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RUST INHIBITING LUBRICANTS

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4 Claims. (Cl. 252—56)

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The present invention relates to improvements in rust preventing lubricants and particularly to improvements in lubricating compositions specifically compounded for the lubrication of tools which are used under particularly corrosive conditions, such as mining or other underground tools, especially rock drills and the like.

Rock drills and other tools which are used under conditions where considerable moisture is present, and particularly where corrosive gases, such as sulfur dioxide are also present, have presented a particular problem in the past as regards their proper lubrication. The reason for this is that such tools show a marked tendency to rust extensively even when left idle for only a short time. In the past, tools of this character, particularly rock drills, have generally been lubricated with an oil consisting essentially of a mineral lubricating oil of appropriate grade and about 4% of a fatty oil, preferably blown rapeseed oil or the like, together with a small percentage, for example 1%, of a stringiness agent, such as a mineral oil solution of isobutylene polymer or the like. Occasionally it has been found desirable to add an extreme pressure agent, such as tricresyl phosphate, which appears to have little or no effect on the rust preventing characteristics of the lubricant. The various additives heretofore used appear not to have solved the rust problem for rock drills and analogous mining equipment.

Lubricants containing blown rapeseed oil appear to be fairly good rust inhibitors under normal conditions above ground and also in some mines. Experience in other mines has shown, however, that rock drills and related tools, even when lubricated with compositions of the character mentioned above, will still rust extensively within a few hours, the rapid development of rust being commonly due, apparently, to the presence of a small amount of sulfur dioxide or other acidic materials in the air, combined with the normally high humidity that ordinarily prevails underground and/or with the moisture which may be present in the compressed air used to actuate the drill. Under severe conditions such as when sulfur dioxide gas and water vapors are present, a mineral oil containing 4% blown rapeseed oil is only slightly superior to straight mineral oil for preventing corrosion of steel.

Applicants have discovered that certain synthetic compounding agents are greatly superior to blown rapeseed oil for the prevention of rust under these conditions. To test the rust preventing characteristics of various compounding

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agents, applicants devised the following method:

A glass desiccator (5100 cc. capacity) fitted with the usual perforated porcelain plate was arranged so as to support four steel test specimens, 5 x 10 centimeters in size. In the bottom of the desiccator 500 cc. of water were placed. The sulfur dioxide atmosphere was generated by adding 0.324 gm. of sulfuric acid and 0.090 gm. of sodium sulfite to the water in the desiccator. Calculation showed that this amount of sulfuric acid and sodium sulfite was sufficient to give a concentration of about 700 parts of sulfur dioxide per million parts (by volume) of the air space in the desiccator. The test was carried out by immersing freshly polished and weighed steel plates in the lubricant under test and allowing the excess oil to drain therefrom for a period of four hours at a temperature of 77° F. After draining, the plates were placed in the desiccator, which was also maintained at 77° F., for a period of 16 hours. The plates were thereafter removed from the desiccator, rinsed in naphtha to remove the residual oil, and weighed. The increase in weight was used as a measure of the degree of rusting.

It was found that oils containing about 4% blown rapeseed oil showed less than 2 mgms. per 100 sq. cm. plate area rusting in this test when no sulfuric acid or sodium sulfite was present in the water in the desiccator. Similar results were obtained when a mineral oil containing 4% rapeseed oil was submitted to a test in which the water contained 0.324 gm. of sulfuric acid. However, when 0.324 gm. of sulfuric acid and 0.090 gm. of sodium sulfite were added to the water in the desiccator, an oil containing 4% blown rapeseed oil showed 90 milligrams of rust per 100 sq. cm. of plate area. Straight mineral oil of the same viscosity showed approximately 120 milligrams of rust under the same conditions.

Using the test procedure as outlined above, applicants discovered that certain partial fatty acid esters of certain polyhydroxy compounds of moderate molecular weight are in general effective materials in reducing the corrosion of steel by sulfur dioxide and water vapor. Specifically, sorbitan mono stearate in combination with other rust inhibitors having greater oil solubility has particular merit. Certain mono-esters of polyhydric alcohols have previously been combined with wetting agents in oil, as in Sharp patent, No. 2,398,193, but the present invention is based on the discovery of outstanding and unexpected properties of sorbitan mono-stearate in combination with certain other materials.

The property of rust inhibition appears to be due in part to the wetting properties of the rust inhibitor although this does not entirely explain their effectiveness since other wetting agents have been found to be much less effective to this purpose.

For example, a lubricant of about 530 S. S. U. viscosity at 100° F., consisting of an acid and clay-treated Colombian mineral oil and 3.6% by weight of pentaerythritol mono-oleate was found to result in the rusting of only 56 milligrams per 100 cm.² of steel plate area. A similar lubricant containing 4.8% of sorbitan mono-oleate allowed 59 milligrams of rust per 100 cm.² of area of the steel plate.

As suggested above, applicants have found that, of the partial fatty acid esters of polyhydroxy compounds investigated, one in particular, namely, sorbitan monostearate, was markedly superior to the others of the series. However, sorbitan monostearate, being relatively insoluble (0.2–0.3%) in mineral oil, required a mutual solvent such as pentaerythritol mono-oleate, sorbitan mono-oleate, sodium sulfonate or the like. A method was devised for determining the solubility of sorbitan monostearate in mineral oil with and without adding solubilizing materials. The method used consisted of placing the ingredients in a test tube and heating until a clear solution was obtained (150° F.). The clear solution was placed in a constant temperature bath maintained at 77° F. and after 16 hours examined for the appearance of undissolved material. The following tabulation shows the results obtained using an acid and clay-treated Colombian distillate of 432 S. S. U. viscosity at 100° F. and a viscosity index of 45:

TABLE I

	Solubilizer (per cent by Wt.)	Solubility of Sorbitan Monostearate at 77° F., per cent by Wt.	
		Clear Solution	Incipient Cloudiness
Sorbitan Monostearate	Nil	0.2	0.3
Do	Pentaerythritol Mono-oleate (3.0).	0.7	0.9
Do	Sorbitan Mono-oleate (4.0).	1.0	1.2
Do	Sodium Sulfonate[1] (Dry Basis) (3.4).	4.0	4.25

[1] Mahogany soap (470 mol. wt., sodium salt of alkyl-aryl sulfonic acids) used in approximately 65% concentration in mineral oil.

A composition of mineral lubricating oil similar to the above containing 0.6% sorbitan monostearate and 3.0% pentaerythritol mono-oleate proved to be very effective as a rust inhibitor, only 13 milligrams of rusting per 100 cm.² being noted as compared with 56 milligrams for a similar oil containing 3.6% pentaerythritol mono-oleate, and 90 milligrams for an oil containing 4% of blown rapeseed oil. Similarly, a composition containing 0.8% of sorbitan monostearate and 4.0% of sorbitan mono-oleate was also effective as a rust inhibitor, only 21 milligrams of rusting being noted for the test outlined above.

Using sodium sulfonate as the mutual solvent, applicants discovered that larger amounts (4.0–4.25%) of sorbitan monostearate could be incorporated in the oil without producing haziness. A lubricant consisting of an acid and clay-treated Colombian mineral oil of about 700 S. S. U. viscosity at 100° F. containing 3.0% of sorbitan monostearate and 3.4% of sodium sulfonate (dry) was found to result in rusting of only 2 milligrams per 100 cm.² of area on the steel plate, as compared with 38 milligrams for a similar oil containing 3.0% sorbitan mono-oleate and 3.4% of sodium sulfonate (dry), and 49 milligrams for an oil containing only 3.4% of sodium sulfonate. The rust inhibiting properties of the sorbitan monostearate-sodium sulfonate blend in the presence of sulfur dioxide and water vapour were equivalent to those of the blown rapeseed oil lubricant in a moist atmosphere entirely free of sulfur dioxide.

The following table shows the amount of rusting which resulted in tests as outlined above, using an acid and clay-treated Colombian mineral oil with sorbitan mono-stearate and/or various compounding agents listed and in the proportions specified. It will be noted that all of the polyhydroxy partial fatty acid esters listed show superior performance to generally equivalent quantities of blown rapeseed oil.

TABLE II

Rusting of various lubricants in presence of sulfur dioxide and water vapour

Compounding Agent, percent by Wt.	Viscosity of Lubricant 100° F., SSU	Mgms. Rusting per 100 cm.² area
Nil	432	125
Nil	638	113
Blown Rapeseed Oil (4.0)	435	115
Blown Rapeseed Oil (4.0)	530	90
Pentaerythritol Mono-oleate (3.6)	536	56
Sorbitan Mono-oleate (4.8)	542	59
Pentaerythritol Mono-oleate (3.0) / Sorbitan Monostearate (0.6)	529	13
Sorbitan Mono-oleate (4.0) / Sorbitan Monostearate (0.8)	533	21
Sodium Sulfonate (Dry Basis) (3.4)	704	49
Sorbitan Mono-oleate (3.0) / Sodium Sulfonate (Dry) (3.4)	737	38
Sorbitan Monostearate (3.0) / Sodium Sulfonate (Dry) (3.4)	717	2

The use of relatively small amounts (0.6–0.8%) of sorbitan monostearate in combination with other partial esters markedly increased their effectiveness as rust inhibitors, the rusting being decreased to about one-quarter to one-third of the rusting obtained before the sorbitan monostearate was added.

The superior results obtained using mixtures of sorbitan monostearate and sodium sulfonate are attributable mainly to the fact that relatively large amounts of sorbitan monostearate can be incorporated when sodium sulfonate is used as mutual solvent, but partly also to the fact that the use of sodium sulfonate leads to a higher viscosity of the lubricant (700 S. S. U. as compared with 530 S. S. U. at 100° F. for lubricants without sulfonate). For an oil containing 4% blown rapeseed oil, increasing the viscosity of the lubricant from 530 S. S. U. to 700 S. S. U. at 100° F. caused a decrease in rusting of the steel plate from 90 milligrams per 100 cm.² to 60 milligrams per 100 cm.² area.

While we have specifically mentioned the partial ester (monostearate) of sorbitan (anhydrosorbitol), it will be understood that related derivatives of various related polyhydric compounds such as mannitol, arabitol, xylitol, and even some of the glycols may have some utility. In general, the polyhydric alcohol radical will have from 4 to 10 carbon atoms and at least two hydroxyl groups, preferably from 4 to 6 hydroxyl groups. The fatty acid radical is preferably stearic acid but for some purposes it may be any saturated or even monoolefinic acid having from 12 to 22

carbon atoms, the oleates and particularly the stearates being preferred. The palmitates, laurates, etc., appear to have some rust inhibiting qualities. The partial ester also may be the di-, tri- or higher ester, but in general the mono-ester is preferred.

In general, the combined rust inhibitor, where more than one ingredient is used, will be employed in proportions of 0.5 to about 15%, by weight, based on the final composition, the preferred range being about 2 to 8%. Where, as is preferred, the relatively oil-insoluble sorbitan stearate is used, a sufficient quantity of an appropriate solubilizer such as sorbitan oleate, pentaerythritol mono-oleate, or sodium or potassium sulfonate, a similar and oil-soluble compound, preferably one having rust preventive properties, must be used. As a rule, the quantity of solubilizer used will be from one-half to three times the quantity of the insoluble ester, sorbitan stearate.

In general, the sorbitan mono-stearate which is the preferred inhibitor will be used in quantities of 0.5 to 5%, based on the finished composition, and the solubilizer for the mono-stearate will vary from 0.25 to about 10% on the same basis. Thus the weight proportions of the inhibitor and solubilizer ingredients may vary from about 2 to 20 parts of the mono-stearate and 1 to 40 parts of the solubilizer. The oil used is preferably a rather heavy one having a viscosity range of the order of at least about 300 S. S. U. at 100° F. and it may be as much as 1000 S. S. U. or more.

If desired, the additive may be prepared alone or as a concentrated oil solution for addition in various quantities to lubricating oils as may be desired. It is to be understood that the invention contemplates the rust inhibiting composition

by itself or as an ingredient of prepared lubricating oils, thickened oils, and greases. Other conventional modifiers and additives such as oxidation inhibitors, pour point depressers, extreme pressure agents, oiliness agents and the like may be included as will be obvious to those skilled in the art.

What is claimed is:

1. A rust inhibiting lubricating composition consisting essentially of mineral lubricating oil containing 0.5 to 5% by weight, based on the total composition, of sorbitan mono-stearate and from 0.25 to 10% of an organic solubilizer and wetting agent for completely dissolving said stearate in said oil, said solubilizer being selected from the class which consists of at least one of the compounds sorbitan mono-oleate and pentaerythritol mono-oleate.

2. A composition as described in claim 1 wherein the solubilizer is sorbitan mono-oleate.

3. A composition as described in claim 1 wherein the solubilizer is pentaerythritol mono-oleate.

4. A rust inhibiting composition consisting essentially of mineral oil of at least 300 S. S. U. viscosity, 0.6% by weight, based on the finished composition, of sorbitan mono-stearate, and 3.0% of pentaerythritol mono-oleate.

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REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
2,398,193	Sharp	Apr. 9, 1946
2,434,490	Duncan	Jan. 13, 1948