United States Patent Office 3,279,901 Patented Oct. 18, 1966

3,279,901

DISTILLATE FUELS

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No Drawing. Filed Aug. 30, 1963, Ser. No. 305,859
3 Claims. (Cl. 44—66)

This invention concerns an improved petroleum distillate composition and, more particularly, relates to a distillate containing additives which obviate the problems caused by water being entrained in the distillate.

Water normally enters an outdoor fuel tank when the ambient temperature rises. At this time the fuel tank walls are colder than the air; therefore water vapor precipitates and freezes onto the tank walls. When the fuel tank walls warm sufficiently, the ice melts and admixes with the fuel. This entrained water causes many problems; for example, ice formation is a common cause of burner failure in home heating oil installations, where the fuel is stored outside. The water in the fuel oil is often dispersed in large droplets. These droplets on freezing form large spherical ice crystals which tend to plug the valve and line leading to the burner. At temperatures where wax has precipitated from the fuel, ice crystals aggravate wax plugging of the valve and line. In addition to the problem of ice formation, water adheres to impurities in a fuel causing a sticky sludge. This, of course, increases the filter plugging tendencies of the fuel oil.

It has now been discovered that the severity of the problem caused by entrained water can be greatly reduced and in many instances the problem virtually eliminated by employing a particular mixture of additives. The periodic addition of the additives of this invention to a stored fuel oil causes the formation of a microemulsion. This microemulsion will keep the water from settling and collecting on the bottom of the tank. Since the water is microemulsified, on freezing only very small ice crystals will form. These small crystals will not plug the valve or line and will be pumped through the burner where the water will eventually be eliminated. In addition, the additive mixture of this invention separates water that adheres to the sludge, thus breaking up the sludge.

The additive mixture consists of three ingredients in relative amounts of from 1 to 9 parts by weight of a fatty acid, from 1 to 5 parts by weight of an amine selected from the group consisting of an alkyl polyamine, an alkanol amine, and preferably a mixture of alkanol amines, and from 1 to 8 parts by weight of an alkyl phenol.

The fatty acids suitable for this invention include those having from 16 to 20 carbon atoms. The acid may be saturated, for example, palmitic or stearic acid or it may be unsaturated. The preferred acids are those which contain 1 (oleic), 2 (linoleic), or 3 (linolenic) double bonds. Other suitable acids include palmitoleic, elaidic, eleostearic, licanic, ricinoleic, vaccenic, and punicic. These acids may be substituted or unsubstituted, however, it is preferred that they be unsubstituted.

The amines that are effective are alkyl polyamines having from 1 to 3 carbons per amine group. Alkyl diamines such as ethylene diamine are preferred.

Although the above-described alkyl amines are effective in the additive mixture of this invention, it has been discovered that certain amino alcohols and preferably mixtures of these amino alcohols are even more effective. Suitable amino alcohols include primary, secondary and tertiary alkyl amino alcohols containing from 2 to 5 carbon atoms per alkyl group. The preferred amino alcohols are the primary, secondary and tertiary isopropanol

amines, to wit, monoisopropanol amine, diisopropanol amine, and triisopropanol amine. Economically, mixtures of isopropanol amines are preferred.

The alkyl phenols for this invention include the mono- and polyhydroxy compounds having an alkyl group containing from 8 to 12 carbon atoms. The alkyl group, saturated or unsaturated, can be branched or straight chained. The group may be substituted with halogen groups or the like but is preferably unsubstituted. Likewise, the aryl group, phenyl or naphthyl, may be substituted with a halogen or the like, but it is preferably unsubstituted. The presence of other alkyl groups on the aryl group will not hinder the performance of a phenol so long as the phenol has at least one alkyl group containing from 8 through 12 carbon atoms. Thus it is seen that the cresols, that is, the methylphenols, may be used to synthesize the alkyl phenols of this invention.

The oils in which the additive mixture of this invention may be incorporated are liquid petroleum distillate products boiling in a range between about 75° and about 900° F. Such products include gasolines, aviation turbo jet fuels, kerosenes, diesel fuels, transformer oils, turbine oils and heating oils. The additives are particularly useful in distillate fuels boiling in a range between about 250° F. and about 750° F. Such fuels include turbo jet engine fuels, diesel fuels and heating oils.

The amount of the additive mixture needed to form the microemulsion will depend upon a variety of factors, for example, the particular additive mixture employed, type of fuel, and the amount of water in the fuel. In general, however, the addition of a small amount of the additive mixture to the distillate equal to from 10% by weight to 200% the amount of the water in the fuel will form a microemulsion with the water.

The microemulsifying additive mixture may, in accordance with this invention, be employed in conjunction with a variety of other additives commonly used in fuels. Typical additives are rust inhibitors, corrosion inhibitors, antioxidants, dispersants, dyes, dye stabilizers, antistatic agents, and the like. It may be found to be convenient to prepare additive concentrtae for use in the various types of fuels and thus add all of the additives simultaneously.

In order to demonstrate the efficacy of the additive mixture, tests were performed with a fuel having the following inspection:

Gravity, ° API (@ 60° F.)	30.5
Color, Tag-Robinson	12
Pensky-Martens flash, ° F.	415 (Cleveland open cup)
Sulfur, wt. percent	0.2
Neutralization No.	0.05
Aniline point, ° F.	
ASTM distillation, 10 mm. Hg:	
Initial boiling point, ° F.	318
10% point, ° F.	432
50% point, ° F.	508
90% point, ° F.	573
Final boiling point, ° F.	596
Conradson carbon residue —percent—	0.04

Additive mixtures consisting of a fatty acid composition, an amino alcohol composition, and an alkyl phenol in relative amounts as shown in Table I were tested in the above identified fuel. The fatty acid composition was a commercial mixture comprising 8.0% conjugated linoleic acid, 36% non-conjugated linoleic acid, 50% oleic acid and 6% stearic acid. A mixture of isopropanol amines consisting of 15% monoisopropanol amine, 40% diisopropanol amine and 45% triisopropanol amine was employed. The alkyl phenol was nonyl phenol. 50 grams of the additive mixture was added to 50 grams of the

above-identified fuel. In a series of tests utilizing various weight ratios of the ingredients of the additive mixture the fuel was titrated to the first water haze to determine the amount of water the system would take up as a microemulsion. The results appear in Table I.

TABLE I.—SURFACTANT MIXTURE RATIO

Tall Oil Fatty Acid	Mixed Isopropanol Amine	Nonyl Phenol	Water, g.	Solution
1	1	1	40.3	Clear.
2	1	2	22.0	Do.
2	1	5	1.3	Do.
5	2	5	13.6	Do.
3	1	1	42.5	Do.
5	1	1	13.7	Slight haze.
1	2	5	3.9	Do.
1	1	5	2.1	Do.
1	5	1	0	Initial haze.
5	1	5	0.6	Clear.

In the absence of the additive mixture a haze appeared as soon as water was added to the system. However, as is seen from the data appearing in Table I, the additive mixture of this invention was effective in causing a substantial amount of water to be microemulsified in the fuel.

What is claimed is:

1. A fuel oil, which is subject to contamination by water and which is inhibited against formation of large ice crystals which can cause valve and filter plugging, containing: a minor amount of a water microemulsifying additive mixture, sufficient to microemulsify water contamination into said oil, of about 1 to 9 parts by weight of C_{16} to C_{20} fatty acid, about 1 to 8 parts of alkyl phenol wherein said alkyl group has 8 to 12 carbon atoms, and about 1 to 5 parts by weight of an amine selected from the group consisting of alkyl polyamine having 1 to 3 carbon atoms per amine group and an alkyl amino alcohol containing 2 to 5 carbon atoms per alkyl group.

2. A fuel oil according to claim 1 wherein said minor amount of additive mixture is equal to from 10% to 200% the amount of water in the distillate.

3. A fuel oil according to claim 1, wherein said alkyl phenol is nonyl phenol, and said amine is a mixture of isopropanol amines.

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