

1

3,137,613 CORROSION INHIBITOR AND METHOD OF USING THE SAME

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This invention relates to compositions and processes for preventing the corrosion of metals by aqueous liquids. More particularly, the invention relates to compositions and methods for inhibiting the corrosivity of aqueous fluids containing dissolved salts and gases to corrodible metals such as ferrous metals, copper, and copper alloys.

The corrosive effect of aqueous liquids on ferrous metals, copper, and copper-containing alloys due to the combined action of the water and other contaminants is well known and many expedients to eliminate or counteract this effect have been proposed. Factors such as temperature, aeration, dissolved solids, and pH have been found to influence corrosion rates greatly. For example, it has been found that for each 25° F. rise in temperature, corrosion rates of copper-containing alloys doubled. The corrosion rate of copper and ferrous metals would be affected similarly. The presence of dissolved solids such as chlorides, sulfates, sulfites, and bisulfates have a marked effect on the rate of corrosion. Furthermore, dissolved gases, such as oxygen, hydrogen sulfide, carbon dioxide, and chlorine, either alone or in combination, have a deleterious effect on the metals listed above.

Corrosion is an important economic factor in industry and its prevention is often necessary and always desirable. For example, the prevention of corrosion in the papermaking industry, particularly the prevention of corrosion of the copper-alloy wire cloths used with Fourdrinier papermaking machines, can double the useful life of these wires in some instances. A considerable amount of wire life research has been conducted in reference to Fourdrinier papermaking machines. These studies reveal that the main factors influencing the useful life of such cloths are actual damage to the wire, mechanical wear, and corrosion. These factors may act alone or in combination with each other.

In addition to damage and mechanical wear, several types of corrosion of copper alloys have been found to be important in affecting the useful life of a Fourdrinier wire. These types are:

- (1) Direct surface corrosion in which the surface of the shute and warp wires are rather uniformly corroded, resulting in a loss of diameter. Generally, the brass shute wire corrodes more rapidly than the bronze warp wires. Surface corrosion results in a rather uniform etching of the surface which is sometimes associated with tarnish or discoloration.
- (2) Galvanic or bimetallic corrosion is caused by the electric current resulting when two different metals or alloys are coupled. This situation exists between the brass shute and the bronze warp and, under certain conditions, the brass shute will corrode quite rapidly.
- (3) Pitting and dezincification usually are associated with a copper sulfide film formation on the surface of the wire. When such films are broken or become porous, localized corrosion takes place resulting in loss of metal, thereby, forming depressions or pits. Loss of zinc from the brass shute often occurs under these surface films. Impingement pitting results from the turbulent flow of a liquid over a metal surface leaving elongated pits.
- (4) Corrosion fatigue and intergranular corrosion seem to be related. Corrosion lowers fatigue resistance,

2

and the presence of fatigue stresses tend to increase corrosion. Intergranular corrosion causes embrittlement.

Because of the vital function served by the Fourdrinier wire cloth in the papermaking operation, and because it is extremely susceptible to mechanical stresses, abrasion, and other deleterious influences, the wire cloth must be protected from lumps of furnish that may accumulate between the various rolls and the wire cloth and distend the wire cloth. The means most frequently adopted for this purpose is that of providing water showers located at various positions relative to the wire cloth to wash and remove any lumps of furnish that may have collected upon the wire cloth and the wire return rolls. In one method of retarding or eliminating the corrosion of Fourdrinier wire cloths, the inhibitor is added to the water shower system so that a uniform coating of the wire is accomplished. If the addition of the inhibitor is on a continuous basis, the surface of the wire is continuously exposed to the inhibitor solution. In some instances intermittent addition of the inhibitor to the wire shower system gives excellent corrosion control and extended wire life. Another method of treating the wire involves the addition of the inhibitor to the mass of paper pulp and water which ultimately comes into contact with the Fourdrinier wire.

The compound 2-mercaptobenzothiazole and its salts, either alone or in combination with other organic or inorganic corrosion inhibitors, have been used in industrial systems to protect copper, copper alloys and ferrous metals from the effects of corrosion. In the papermaking industry, 2-mercaptobenzothiazole has been used in the absence of other inhibitors to prevent corrosion and to extend the useful life of Fourdrinier wires. However, its usefulness has been limited and it is generally used in combination with other organic compounds. A combination of an alkali-metal salt of 2-mercaptobenzothiazole and an alkanolamine has been effective in extending the useful lives of Fourdrinier wire cloths. Alkanolamines are used for the removal of acid gases from air streams in industrial scrubbing operations. In addition, these amines are sometimes used as corrosion inhibitors in acid systems. Because of their basicity, solutions of alkanolamines in combination with alkali-metal salts of 2-mercaptobenzothiazole are very alkaline, even at very low concentrations. This is objectionable because calcium and magnesium compounds are precipitated when many industrial hard water systems are treated with alkalines, and these precipitates cause plugged valves, pumps and pipelines. Moreover, many papermill systems contain aluminum sulfate (added to control pH) or dispersions of resinous pitch derived from the wood pulp. The addition of alkaline materials may precipitate hydrous aluminum oxide or particles of pitch, both of which adhere to the paper or the papermaking equipment and interfere with the papermaking operations.

Another example where corrosion is important economically is in the oil industry. In the production of oil, corrosion of steel and other metal well equipment is caused by the action of water and natural brines, which contain dissolved sulfides and/or carbon dioxide. Corrosive sulfide brines may contain alkali and alkaline earth metal sulfides and hydrogen sulfide. Hydrogen sulfide is very soluble in water, brines, and crude oil, and forms corrosive solutions which cause deterioration of well and surface equipment. This corrosion takes place in both acidic and alkaline brines.

Corrosion in waterflood systems is also an important factor in oil production. Reference is hereby made to the paper by L. C. Case entitled "Will Corrosion Eat Up the Water-Flood Profit?" in The Oil and Gas Journal, p.76,

January 16, 1961, for a discussion as to the causes and extent of corrosion in such systems. This article discusses chemical corrosion due to the action of dissolved oxygen, hydrogen sulfide and carbon dioxide and corrosion caused by bacteria. One organism usually associated with bacterial corrosion is *Desulfovibrio desulfuricans* which liberates hydrogen sulfide as a result of the sulfate-reducing metabolic processes. Although, as this article points out, there may not be exact agreement concerning the fundamental mechanism, there is agreement that corrosion in waterflood systems is a major problem.

It is, therefore, an object of our invention to provide a composition that will, when it is added to an aqueous corrosive fluid in small amounts, materially inhibit the corrosive action of such a fluid.

Another object of the present invention is to provide a composition which when applied to wire cloths used on Fourdrinier papermaking machines acts as an anti-wear or wear-inhibiting agent, and thereby extends the useful life of such cloths in papermaking machines.

Other objects and advantages of the invention will become apparent as the description proceeds.

To the accomplishment of the foregoing and related ends, this invention then comprises the features herein-after fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

Broadly stated, the corrosion of copper, copper alloys, and ferrous metals in contact with an aqueous system containing dissolved corrosive compounds is inhibited by adding to such an aqueous system a mixture comprising an alkali-metal salt of 2-mercaptobenzothiazole and an alkanolamide of a normal, saturated, monobasic carboxylic acid.

We have discovered that combinations of alkali-metal salts of 2-mercaptobenzothiazole and alkanolamides of normal, saturated, monobasic, carboxylic acids afford excellent corrosion protection to Fourdrinier wires treated in accordance with the provisions of this invention and the useful lives of these wire cloths are significantly increased. These wires are resistant to the formation of copper sulfide by the reaction of hydrogen sulfide with the copper alloy surface. The use of the compositions of this invention coat the wires with a sufficient quantity of the composition so that the wires are effectively lubricated. In addition, protection against the oxidizing corrosive agents in the papermill systems is obtained because of the anti-oxidant properties of the 2-mercaptobenzothiazole as it is converted into its oxidized form, benzothiazolyldisulfide. Moreover, the compositions of this invention are considerably less alkaline than the combinations described previously and the new compositions are compatible with almost all papermill systems and pitch, alumina, and calcium deposits do not appear in troublesome quantities.

The use of 2-mercaptobenzothiazole and its salts, either alone or in combination with inorganic or other organic corrosion inhibitors, is not so widespread in the petroleum industry or in other industrial processes involving ferrous metals as it is in the papermaking industry. The use of 2-mercaptobenzothiazole alone has not provided the desired degree of corrosion inhibition and the use of the other inhibitors in combination with the 2-mercaptobenzothiazole has introduced the same type of compatibility problems mentioned above. The compositions of this invention, however, provide equal or better corrosion protection in the petroleum industry than that obtained with the usual inhibitors such as amines and imidazolines. Moreover, the usual compatibility problems of the reactive amines and imidazolines are reduced or eliminated.

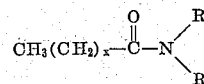
Compositions made in accordance with this invention are stable solutions which can be easily handled and fed into the system being protected with metering pumps. These compositions when diluted with water yield solu-

tions or stable emulsions which do not foam and actually impart defoaming action to papermill systems. In addition, these compositions act as detergents and as solvents to pitch which is a troublesome component of some pulps used in papermills.

Before proceeding with specific examples illustrating our invention, it may be well to indicate in general the nature of the materials required in the process.

Any of the alkali-metal salts of 2-mercaptobenzothiazole may be used in the process of our invention. Examples of specific salts which are preferred because of cost and availability include the sodium and potassium salts.

Suitable amides for use in the compositions of this invention are those having the following structure.



wherein x varies from 4 to 10; R may be hydrogen, methyl, 2-hydroxyethyl, 2-hydroxypropyl or 3-hydroxypropyl; and R' may be 2-hydroxyethyl, 2-hydroxypropyl, or 3-hydroxypropyl.

Obviously these amides may be prepared by any one of several methods, such as reactions of acid anhydrides and amines, acid chlorides and amines, acids and amines, and esters and amines. For economic reasons and convenience, we prefer the method involving the reaction of carboxylic acids and the amines at temperatures of about 200° C. At these temperatures the water of reaction is simultaneously removed as it is formed. Alternately, carboxylic acid esters, such as the methyl or ethyl esters, may be reacted with the amines at temperatures between about 150° C. and about 200° C. while removing the alcohol that is formed during the course of the reaction. Excellent yields of the amides are formed in these reactions and it is not usually necessary to purify the amides. These amides are low-melting, waxy solids which have varying degrees of water solubility and which are extremely soluble in polar organic solvents.

Although many acids and many amines can be used to prepare amides, we have found that the most effective alkanolamides for use in our invention in combination with alkali-metal salts of 2-mercaptobenzothiazole are those prepared from primary or secondary alkanolamines containing from 2 to 6 carbon atoms and one amino group. Mixtures of such amines are equally suitable. Generally, because they are available in large quantities and at economical prices, we prefer to use an alkanolamine such as monoethanolamine or diethanolamine. Other amines which may be used include isopropanolamine, diisopropanolamine, n-propanolamine, di-n-propanolamine and N-methyl-2-hydroxyethylamine. Acids which may be used in preparing suitable amides are normal, saturated, monobasic, carboxylic acids containing from 6 to 12 carbon atoms or mixtures of such acids. If the amide is considered as being derived from an amine and a carboxylic acid, a suitable amide for use in our invention may be defined as an amide of an alkanolamine containing from 2 to 6 carbon atoms and one amino group and a normal, monobasic, saturated carboxylic acid containing from 6 to 12 carbon atoms. Although any carboxylic acid as defined above may be used, preferred acids are caproic, caprylic, pelargonic, capric, lauric, and mixtures thereof. A mixture of acids containing primarily caprylic and capric acids is particularly effective. These acids are usually obtained from natural sources, such as babassu, coconut, and palm kernel oils, but synthetic acids are equally satisfactory. When acid mixtures are used in preparing the amide, the relative amounts of each of the acids making up the acid mixture may vary rather widely without any material effect on the effectiveness of the inhibitor composition. In Examples 1, 2, and 6 the samples of fractionated coconut oil acids used consisted of acid

5

mixtures comprising caprylic and capric acids plus small amounts of other acids as follows:

TABLE 1

	Acid content in percent			
	Capric	Caproic	Caprylic	Lauric
Examples 1 and 2.....	40.0	3.0	55.0	2.0
Example 6.....	31.8	2.4	63.3	2.2

The amount of each of the two components making up the corrosion inhibitor may vary from 20 to 80 parts of the alkali-metal salt of 2-mercaptobenzothiazole admixed with 20 to 80 parts of the alkanolamide. Somewhat better results are attained when the ratio of the two components making up the corrosion inhibitor varies from 40 to 60 parts of the former and 40 to 60 parts of the latter. Parts as used above, in the following examples, and in the appended claims are parts by weight.

When the corrosion inhibitor composition of our invention is used in conjunction with a Fourdrinier paper-making machine, it may be added to the aqueous fluids circulating in the machine in such a quantity to maintain a concentration of the inhibitor of at least 0.5 to 100 p.p.m. An equivalent quantity of the inhibitor (0.5 to 100 parts of inhibitor per million parts of well fluids) is also suitable for use in waterflood operations. Larger quantities of the inhibitor may be used, but such is not practical because costs are increased thereby with no corresponding beneficial results.

When the corrosion inhibitor is added to the water shower system, the concentration employed is usually

6

N-(2-hydroxyethyl)capramide, about 45 parts of water, and about 5 parts of acetone. One purpose of the organic solvent is to insure stable solutions at low temperatures. As will be obvious to those skilled in the art, the alcohols and the glycols listed may be used for this purpose with equal facility.

In order to disclose the nature of the present invention still more clearly, the following illustrative examples will be given. It is to be understood that the invention is not to be limited to the specific conditions or details set forth in these examples except insofar as such limitations are specified in the appended claims.

Example 1

Fourdrinier wire samples were cut into $\frac{3}{8}$ in. x $\frac{3}{4}$ in. pieces, washed with petroleum ether and dried under vacuum. The dry samples were then weighed to 0.01 mg. with a semi-micro balance and each was immersed in 100 ml. of a solution containing 250 p.p.m. of a combination of potassium 2-mercaptobenzothiazole and the N-(2-hydroxyethyl)amides of a mixture of saturated fatty acids having the composition listed in Table 1. In this example, the parts of potassium 2-mercaptobenzothiazole and parts of the N-(2-hydroxyethyl)amides included as active ingredients varied from 100 to 0 and 0 to 100 respectively.

Each solution was adjusted to pH 5.0, 6.5, or 8.0 with aluminum sulfate or sodium hydroxide solutions. The wires were maintained in the solutions for 15 hr. at 40° C. At the end of this period, the wires were removed, rinsed with water, air dried, and weighed.

The weight changes between the original weights of the wires and the weights after treatment with the inhibitor solutions are listed in Table 2.

TABLE 2

Weight change of Fourdrinier wire strips after treatment with solutions containing 250 p.p.m. of corrosion inhibitor compositions											
Concentration in test solutions parts per million:	250	225	200	175	150	125	100	75	50	25	0
Potassium 2-mercaptobenzothiazole.....	250	225	200	175	150	125	100	75	50	25	0
N-(2-hydroxyethyl)amides of the acid mixture in Table 1.....	0	25	50	75	100	125	150	175	200	225	250
Parts in active ingredients portion of test solutions:											
Potassium 2-mercaptobenzothiazole.....	100	90	80	70	60	50	40	30	20	10	0
N-(2-hydroxyethyl)amides of the acid mixture in Table 1.....	0	10	20	30	40	50	60	70	80	90	100
Change in weight in milligrams:											
pH 5.0.....	0.90	0.44	0.33	0.56	0.54	0.36	0.48	0.53	0.55	-0.11	-0.17
pH 6.5.....	-0.08	-0.03	0.15	0.15	0.60	0.50	0.47	0.47	0.33	0.19	0.16
pH 8.0.....	-0.12	-0.01	0.11	0.07	0.44	0.36	0.37	0.36	0.27	0.34	0.26

higher and will vary from 5 to 5000 p.p.m. of the shower water used.

In another application, the manufacturer of the Fourdrinier wire cloth or the users may employ these compositions to impart a coating on the wires to furnish protection and corrosion resistance during shipping and storage. The treatment may be accomplished by spraying or dipping the wire cloths, using a solution where the concentration of the inhibitor therein may be as high as 5 percent.

For convenience and ease in handling, the corrosion inhibitor composition is generally marketed as a 40 to 60 percent solution of the two active components consisting of an alkali-metal salt of 2-mercaptobenzothiazole and the alkanolamide in one or more inert solvents. Suitable solvents include water; the lower aliphatic alcohols such as methanol, ethanol, and isopropanol; ketones such as acetone; glycols, such as ethylene glycol, diethylene glycol, and hexylene glycol; and glycol ethers such as the methyl and ethyl ethers of ethylene and diethylene glycol. A specific example of a solution particularly suitable for marketing comprises about 25 parts potassium 2-mercaptobenzothiazole, about 25 parts of a mixture of alkanolamides comprising N-(2-hydroxyethyl)caprylamide and

These results show that at pH 6.5 and pH 8.0 the 2-mercaptobenzothiazole or the N-(2-hydroxyethyl)amides used separately are considerably less effective in coating the wire samples than compositions containing mixtures of the two materials. At pH 5.0, potassium 2-mercaptobenzothiazole used alone showed a considerable increase in weight, but practical experience in papermills has demonstrated that the 2-mercaptobenzothiazole alone is not sufficiently effective in providing either corrosion control or inhibiting the formation of copper sulfide on the wires.

The results above show, in particular, that the solutions containing from 40 to 60 parts of potassium 2-mercaptobenzothiazole and from 40 to 60 parts of the N-(2-hydroxyethyl)amides of the acid mixture in Table 1, comprising caprylic and capric acids, were very effective in providing protective coatings for the wires.

Example 2

Fourdrinier wire samples were cut into $\frac{3}{8}$ in. x $\frac{3}{4}$ in. pieces, washed with petroleum ether, and dried under vacuum. The dry samples were then weighed to 0.01 mg. with a semi-micro balance and each was immersed in 100 ml. of a solution containing 250 p.p.m. of a combination of potassium 2-mercaptobenzothiazole and the N,N-di(2-

hydroxyethyl)amides of a mixture of saturated carboxylic acids the composition of which is described in Table 1. The parts of potassium 2-mercaptobenzothiazole and parts of the N,N-di(2-hydroxyethyl)amides included as active ingredients varied from 100 to 0 and 0 to 100 respectively.

Each solution was adjusted to pH 6.5 with aluminum sulfate. The wires were maintained in the solutions for 15 hr. at 40° C. At the end of this period, the wires were removed, rinsed with water, air dried, and weighed. A second series of wire samples was treated in the same manner as the above except that, after removal from the corrosion inhibiting solutions and rinsing with water, the wires were immersed in 100 ml. of a solution containing 3 p.p.m. of sulfide (as sodium hydrosulfide). This series of wires was also maintained in the solutions for 15 hr. at 40° C. and then removed, rinsed with water, air dried, and weighed.

The weight changes between the original weights of the wires and the weights after treatment with the inhibitor solutions in the first series and the weight changes between the original weights of the second series of wires and the weights after treatment with the sulfide solutions are listed in Table 3.

TABLE 3

Concentration in test solutions, parts per million:	Weight change of Fourdrinier wire strips after treatment with solutions containing 250 p.p.m. of corrosion inhibitor compositions and after treatment with 3 p.p.m. of sulfide solution										
	Potassium 2-mercaptobenzothiazole	N,N-di(2-hydroxyethyl) amides of the acid mixture in Table 1	Potassium 2-mercaptobenzothiazole	N,N-di(2-hydroxyethyl) amides of the acid mixture in Table 1	Change in weight after treatment with corrosion inhibitor, milligrams	Change in weight after treatment with corrosion inhibitor and then with sulfide solution, milligrams	Change in weight caused by treatment with sulfide solution, milligrams				
Potassium 2-mercaptobenzothiazole	250	225	200	175	150	125	100	75	50	25	0
N,N-di(2-hydroxyethyl) amides of the acid mixture in Table 1	0	25	50	75	100	125	150	175	200	225	250
Potassium 2-mercaptobenzothiazole	100	90	80	70	60	50	40	30	20	10	0
N,N-di(2-hydroxyethyl) amides of the acid mixture in Table 1	0	10	20	30	40	50	60	70	80	90	100
Change in weight after treatment with corrosion inhibitor, milligrams	-0.08	0.07	0.18	0.07	0.25	0.19	0.24	0.22	0.14	-0.03	1.09
Change in weight after treatment with corrosion inhibitor and then with sulfide solution, milligrams	0.99	0.44	0.49	0.29	0.46	0.40	0.39	0.29	0.43	0.51	0.64
Change in weight caused by treatment with sulfide solution, milligrams	1.07	0.37	0.31	0.22	0.21	0.21	0.15	0.07	0.29	0.54	-0.45

These results show that the changes in weight of the wire samples resulting from the deposition of a coating is similar to that observed in Example 1, and that the combination of the potassium 2-mercaptobenzothiazole and the N,N-di(2-hydroxyethyl)amides of the acid mixture in Table 1 comprising caprylic and capric acids, is superior to either of these materials used separately. In this example, the gain in weight when the amides were used alone was exceptionally high, but when the wire sample was immersed in the sulfide solution, a large decrease in weight occurred. With potassium 2-mercaptobenzothiazole alone, a large increase in weight occurred upon treatment with sulfide. The wires treated with the combination of the two inhibitors showed the greatest gain in weight in the initial treatment and the least change in weight upon treatment with sulfide. A wire with a perfect protective coating deposited on it would not have shown any change in weight upon treatment with sulfide. Thus, these results show that the solution containing from about 20 to about 80 parts of potassium 2-mercaptobenzothiazole and from about 20 to about 80 parts of the N,N-di(2-hydroxyethyl)amides of the caprylic-capric acid mixture were very effective in providing protective coatings on Fourdrinier wires.

Examples 3 to 5

A procedure similar to that followed in Example 1 was used to determine the film forming effectiveness of mixtures containing approximately equal parts of potassium

2-mercaptobenzothiazole and the N-(2-hydroxyethyl)amides of caproic acid, pelargonic acid and lauric acid, respectively. In each example, the Fourdrinier wire samples were coated with the corrosion inhibiting materials at all three pH values and these wire samples were resistant to the attack of sulfide solutions.

Example 6

The effectiveness of our compositions in inhibiting the corrosion of steel was determined by comparing the weight loss of a steel test coupon subject to corrosion conditions in the presence of the inhibitor composition to the weight loss of a similar steel test coupon subject to the same corrosion conditions in the absence of the inhibitor.

The test procedure was as follows: Dry soft-drink bottles were each charged with 185 ml. of fresh brine solution obtained from a source well immediately prior to use. During the addition of the brine solution to the bottle, a nitrogen blanket was maintained over the brine to prevent contact with air. Different amounts of the corrosion inhibitor composition were then added to the bottles to provide concentrations of 0, 5, 7.5, and 10 p.p.m. of the inhibitor consisting of approximately equal parts by weight

of potassium 2-mercaptobenzothiazole and the N-(2-hydroxyethyl)amides of the mixture of carboxylic acids having the composition listed in Table 1. A ½ in. x 7¼ in. x 25/1000 in. sandblasted steel shim stock coupon (cleaned and weighed) was then placed in each bottle and each bottle sealed with a new cap. The bottles were then mounted on a wheel in such a manner that the bases of the bottles were at the circumference with the caps pointing toward the center of the wheel.

After all the bottles were mounted on the wheel, the entire apparatus was placed in an air oven which was maintained at 90° F. and the wheel was rotated for a period of 24 hr. The metal coupons were removed from the bottles, cleaned, and weighed to determine the loss in weight.

The inhibitor composition afforded a substantial degree of protection to the steel coupons. The effectiveness was comparable to that obtained with such widely used corrosion inhibitors as long chain amines, diamines, and imidazolines. In addition, the compositions containing alkali-metal salts of 2-mercaptobenzothiazole and alkanolamides of the caprylic-capric acid mixture possess other desirable properties in comparison to the commonly used corrosion inhibitors. For example, amines and diamines are very reactive compounds and are incompatible with many other materials present in industrial systems requiring corrosion protection. Imidazolines are subject to cleavage of the ring structure by alkalies.

In comparison, the compositions of this invention are stable and relatively unreactive.

While particular embodiments of the invention have been described, it will be understood, of course, that the invention is not so limited, since many modifications may be made thereto. When the inhibitor compositions of our invention are used in waterflood systems, it may be advisable to use these compositions in conjunction with a bactericide. For further information regarding the use of bactericides in the treatment of flood water for secondary recovery, reference is made to U.S. Patent 2,839,467 issued June 17, 1958, to Charles Bryce Hutchison et al., and to the references listed in that patent regarding that subject. Other uses for our corrosion inhibitor will be apparent to those skilled in the art. It is, therefore, contemplated to cover by the appended claims any such modifications as fall within the true spirit and scope of the invention.

The invention having been described, what is claimed and desired to be secured by Letters Patent is:

1. A corrosion inhibiting composition comprising 20 to 80 parts of an alkali-metal salt of 2-mercaptobenzothiazole and 20 to 80 parts of an alkanolamide of an alkanolamine containing from 2 to 6 carbon atoms and one amino group and a normal, monobasic, saturated, carboxylic acid containing from 6 to 12 carbon atoms.
2. A corrosion inhibiting composition comprising 40 to 60 parts of an alkali-metal salt of 2-mercaptobenzothiazole and 40 to 60 parts of an alkanolamide of an alkanolamine containing from 2 to 6 carbon atoms and one amino group and a normal, monobasic, saturated, carboxylic acid containing from 6 to 12 carbon atoms.
3. The corrosion inhibiting composition of claim 1 wherein the alkanolamine is monoethanolamine.
4. The corrosion inhibiting composition of claim 1 wherein the alkanolamine is diethanolamine.
5. A corrosion inhibiting composition comprising 20 to 80 parts of an alkali-metal salt of 2-mercaptobenzothiazole and 20 to 80 parts of an alkanolamide of an alkanolamine containing from 2 to 6 carbon atoms and one amino group and a normal, monobasic, saturated, carboxylic acid containing from 8 to 10 carbon atoms.
6. The corrosion inhibiting composition of claim 1 wherein the alkali-metal salt of 2-mercaptobenzothiazole is potassium 2-mercaptobenzothiazole.
7. The corrosion inhibiting composition of claim 1 wherein the alkali-metal salt of 2-mercaptobenzothiazole is sodium 2-mercaptobenzothiazole.
8. The corrosion inhibiting composition of claim 1 wherein the carboxylic acid is caprylic acid.
9. The corrosion inhibiting composition of claim 1 wherein the carboxylic acid is capric acid.
10. The corrosion inhibiting composition of claim 1 wherein the carboxylic acid is a mixture comprising caprylic and capric acids.
11. The corrosion inhibiting composition of claim 1 wherein the carboxylic acid is a mixture of acids derived from fractionated coconut oil acids.
12. A corrosion inhibiting composition comprising an inert solvent in which is dissolved a mixture comprising 20 to 80 parts of an alkali-metal salt of 2-mercaptobenzothiazole and 20 to 80 parts of an alkanolamide of an alkanolamine containing from 2 to 6 carbon atoms and one amino group and a normal, monobasic, saturated, carboxylic acid containing from 6 to 12 carbon atoms.
13. The corrosion inhibiting composition of claim 12 wherein the parts of the mixture comprising an alkali-metal salt of 2-mercaptobenzothiazole and an alkanolamide vary from 40 to 60 and that of the inert solvent vary from 40 to 60.
14. A corrosion inhibiting composition comprising about 25 parts of potassium 2-mercaptobenzothiazole,

about 25 parts of a mixture comprising N-(2-hydroxyethyl) caprylamide and N-(2-hydroxyethyl) capramide, about 45 parts of water, and about 5 parts of acetone.

15. A method of inhibiting corrosion of a copper alloy normally corrodible in an aqueous medium which comprises adding to said aqueous medium a corrosion inhibiting composition comprising 20 to 80 parts of an alkali-metal salt of 2-mercaptobenzothiazole and 20 to 80 parts of an alkanolamide of an alkanolamine containing from 2 to 6 carbon atoms and one amino group and a normal, monobasic, saturated carboxylic acid containing from 6 to 12 carbon atoms in an amount sufficient to provide a concentration of said corrosion inhibiting composition in said aqueous medium of at least 0.5 p.p.m.

16. A process for the production of paper in which an aqueous fluid containing cellulosic pulp and other papermaking ingredients is circulated in contact with a Fourdrinier wire cloth composed of strands of copper containing alloys that are normally subject to mechanical wear and corrosion, whereby the useful life of such wire may be increased, which comprises adding to aqueous fluids with which the said wire cloth comes into contact a mixture comprising 20 to 80 parts of an alkali-metal salt of 2-mercaptobenzothiazole and 20 to 80 parts of an alkanolamide of an alkanolamine containing from 2 to 6 carbon atoms and one amino group and a normal, monobasic, saturated carboxylic acid containing from 6 to 12 carbon atoms in an amount sufficient to provide a concentration of said corrosion inhibiting composition in said aqueous medium of at least 0.5 p.p.m.

17. A process comprising adding to the aqueous fluids of a papermaking machine system that includes a Fourdrinier wire cloth the strands of which are composed of copper containing alloys a mixture comprising 20 to 80 parts of an alkali-metal salt of 2-mercaptobenzothiazole and 20 to 80 parts of an alkanolamide of an alkanolamine containing from 2 to 6 carbon atoms and one amino group and a normal, monobasic, saturated carboxylic acid containing from 6 to 12 carbon atoms in an amount sufficient to provide a concentration of said corrosion inhibiting composition in said aqueous medium of at least 0.5 p.p.m.

18. A process for the treatment of a Fourdrinier wire cloth composed of copper containing alloy strands which comprises contacting said cloth with an aqueous solution containing at least 5 p.p.m. of a mixture comprising 20 to 80 parts of an alkali-metal salt of 2-mercaptobenzothiazole and 20 to 80 parts of an alkanolamide of an alkanolamine containing from 2 to 6 carbon atoms and one amino group and a normal, monobasic, saturated carboxylic acid containing from 6 to 12 carbon atoms.

19. A method of reducing the corrosiveness to ferrous metals of a corrosive aqueous fluid which comprises introducing into said fluid a corrosion inhibiting amount of a mixture comprising 20 to 80 parts of an alkali-metal salt of 2-mercaptobenzothiazole and 20 to 80 parts of an alkanolamide of an alkanolamine containing from 2 to 6 carbon atoms and one amino group and a normal, monobasic, saturated carboxylic acid containing from 6 to 12 carbon atoms.

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