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METHOD FOR DERUSTING AND REMOVING HEAT SCALE FROM FERROUS BODIES AND COMPOSITIONS OF MATTER USEFUL THEREFOR

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This invention relates to the removal of rust and light heat scale from oxidized metals, and particularly ferrous metals.

We have found rusts, such as are formed on atmospheric corrosion of mild steels and iron, and sometimes even on alloy steels, may be removed by treating them with solutions of high alkalinity containing alkali metal hydroxides and a complexing agent capable of holding iron in soluble form in solution in the alkali reagent.

We have found that a highly effective derusting reagent is obtained when there is added to an alkali solution of sufficiently high alkalinity, a suitable amount of a soluble salt of an aliphatic hydroxy acid, for example, an alkali metal salt of lactic, citric, tartaric, gluconic, glyceric, malic, glycolic or saccharic acid. All of these salts have the property, it is believed, of complexing the iron in the form of a compound soluble in the alkali solution.

We have also found that the additon of an alkanolamine in the form of a trialkanolmonoamine or an alkanolpolyamine is useful in improving the action of the reagent. Such alkanolamines also have the property of reducing the vapor pressure of the solution and permitting the solution to be heated to the elevated temperatures at which the derusting action is most pronounced.

In formulating the compositions of our invention and in carrying out the process of our invention, we prefer to employ solutions containing sufficient free alkali to give solutions of pH in excess of 13, for example, containing from about 4 to about 40% by weight of the solution or higher of alkali metal hydroxides (calculated as alkali metal oxide). However, when employing the complexing reagents referred to above, we may operate, for example, within the range of from about 4 to about 25% of sodium hydroxide. This we may do by adding from about 1 to about 5% by weight of the solution of the salts of the aliphatic hydroxy acids referred to above. Water should be present in an amount equal to at least 25% by weight of the solution.

The addition of alkanolamine also assists in the removal of the iron rust and light heat scale, and we may incorporate from about 1 to about 8%, by weight of the solution, of the alkanolamine.

The alkanolamines found particularly suitable for the removal of rust are the polyalkanolmonoamines such as trialkanolamines, for example, triethanolamine, tripropanolamine, and triisopropanolamine. We may, if desired, employ also the polyalkanolpolyamines, for example, N,N,N',N' tetra-kis (2-hydroxypropyl) ethylenediamine or its hydroxy ethyl analogue, N,N'-dihydroxy ethyl ethylene diamine, tetraethanol propylene diamine, pentaethanol diethylene triamine, hexaethanol triethylene tetramine.

Substituted alkanolamines may also be employed as, for example, the carboxylic acid derivatives such as N-hydroxyethyl ethylene diamine triacetic acid of di-N-hydroxyethyl ethylene diamine diacetic acid.

We may also employ mixtures of these alkanolamine compounds in the system composed of water, alkali metal hydroxide and salt of the hydroxy aliphatic carboxylic acids referred to above.

The trialkanolamine may be triethanolamine or tripropanolamine, for example, tri-isopropanolamine. Commercial technical grade trialkanolamine may be employed if the mono- and dialkanolamine is in minor proportions. These act as diluents. It has been found that the trialkanolamine may not be replaced by mono- and dialkanolamine without greatly impairing the derusting effectiveness of the solution. However, technical grade triethanolamine in which there are present about 5% monoalkanolamines and 10% dialkanolamines are usable and may be replaced for the trialkanolamine in substantially equal weight amounts, as may also the technical grades containing 5% to 10% polyethoxyethanolamines and analogues higher than triethanolamine. Homologues of the alkanolamines higher than propanolamines tend to be less soluble and may be used if their solubility is sufficiently high to give suitable concentration of the active forms of the alkanolamines.

In formulating the compositions of our invention we may mix the dry ingredients, for example, the dry alkali and the salts of the acids employed, and incorporate them by mixing with the alkanolamines. The alkanolamines may be incorporated in the form of their reaction product with alkali, as for example as the alkali alcoholate of the alkanolamine, e.g., trialkanolamine alcoholate of sodium or potassium, or the salt of the alkanolalkylene diamine carboxylic acids referred to above. These ingredients are relatively free of water, although through hygroscopicity they may absorb water. They may be dispersed in water to form the above solutions. On the other hand, the materials may be separately dissolved in water to give the above solutions.

The solutions because of the content of alkali, salts, or when used, the alkanolamines, have boiling points above 212° F. and may be employed in the neighborhood of 200 to 210° F. without excessive evaporation of water. By using concentations of alkali and salts above about 5% up to 45% by weight, the solutions may have their boiling point raised above about 300° F. permitting the reagents to be used in the neighborhood of 250° to 275° F. without excessive vaporization of water.

We may also employ as a wetting agent an alkali stable wetting agent, such as the fatty acid soaps of such chain length as not to cause gelation, for example, an alkali metal salt of caprylic acid, sulfonated or unsulfonated petroleum naphthenates, sulfonated fatty acids, or alkyl aryl sulfonic acids.

Examples of suitable compositions are as follows:

	Percent by weight
Composition No. 1:	
Sodium hydroxide	68.7
Triethanolamine	17.6
Sodium glycolate	1.7
Sodium gluconate	12.0
Composition No. 2:	
Sodium hydroxide	67.5
Versene T	17.0
Sodium gluconate	10.0
Potassium sodium tartrate	5.5

Versene T is a product manufactured and sold by the Bersworth Chemical Co. of Framingham, Mass., and is believed to be a mixture of triethanolamine and a salt of ethylene diamine tetracetic acid.

The Compositions 1 and 2 are dry powders and are suitable for packaging as powders. They are employed in water solutions for derusting purposes. Suitable concentrations of the above formulas (Compositions 1 and 2) for derusting purposes are about one-half to four pounds per gallon of water.

The following will illustrate the effectiveness of the above material:

One pound of each of the materials was dissolved in one gallon of water, the water solutions having the

following composition, all percentages being by weight of the water solution:

	Solution of Composition No. 1, percent	Solution of Composition No. 2, percent
Sodium hydroxide	8.2	8.1
Triethanolamine	2.1	
Versene T		2.0
Sodium Gluconate	1.4	1.2
Sodium Glycolate	0.3	
Sodium Potassium Tartrate		0.7
Water	88.0	88.0

Each of these compositions removed rust from mild steel in about 10 to 20 minutes when the heavily rusted part was heated in the solution at 200° F.

The same compositions, omitting however the gluconate, when dissolved in water, to give the same concentration of the sodium hydroxide, gave solutions which were markedly less active in the removal of rust. Thus, pieces of mild steel similar in character and degree of rusting as given above, when heated in these solutions at 200° F. resulted in the removal of but 50% of the rust in 30 minutes. When the hydroxy aliphatic acid salts are omitted from the solutions of Compositions 1 and 2, as given above, the derusting activity of the solution is markedly reduced.

The addition of the hydroxy acids in the above concentrations also permits of a substantial reduction in the concentration of the alkanolamine in the solution to obtain satisfactory derusting. This is illustrated by the following example:

A solution was made up to contain as follows:

	Percent by weight
Potassium hydroxide	5
Triethanolamine	10
Water	85

A test sample similar to that referred to above was derusted in about 18 minutes when heated in the solution at 215°–220° F.

The addition of the hydroxy acid salts thus permits of a substantial reduction in the amount of the alkanolamine required to obtain a given level of derusting activity.

The solutions described above may be repeatedly used in the procedures described. After cleaning of the metallic parts the solutions may be repeatedly used on other metallic pieces to be cleaned according to this invention. The partially spent solutions may be fortified by adding additional ingredients to maintain their concentration within the ranges specified, and the fortified solution employed in the above procedures. While the solutions have been described above according to their content when freshly compounded for use according to this invention, this description does not exclude the possibility that transformations during use may occur. Thus, for example, oxidation of the alkanolamines or the corresponding carboxylates may occur in part, and thus the ingredients of the solution be changed in some respects during use without substantially impairing the utility of the solutions for the uses described. Such used solutions are within the scope of the invention disclosed and claimed herein.

Like Compositions 1 and 2 described above, the other compositions described in this application may be compounded without water, i.e., on a dry basis, by mixing the ingredients in the absence of water in the proportions given for the several ingredients in this specification. Those skilled in the art will be able to determine these proportions by a simple arithmetical calculation from the compositions of the water solutions as given above.

While we have described a particular embodiment of our invention for purposes of illustration, it should be understood that various modifications and adaptations thereof may be made within the spirit of the invention as set forth in the appended claims.

The invention claimed is:

1. A method of removing corrosion coating from ferrous bodies, which comprises: treating such bodies with a hot aqueous alkali metal hydroxide solution containing about 4 to about 40% of alkali metal hydroxide and from about 1 to about 5% by weight of an alkali metal iron complexing salt of an hydroxy aliphatic acid chosen from the group consisting of lactic acid, citric acid, tartaric acid, gluconic acid, glyceric acid, malic acid, glycollic acid, and saccharic acid, and from about 1 to about 8% of a trialkanolamine in which each carbon chain has 2 to 3 carbon atoms, and at least about 25% by weight of water at a temperature of about 200° to 275° F.

2. The method of claim 1 in which the trialkanolamine is triethanolamine.

3. The method of claim 1 in which the trialkanolamine is triethanolamine and the solution also contains a polyalkanolpolyamine.

4. A composition suitable for derusting of iron when used in water solution, said composition consisting essentially of a mixture of an alkanolamine in which each carbon chain has 2 to 3 carbon atoms, said alkanolamine being a member of the group consisting of trialkanolmonoamines and polyalkanolpolyamines, said polyalkanolpolyamines containing up to 6 alkanol groups and up to 4 amino groups, a water soluble salt of a hydroxy aliphatic acid chosen from the group consisting of lactic acid, citric acid, tartaric acid, gluconic acid, glyceric acid, malic acid, glycollic acid, and saccharic acid, and water soluble alkali such that when said composition is added to water the resulting solution has a pH in excess of 13, said mixture consisting essentially of from about 2% to 95% by weight of said alkali, about 2% to about 62% by weight of said alkanolamine and from about 2% to 50% by weight of said salt, the said ingredients totaling 100% of said mixture.

5. The composition in claim 4, in which the alkanolamine is triethanolamine:

6. The compostion of claim 4, in which the alkanolamine is a mixture of a trialkanolmonoamine and a polyalkanolpolyamine.

7. The composition of claim 6, in which the trialkanolmonoamine is triethanolamine.

8. An alkaline cleaning mixture consisting essentially of about 69% by weight of sodium hydroxide, about 18% by weight of triethanolamine and the balance of said mixture consisting of an alkali metal salt of a hydroxy aliphatic acid chosen from the group consisting of lactic acid, citric acid, tartaric acid, gluconic acid, glyceric acid, malic acid, glycollic acid, and saccharic acid.

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