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SOLUBLE OILS

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This invention relates to soluble oils and more particularly to the control of undesirable odor and color producing phenomena heretofore encountered in certain uses of soluble oils.

Soluble oils are homogeneous compositions containing lubricating oil, soap and a small amount of water. Other ingredients are often present. The ingredients and their relative proportions are carefully chosen to achieve a "balanced" composition which has the appearance of a pure mineral oil but which will disperse on contact with water to form a very fine, stable, milk-like emulsion.

These soluble oils have many uses which are well known to the art. One of their most important uses is as lubricating and cooling agents in connection with the cutting, threading, etc. of metals, and particularly ferrous metals. For this use the soluble oil is dispersed in from 10 to 80 times its own volume of water and is put into a circulation system comprising a large tank or sump from which the dispersion is withdrawn and pumped over the metal being cut and the cutting tool. It then flows back to the sump for re-use.

Much difficulty has been encountered in this type of operation by virtue of the fact that the soluble oil dispersion tends in the course of time to develop extremely strong, putrid and undesirable odors which, in extreme cases, render its continued use practically impossible. These phenomena occur particularly when the material being worked upon is a ferrous metal such as cast iron or malleable iron. The dispersion also tends to develop a dark color.

It is an object of our invention to provide means and methods for controlling these phenomena. Other and more detailed objects of our invention will become apparent as the description thereof proceeds.

The cause of this odor difficulty was not previously understood but we have determined that it is caused by the action of one or more peculiar bacteria. These bacteria are facultative anaerobes, i. e. they will grow either aerobically or anaerobically. We have succeeded in isolating these bacteria, have studied their effects, and have devised means and methods for controlling them.

We have found that by taking some of the sludgy material from the bottom of the sump of a cutting oil system which is giving serious odor difficulties and plating this out in accordance with the ordinary bacteriological practice on a special culture medium, viz. iron agar, a number of types of bacterial colonies are obtained. By transferring certain of the predominating colonies to a nutrient agar we have found that the odor and color phenomena occur, provided iron is present. The iron can be added in solid form in which case the black color is limited to the region surrounding the iron, or an iron compound such as ferric ammonium citrate can be used.

When a dilute dispersion of soluble oil and water is seeded with a small amount of an agar culture of the hydrogen-sulfide-producing bacteria and a small amount of iron, for instance as iron agar, is added, the odor and color producing phenomena begin to occur in a short time.

It is possible to test various agents for controlling these phenomena by incorporating them in the soluble oil and repeating the experiment outlined in the last paragraph and by other procedures.

These odor-producing bacteria apparently feed on organic contamination which is more or less inevitably present in commercial cutting fluid systems and the like. They may also feed to some extent on constituents of the oil. When these bacteria reach high concentrations in the soluble oil dispersion or similar medium in the presence of iron, their metabolic processes begin to involve the iron and they then give off a very fetid odor which is due at least in large measure to the liberation of large quantities of sulfur compounds, particularly hydrogen sulfide (H_2S), the sulfur coming from the ferrous metal, from the organic contamination or from some other source. The phenomenon does occur with sulfur-free oils but does not occur in the absence of ferrous metals. The iron involved in these reactions is presumably in the form of soluble iron compounds which pass into the cutting fluid from the metal being cut, from the cutting tool and/or from other parts of the system.

This odor-producing phenomenon does not reach serious proportions until the bacteria concentration reaches a certain threshold value in the neighborhood of 20,000,000 to 30,000,000 odor-producing bacteria per cubic centimeter. It is therefore not necessary to sterilize the cutting fluid but only to keep the bacteria count below the threshold value.

Nevertheless we have found that this is not accomplished readily. The common bactericidal agents such as phenol, cresol, etc. are ineffective in any usable concentrations against these hydrogen-sulfide-producing bacteria. We have found,

however, that certain complex phenolic compounds and other substances can be used to control these bacteria in a satisfactory manner when added to the soluble oil or similar composition in amounts of from 0.05% to 4% and preferably from 0.1% to 3% by weight of the soluble oil.

Thus we have found that 0.25% by weight of crude tetrachlorphenol added to a soluble oil having about the following weight composition:

	Per cent
Straw oil	83
Purified mahogany soap	11
Soda rosin soap	3.5
Alcohol	1
Water	1.5

will prevent odor formation even when the oil is used diluted with 40 times its volume of water in a system already contaminated with the type of bacteria above referred to.

This composition can be made by mixing the mahogany soap (or in other words preferentially oil-soluble petroleum sulfonic soap) in an agitator with the soda rosin soap (which will normally contain considerable water), drying out the mixture by heating the agitator, adding the straw oil or other light mineral lubricating oil while maintaining the material in a warm condition, checking the mixture to make sure that the various ingredients are dissolved in each other, then adding the tetrachlorphenol (previously heated if desired) to the warm oil and adjusting the water and alcohol content in accordance with a series of small scale experiments until a mixture is produced which is clear and homogeneous and which will readily emulsify when added to water to give a fine-grained stable emulsion.

Instead of this soluble oil formula, other soluble oil formulas known to the art can be used in connection with the bacteria controlling agents of our invention. Thus, for example, the basic soluble oil formula can be that of an improved hard water soluble oil having the following composition by weight:

	Per cent
Light lubricating oil	84
Highly purified mahogany soap	12
Soda rosin soap	2.5
Water	1.5

In this last composition it is possible to eliminate the alcohol by using a highly purified mahogany soap made by extracting commercial mahogany soap with 80% alcohol and by carefully balancing the relative proportions of the various ingredients. As in the case of the first composition mentioned, the bacteria controlling agent can be added at the end of the soluble oil manufacturing operation or preferably just before the desired water content is achieved by the addition or evaporation of water.

The mahogany soap used in either of the foregoing examples will normally contain considerable oil and the soda rosin soap stock will normally contain considerable water. However, the foregoing examples are based on oil-free and water-free soaps. The oil and water in the soap stocks are figured as part of the oil and water in the finished composition.

As aforementioned, we find tetrachlorphenol to be peculiarly effective and in fact this is the best of the many compounds tested. From the economic standpoint it is desirable to use crude tetrachlorphenol but the various pure isomeric tetrachlorphenols can be used.

We have also found the trichlorphenols (particularly 2,4,5,trichlorphenol) to be highly effective. The mono-, di-, and penta-chlorphenols can also be used as can the corresponding bromine and iodine compounds. In fact the halogen substituted phenols both with and without other substituents are effective as a class.

Another closely related class of compounds which has been found valuable in connection with our invention is that of the phenyl phenols. Of these, orthophenyl phenol, chlor ortho phenyl phenol, chlor para phenyl phenol, and brom para phenyl phenol have all been found highly useful in concentrations of about 1% in soluble oil for the purpose of preventing bacterial action of the type above discussed.

These compounds are far more effective for the purpose of our invention than various other compounds having higher phenol coefficients as ordinarily determined. Apparently the bacteria controlling agents used in our invention owe much of their peculiar efficacy to the fact that they are preferentially oil soluble and therefore remain mostly in the oil phase and the highly dispersed oil phase carries them into contact with the micro-organisms which are responsible for the odor and color formation. At the same time these bacteria controlling agents have sufficient water solubility to carry them into the organisms. It thus appears that bacteria controlling agents used in connection with soluble oils and similar products which are to be dispersed in water should not only have high phenol coefficients but should be preferentially oil soluble and should have a slight water solubility.

Instead of the phenols the sodium or other salts of the phenols (phenolates) can be used with equal effectiveness. In fact if tetrachlorphenol, for example, is used in soluble oil the phenolate will normally be formed when the phenol is added to the soluble oil, since these products are usually slightly alkaline, or when the soluble oil is used, since most water is sufficiently alkaline to accomplish this result. In the claims where a phenol is mentioned it is to be understood that the corresponding phenolate is included.

It is to be understood that the manufacture of soluble oils is a very delicate operation which requires a very careful "balance" of the various ingredients and particularly of the water or water and alcohol. Enough water and/or water soluble solvent must be present to make the composition disperse instantly on contact with a body of water but too much can not be present since an excess tends to produce a cloudy and non-homogeneous composition particularly at low temperatures. One of the desirable features of the bacteria controlling agents which we have invented is that they can be used in very small quantities and that their presence interferes in no way with the "balance" of the composition.

While the two foregoing soluble oil formulas are typical of those which can be used, a great variety of other formulas can be used in connection with our invention. In general these formulas will contain the following constituents by weight:

	Per cent
Lubricating oil	60 to 85
Soap	10 to 30
Water	0.25 to 4

Other constituents, such as alcohol, oleic acid, etc., can be included. The basic soluble oil

formula, for example, can be any of those of the following patents:

Hughes, 1,577,723; Johnson, 1,619,074; Merrill, 1,739,686; Adams, 1,871,940; Hoel, 1,875,001; Strauch, 1,909,080; Patch et al., 1,919,125; Butts, 1,979,250.

In any event our improved soluble oils should preferably contain from 0.1% to 3% by weight of one of our bacteria controlling agents although other amounts can be used in some cases and it is desirable to use 1% or less.

We prefer to add our bacteria controlling agent directly to the soluble oil but it is, of course, possible to add it to the dispersion of soluble oil in water. In this case it is better to use the sodium salts or phenolates since they are somewhat more soluble in water than the phenols.

While we prefer to use these bacteria controlling agents in connection with true soluble oils, they can also be used in connection with other emulsifiable compositions whether used as cutting oils or as drawing lubricants or in other ways. Furthermore, our invention is not necessarily limited to emulsifiable compositions but our bacteria controlling agents added to any type of cutting fluid in connection with which the above-discussed bacteria are encountered.

We have described our invention in connection with certain theories and in connection with certain specific embodiments, but it is to be understood that these are merely by way of illustration and we mean to be bound only by the appended claims which should be construed as broadly as the prior art will permit.

We claim:

1. A soluble oil adapted for use in dilute aqueous dispersions as a lubricating and cooling agent in cutting or threading operations or the like involving the presence of ferrous metal in the work, in the tool or both, said soluble oil containing between about 0.05% and about 4% of a bacteria controlling agent selected from the group consisting of the halogen substituted phenols and the phenyl phenols adapted, under conditions which otherwise foster the production of facultative-anaerobic-hydrogen-sulfide-producing bacteria in undesirable concentrations, to keep the concentration of said facultative-anaerobic - hydrogen - sulfide-producing bacteria below a threshold value at which odor formation becomes objectionable.

2. A soluble oil according to claim 1 in which said bacteria controlling agent comprises tetrachlorphenol.

3. A soluble oil according to claim 1 in which said bacteria controlling agent comprises trichlorphenol.

4. A soluble oil according to claim 1 in which said bacteria controlling agent comprises chlor phenyl phenol.

5. A soluble oil adapted for use in dilute aqueous dispersions in cutting or threading operations or the like involving the presence of ferrous metal in the work, in the tool or both, said soluble oil containing between about 0.05% and about 4% of a bacteria controlling agent selected from the group consisting of the halogen substituted phenols and the phenyl phenols adapted to keep the concentration of facultative-anaerobic - hydrogen - sulfide-producing bacteria below a threshold value of about 20,000,000 to about 30,000,000 per cubic centimeter under conditions which otherwise foster the production of said bacteria in much larger concentrations, whereby the evolution of substantial quantities of hydrogen sulfide is prevented.

6. A soluble oil according to claim 5 in which said bacteria controlling agent comprises a chlorphenol.

7. A soluble oil according to claim 5 containing the following constituents in the following weight proportions:

	Parts
Lubricating oil	60 to 85
Soap	10 to 30
Water	0.25 to 4
Bacteria controlling agent	0.1 to 3

8. An emulsifiable composition of matter for use in the form of a dilute aqueous emulsion in the presence of organic contamination in metal-removal operations involving a sulfur-containing ferrous metal, said composition of matter comprising mineral lubricating oil as a major constituent, an emulsifying agent compatible with said oil, and a small amount of a bacteria controlling agent selected from the group consisting of the halogen substituted phenols and the phenyl phenols adapted to keep the concentration of facultative - anaerobic-hydrogen-sulfide-producing bacteria below a threshold value of about 20,000,000 to about 30,000,000 per cubic centimeter under conditions which otherwise foster the production of said bacteria in much larger concentrations, whereby the evolution of substantial quantities of hydrogen sulfide is prevented.

9. An emulsifiable composition of matter according to claim 8 in which said bacteria controlling agent comprises tetrachlorphenol.

10. An emulsifiable composition of matter according to claim 8 in which said bacteria controlling agent comprises trichlorphenol.

11. An emulsifiable composition of matter according to claim 8 in which said bacteria controlling agent comprises chlor phenyl phenol.

12. A dilute dispersion of an emulsifiable composition of matter in water, adapted for use in cutting or threading operations or the like involving the presence of ferrous metal in the work, in the tool or both, said emulsifiable composition of matter comprising mineral lubricating oil as a major constituent, and an emulsifying agent compatible with said oil, said dispersion containing a small amount of a bacteria controlling agent selected from the group consisting of the halogen substituted phenols and the phenyl phenols adapted to keep the concentration of facultative-anaerobic - hydrogen - sulfide-producing bacteria below a threshold value of about 20,000,000 to about 30,000,000 per cubic centimeter under conditions which otherwise foster the production of said bacteria in much larger concentrations, whereby the evolution of substantial quantities of hydrogen sulfide is prevented.

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