Patented Oct. 28, 1941 2,261,003

UNITED STATES PATENT OFFICE

2,261,003

STABILIZED FUEL OIL

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No Drawing. Application December 5, 1939, Serial No. 307,604

4 Claims. (Cl. 44—9)

Light fuel oils, such as the No. 2 and No. 3 grades produced for and used in uses such as domestic heating, light heating, and the like, are oils of boiling range similar to kerosene and light gas oil, usually derived from a cracking operation. They are not to be confused with the heavier fuel oils of residual nature, obtained as a residue from the distillation of crude oil, or as a residue from cracking.

These light fuel oils are frequently prone to deterioration in storage, possibly due to the mild but prolonged oxidizing conditions of such storage. The deterioration results in the formation of sludge or sediment, which if not removed, plugs filter screens, orifices, and other parts of the equipment used in burning such fuel. Even when, after some storage, all visible sediment is removed from such oils, other sediment continues to form.

This invention is directed to the provision of such a fuel oil, relatively stable against the formation of such sediments and sludges.

This invention has for its object the provision of light fuel oils containing inhibitive materials capable of preventing the formation of sludge and/or sediment in such oil, under the conditions of use usually encountered.

To enable understanding of this invention, there is first defined the type of fuel oil with which it is concerned, by way of the following example, showing properties of a typical "#3" fuel oil.

Untreated #3 fuel oil

Gravity A. P. I.	34.0
Distillation, A. S. T. M.—I B. P. °F.	342
5	405
10	417
20	434
30	444
40	454
50	464
60	473
70	484
80	494
90	524
E. P.	580
Recovery percent	98
Residue percent	2
Loss percent	
Pour point °F.	−30
Flash point P. M. °F.	156
B. S. & W.	0
Kinematic visc. @ 100 °F.	1.98
Aniline cloud point, °F.	112.0
Kauri-butanol No.	43.5
Neutralization number	0.07
Ash of 10% bottoms (percent wt.)	

While the above oil is an untreated oil, many of these oils are "treated," that is have been treated with 5 pounds per barrel of 66° Bé. sulphuric acid, followed by water washing and neutralizing. This treating has little effect upon physical properties, but serves to reduce the tendency to sludging, sediment formation, etc.

This invention is based upon the discovery that the formation of sludge and sediment under normal storage conditions may be prevented substantially by the addition to such an oil of small amount of di-cyclohexyl amine.

For example, the effectiveness of such addition may be shown by the following tabulation of data:

Table I

98% sulphuric acid pounds per 42 gallon bbl.	Time before appearance of sediment in days. Inhibitor concentration, percent weight					
	0	0.05	0.01	0.02	0.05	0.10
0	2	6	6	6	------	------
2	4	------	6	6	6	6
5	4	------	11	11	12	12
10	1	------	8	11	11	11

In the above tests, a light fuel oil, both untreated, and treated with various amounts of acid, as shown in the first column, then doped with varying amounts of inhibitor, as shown by columns 3–7 inclusive, was compared with an undoped oil, shown by column 2, in an accelerated test wherein samples of the oil were held at 160° F. in the presence of iron, while exposed to the atmosphere. Reading the first horizontal line, it is found that in an untreated oil which formed sediment when undoped in 2 days, even 0.05 percent by weight of the inhibitor, prevented the appearance of sediment until the elapse of 6 days. Similarly, in line 3 of Table I, where the oil was treated with 5#/bbl. of acid, sediment formed in the undoped oil in 4 days, while 0.01% by weight of the inhibitor prevented its appearance until the eleventh day.

As shown in Table II below, while quite small amounts of inhibitor delay the formation of sediment, they do not greatly reduce the total amount eventually formed, but larger amounts of inhibitor markedly reduce the amount formed, particularly with heavily acid treated oils.

Table II

98% sulphuric acid pounds per 42 gallon barrel	Sediment after 20 days' storage, percent volume. Inhibitor concentration, percent weight			
	0	0.01	0.02	0.10
0	0.40	------	0.40	------
2	0.70	0.40	------	0.34
5	0.12	0.20	------	0.18
10	0.10	0.04	------	Trace

The above tests were conducted as an accelerated aging test in the same manner as before, by exposing oil to storage at 160° F., exposed to atmosphere, in the presence of iron, except the test was continued for 20 days.

These accelerated tests are quite severe, and inhibition of sediment to the degree noted there-

in would practically mean complete inhibition of sedimentation for the normal period of storage at normal temperature conditions.

In general, since the prime necessity is that of preventing the appearance of sediment in the oil under the normal conditions of storage at atmospheric temperature during the normal time which elapses prior to its use, the lower concentrations are the more economically useful and while from about 0.01% to 0.10% by weight may be used, the preference is for concentrations of from 0.01% to 0.02% by weight of the fuel treated.

It may be noted that the problem does not appear analogous to the inhibition of gum formation in gasoline, since the inhibitor used, di-cyclohexyl amine, is of little use for preventing gum formation in gasoline, and effective gum inhibitors such as for example alpha-naphthol and other recognized gasoline inhibitors are not effective for the present purpose.

I claim:

1. An unrefined light fuel oil of gas oil nature inhibited against the formation of sediment by oxidation under conditions of normal storage by the addition thereto of small amounts of di-cyclohexylamine.

2. An unrefined light fuel oil of gas oil nature which has been treated with sulphuric acid, and inhibited against the formation of sediment by oxidation under conditions of normal storage by the addition thereto of small amounts of di-cyclohexyl amine.

3. An unrefined light fuel oil of gas oil nature inhibited against the formation of sediment by oxidation under conditions of normal storage by the addition thereto of from about 0.01 to about 0.10 percent by weight of di-cyclohexyl amine.

4. An unrefined light fuel oil of gas oil nature inhibited against the formation of sediment by oxidation under conditions of normal storage by the addition thereto of from about 0.01 to about 0.02 percent by weight of di-cyclohexyl amine.

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