point of the heavy fraction which has been treated in accordance with the invention is not appreciably changed from that of the heavy fraction prior to treatment.

The temperature and conditions utilized in the invention avoid appreciable formation of light gases or of coke. These substances represent undesirable loss in yield in processing oils, and in the method of the invention are not formed even as by-products.

The carbonaceous materials from which the feed stocks employed in the process of the invention are derived include, without limitation, oil shale, bituminous sands, brown coal, peat and the like. The oil contemplated for treatment by the method of the present invention is any crude oil or heavy oil fraction derived from these sources as opposed to petroleum hydrocarbons. Crude oils produced from oil shale deposits in the United States usually contain up to about 50 percent by weight of hydrocarbons boiling above heavy fuel oil and are characterized by a pour point above about 70° F., usually from about 80° F. to about 100° F. These shale oils are especially suited for treatment in accordance with the present invention.

Oils formed by combination of the treated heavy fraction with lighter hydrocarbons are characterized by pour point and thixotropic properties much improved over that of the crude oil employed as the starting material. In accordance with the present invention, crude oils unsuitable for handling and transmission by pipeline by virtue of their pour point characteristics readily may be adapted for such purposes. Shale oil having a pour point of above about 80° F. to about 100° F. suitably may be treated by the process of the invention to reduce the pour point to a value in the range of from about 10° F. to 40° F. or lower. Shale oils treated in accordance with the invention also are significantly less thixotropic than untreated shale oils of comparable pour point and are more nearly Newtonian. In general the rheology of oils produced by thermal treatment of solid carbonaceous materials may be significantly improved by employing the process of the invention.

In the method of the invention the heavy fraction of a suitable oil is heat treated in a vessel to a temperature of at least about 600°F. but below the temperature of incipient thermal decomposition of the oil. In this range of temperatures, usually between about 600°F. and about 800°F., the desired modification is effected without formation of appreciable amounts of non-condensible gases and coke. The range of temperatures which may be employed to accomplish the requisite molecular modification of a particular heavy fraction will depend upon the composition of the particular oil and may be predetermined by appropriate runs on the oil. For oils derived from oil shale, the desired molecular modification preferably is carried out at temperature in the range from about 600°F. to about 800°F., and preferably from about 700°F. to about 750°F.

The pressure in the vessel in which the oil is heat-treated suitably may be any pressure which does not effect the formation of coke and non-condensible gases. Pressures preferred are in the range of from about 1 to about 2 atmospheres, and more preferably, the pressure employed is the autogenesis pressure. Moderate pressure may be beneficial in reducing foaming and vaporization during the digesting step.

The oil undergoing treatment preferably is digested in a suitable vessel at the autogenesis pressure for the time requisite to effect the desired molecular modification. Normally, where a pour point diminution of at least about 10°F is desired in a composite oil containing the heated residue and lighter hydrocarbons, a digestion period of at least about 30 minutes is employed. The actual time period required in the digestion step naturally depends upon the particular oil being treated, the specific temperature and pressure conditions employed in the digestion, and the particular pour point properties desired in the final oil. The digestion desirably is terminated when the treated fraction will produce the desired diminution in pour point and the required rheological characteristics. In the case of oil derived from American oil shale, the preferred digestion time period is in the range of from about 20 minutes to about 3 hours. Substantial reduction in pour point can be obtained with some oils with a digestion period as low as 10 minutes, and even as low as 1 minute, particularly at the higher soaking temperatures. Digestion times of longer than 3 hours may be employed but generally are unnecessary and normally produce no further significant improvement in rheological properties or pour point reduction.

The invention in a preferred embodiment contemplates treatment of oils from solid carbonaceous material, for example crude Colorado shale oil, wherein the lower boiling hydrocarbons are removed prior to the digestion step. The lower boiling hydrocarbons may be removed by any suitable method, preferably by a fractionation of the oil under non-cracking conditions to obtain a light fraction comprising such light hydrocarbons and an oil residue. Fractional condensation, solvent extraction procedures and the like, also may be employed to separate the residual heavy fraction from the crude. In the preferred

practice of the invention it is desirable to remove as large a proportion of hydrocarbons boiling above waxes, tars, and asphalts as possible without necessitating the use of cracking conditions.

When the crude oil is derived by pyrolysis of oil shale, the fractionation, solvent extraction or other procedure employed to obtain a heavy, high molecular weight fraction preferably is controlled to produce such a fraction consisting of from about 5 to about 70 percent by volume of the original crude oil charge. Preferably, the crude oil is fractionated to provide a residue consisting of from about 10 to about 30 percent by volume of the original crude. Desirably, such residue is soaked for a period of from about thirty minutes to about one hour at a temperature of about 700°F. to about 750°F.

The light fraction removed from the oil is collected and in the preferred embodiment of the invention subsequently is combined in whole or in part with the treated residue to form a shale oil of low pour point.

It is contemplated that light fractions obtained from shale oils other than that from which the oil residue is obtained and treated also may be combined with such treated residue and may in whole or in part replace the light ends preliminarily separated. When a light hydrocarbon fraction is combined with the modified oil residue, it is preferred that the modified oil residue be at moderate temperatures before the addition of the light fraction thereto to prevent vaporization of low molecular weight components of the admixture. This cooling may be accomplished in any expedient manner.

If the shale oil treatment is carried out in a continuous manner as is preferred, it is also preferred that the residue be removed from the fractionating or extracting vessel prior to being heated at temperatures higher than those employed in the distillation or extraction process. This will prevent the retention of heavy constituents for long periods of time at elevated temperatures with possible resultant carbonization or production of non-condensibles. Alternatively, in such a continuous process the heat treatment may be carried out in situ without the addition of external heat, such as by soaking in a separating vessel.

When the shale oil treatment is conducted as a batch-type operation, the retention or soaking vessel and the fractionating vessel, with proper control of conditions, may be the same without encountering carbonizing conditions and production of non-condensibles.

The heat treatment step of the present invention appropriately may be carried out in equipment which is made an integral part of the plant equipment employed in the thermal treatment of the solid carbonaceous material. In this manner crude oil advantageously may be treated at the production site and suitably prepared for movement to a distant refinery by pipeline transportation.

In accordance with a further embodiment of the invention, the heat treated heavy fraction is added to petroleum oils or petroleum oil fractions to, inter alia, reduce the pour point of such oils and oil fractions. The amount of heat treated heavy fraction added depends on the degree of pour point reduction required. Amounts of heat treated heavy fraction up to about thirty percent by weight preferably are added to the petroleum oil or oil fraction.

While the oil to be treated in accordance with the process of this invention may be produced from soild carbonaceous material, such as oil shale, tar sands, and the like, by any of the known processes, it preferably is produced by the process of Aspegren U.S. patent No. 3,025,223. Pursuant to the Aspergren process, particulate oil shale or oil-bearing said or similar material is pyrolyzed in a revolving drum. The heat for the pyrolysis is furnished in the revolving drum by solid-to-solid milling contact with heat-carrying bodies such as balls of refractory material less attritionable than the oil- or kerogen-bearing feed. The heat-carrying bodies are separated from the pyrolysis residue and then preferably are reheated by combustion of the carbonaceous pyrolysis residue in a separate zone. The reheated bodies then are recirculated to the pyrolysis drum in solid-to-solid milling contact with fresh feed. Such process has been found more effective than any other known pyrolysis process for production of oil from solid carbonaceous material and particularly from oil shale.

The process of this invention is to be distinguished from the visbreaking techniques practiced by the prior art. The difference between visbreaking, where considerable cracking is desired and in fact is obtained along with substantial amounts of coke, is illustrated by the fact that the distillation curves of visbroken oils are materially different from those of the original stock. The distillation curves of oils treated in accordance with the present invention, on the other hand, are not appreciably different from those of the original stock. Further, in visbreaking techniques the oil or oil fraction treated is not combined with lighter fractions to produce a composite oil. Moreover, visbroken oils in contradistinction to the treated heavy fractions of the invention, are characterized by pour points lower than the original oil or oil fraction. In all cases where pour points have been taken on the heavy fraction before and after heat treatment in accordance with the invention, such values have been within the 5° F. margin of error provided for in standard pour point determination techniques.

Having generally described the invention, the following examples are given specifically to illustrate embodiments of the method of the invention. The examples are given for illustrative purposes only and are not intended to limit the scope of the invention. The pour points referred to in the general description and in the examples were determined by ASTM Designation D97–47. Pour points were taken to the nearest 5° F. The distillations employed in the examples were conducted according to ASTM Designation D–1160–52T.

Example I

In order to demonstrate the effectiveness of the method of the present invention in lowering the pour point of oils derived by thermal treatment of solid carbonaceous materials by thermal means, runs were carried out on samples of a crude Colorado shale oil having a pour point of 80° F. wherein each sample of the oil initially was fractionated to provide a light fraction consisting of about 70% by volume of the crude oil and a residue. Portions of the residue then were heated to and maintained at temperatures of about 650° F., 700° F., and 750° F., for a time period of about 1 hour. No discernible amount of non-condensibles or elemental carbon were produced. At the end of the heating period each treated residue was cooled to about 70° F., tested for pour point properties, and recombined with its corresponding, previously removed light fraction. Each oil resulting from the recombination was then tested for its pour point characteristics. The results of the various runs are set forth in the table below:

TABLE

Run	Temp., °F.	Coke and Gas Losses	Residue Pour Point, °F.		Final Oil Pour Point, °F.
			Before Soaking	After Soaking	
1	650	None	80	80	50
2	700	do	80	80	15
3	750	do	80	80	5

Example II

The general procedure of Example I was repeated in a series of runs wherein various residues were heat treated for a period of 1 hour following removal of the light fractions indicated in the table below. Runs 1, 2 and 3 of Example I are included for comparative purposes. There

was no discernible production of either non-condensible hydrocarbons or elemental carbon. The results are set forth below:

TABLE

Temperature, ° F	650			700							750
Run	1	4	5	6	7	2	8	9	10	11	3
Light Fraction Removed, Percent by Volume	70	50	30	90	80	70	65	60	50	30	70
Residue Pour Point Before Soaking	80	95	90	----	----	80	90	95	95	90	80
Residue Pour Point After Soaking	80	90	90	----	95	80	85	95	----	85	80
Final Oil Pour Point, ° F	50	70	75	55	45	15	20	15	35	50	5

Example III

The general procedure of Example I was repeated in a series of runs employing the same shale oil wherein temperature and treating time were varied as indicated in the table below. A light fraction of 70% by volume was removed and the residue treated as indicated in the table below. Runs 1, 2 and 3 are recorded for purposes of comparison. There was no discernible production of non-condensibles or elemental carbon. The results of these runs are tabulated below.

TABLE

Time, hr	.25			1.0			2.0	
Run	12	13	14	1	2	3	15	16
Temp., ° F	650	700	750	650	700	750	650	700
Residue Pour Point ° F. Before Soaking	80	80	80	80	80	80	80	80
Residue Pour Point, ° F. After Soaking	------	80	75	80	80	80	85	------
Final Oil Pour Point, ° F	70	40	15	30	15	5	61	25

Example IV

The general procedure of Example I was repeated except for removing a light fraction of 36 volume percent and employing a soaking time of 2 hours at 600° F. The pour point of the final recombined oil was 55° F. No discernible non-condensibles or elemental carbon were produced.

Example V

A Colorado shale oil having a pour point of about 80° F. was fractionated to produce a heavy residue constituting a 70–100% fraction, i.e., 30% by volume, and various lighter fractions as set out in the table below. The residue was heat treated in accordance with the invention at a temperature of about 700° F. for a period of about 1 hour. The pour point of the residue before and after heat treatment was 80° F. There was no discernible production of either non-condensible hydrocarbons or free carbon. The treated residue was combined with varying amounts of the various lighter fractions and pour point determinations made. The results are set forth below.

TABLE

Run No.	Volume Percent of Residue	Volume Percent of 0–20% Fraction	Pour Point of Combined Mixture, ° F.
17	0	100	−70
18	25	75	−65
19	40	60	−65
20	55	45	−35
21	70	30	0
		Volume percent of 20–70% Fraction	
22	0	100	80
23	25	75	80
24	40	60	80
25	55	45	80
26	70	30	85
		Volume Percent of 0–35% Fraction	
27	0	100	0
28	15	85	−30
29	25	75	−35
30	40	60	−30
31	55	45	−15
32	70	30	10
		Volume Percent of 35–70% Fraction	
33	0	100	90
34	25	75	90
35	40	60	85
36	55	45	90
37	70	30	85
		Volume Percent of 0–50% Fraction	
38	0	100	40
39	10	90	15
40	20	80	−5
41	30	70	−10
42	40	60	−10
43	50	50	5
44	60	40	20
45	70	30	40
		Volume Percent of 50–70% Fraction	
46	0	100	100
47	30	70	95
48	40	60	95
49	50	50	95
50	60	40	95
51	70	30	95
		Volume Percent of 0–70% Fraction	
52	0	100	65
53	20	80	65
54	25	75	55
55	30	70	40
56	35	65	15
57	40	60	10
58	45	55	10
59	50	50	15
60	60	40	25
61	65	35	30
62	75	25	40
63	100	0	80

From the data given above it is apparent that by combining the treated residue with various amounts of the lighter fractions, especially the lighter ends of the originally separated light fraction, oils of extremely low pour point may be produced.

Example VI

A Colorado oil shale was pyrolyzed to produce a vaporized effluent which, when condensed, produced a shale oil characterized by a pour point of 80° F. The vaporous effluent was fractionally condensed to produce the fractions indicated in the table below in terms of weight percent of the effluent. These fractions were soaked for the lengths of time shown at a temperature of about 730° F. The soaked fractions were combined with the light ends in each case to give the following final pour points:

Run No.	Percent Soaked	Soaking Time, Hrs.	Pour Point, ° F.
64	6.9	1.42	10
65	17.5	1.66	−10
66	22.4	1.17	15
67	24.3	3.44	10
68	37.8	3.82	0

Example VII

A Colorado shale oil was fractionated to remove a light fraction of 70 volume percent and leave a residue of 30 volume percent. The residue was heated at 750° F. for one hour. No discernible non-condensibles or free carbon were produced. The residue was characterized by a pour point of 80° F. both before and after treatment. Thirty volume percent of the treated residue was combined with 70 volume percent of a waxy East Utah petroleum crude oil having a pour point of 70° F. The combined oil was characterized by a pour point of 35° F.

Example VIII

A crude Colorado shale oil having a pour point of 70° F. was fractionated to provide a light fraction consisting of about 72% by volume of the crude oil and a heavy residue of about 28% by volume. Portions of the residue were heated at the temperatures and for the time periods set forth below. No discernible amount of non-condensibles or elemental carbon were produced. At the end of the heating period each treated residue was cooled to about 70° F. and recombined with its corresponding, previously removed light fraction. Each oil resulting from the recombination or blending was then tested for its pour point characteristics. The results of the various runs are set forth in the table below.

TABLE

Run No.	Soaking Time (Minutes)	Soaking Temperature (° F.)	Pour Point of Blended Oil (° F.)
69	9.75	646	70
70	5.97	654	70
71	3.00	653	70
72	8.08	706	55
73	5.47	708	60
74	3.07	708	65
75	8.32	751	15
76	5.93	745	35
77	3.15	754	55
78	1.13	746	65
79	9.58	793	−10
80	5.80	795	25
81	3.12	797	45
82	1.07	791	60

Since modifications of the processes and products of the invention which do not depart from its scope will become apparent from the general description and specific embodiments appearing in the specification, it is intended that this invention be limited solely by the scope of the appended claims.

We claim:

1. A method for treating a heavy fraction separated under substantially non-cracking conditions from a crude oil derived by thermal treatment of solid carbonaceous material, to produce said heavy fraction and at least one light fraction which method comprises heat treating said separated heavy fraction alone at a temperature above about 600° F. and below the point of incipient thermal decomposition of the heavy fraction for a period of time which is inversely proportional to said temperature to produce a product which when combined with at least part of a light fraction, results in an oil having a pour point lower than that of the original crude oil, said heat treatment producing substantially no non-condensible hydrocarbons and substantially no elemental carbon.

2. The method according to claim 1 wherein the solid carbonaceous material is oil shale.

3. The method according to claim 1 wherein the crude oil is a shale oil having a pour point of at least about 70° F.

4. The method according to claim 1 wherein the heavy fraction is heat treated at a temperature of from about 600° F. to about 800° F.

5. The method according to claim 1 wherein the heavy fraction is heat treated for a period between about 1 minute to about 3 hours.

6. The method according to claim 1 wherein the heat treatment of the heavy fraction is conducted at the autogenesis pressure.

7. A method for reducing the pour point of an oil derived by thermal treatment of solid carbonaceous materials and containing hydrocarbons which comprises treating said oil under substantially non-cracking conditions to obtain at least one light fraction and an oil residue, heat treating said oil residue at a temperature above about 600° F. and below the point of incipient thermal decomposition of the residue for a period of time which is inversely proportional to said temperature to produce a product which when combined with a light fraction results in an oil having a pour point lower than the original crude oil, said heat treatment producing substantially no non-condensible hydrocarbons and substantially no elemental carbon; and combining said modified oil residue product with at least a portion of a light fraction to produce an oil of lower pour point than the original crude.

8. The method according to claim 7 wherein the solid carbonaceous material is an oil shale.

9. The method according to claim 7 wherein the oil derived from thermal treatment of solid carbonaceous material is a shale oil having a pour point between about 70° F. and about 100° F.

10. The method according to claim 7 wherein the residue heat threated is under a pressure not in excess of 2 atmospheres.

11. The method according to claim 7 wherein said residue represents from about 5% to about 70% by volume of said crude shale oil.

12. The method according to claim 7 wherein the residue is heat treated for between about 1 minute and about 3 hours at a temperature between about 600° F. and about 800° F.

13. A method for reducing the pour point of crude shale oil which comprises treating a crude shale oil at non-cracking conditions to produce a light fraction and an oil residue containing waxes and asphaltenes, heat treating said oil residue at a temperature of from about 600° F. to about 800° F., said heat treatment producing substantially no non-condensible hydrocarbons and substantially no free carbon and being continued for a period of time which is inversely proportional to said temperature to producing of a treated residue which when combined with at least a portion of a light fraction, produces an oil characterized by a pour point at least 10° F. lower than that of the crude shale oil.

14. The method according to claim 13 wherein said crude shale oil has a pour point in the range of from about 70° F. to about 100° F.

15. The method according to claim 13 wherein said residue represents from about 5% to about 70% by volume of said crude shale oil.

16. The method according to claim 13 wherein the residue is heat treated in the range of from about 650° F. to about 750° F.

17. The method according to claim 13 wherein said time period is in the range of from about 1 minute to about 3 hours.

18. The method according to claim 13 wherein all of said light fraction is combined with said modified oil residue.

19. An oil product prepared by heat treating a separated heavy residue formed by separating said residue and a light fraction under substantially non-cracking conditions from a crude oil derived by thermal treatment of solid carbonaceous material; said heat treatment of the residue being conducted at a temperature between about 600° F. and the point of incipient thermal decomposition of the residue and for a period of time which is inversely proportional to said temperature to produce a product which, upon combination with at least part of a light fraction, results in an oil having a pour point lower than that of the original crude oil.

20. An oil product according to claim 19 in which the oil produced by thermal treatment of solid carbonaceous material is shale oil.

21. A method for reducing the pour point of crude shale oil which comprises treating a crude shale oil at non-cracking conditions to produce from 30 to 95 volume percent of said crude shale oil of a light fraction and from 70 to 5 volume percent of said crude shale oil of an oil residue; ceasing the production of light fraction; heating said residue at a temperature between about 600° F. and the point of incipient thermal decomposition of the residue for a period of at least about 10 minutes without further removal of substantial quantities of light fraction and with substantially no formation of non-condensible hydrocarbons and free carbon; and recombining said light fraction and heat-treated residue to provide a product having a substantially lower pour point than the original crude shale oil.

22. A pour point depressant prepared by heat treating a separated heavy residue formed by separating said residue and a light fraction under substantially non-cracking conditions from shale oil derived by thermal treatment of oil shale; said heat treatment being conducted at a temperature between about 600° F. and the point of incipient thermal decomposition of the residue and for a period of at least about 1 minute, said period varying inversely with said temperature.

References Cited by the Examiner

UNITED STATES PATENTS

781,240	1/1905	Stark	208—106
1,886,262	11/1932	Nielson	208—11
1,953,039	3/1934	Bonnell	208—19
2,315,935	4/1943	Child	208—15
2,885,338	5/1959	Evans	208—11

OTHER REFERENCES

Bell, H. S.: Oil Shale and Shale Oils, D. Van Nostrand Co. Inc., New York, 1948 (Chapt. VIII).

Sachanen: The Chemical Constituents of Petroleum, Reinhold Publ. Corp., New York, 1945 (pp. 304–305).

DANIEL E. WYMAN, *Primary Examiner.*

P. KONOPKA, *Assistant Examiner.*