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The starting material from which these amines are commonly prepared is usually a mixture of fatty acids rather than a pure fatty acid, and the amines therefore usually are available as mixtures of amines having carbon chains of varying lengths. For example, the amines are commonly prepared from mixed coconut oil fatty acids, mixed soya fatty acids or mixed tallow fatty acids. Coconut oil fatty acids consist primarily of fatty acids having twelve carbon atoms and contain minor proportions of fatty acids having eight or ten carbon atoms, as well as fatty acids having more than twelve carbon atoms. On the other hand, tallow fatty acids and soya fatty acids consist primarily of fatty acids having eighteen carbon atoms, with a small proportion of fatty acids having sixteen carbon atoms. The proportion of fatty acids hav-

ing eighteen carbon atoms is most predominant in soya fatty acids, and tallow fatty acids ordinarily contain a small percentage of fatty acids having fourteen carbon atoms. Amines derived from soya fatty acids and tallow fatty acids are preferred for use as starting materials in the practice of the present invention, because the average length of the carbon chains which they contain is greater than in amines derived from coconut oil fatty acids.

The addition of ethoxy groups, for example in preparing an amine having the general Formula (b) from an amine having the general Formula (a), tends to increase the solubility, to some extent at the expense of other properties of the amine. Thus, the preferred amines having the general Formula (b) or (c), for use in the practice of the invention, are amines having from two to three ethoxy groups.

BORIC ACID

The boric acid used in preparing the amine salts may be obtained by using ordinary boric acid (i.e., orthoboric acid, H_3BO_3) or any other boron compound that forms boric acid in aqueous solution, for example, metaboric acid or boric oxide. Salts or boric acid with the amines hereinbefore described, when used in aqueous cutting fluids, leave a soft residue upon evaporation of the water. The fluidity of this residue can be increased by the incorporation of a suitable solvent, such as an alcohol having more than three carbon atoms or an ether thereof.

OTHER INGREDIENTS THAT MAY BE USED

Ingredients that may be added to improve the properties of a cutting fluid embodying the invention include alkali metal borates and alkali metal nitrites, which act as rust inhibitors for steel. Among these compounds, the potassium compounds such as potassium tetraborate and potassium nitrite are preferred. Potassium nitrite, in particular, gives aqueous cutting fluids that leave fluid residues upon evaporation of the water.

Substances that inhibit the corrosion of copper and other nonferrous metals, such as benzotriazole, may be incorporated in the present aqueous cutting fluids if desired.

PREPARATION OF CUTTING FLUID

Aqueous cutting fluids of the invention may be prepared by simply mixing an amine of the class hereinbefore described with boric acid and water for a few minutes to form a solution. If the amine is a solid, it is desirable to warm the ingredients in order to form a solution more rapidly, but in the case of a liquid amine the solution may be prepared by mixing at room temperature. One mole of the amine may be used for each mole of the boric acid, or a molar excess of the amine up to about 10 percent may be employed. In the case of an amine having two amino nitrogen atoms, it is permissible to use two moles of boric acid to react with each mole of the amine. The proportion of water should be sufficient to form a clear liquid, and the proportion of water necessary to form a clear liquid depends on the solubility of the amine salt. In some cases, the proportion of water required may be no more than the total weight of the amine and the boric acid, particularly when a higher alcohol or ether is incorporated as a solvent.

In the preparation of the cutting fluid it often is advantageous to replace up to one half of the boric acid with an equal molar proportion of benzoic acid, in order to produce an aqueous cutting fluid that leaves a more highly fluid residue upon evaporation of water. The maximum proportion of benzoic acid that should be used in the preparation of the cutting fluid is two moles of benzoic acid for each mole of boric acid. It has been found that the use of more than this maximum proportion of benzoic acid impairs the corrosion-inhibiting properties of the composition.

The boric acid and the benzoic acid may be reacted simultaneously with an amine, or a benzoic acid salt of

an amine may be prepared in the same manner as the boric acid salt and then may be mixed with a boric acid salt of the same amine or of a different amine.

A relatively concentrated solution prepared as hereinbefore described is convenient for shipment or storage. Before use as a cutting fluid, such a solution is diluted with water. The concentration of the amine salts in the final aqueous cutting fluid may be varied to meet various requirements, and may range from $\frac{1}{4}$ percent to 5 percent.

Example 1

A viscous liquid, suitable for dilution with water to produce an aqueous cutting fluid, is produced by warming 25.4 grams of boric acid, 50.8 grams of propylene glycol, 138 grams of water and 100 grams of a mixture of amines derived from tallow fatty acids, having the above structural Formula (b), and containing an average of two ethoxy groups per molecule. This mixture of amines, which is commercially available under the name "Ethoduomeen T 12," contains about 74 mole percent of amines having a carbon chain containing 18 carbon atoms, about 24 mole percent of amines having a carbon chain containing 16 carbon atoms and about 2 mole percent of amines having a carbon chain containing 14 carbon atoms.

A thin liquid is obtained by this procedure if the amount of propylene glycol is increased to 76.2 grams and the amount of water is reduced to 111.6 grams.

A viscous liquid suitable for dilution to an aqueous cutting fluid is prepared by mixing 100 grams of "Ethoduomeen T 13" (which is substantially the same as "Ethoduomeen T 12" except that it contains an average of three ethoxy groups per molecule), 23.3 grams of boric acid, 23.3 grams of propylene glycol and 161.6 grams of water. If the amount of propylene glycol is increased to 46.6 grams and the amount of water is reduced to 138.3 grams, the product is a thin liquid.

A thin liquid suitable for dilution to an aqueous cutting fluid is prepared by mixing 20 grams of boric acid, 180 grams of water and 100 grams of "Ethoduomeen T 15," which is substantially the same as "Ethoduomeen T 12" except that it contains an average of five ethoxy groups per molecule.

The solids concentration in each of the liquids prepared in accordance with the foregoing example is about 40 percent.

Example 2

(a) A viscous liquid suitable for dilution to an aqueous cutting fluid is prepared by warming 100 grams of "Ethoduomeen T 12," 25.3 grams of boric acid, 50.6 grams of hexylene glycol and 137.4 grams of water.

An aqueous cutting fluid obtained by diluting this liquid with water leaves a liquid residue upon evaporation of the water.

(b) A thin liquid suitable for dilution to an aqueous cutting fluid is prepared by mixing 100 grams of "Ethoduomeen T 13," 23.3 grams of boric acid, 46.4 grams of hexylene glycol and 139 grams of water.

An aqueous cutting fluid obtained by diluting this liquid with water leaves a clear liquid residue upon evaporation of the water.

(c) A thin liquid suitable for dilution to an aqueous cutting fluid is prepared by mixing 17 grams of boric acid, 34 grams of hexylene glycol, 141.5 grams of water and 100 grams of "Ethomeen O 12," which is a commercially available mixture of amines obtained by reacting a primary amine derived from oleic acid with a sufficient proportion of ethylene oxide to convert the amine into a mixture of amines having the above general Formula (c) and having an average of two ethoxy groups per molecule.

(d) Another liquid suitable for dilution to an aqueous cutting fluid is prepared by mixing boric acid (17.0 grams), hexylene glycol (34.0 grams), water (141.5 grams) and 100 grams of "Ethomeen T 12," which is a

commercially available mixture of amines obtained by reacting a mixture of primary amines derived from tallow fatty acids with a sufficient proportion of ethylene oxide to convert the amines into a mixture of amines having the above general Formula (c) and having an average of two ethoxy groups per molecule. The mixture of amines derived from tallow fatty acids consisted of about 74 mole percent of amines having a carbon chain contain-18 carbon atoms, about 24 mole percent of amines having a carbon chain containing 16 carbon atoms and about 2 mole percent of amines having a carbon chain containing 14 carbon atoms.

(e) A control solution was prepared by mixing benzoic acid (29.7 grams), hexylene glycol (59.4 grams), water (135.2 grams) and 100 grams of "Ethomeen T 12."

(f) Another control solution was prepared by mixing lactic acid (28.7 grams), hexylene glycol (57.4 grams), water (135.6 grams) and 100 grams of "Ethomeen T 12."

(g) Another control solution was prepared by mixing phosphoric acid (31.7 grams), hexylene glycol (63.4 grams), water (134.2 grams) and 100 grams of "Ethomeen T 12."

(h) Another control solution is prepared by mixing 100 grams of "Ethoduomeen T 13," 45.9 grams of benzoic acid 92 grams of hexylene glycol and 127 grams of water.

(i) Another control solution, in the form of a stiff gel, is prepared by mixing 100 grams of "Ethoduomeen T 13," 39.1 grams of lactic acid, 78.2 grams of hexylene glycol and 130.5 grams of water.

(j) Another control solution, in the form of a stiff gel, is prepared by mixing 100 grams of "Ethoduomeen T 13," 43.4 grams of phosphoric acid, 86.8 grams of hexylene glycol and 128.3 grams of water.

Example 3

A series of solutions was prepared from the liquids obtained in Example 2(b), 2(d), 2(e), 2(f), 2(g), 2(h), 2(i) and 2(j). Each of those solutions was prepared by mixing 10 grams of such solution with 90 grams of distilled water.

In order to conduct corrosion tests, metal samples were prepared each consisting of a metal strip about 3/8 inch wide, about 4 inches long and about .03 inch thick. Each of the diluted solutions prepared as above described was tested with several different metals by placing one or more of the metal strips in a test tube and adding a sufficient amount of the solution to cover the metal for a depth of about 3 inches, leaving about 1 inch of the metal strip exposed above the liquid. Each of the test tubes was tightly stoppered and was kept at room temperature during the test, and was observed at the end of a period of 28 days. In this manner nine tests were conducted with each of the diluted solutions in nine test tubes. The metal strips used in these nine test tubes were as follows:

Test Tube	Number of Metal Strips	Metal
a.-----	1	Galvanized iron.
b.-----	2	Galvanized iron and yellow brass.
c.-----	2	Galvanized iron and copper.
d.-----	2	Galvanized iron and No. 7075 ST aluminum.
e.-----	2	Galvanized iron and No. 1020 cold rolled steel.
f.-----	3	Galvanized iron, yellow brass and No. 1020 steel.
g.-----	3	Galvanized iron, copper and No. 1020 steel.
h.-----	3	Galvanized iron, No. 7075 ST aluminum and No. 1020 steel.
i.-----	5	Galvanized iron, yellow brass, copper, No. 7075 ST aluminum and No. 1020 steel.

At the end of the 28 day period, the condition of the metal strips was as follows:

Source of Solution	Condition of Metal Strips
Ex. 2(b) (boric)-----	Substantially unaffected.
Ex. 2(d) (boric)-----	Do.
Ex. 2(e) (benzoic)-----	Slightly corroded.
Ex. 2(f) (lactic)-----	Badly corroded.
Ex. 2(g) (phosphoric)-----	Do.
Ex. 2(h) (benzoic)-----	Do.
Ex. 2(i) (lactic)-----	Do.
Ex. 2 (j) (phosphoric)-----	Do.

Example 4

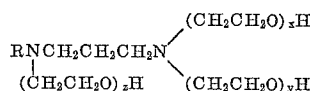
Samples of some of the liquids prepared in accordance with Example 2 were tested for inhibition of the growth of bacteria. A sample of each liquid was first diluted with thirty times its weight of water, and an equal amount of a suspension of aerobic bacteria was added to each diluted sample. The diluted samples were aerated at room temperature, and the count of bacteria per ml. in each diluted sample was determined at intervals of one to two weeks.

The sample prepared from the liquid obtained in accordance with Example 2(a) showed very numerous bacteria when examined at the end of the ninth day, but was found to be free of bacteria when examined two weeks later, and remained free of bacteria during the test for a period of over 100 days.

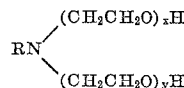
The sample prepared from the liquid obtained in accordance with Example 2(b) showed very numerous bacteria when examined at the end of the ninth day, but was found to be free of bacteria when examined two weeks later, and again three weeks later.

Having described the invention, I claim:

A stable aqueous solution which is useful in the preparation of an aqueous cutting fluid having powerful lubricating properties that leaves a soft residue upon evaporation of water, and which consists essentially of water and from 1/4 percent to 50 percent by weight of salts of boric and benzoic acids with at least one amine of the class consisting of those having the general formulas



and



wherein R is a normal aliphatic hydrocarbon radical having from 8 to 18 carbon atoms and each of the subscripts x, y, and z is of the class consisting of integers and zero, the total of such subscripts having an average value from two to five, the molar proportion of salts of benzoic acid to salts of boric acid being not greater than 2:1.

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