United States Patent Office 3,078,189 Patented Feb. 19, 1963

3,078,189
METHOD FOR SALVAGING ELECTRICAL EQUIPMENT AND MACHINERY

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No Drawing. Original application June 18, 1959, Ser. No. 821,332. Divided and this application June 29, 1960, Ser. No. 39,737
(Granted under Title 35, U.S. Code (1952), sec. 266)
5 Claims. (Cl. 134—26)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This application is a division of copending application Serial No. 821,332, filed June 18, 1959.

This invention concerns a method for removing fuel oil contamination from electrical and mechanical equipment. More particularly, it concerns a cleaning composition and technique for rapid and effective recovery of electrical and mechanical equipment which have become flooded and fouled with fuel oil.

Electrical and mechanical installations and equipment on Navy vessels are subject to salt water flooding and fuel oil contamination as a result of battle damage, collision, as a necessary fire control action, or as a result of mechanical and personnel failures in the operation of fuel storage and ballasting systems. It is also of the greatest importance that equipment on Navy vessels and shore installations be returned to service, often, on emergency basis and at the earliest possible moment with minimum assistance from trained overhaul men. It is, furthermore, essential in all cases that damage by corrosion to metal and deterioration to electrical insulation should be prevented or minimized.

Heretofore, equipment on board ships and on shore installations, which have become water-logged by flooding or by excessive condensation have been recovered by treating them with a water-displacing composition which provides positive displacement of water from metal parts and from insulating material; said water-displacing composition forms the subject matter of U.S. Patent 2,647,839 which was issued on August 4, 1953, to William A. Zisman and Hayward R. Baker. The patented water-displacing and corrosion-inhibiting composition (Spradri) has found wide usage in the Navy as well as in industry as an effective product for returning water-flooded equipment to service without dismantling and within a few hours after their recovery from submersion.

Shipboard experience, however, has shown that compartment flooding is often accompanied with fuel oil contamination resulting from damage to fuel lines or from escape of oil cargo. In such cases, the viscous, adherent oil residues resist removal by water and prevent the water-displacing composition from removing the water which is present.

The present invention involves a cleaning composition and a technique for removing burner fuel oils, such as Bunker C or Navy Special, from electric motors, electronic equipment, machinery, and the like, which have been submerged in sea water and/or have become contaminated with fuel or waste oils, petroleum, oily residues, along with dirt, grime and trash. The composition is poured over or preferably, sprayed lightly on contaminated surfaces, followed with water-rinsing to remove the displaced contamination and remaining cleaning composition; finally the cleaned electric motors, electronic devices, etc. may be sprayed with a water-displacing composition to remove surface water and then air dried to the point where they can be returned to service safely.

An object of this invention is to provide a method for removing fuel oil, oily wastes, dirt, and other contamination from water-logged compartments on naval vessels wherein said contamination is difficult to remove by conventional cleaning methods.

Another object of this invention is to provide a method for utilizing a cleaning composition for removing oil contaminations without damage to electrical equipment and insulation.

A further object of this invention is to provide a new method and composition for salvaging operations on shipboard, said composition being relatively simple to use, requiring little or no mechanical treatment of the affected parts and being moreover equally effective with either fresh water or salt walter.

It is also an object of this invention to provide a salvage method that can be performed by routine maintenance crews on board ship and that permit reuse of the flooded equipment in the shortest possible time. While the disclosure that follows is concerned with Navy salvaging operations, the novel cleaning composition and method may be utilized in any salvaging, reclaiming or cleaning operation in which a persistant oily contaminant is present.

Still other advantages of the invention, and the invention itself, will become apparent from the following detailed description of a particular embodiment thereof.

According to the invention, a composition is formulated which consists of an emulsion of a dispersed hydrocarbon solvent in water and containing therein a surfactant or surface-active agent, in an amount sufficient to hold the hydrocarbon solvent and water in a useful emulsion, and an effective component, one that is capable of penetrating the contaminating film which is to be removed. According to the present invention, the present cleaning emulsion breaks and displaces adherent fuel oil films by spraying a fine stream of cleaning emulsion on viscous oil contaminations at spraying pressures of about 20 to 80 p.s.i. and then flushing the sprayed parts with water. Once the contaminating oil film is broken and pushed back as a result of the present cleaner and the spraying force of the water, it is rendered relatively non-wetting and does not contaminate the surface over which it is flushed.

The dispersed hydrocarbon in the cleaning composition is an aliphatic type solvent having a flash point in the vicinity of 140° F. The solvent, as specified for herein, may be a naphtha fraction that meets the flash point requirement or it may be the Dry Cleaning Solvent, Type II, which meets Federal Specification P–S–661b. The Amsco 140 Solvent supplied by the American Mineral Spirits Company is a specific example of a commercially available product that may be used in the present composition. It has an initial boiling point of 364° F., the 90% fraction thereof boiling at 387° F., thus providing a close-cut boiling range for a solvent with a remarkably mild odor. In an oil-in-water emulsion an aliphatic hydrocarbon with a flash point in the vicinity of 140° F. is less of a fire hazard than the solvents normally used in cleaners with flash points of about 104° F. As a result of the higher flash point, there is no requirement for a chlorinated hydrocarbon snuffer in order to suppress the volatile nature of the solvent. The flash point of the solvent in the vicinity of 140° F. is generally higher than the flash point of most contaminating fuel oils with which the solvent will come in contact. It is to be understood, however, that the high flash point of 140° F. for the aliphatic solvent specified herein is not critical for the practice of the present invention and that an aliphatic solvent having a flash point somewhat less than 140° F. may be used without reducing the effectiveness of the cleaning emulsion.

The surfactant used in the present composition may be

any one of the commercially available products, for instance, Span 85, Monisol X–100, Tergitol Monionic NPX, and Pluronic L–63, which are surface-active agents of the non-ionic type. The inclusion of a surface-active agent of this type, in a relatively small amount of less than 1% and preferably between 0.2 and 0.5% by weight of the composition, causes the emulsion to break upon coming in contact with the fuel oil film and releases the solvent at the point of contact, where it penetrates and dilutes the oil film. A surfactant in a relatively small concentration provides an unstable emulsion which has been found useful for the present cleaning composition. It has been observed that emulsions of maximum stability—those containing surfactants of about 1% or more—do not cut the oil film effectively. On the other hand, compositions which contain surfactants in very low concentrations, those containing about 0.1% or less, form emulsions which break so rapidly that they cannot be handled and sprayed conveniently.

Non-ionic type surfactants may be used effectively with either fresh water or with salt water. Surfactants of this type are mainly polyglycol esters of the fatty acids and polyoxy-alkylene derivatives. A particularly effective compound of this type is the polyethylene glycol monooleate. Emulsions containing 0.25% of this surfactant provide cleaning compositions of high cutting power as measured by the area of fuel oil which is ruptured and pushed back to expose bare surface. In addition to its cleaning power, this composition is a good rust inhibitor and provides protection to the treated surface during the cleaning operation and also after the surface has dried by means of a fine film of the composition which remains on the clean surface. The particular product which is esterfied to form this compound has an average polyethylene glycol molecular weight of about 300 to 600 and the final product is usually designated by a number in this range, as "polyethylene glycol 400 monooleate."

An additional component which is included in the present cleaning composition is one which allows for rapid penetration of fuel oil films without the need for soaking or for mechanically treating the contaminated surface to loosen the oily film. Such a material is the fuel oil itself. Its presence in the composition hastens the break up of the fuel oil film and causes the oil residue to be pushed back without any mechanical agitation. Compositions which are formulated without the fuel oil component were found ineffective as cleaners unless some eroding action was also provided, for instance, a spraying force or scrubbing in order to penetrate the film. The fuel oil added in amounts of from about 3 to about 7% by weight of the composition facilitates in penetrating the oil film, carrying solvent and surfactant to the surface. Once such contact with the surface has been established, rapid absorption of the contaminant oil will occur and the spreading action of the cleaner clears large areas of contaminant oil.

Fuel oils most often encountered in salvage work are Bunker C (No. 6 burner oil) and the Navy Special fuel oil (No. 5 burner oil). Bunker C oil is described in Modern Petroleum Technology published by the Institute of Petroleum, London (1946), as the heaviest grade fuel oil sold on the market with a maximum viscosity as measured by Saybolt Furol @ 122° F. of about 300, and a water and solid content of not more than 2%. The Navy Special fuel has a maximum viscosity of 40 SSU @ 122° F. and a solid content of not more than 0.10%. The composition of the cleaner depends, of course, on the particular fuel oil found contaminating the salvage operation. When the fuel oil that may be contaminating is known, the cleaning composition may be prepared in advance and only the water component is added at the time of use. However, when the fuel oil or other contaminant cannot be anticipated in advance, the fuel oil component may be omitted from the cleaning composition as initially prepared and the particular oil which is found contaminating a salvage operation may then be added to the cleaning solution in amounts ranging from about 3 to about 7 percent by weight based on the final composition.

The materials originally blended consist of 89.5% aliphatic hydrocarbon solvent, 10% fuel oil and 0.5% surfactant. During a salvaging operation this mixture is emulsified with an equal volume of water, or with sea water, to form a composition consisting of 50% water, 44.75% aliphatic hydrocarbon, 5% fuel oil and 0.25% surfactant, all percentages by weight.

A specific composition by way of illustration includes:

Components—	Percent by weight
Aliphatic hydrocarbon solvent, flash point 140° F	44.75
Navy Special fuel oil	5
Polyethylene glycol 400 monooleate	0.25
Sea water	50

The efficiency of the cleaning composition is considerably increased by utilizing a spraying technique, for instance, using a fine spray of the cleaning emulsion at a pressure of from 20 to about 80 p.s.i. which speeds up and also improves the cleaning process. A fine emulsion spray of about 80 p.s.i. requires less amount of cleaning fluid and provides the most thorough removal of an oil contaminant without damage to electrical insulation. As a spray cleaner, the emulsion may be ejected from an oil spray gun for better penetration, dispersion and complete removal of fuel oils. The emulsion is not toxic, nor irritating to the skin and fire hazard is considerably minimized, so that the cleaner may be used without any special health or safety precautions.

Equipment which is contaminated with a heavy grade fuel oil (Bunker C) is more easily cleaned if the cleaning fluid is initially warmed to about 100° F. Warming the cleaning fluid has also been found to improve as well as hasten the removal of other fuel oils but this step is not essential for the removal of other fuels. With the more viscous, adhering Bunker C fuel, however, when the emulsified composition is warmed slightly above room temperature and used as a fine spray at about 80 p.s.i., the cleaner can be utilized more efficiently with considerable savings in time and expense. Even under the most drastic and vigorous conditions, the cleaning composition, when used in this manner, will not damage delicate insulations and windings on electric motors.

In a simulated salvaging operation, electronic equipment, electric motors, selected samples of insulating fabrics, tapes, plastics and varnishes were submerged into synthetic sea water containing on the surface thereof about ⅛ of an inch of Navy Special fuel oil. After 24 hours the samples were removed and sprayed with the present cleaning solution containing therein 5% of Navy Special fuel oil. The equipment and insulating samples were then flushed clean with water and sprayed with a water-displacing composition, for example, one containing butanol-1 and glyceryl oleate. All accessible parts were sprayed with this composition to remove as much of the surface water as possible, in particular from the electromotive equipment. The electric motors were so constructed that water did not penetrate into the stator or armature coils and a high resistance to ground (in the order of several megohms) was obtained as soon as the butanol-water mixture had evaporated from the surface by blowing the equipment with heated air. When water penetrates into the stator windings, low resistance readings are obtained and additional heating and possibly additional treatment with the water-displacing composition is required until enough water has been removed to permit no-load operation. Motors operated at no-load for a short time are capable of generating enough internal heat to help dry out the equipment.

In an actual salvaging operation, an integrated procedure for cleaning electrical and mechanical equipment requires rapid removal of fuel oil and sea water contamina-

tion. When equipment wet with sea water is moved to an oxygen-rich atmosphere, such as exposure to air, the ferrous surfaces will rust rapidly causing severe damage to sensitive parts. If fuel oil contamination is a problem, the cleaning composition is formed and emulsified with about an equal quantity of sea water or fresh water when this is available. Using a spray apparatus, the exterior of the equipment is sprayed thoroughly and when access to the interior of the equipment can be gained by partial disassembly, the equipment is further sprayed and then rinsed thoroughly with sea water, or fresh water when this is available. The emulsion spray and rinsing steps are repeated when necessary to remove all traces of the contaminant.

After the fuel oil contamination has been removed, the equipment is further flushed with fresh water in order to remove all traces of sea water. Spray flushing, and whenever possible, immersion and draining should be employed to remove all traces of salt water which is injurious to metals and causes electrical shorts and burn outs in electrical equipment. As much of the water should then be blown from the wet surface as possible with compressed air, by draining or simply by exposure to the sun's rays. All parts and interior surfaces, crevices or openings should be sprayed with any of the water-displacing compositions to absorb all remaining traces of water. Some time should be allowed for this composition to penetrate, displace and combine with the water remaining in the equipment. When the water-displacing composition has combined with all available water, it is evaporated from the surface, preferably by blowing with heated air from an electric blower, but in the absence of such equipment sufficient time should be allowed for the mixture to evaporate completely from the surfaces.

Obviously many modifications and variations of the invention may be made without departing from the spirit and scope thereof, and therefore, only such limitations should be imposed as are indicated in the appended claims.

What is claimed is:

1. A method for salvaging electrical equipment and machinery contaminated with fuel oil comprising combining a selected amount of fuel oil substantially identical in composition to said fuel oil contamination to be removed with an aliphatic hydrocarbon having a minimum flash point in the vicinity of 140° F. and a surfactant of the non-ionic type in an amount that will keep said aliphatic hydrocarbon solvent and said fuel oil dispersed in an unstable emulsion with water, stirring the newly formed mixture with about an equal volume of water to form an emulsion therewith, applying said emulsion to the contaminated parts to penetrate said oil contamination and rinsing said parts to remove the emulsion and contamination with water.

2. A method for salvaging electrical equipment and machinery contaminated with fuel oil comprising the steps of combining a selected amount of fuel oil substantially identical in composition to said fuel oil contamination to be removed with a mixture of an aliphatic hydrocarbon solvent having a minimum flash point in the vicinity of 140° F. and a surfactant of the non-ionic type in an amount sufficient to maintain said aliphatic hydrocarbon solvent and said fuel oil in an unstable emulsion with sea water, stirring the newly formed mixture with about an equal volume of sea water to form an emulsion therewith, applying said emulsion to the contaminated parts to penetrate the oil contamination, rinsing said parts to remove the emulsion and contamination with water, and spraying the rinsed parts with a water-displacing composition containing butanol-1 and glyceryl oleate to remove the surface water.

3. A method for salvaging electrical equipment and machinery contaminated with fuel oil comprising combining a selected amount of fuel oil substantially identical in composition to said fuel oil contamination to be removed with a mixture of an aliphatic hydrocarbon solvent having a miniumum flash point in the vicinity of 140° F. and a surfactant of the non-ionic type in an amount sufficient to maintain said aliphatic hydrocarbon solvent and said fuel oil in an unstable emulsion with water, stirring the newly formed mixture with about an equal volume of water to form an emulsion therewith, applying said emulsion to the contaminated parts to penetrate the oil contamination, rinsing the emulsion and contamination with water and spraying the rinsed parts with a water-displacing composition containing butanol-1 and glyceryl oleate to remove the surface water.

4. The method as disclosed in claim 3 including the step of air drying the cleaned parts sufficiently to permit operation of said electrical equipment and machinery.

5. A method for salvaging electrical equipment and machinery contaminated with fuel oil and sea water comprising the steps of spraying the contaminated parts with an emulsion containing sea water, a selected amount of fuel oil substantially identical in composition to said fuel oil contamination to be removed, an aliphatic hydrocarbon solvent having a minimum flash point in the vicinity of 140° F. and a surfactant of the non-ionic type in an amount that retains said fuel oil and said aliphatic hydrocarbon solvent in an unstable emulsion with sea water, and rinsing said sprayed parts to remove said emulsion and contamination with water.

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