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METHOD OF INHIBITING CORROSION

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The invention relates to a method and materials for preventing corrosion of metal, particularly ferrous metals, although metals not containing iron may also be protected. It also relates to a method and materials for cleaning of metal objects, for example, those in the process of manufacture, and then preventing the corrosion of said metal objects.

The manufacture of pocket knives can be cited as one example of a use for the invention, although it is to be understood that the invention is suitable for any purpose wherein it is desirable to prevent corrosion. Dirt and grease accumulate on a pocket knife during manufacture, particularly from the grinding operations, and it is necessary that this dirt be completely removed and that corrosion or rusting be prevented thereafter. It is evident, however, that the same problem exists in a multitude of processes and manufactures and that the necessity of rust or corrosion prevention exists in a wide variety of places in which metals are used or processed.

The atmosphere has a particularly deleterious effect on some metals, such as those containing iron, and this is accentuated in the presence of high humidity.

It has been found that the dirt and grease can be removed by the use of an emulsified solvent mixture without scrubbing the article, the emulsified solvent mixture being subsequently removed by the use of a suitable spray device. If the spray is not used, scrubbing is necessary if the article is very dirty. A conventional soap solution may also be used. The solvent mixture employed may comprise: a solvent for the grease or oil; a soap preferably of a kind soluble readily in cold water; a solvent agent for the grease solvent and the soap; and water. One example of a suitable emulsified solvent mixture is disclosed in the patent to Johnson, No. 2,032,174, wherein the preferred embodiment is described as being composed of: kerosene; soap made from oleic acid and potash; a cresylic acid as a blending agent; and water. It is to be understood, however, that any suitable emulsified solvent mixture may be used.

After the dirt and grease or oil have been removed, the surface of the metal is left in a clean, but unprotected condition, which will rapidly corrode or rust. Surfaces, which are exposed to the atmosphere, have had coatings or materials such as lacquers and paints placed thereon to exclude the atmosphere, the efficacy of these coatings depending upon the imperviousness thereof. Such a treatment of the metal by coating is not desirable in many instances because the object is worked on or treated after the cleaning. This is the case with the pocket knife above mentioned.

It has been found that certain inorganic nitrites, such as the nitrites of the alkali metals, when placed in contact with a metal body, particularly one of ferrous metal, have a passivating, corrosion-preventing action thereon. A plausible theoretical explanation is that the nitrite ion equi-potentializes the whole surface of the metal. The term "alkali metal nitrite" includes ammonium nitrite and is to be so construed.

It is to be understood that where the term "ferrous" is used in the specification and claims that it is intended to include metals containing a substantial amount of iron which is subject to rusting, and that the term "ferrous" is not to be construed as limited to a metal that is composed almost entirely of iron.

In applying such a solution to a bright surface or to a surface containing a slight film of oil or grease, the surface tension of the solution tends to prevent the complete covering of the surface. In order to overcome this, it has been found that if the inorganic nitrite solution be placed in a solution having a wetting agent or agent reducing the surface tension in the solution, that the action of the nitrite is improved.

In general, wetting agents are composed of a hydrocarbon chain of varying length, which is more or less hydrophobic in character, depending upon the length of the chain, and has one or more groups of strongly hydrophilic nature, which act as solubilizing groups for the compound. The theory that may be advanced is that hydrophobic matter attracts the hydrophobic part of the hydrocarbon chain, and that the hydrophilic portion is free to attach itself to any sufficiently hydrophilic substance. The surface tension of the liquid is probably reduced by the action of the wetting agent, allowing and facilitating the spreading of the solution and completeness of contact with the object.

A detergent and a wetting agent are closely related in that the hydrophobic portion of a detergent attracts the oil or film together with any dirt that might be on the surface and that then the hydrophilic group will wet the surface and tend to release the oil or dirt which may or may not become emulsified in the solution.

In this invention, the wetting agent may also be a detergent agent but the important desideratum is that the surface be wetted in its entirety in order to carry the alkali metal or inor-

ganic nitrite inhibitor over the entire surface and into intimate contact therewith, creating the desired passivating action.

The reduction of lathering and sudsing obtained with the compositions of this invention as compared with ordinary soap is important as the lather tends to get into the corners of the article, preventing adequate inspection. Another important factor is the reduction of the slippery film deposited on articles by the ordinary soaps.

The emulsified solvent mixture previously described requires very little scrubbing and, by washing thereafter, practically all of the dirt and oil or grease are removed with very little sudsing or lathering involved.

As a wetting agent, one of the ordinary soaps, such as the alkaline salts of palmitic, stearic and oleic acid may be used. Such a soap in an aqueous solution reduces the surface tension of the liquid and causes the surface of the object to be treated to be wet thereby. It is also possible that the soap serves as a detergent and removes the oil or dirt film from the surface so that the inhibitor has access to the surface.

One of the synthetic detergents or wetting agents may be used in place of soap. Many of the fatty alkyl sulphates are suitable for this purpose, the alkyl sulphate being carried in a solvent.

The following composition has been found to be satisfactory and is the preferred agent:

	Per cent by weight
Sodium oleyl sulphate	13.5–15.0
Water	36.5–35.0
Borneol terpene	40.0
Ethyl alcohol	10.0

The borneol terpene comprises a solvent for the sodium oleyl sulphate, and in addition assists in the wetting action. Borneol terpene is a mixture of hydrocarbons obtained as a by-product in the isolation of terpin hydrate and camphene from turpentine, the hydrocarbon mixture containing dipentene as the major constituent. The ethyl alcohol serves as a stabilizing solvent.

There are other satisfactory detergent and wetting agents, such as one having the composition:

	Per cent by weight
Sodium lauryl sulphate	4.7– 5.3
Water	12.8–12.3
Borneol terpene	73.3
Ethyl alcohol	3.3
Octyl alcohol	5.8

The octyl alcohol comprises one of the solvents and assists in the wetting action.

Still another satisfactory wetting agent is composed of:

	Per cent by weight
Sodium lauryl sulphate	30
Water	33
Ethyl alcohol	18.5
Methyl cyclohexanol	18.5

Among the other agents that would be effective are agents containing 25% by weight of C-cetyl betaine, mixtures of soaps, sulphonated castor oils, and other synthetic detergents with solvents such as tetra hydro-naphthalene, cyclohexanol and pine oil. These agents usually contain water and, in some instances, other solvents as stabilizing agents.

The foregoing compositions are preferably used in aqueous solutions of relatively low concentration. It has been found that in the case of the sodium oleyl sulphate composition that 1% is adequate, and that for the C-cetyl betaine composition, that .5% is adequate.

In such an aqueous solution, there is placed about .1% to 3% by weight of sodium nitrite. A corresponding percentage may be used of other of the inorganic nitrites such as calcium nitrite.

It is possible to first apply the detergent or soap to the article and then to dip it into the aqueous alkali metal or inorganic nitrite solution, but it has been found that the corrosion inhibition is better when the nitrite is placed in a solution with the wetting agent or detergent.

Examples of a complete method of washing and inhibiting will now be given.

Example I

The articles bearing dirt, grease and oil incident to their fabrication are first placed in the emulsified solvent mixture bath of the character described, the bath being at about 120–140° F., and are kept there for about two minutes. The articles are then removed and subjected to a water spray which removes the emulsified grease and dirt. The articles are then dipped into an aqueous solution containing approximately .1% to 3% by weight sodium nitrite and 1% by weight wetting and/or detergent agent of the composition comprising:

	Per cent by weight
Sodium oleyl sulphate	13.5–15.0
Water	36.5–35.0
Borneol terpene	40.0
Ethyl alcohol	10.0

and then allowed to dry.

Example II

The articles bearing dirt, grease and oil are first placed in the emulsified solvent mixture bath of the character described, the bath being at about 120–140° F., and are kept there for about two minutes. The articles are then removed and subjected to a water spray which removes the emulsified grease and dirt. The articles are then dipped into an aqueous solution containing approximately .1% to 3% by weight of sodium nitrite with approximately .5% wetting or detergent agent comprising sodium oleyl sulphate in a borneol terpene and ethyl alcohol solvent.

Example III

The articles are first scrubbed in the emulsified solvent mixture similar to that of Example 1, dipped in water to wash off the emulsified grease and oil, then dipped into the inhibitor and wetting and/or detergent solutions of Examples I and II and allowed to dry. The water dip is not an essential part of the process, but such a dip prevents the accumulation of the emulsified oil and grease in the inhibitor and wetting and/or detergent agent solution.

Example IV

The article is dipped directly into the inhibitor and wetting and/or detergent agent solution described in Examples I and II.

Example V

The article is dipped into a soap and water mixture, then washed, and then dipped into an aqueous solution similar to that of Example I.

It is to be understood that in the above-cited examples, the temperature of the emulsified sol-

vent mixture and the time of immersion therein may be varied as desired and that the particular nitrite or corrosion inhibitor may be any of those disclosed in the foregoing and that the amount used may be varied. The wetting agent employed may be any of those disclosed in this specification and the percentage varied as found necessary to obtain complete wetting of the surface.

The invention, therefore, is seen to disclose a simple and efficient means of cleaning articles and rendering them corrosion-resistant to ordinary atmospheric conditions.

It is evident that the invention permits of numerous modifications; as for example, the concentration of the nitrite and wetting agents disclosed herein may be varied to obtain the best results, such variation being made without departing from the scope or spirit of the disclosed invention.

What is claimed is:

1. The method of imparting corrosion resistance to a ferrous metal body comprising treating said body by subjecting the surface thereof to an aqueous solution consisting of an inorganic nitrite, water and a wetting agent comprising sodium lauryl sulphate, borneol terpene and an alcohol; and thereafter removing the solvent by drying said body.

2. The method of imparting corrosion resistance to a ferrous metal body comprising treating said body by subjecting the surface thereof to an aqueous solution consisting of an inorganic nitrite, water and a wetting agent comprising sodium oleyl sulphate, water, borneol terpene and an alcohol; and thereafter removing the solvent by drying said body.

3. The method of imparting corrosion resistance to a ferrous metal body comprising treating said body by subjecting the surface thereof to an aqueous solution consisting of sodium nitrite, water and a wetting agent composed substantially of

	Per cent by weight
Sodium oleyl sulphate	13.5–15.0
Water	36.5–35.0
Borneol terpene	40
Ethyl alcohol	10

and thereafter removing the solvent by drying said body.

4. The method of imparting corrosion resistance to a ferrous metal body comprising treating said body by subjecting the surface thereof to an aqueous solution consisting of an inorganic nitrite, water and a wetting agent selected from the group consisting of sodium oleyl sulphate, sodium lauryl sulphate, alkali metal salts of palmitic, stearic and oleic acid, C-cetyl betaine and sulphonated castor oil; and thereafter removing the solvent by drying said body.

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