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FUEL OIL ADDITIVE TO REDUCE CORROSION AND DEPOSITS

Robert S. Norris, 26 Valley Road, Larchmont, N.Y.

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This invention relates to fuel oil additives.

It has been recognized in recent years that fuel oils containing sulfur, vanadium, sodium, and water, cause corrosion and deposits when burned in diesel engines, gas turbines, and other oil-fired burner applications such as steam boilers and heating plants. There are differences of opinion as to the exact mechanism by which the corrosion and deposits take place; i.e., whether deposits of vanadium and other compounds form and when heated to the fusion temperature, cause pitting and corrosion, or whether the vanadium and other compounds are liquefied in the gas stream and attack the metal as they impinge on various parts. Parts affected include such items as nozzles and rotor buckets in a gas turbine, valves, piston heads, flame rings, etc., in diesel engines, and superheater tubes and boiler tube-support plates in boilers using steam or mercury.

In examining certain parts where slag deposits are present and corrosion has taken place, such as exhaust valves in diesel engines, after removing the deposit, there is evidence of pitting and corrosion. With other parts in other types of diesel engines, examination of flame rings and piston heads, show evidence of pitting and corrosion without the presence of slag deposits. This corrosion is attributed to one or more of the compounds containing sodium, vanadium, and/or sulfur.

It has been established that certain of the vanadium oxides are corrosive to metals, and that vanadium pentoxide is the particularly troublesome oxide since it fuses and melts in the temperature range which is often experienced in the combustion chambers of diesel engines, gas turbines, and oil-fired burners for boilers.

It is accordingly a principal object of the present invention to provide a fuel oil additive which, when introduced into the fuel oil, will limit the corrosive effects attributed to the afore-mentioned sulphur, vanadium, and sodium compounds present in residual type fuels, and present to a lesser extent in distillate type fuels as well.

It is still another object of the present invention to provide a fuel oil additive in oil soluble form which will reduce the pitting and corrosion of the fire side of boiler tubes, superheater tubes, and boiler tube-support plates, in high pressure steam boilers such as those generating steam for steam turbines, where heavy under-boiler or bunker C type fuels are used.

It is still another object of the present invention to provide a fuel oil additive which, due to the detergent-dispersant nature thereof, will when used with fuel oils, tend to disperse the carbon particles and ash-forming particles and thereby promote better atomization characteristics, minimizing carbonization build-up on fuel valves, injectors, atomizers, and also in the exhaust ports and passages. Also as a result of this better dispersion characteristic imparted to the fuel by the additive, an improved and more complete combustion will be provided in the combustion chamber.

The most efficient centrifuge and purification equipment available for installation at the operator's plant is unable to remove all of the water and dissolved harmful particles present in residual type fuel oils. The sulphur and vanadium compounds are soluble in the oil and cannot be removed by physical means such as centrifuging or filtering. A large part of the sodium compounds are present as sodium chloride which is in the salt water entrained in the fuel, and since the specific gravity of many of these residual fuels approaches or even exceeds the specific gravity of water, it is similarly not possible to remove by centrifuging, all the salt water, and consequently the sodium compounds, from the fuel oils.

It is still another object of the present invention to provide a fuel oil additive which will take these water particles and put them into solution with the fuel oil, rendering them less harmful when injected into the combustion chamber. Since the present invention is an emulsion, it will emulsify with the salt water present in the fuel oil, rendering the salt water particles less harmful upon combustion.

It is still another object of the present invention to provide a fuel oil additive which during times of national emergency will conserve critical alloy metals that might be affected and which would otherwise wear and corrode.

It is still another object of the present invention to provide a fuel oil additive which during times of national emergency would permit residual type fuels and lower quality fuels to be used more satisfactorily than heretofore, particularly in diesel engines and gas turbines, thereby releasing more distillate fuels for jet aircraft and other prime movers specifically requiring highly refined fuels.

Other objects and advantages and nature of my improved fuel additive will be apparent from the following description of the ingredients making up the same, the proportions thereof, the method of preparation, and the manner in which the aforesaid fuel additive is to be used.

I have discovered that, in addition to alkaline metallic water soluble salts, those water soluble salts of aluminum, boron, copper, silicon, zinc, and others, when dissolved in an aqueous solution, will emulsify with calcium sulfonate, barium sulfonate, or magnesium sulfonate, and may be added to fuel oils to promote the foregoing objects. In view of the relative costs and availability of the water soluble salts referred to above, the invention incorporates aluminum sulfate into the example formulation, although comparable results can be obtained with many other water soluble inorganic compounds. A few of these are as follows: aluminum acetate, aluminum bromate, aluminum bromide, aluminum chlorate, aluminum chloride, aluminu citrate, aluminum iodide, aluminum nitrate, aluminum potassium tartrate, aluminum silico fluoride, aluminum sodium chloride, aluminum sulfate, boric acid, boron fluoride, boron oxide, cupric acetate, cupric nitrate, cupric sulfate, cupric silicafluoride, zinc acetate, zinc nitrate, zinc silicofluoride, etc.

The following example is further illustrative of the invention and it will be understood that the invention is not limited thereto:

Example

An aqueous solution of aluminum sulfate was prepared to a concentration of 40% by weight. This aqueous solution was slowly added to an oil phase consisting of equal parts of a 100 S.S.U. viscosity at 100° F. pale oil with basic barium sulfonate, using a mixer or paddle, in the ratio of 6 parts by volume of the aqueous solution of aluminum sulfate to one part of the oil phase.

The resulting water-in-oil emulsion is quit viscous, but may be reduced in viscosity with any light mineral oil, and may be homogenized by passing it through a gear pump. It is stable on storage at temperatures from —40 degrees F. to 160 degrees F. without any water or oil separation. The additive when blended to the above

formulation had a sulfated residue of approximately 25 percent by weight.

When the above additive was introduced into residual type fuel in the ratio of one gallon of additive to 1,000 gallons of fuel oil, it imparted to the fuel oil approximately 250 parts per million of aluminum particles of a size not exceeding two microns, and, in addition, there are present some particles of the metallic portion of the sulfonate, which also have a beneficial effect. These particles, well dispersed in the fuel oil and in small particle size, come in intimate contact upon combustion, with the sulfur, vanadium, and sodium compounds present in the fuel. In combining with these latter compounds, the aluminum particles raise the fusion and melting temperatures of the ash in such a manner that its corrosive attack of ferrous metals and alloys is minimized. By thus raising the melting point of the corrosive compounds of vanadium, sulfur, and sodium, they pass through the combustion chamber of a gas turbine, steam boiler, or diesel engine, in a solid state of finely divided ash without causing corrosion or deposition on any parts on which they impinge.

Depending on the nature and quantity of harmful compounds in the fuel oil, the ratio of additive to fuel oil may be increased or decreased from the ratio of 1 to 1,000.

While the invention has been described with reference to a particular example and embodiment, it will be apparent to those skilled in the art, that various modifications may be made, and equivalents substituted therefor, without departing from the principles and true nature of the present invention. In case it is found advisable from an economic standpoint to substitute an inorganic compound which is only slightly water soluble at normal ambient temperatures but much more water soluble at elevated temperatures, the aqueous phase and the oil phase may be heated separately and mixed at elevated temperatures.

Having thus set forth and disclosed the nature of my invention, what is claimed is:

1. A viscous water-in-oil fuel oil additive emulsion stable against extreme conditions of temperature and adapted to render vanadium and sulfur compounds in fuel oil relatively innocuous during combustion thereof,

the water phase of which consists essentially of a concentrated aqueous solution of a water-soluble salt containing an element selected from the group consisting of aluminum, boron, copper, silicon, and zinc, and as an emulsifying agent a sulfonate of an alkaline earth metal; the oil phase of the said emulsion consisting essentially of a mineral oil, and being present in the amount of about 1 part for each 6 parts of water phase by volume.

2. The emulsion of claim 1 in which the said water-soluble salt is aluminum acetate.

3. The emulsion of claim 1 in which the said water-soluble salt is aluminum sulfate.

4. A fuel oil comprising a main body of petroleum fuel oil and uniformly distributed therein finely-divided particles of the emulsion of claim 1, the salt particles having an average diameter of less than about 2 microns.

5. The fuel oil of claim 4 in which about 250 parts per million of aluminum sulfate particles are distributed uniformly in the fuel mixture.

6. In the process of rendering vanadium and sulfur compounds innocuous to the parts of a combustion chamber in which fuel oil containing such compounds are burned and in which the fuel contains a sulfonate of an alkaline earth metal, the improvement which comprises uniformly distributing the said sulfonate and a salt containing an element selected from the group consisting of aluminum, boron, copper, silicon, and zinc in an aqueous solution throughout the fuel oil as a stable water-in-oil emulsion, the particle size of which salt is less than about 2 microns.

7. The process of claim 6 in which the said salt is aluminum sulfate.

8. The process of claim 6 in which the said salt is aluminum acetate.

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