Patented Feb. 2, 1954

2,668,146

UNITED STATES PATENT OFFICE

2,668,146

METAL-WORKING COMPOSITIONS

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No Drawing. Application July 23, 1949, Serial No. 106,488

3 Claims. (Cl. 252—33.4)

1

This invention relates to improved soluble-oil compositions, and more particularly pertains to improved emulsifiable cutting compositions.

It is well known in the art to employ lubricating oil emulsions which function to lubricate and cool various metallic surfaces under metal working operations such as cutting, turning, drilling, grinding and similar operations on metals such as, for example, iron, copper, bronze, steel and various metal alloys. Although these lubricating compositions may be satisfactory with regards to lubricating and cooling characteristics, in some instances, they are not as satisfactory as desired in the respect that the compositions to a varying degree tend to retain in suspension the metallic particles produced in the metal-working. Generally, the lubricating oil emulsion containing metallic particles passes to a settling zone, wherein the metallic particles are allowed to settle by gravity, before the lubricant is recycled for use. If the metallic particles are not substantially removed from the composition prior to reuse, they are recirculated to the point of contact of the tool and the metal being fabricated, and therefore seriously interfere in the machining operation.

It is an object of our invention to provide an improved lubricating and cooling composition. Another object of our invention is to provide an improved soluble-oil lubricating and cooling composition. Still another object of our invention is to provide a stable improved emulsifiable lubricating and cooling composition, particularly a composition especially adapted to inhibit flotation of metal particles therein. Other objects and advantages of our invention will be apparent from the following description and explanation thereof.

It was found that a hydroxy aromatic acid added to conventional soluble-oil compositions improved the settling and removal of metal particles. The conventional soluble oils to which the hydroxy aromatic acid, hereinafter referred to as settling agents, can be added have the following general formulae.

FORMULA I

	Weight percent
Base oil	45–95
Emulsifying agent	5–40
Dispersing agent	0–5
Rustproofing agent	0–1
Bactericidal agent	0–1
Water	0–3

2

FORMULA II

	Weight percent
Base oil	45–95
Base sulfurized oil	5–25
Emulsifying agent	5–40
Dispersing agent	0–5
Rustproofing agent	0–1
Bactericidal agent	0–1
Water	0–5

In addition to the above formulae employing petroleum oil as the base material, compositions containing water as the principal base constituent also may be improved by incorporation of our novel settling agents. Formula III represents a general formula for such a composition.

FORMULA III

	Weight percent
Base oil	1–20
Emulsifying agent	10–30
Rustproofing agent	0–1
Dispersing agent	0–5
Bactericidal agent	0–1
Water	40–90

The settling agent to be employed for the purposes of our invention is a hydroxy aromatic acid such as for example monohydroxy aromatic acids, dihydroxy aromatic acids, trihydroxy aromatic acids and tannins or tannic acids. For the purpose of this specification and appended claims, hydroxy aromatic acids include monohydroxy aromatic acids as well as polyhydroxy aromatic acids. As an example a monohydroxy aromatic acid which can be used in our invention is salicylic acid. The dihydroxy aromatic acids which can be used in our invention include protocatecheric acid, pyro-catechin-o-carboxylic acid, α-resorcylic acid, β-resorcylic acid, γ-resorcylic acid and hydroquinone carboxylic acid. The trihydroxy aromatic acids which can be used include a variety of compounds such as, for example, gallic acid, pyrogallol-carboxylic acid, phloro-glucin-carboxylic acid, and oxy-hydroquinone-carboxylic acid. The tannins or tannic acids which can be used include, for example, kino-tannin, catechu tannin, quebracho tannin, gallo tannin, leuco tannin, moringa tannin, tannins from coffee, oak, hemlock, chestnut and larch. Ellagic acid, luteic acid, digallic acid can likewise be used. Of the polyhydroxy aromatic acids in our invention, the tannic acids or tannins are preferred for the reason that better settling rates are obtained. It is not to be inferred that the hydroxy aromatic acids enumerated above are equivalent in effectiveness in conventional soluble-oil compositions, but under

certain conditions, depending on the composition employed, some settling agents are more desirable than others.

In practicing our invention, generally, the hydroxy aromatic acids are added to conventional lubricating and cooling compositions either as a single acid or a mixture of acids in small amounts such as in the order of about 0.01 to 5.0 weight per cent, preferably about 0.1 to 0.5 weight per cent.

The settling agents can be used in any conventional soluble oil including soluble sulfurized oil compositions. The base oil of the soluble oil can comprise a hydrocarbon oil, vegetable oil, animal oil and/or a marine oil, although it is preferred to use a hydrocarbon oil having a Saybolt viscosity of about 60 seconds and upward at 100° F. Usually hydrocarbon oils having a Saybolt viscosity in the range of about 75 to 150 seconds at 100° F. are preferred. In general, we can use base oils in the amounts of about 45 to 95%, preferably about 75 to 90%.

In those instances where our settling agent is added to conventional soluble sulfurized oils, a sulfurized base oil is also present in our compositions. The sulfurized base oil is obtained for example, by sulfurizing lard oil or sperm oil. Similar sulfur-containing bases can be made by sulfurizing a wide variety of animal, fish, vegetable, or other oils, such as, for example, sulfurized oleic and stearic acids, sulfurized soya bean oil, sulfurized hydrocarbon oils, sulfurized terpenes, and the like. In our compositions, based on the mixture of emulsifying agent and the base oil, the sulfurized base oil can constitute about 5 to 25% by weight, preferably about 10 to 15%. For the purposes of our invention, the preferred sulfurized base oil is prepared by reacting 2 to 10% sulfur with the oil.

Suitable emulsifying agents which can be employed in our invention include soaps of naphthenic acids or preferentially oil-soluble sulphonic acids or other suitable emulsifying agents such as non-ionic emulsifying agents. The soaps are prepared from sodium or potassium hydroxides or from ammonia and ammonia derivatives, such as amines. Organic naphthenate soaps, such as diethanolamine and triethanolamine naphthenate can likewise be used. The soaps of the preferentially oil-soluble sulphonic acids are preferably prepared by reacting a petroleum distillate with sulphuric acid and neutralizing the sulphonic acid thus produced with the appropriate alkaline solution. In our invention, we may employ either a single soap or a mixture of soaps. We may also employ as part of the emulsifying agent, rosin soaps prepared from sodium or potassium hydrate. Usually the rosin soap can constitute about 10 to 20% of the emulsifying agent, the remainder being one or more of the soaps aforementioned. In general the emulsifying agent in the base oil can comprise about 5 to 40% by weight, preferably about 10 to 25%. Of the soaps which may be used as emulsifying agents, the petroleum sulphonates or so-called mahogany soaps prepared from sodium or potassium hydroxides are preferred.

Suitable dispersing or coupling agents may be added to our compositions to enhance clearness and stability thereof. Various dispersing agents can be used including, for example, monohydric alcohols, polyhydric alcohols, and alcohol ethers, examples of which are ethanol, propanol, isopropanol, butanol, amyl alcohol, diethylene glycol, diethylene glycol monobutyl ether, etc. In some instances, it is advantageous to employ a dispersing agent, but it is not always necessary. In those cases wherein it is desirable to employ a dispersing agent, generally concentrations in the range of about 0.5 to 5.0% can be employed, preferably about 1 to 2%.

To our compositions we may also add rustproofing agents to inhibit or prevent corrosion of metals undergoing machining operations. A wide variety of compounds can be employed, for example, propanolamine, butanolamines, mono-, di-, and triethanolamines, hydroxamic acid derivatives, e. g., naphthenehydroxamic acid, alkylamine soaps of naphthenic acids, e. g., didodecyl ammonium naphthenate and stearic acid. When employed, such rustproofing agents can be present in our compositions in amounts of about 0.1 to 1.0%, preferably about 0.25 to 0.75%.

We may also add to our compositions antiseptic or bactericidal agents such as chlorinated phenols, for example, trichlorophenol, tetrachlorophenol, or ortho phenyl phenol. Such compounds when used can be present in our compositions in the amounts of about 0.1 to 1.0%, preferably about 0.2 to 0.8%.

In practicing our invention, generally, the settling agent, that is, the hydroxy aromatic acid may be added to conventional soluble oils before or after dilution with water. Usually, the conventional soluble oils are diluted in the volumetric ratio of about 5 to 100 parts of water to one part of soluble oil. In those cases where a dispersing or coupling agent is employed in conventional soluble oils, the settling agent may be added to the composition prior to dilution with water by a preferred technique in order to obtain better dispersion of the settling agent in the composition. The method of preparation will be described in connection with the general formulae given in Formulae I and II.

In the conventional manner, the emulsifying agent is added to the base oil in the proper proportions. The temperature of this mixture is maintained at about 75° to 120° F., preferably about 80° to 110° F., and then the dispersing agent in the desired amount is added thereto. Meanwhile, the desired concentration of settling agent is dissolved in water of the desired proportion. The water solution of settling agent is then added to the base oil-emulsifying agent-dispensing agent mixture which is being held at a temperature of about 75° to 120° F., preferably about 80° to 110° F. In this manner, the settling agent is substantially dispersed throughout the mixture, and the composition appears clear and bright.

Referring to the above preferred technique for adding the settling agent prior to dilution with water, a base sulfurized oil as well as rustproofing and bactericidal agents may be used. The concentrations of these components can vary within the ranges specified in Formulae I and II.

The following examples are illustrations of our invention and should not be interpreted as limiting the scope thereof:

Example I

	Weight per cent
Sodium sulfonate	14.00
Sodium rosinate	3.00
Petroleum oil (140 S. S. U. at 100° F.)	79.00
Tetrachlorophenol	0.25
Triethanolamine	0.50
Water	1.50
Ethanol	1.50
Gallic acid	0.50

Example II

	Weight per cent
Sodium sulfonate	10.00
Petroleum oil (80 S. S. U. at 100° F.)	86.50
Tetrachlorophenol	0.25
Isopropanol	1.50
Water	1.50
Tannic acid	0.25

Example III

	Weight per cent
Sodium sulfonate	11.00
Sodium rosinate	3.00
Petroleum oil (80 S. S. U. at 100° F.)	60.25
Sulfurized lard oil	10.00
Lard oil	5.00
Sodium salt of o-phenyl phenol	0.50
Ethanol	5.00
Water	5.00
Tannic acid	0.25

Unless otherwise specified, for the purposes of this specification and the subjoining claims, all parts of compositions are by weight. If desired there may be added to the petroleum oil an amount of solubilizing agent equal approximately to the amount of chip-settling agent. Such a material is polyoxyethylene sorbitan trioleate, known commercialy as Tween 85.

To determine the relative effectiveness of hydroxy aromatic acids and benzoic acid for chip settling and detergency properties, the desired agent was added to an emulsion comprising one part by volume of lubricating composition and 25 parts by volume of water. The lubricating composition had the following proportions of ingredients:

	Weight per cent
Sodium sulfonate	15
Petroleum oil (80 S. S. U. at 100° F.)	85

To the above mixture was added:

Tetrachlorophenol	0.25
Isopropanol	1.0
Water	1.0

The results of these tests were obtained by visual inspection, and are reported in the following table:

TABLE

Settling Agent	Concentration in Emulsion, Percent by Wt.	Chip Settling	Cleanliness of Emulsion System
None		Poor	Poor to Fair.
Benzoic acid	0.009	do	Do.
Salicylic acid	0.009	Fair	Fair.
β-resorcylic acid	0.009	Fair to Good	Good.
Tannic acid	0.009	Excellent	Excellent.

The term "detergency" as used in this specification and in the claims refers to the general property of the emulsion to maintain parts in contact with the emulsion circulating system in a clean state free from adhering metal fines and/or metal-oil aggregates. This property, as indicated in the above table seems to be related to the chip-settling property of the emulsions. It is to be noted that benzoic acid which has little or no effect relative to detergency is also not suitable as a chip-settling agent and that tannic acid which is an excellent agent for chip settling also maintained a clean system.

We claim:

1. An improved emulsifiable soluble oil composition comprising from about 45% to about 95% of a hydrocarbon oil, from about 5% to about 40% of an emulsifying agent selected from the class consisting of an alkali metal, ammonia and amino soap of a preferentially oil-soluble sulfonic acid, and a sodium, potassium, ammonia and amino soap of a naphthenic acid, and from about 0.01% to about 5% of a tannic acid.

2. An improved emulsifiable soluble oil composition comprising from about 45% to about 95% of a hydrocarbon oil, from about 5% to about 25% of a sulfurized oil, from about 5% to about 40% of an emulsifying agent selected from the class consisting of an alkali metal, ammonia and amino soap of a preferentially oil-soluble sulfonic acid, and a sodium, potassium, amino soap of a naphthenic acid, and from about 0.01% to about 5% of a tannic acid.

3. An improved emulsifiable soluble oil composition comprising from about 45% to about 95% of a hydrocarbon oil, from about 5% to about 40% of an alkali metal soap of a preferentially oil-soluble sulfonic acid, and from about 0.01% to about 5% of a tannic acid.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,062,652	Herrmann et al.	Dec. 1, 1936
2,097,085	Fabian	Oct. 26, 1937
2,252,385	Orozco	Aug. 12, 1941
2,320,263	Carlson et al.	May 25, 1943
2,376,885	Sherwood	May 29, 1945

OTHER REFERENCES

"The Concentration of Ores by Flotation," Edser, found on page 263 of the Fourth Report on Colloid Chemistry and its General and Industrial Applications (1922), a publication of the British Association for the Advancement of Science, pages 269 and 320.