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## METAL-WORKING LUBRICANTS

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This invention relates to aqueous base metal-working lubricating compositions. More particularly it relates to a water-base metal cutting fluid.

It is well known in the art that water base fluids and water-oil emulsions possess good cooling properties for processing metals, but that they lack the extreme pressure properties of oil base lubricants and usually cause corrosion. On the other hand, oil base lubricants are inferior coolants and are costly.

The art discloses various means of imparting rust inhibiting and extreme pressure properties to water base and water-oil emulsion lubricants, but with little success. Among the materials commonly used for this purpose are non-ionic compounds, fats and their derivatives and soaps such as reaction product of alkyl phenol-ethylene oxide, tallow, fatty acids, soap such as sodium or potassium oleate or sulfonate in combination with mixtures of two or more water-soluble alkali metal compounds such as the nitrites, phosphates, carbonates, chromates or ethanolamine soaps e.g. mixtures of sodium nitrite and sodium phosphate, mixtures of sodium nitrite and sodium carbonate, or mixture of sodium nitrite and triethanolamine oleate. Water-oil emulsions additionally present a dermatitis and stability problem and are generally undesirable because of their opaqueness thus making it difficult to observe the machining process.

It is an object of this invention to provide a cutting fluid having both good cooling and good lubricating properties. Another object of the invention is to provide a non-corrosive aqueous cutting solution. Still another object of the invention is to provide a stable, non-corrosive, aqueous cutting composition free of ingredients capable of causing dermatitis infections. Another object of the invention is to provide a multi-functional metal working lubricant useful at high speeds, heavy loads, high pressures and high temperatures.

The above and other objects are attained in accordance with the present invention by an aqueous medium, such as water containing: (a) from about 1% to about 25%, preferably 5% to 20%, of a water-soluble heavy metal salt of a sulfamic acid or mixtures of said salt and a free sulfamic acid in the ratio of 1:1 to 5:1, respectively, and (b) from about 0.01% to about 5%, preferably from about 0.1% to about 2%, of a water-soluble inorganic phosphate, such as an alkali metal orthophosphate, the composition having a pH not above 7. The sulfamates and sulfamate-sulfamic acid mixtures function as extreme pressure and load carrying agents while the phosphates function as compatible rust and corrosion inhibitors.

The combination of the sulfamates and phosphates appears to be unique since well known corrosion inhibitors such as nitrites and chromates are ineffective in inhibiting the corrosivity of the sulfamates and it is known that alkali metal phosphates alone are not very effective as corrosion inhibitors.

The sulfamate extreme pressure additives include the

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silver, zinc, iron, cobalt, nickel, copper, cadmium and lead salts of a sulfamic acid such as lead, iron, nickel, copper, cadmium and cobalt salts of sulfamic acid as well as of C<sub>1</sub>-C<sub>4</sub>-alkyl-substituted sulfamic acids, e.g. methyl, ethyl, propyl or butyl sulfamic acid. The polyvalent heavy metal salts of sulfamic acid are preferred, e.g. lead and copper sulfamate. Mixtures of one or more of these salts and free acid in the ratio indicated above are useful, preferred are the salts such as lead and copper sulfamate.

The other essential additive is a water-soluble alkali metal ortho-phosphate of which the mono-, di- and tri-sodium ortho-phosphates are preferred. However, the corresponding potassium phosphates, tetra-sodium pyrophosphate, sodium tripolyphosphate and sodium borophosphate, can be used and the like.

Compositions A to J are representative compositions of this invention which can be used neat or diluted with from 1 to 20 parts of water, as metal working lubricants for cutting, drilling and the like. The proportions are given in percentages by weight.

| Composition A:     | Percent |
|--------------------|---------|
| Lead sulfamate     | 5       |
| Disodium phosphate | 2       |
| Water (tap)        | Balance |

| Composition B:     | Percent |
|--------------------|---------|
| Cobalt sulfamate   | 5       |
| Disodium phosphate | 2       |
| Water (tap)        | Balance |

| Composition C:     | Percent |
|--------------------|---------|
| Copper sulfamate   | 5       |
| Disodium phosphate | 2       |
| Water (tap)        | Balance |

| Composition D:     | Percent |
|--------------------|---------|
| Cadmium sulfamate  | 5       |
| Disodium phosphate | 2       |
| Water (tap)        | Balance |

| Composition E:     | Percent |
|--------------------|---------|
| Zinc sulfamate     | 5       |
| Disodium phosphate | 2       |
| Water (tap)        | Balance |

| Composition F:     | Percent |
|--------------------|---------|
| Silver sulfamate   | 5       |
| Disodium phosphate | 2       |
| Water (tap)        | Balance |

| Composition G:     | Percent |
|--------------------|---------|
| Lead sulfamate     | 15.4    |
| Sulfamic acid      | 4       |
| Disodium phosphate | 2       |
| Water (distilled)  | Balance |

| Composition H:           | Percent |
|--------------------------|---------|
| Lead sulfamate           | 5       |
| Sodium hexametaphosphate | 1       |
| Water (distilled)        | Balance |

| Composition I:           | Percent |
|--------------------------|---------|
| Lead sulfamate           | 5       |
| Potassium acid phosphate | 1       |
| Water (tap)              | Balance |

| Composition J:         | Percent |
|------------------------|---------|
| Copper butyl sulfamate | 5       |
| Sulfamic acid          | 1       |
| Disodium phosphate     | 2       |
| Water (tap)            | Balance |

The outstanding properties of compositions of this invention were demonstrated by subjecting them to the following tests:

(1) Four-ball machine test as described in the Journal of the Institute of Petroleum Technology, pages 206-229, April 1946.

(2) Tool life test: The compositions were used as

lubricants in drilling 1" holes in AISI 4340 steel and the number of holes drilled to failure was noted.

(3) Rust test: Case iron strips were immersed in the test lubricant for 24 hours and the strips were then removed and assigned a rust rating of A=none, B=trace, C=moderate, D=heavy.

Compositions A-J in the four-ball test gave average weld load (kg.) values of between 600 and 800, averaged around 175 holes drilled in the tool life test and in the rust test gave a rating of A. When sodium nitrite or sodium chromate was substituted for the phosphate in compositions A-J the rust rating dropped to D. Also when a corresponding acetate or nitrate was used in place of the sulfamate in compositions A-J the weld load in kg. (four-ball test) was reduced to 100-300 and the tool life was also reduced to approximately 30-35 holes drilled.

Compositions of this invention can contain additional additives such as anti-foaming agents, such as silicone and water-soluble organic phosphates, perfuming agents, dyes and may be applied with excellent results to general cutting operations where cooling and lubricating of the tool and work piece under adverse conditions are encountered. Metals machined with the aid of fluids of this invention have good surface finish, are free from rust and the tool life is excellent.

I claim as my invention:

1. An aqueous metal-working solution having a pH not greater than 7 consisting essentially of from about 1% to 25% by weight of a water-soluble heavy metal sulfamate and from about 0.01% to about 5% by weight of a water-soluble alkali metal ortho-phosphate and the balance of the solution being water.

2. A composition as in claim 1 wherein said sulfamate is a polyvalent heavy metal sulfamate and the phosphate is a dialkali metal phosphate.

3. An aqueous metal-working solution having a pH

not greater than 7 consisting essentially of from about 5% to 20% by weight of a mixture of a water-soluble heavy metal sulfamate and free sulfamic acid in the ratio of 1:1 to 5:1 respectively, and from about 0.1% to 2% by weight of a water-soluble alkali metal ortho-phosphate and the balance of the solution being water.

4. An aqueous metal-working solution having a pH not greater than 7 consisting essentially of from about 5% to about 20% by weight of lead sulfamate and from about 0.1% to about 2% by weight of disodium phosphate and the balance of the solution being water.

5. An aqueous metal-working solution having a pH not greater than 7 consisting essentially of from about 5% to about 20% by weight of copper sulfamate and from about 0.1% to about 2% by weight of disodium phosphate and the balance of the solution being water.

6. An aqueous metal-working solution having a pH not greater than 7 consisting essentially of from about 5% to about 20% by weight of nickel sulfamate and from about 0.1% to about 2% by weight of disodium phosphate and the balance of the solution being water.

7. An aqueous metal-working solution having a pH not greater than 7 consisting essentially of from about 5% to about 20% by weight of cobalt sulfamate and from about 0.1% to about 2% by weight of disodium phosphate and the balance of the solution being water.

8. An aqueous metal-working solution having a pH not greater than 7 consisting essentially of from about 5% to about 20% by weight of zinc sulfamate and from about 0.1% to about 2% by weight of disodium phosphate and the balance of the solution being water.

#### References Cited in the file of this patent

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