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METHOD OF TREATING METAL SURFACES

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This invention relates to a method for treating metal surfaces and, more particularly, to a method for treating surfaces to provide a highly uniform surface condition prior to and/or after chemical or electrochemical treatment thereof.

Chemical treatment of metal surfaces generally involves the three following steps:

(1) Cleaning the surface in preparation for treatment;

(2) Treatment by chemical or electrochemical means; and

(3) Removing residual treating solution from the treated surface.

Numerous processes are well known for chemically and electrochemically treating metal surfaces including cleaning, degreasing, etching, pickling, passivating, plating, brightening, anodizing, deoxidizing and the like. The metals treated are aluminum and its alloys, iron and its alloys and other metals.

When a surface is to be cleaned prior to treatment and the cleaning involves such steps as, for example, degreasing for which chemical cleaners such as, for example, alkali or acid cleaners, are employed, it is highly desirable to provide, prior to the treatment by such cleaners, a uniform metal surface condition in order that the cleaning solution will clean the entire surface substantially simultaneously and will thus act upon the cleaned metal surface substantially uniformly over the entire area thereof.

After surfaces have been chemically treated and the surfaces are water-wet by the chemical or electrochemical solution it is desirable to provide a uniform surface condition after removal of residual treating solution has been accomplished in order to reduce to a minimum staining, spotting, rusting, corrosion, etc., on the surfaces after they have dried.

Considering first the use of my method in connection with preparing surfaces for treatment, when, for example, surfaces must be degreased and otherwise cleaned, it is common practice to employ various solvents to accomplish the cleaning. Typical solvents employed for this purpose are stoddart solvent, kerosene, toluol, xylol, trichlorethylene, carbon tetrachloride, acetone, methyl ethyl ketone, etc., either as a straight solvent, or compounded with an emulsifying agent to make the solvent emulsifiable. When a solvent is used in its emulsifiable state, it is usually followed by a water rinse, and when the emulsifiable solvents are mixed with water and agitated, an emulsion is formed and such an emulsion is classified as a cleaning solvent.

After such a solvent degreasing operation and before the metal is immersed in a cleaning solution such as, for example, an alkali or acid solution, a residual solvent which clings to the surface in the form of a relatively thick layer must be removed by the solution and due to the fact that the residual solvent layer is relatively thick and, more importantly, of unequal thickness, the solvent layer is not removed substantially simultaneously over the entire metal surface. Thus, some areas of the surface are acted upon by the cleaning acid or alkali solution for a greater period of time than the other surfaces. This disproportionate period of time exposure produces a non-uniform surface condition and subsequent chemical and electrochemical treatment of the surface will not produce a unform surface condition.

To rectify this I employ, following the solvent degreasing operation, a rinsing of the solvent coated surface with water carrying a wetting agent. The wetting agent lowers the surface tension of the water and causes the water to remove from the treated metal surface all except a very thin film or coating of the solvent material. The residual solvent coating is highly uniform. Having been provided with a uniform surface condition the metal surface may now be treated, for example, by an alkali or acid cleaning or degreasing solution. The solution will now remove the residual solvent substantially simultaneously over the entire surface of the metal and will act upon the cleaned metal surface for a substantially identical period over the entire surface area. Accordingly, there is provided a highly uniform surface condition for subsequent chemical or electrochemical treatment.

In some instances it may be desirable to rinse the solvent coated metal surface with water or other material to remove excess residual solvent before rinsing the solvent coated surface with water carrying a wetting agent. This step is, however, not necessarily employed in all cases.

As noted above, my method may also be employed for the treatment of surfaces after they have been chemically or electrochemically treated. Chemical or electrochemical treatments generally involve the use of aqueous solutions and upon the completion of the treatment the residual solution is washed from the surface of the treated metal by means of a water rinse. The surface is wetted by the water and, thus, it is difficult to obtain a complete drainage of rinse water and residual water dries on the surface of the metal. This drying of residual water gives rise to water marks on the treated metal surfaces and to areas particularly susceptible to staining or corrosion. Furthermore, even though distilled water may be employed as a final rinse, the residual water droplets upon drying may leave surface areas of the metal which are either spotted or are susceptible to future corrosion.

In the past efforts have been made to avoid this problem by adding a wetting agent to the final rinse water in order to lower the surface tension of the water and thereby lessen the size and number of residual water droplets. This approach has not been entirely satisfactory for the reason that it has not eliminated residual droplets and where these droplets exist the addition of the wetting agent increases the degree of spotting caused by the droplets.

A second method heretofore employed involves the displacement of water by use of an organic solvent, for example, a petroleum solvent such as kerosene or stoddart solvent. These solvents have a lower surface tension than water and will, thus, displace the water by forming a film over the treated metal surface which will lift the water therefrom. The residual water then freely runs off the surface. The difficulty involved in this type of treatment is primarily that a thick undesirable solvent film remains on the treated metal surface.

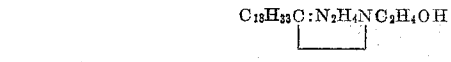
My method when employed in treating metal surfaces after chemical or electrochemical treatment involves the following steps:

(1) Rinsing the treated metal surface with water to re-

move residual treating chemicals therefrom. This rinsing step is particularly desirable where there is any impregnation of the treating chemicals into the surface of the metal treated. On the other hand, if the metal treated has a dense surface this water rinse may be unnecessary. While the water rinse is in many instances necessary in order to rinse or flush the pores of the metal, the rinse step gives rise to complete loss of carried out treatment solution.

(2) Coating the treated metal surface with an organic solvent, which may be in the form of an emulsion, to displace residual treatment solution or residual rinse water.

Suitable water displacing solvents are, for example, hydrocarbon solvents such as kerosene or stoddard solvent with a small percentage of an amine. The percentage of amine is variable ranging from about 1% to 5% by volume. A suitable amine is one having the following composition:



The kerosene or stoddard solvent or other hydrocarbon solvent is desirably employed in the form of an emulsion. The relative proportions of solvent and water in the emulsion may vary greatly. However, an example of a suitable solvent is an emulsion involving two gallons of stoddard solvent, containing about 5% of an emulsifying and coupling agent well known in the art, mixed with 198 gallons of water to form a milk-like emulsion.

The treated metal surface is coated with the organic solvent material. The solvent having a lower surface tension than the residual rinse water will wet the treated metal surface and the residual water will thus be displaced from the metal surface and will run off the surface over the solvent film.

(3) Rinsing the solvent coated metal surface with water to remove excess residual solvent if desired.

(4) Rinsing the solvent coated surface with water carrying a wetting agent. The wetting agent lowers the surface tension of the water and causes the water to remove from the treated metal surface all except a very thin film or coating of the organic solvent material. This extremely thin film does not adversely effect the appearance of the surface but has the effect of drying the surface uniformly without the existence of water marks or other corrosive or spot producing residual local deposits as occur when a rinse water is allowed to dry on the metal surface.

Following are typical wetting agents:

Non-ionic wetting agents such as aromatic polyglycol ether condensate.

Anionic wetting agents such as alkyl aryl sulfonate, and sodium sulfate derivative of 3,9-diethyl-tridecanol-6.

Cationic wetting agents such as quaternary ammonium compound, and alkyl polyoxyethylene glycol amine.

While the foregoing has referred to "treating, rinsing and coating," it will be evident that these steps may be accomplished by dipping, spraying, washing and the like.

An advantage obtained from my method is that the thin residual solvent film is not sufficiently thick or heavy as to provide an undesirable surface or to provide a surface which will accumulate foreign matter. On the other hand, however, the thin residual solvent film serves to effectively retard subsequent corrosion of the treated surface. An additional advantage is that the finished surface is highly uniform, i.e., a clean surface uniformly coated with a thin film of organic solvent.

These advantages have numerous applications over extremely broad ranges of treatments. For example, chemical brightening treatments leave the brightened surface particularly susceptible to finger marking, water drop staining and high humidity atmospheres due to residual brightening chemicals entrapped in the pores of the metal surface. These sensitivities are minimized when the surface is provided with a thin film of an organic solvent material.

Another example of the particular utility of my invention is found in the processes of degreasing iron surfaces with solvents and alkalies. Particularly when solvents such as chlorinated solvents are employed the degreased iron surfaces are particularly subject to rust and corrosion upon contact with high humidity atmospheres and particularly in areas which are finger-marked from handling. When these surfaces are treated in accordance with my invention the thin residual solvent film serves to effectively reduce the susceptibility of these surfaces to subsequent corrosion.

In processes involving the deoxidizing of metal surfaces principally of aluminum prior to welding it is necessary not only to remove the oxide coating on the metal surface but also to provide a uniform and substantially deoxidized surface or welding. It is sometimes necessary that the surface be deoxidized sometime before welding is actually accomplished and, thus, it is highly desirable that the surface be provided with a protective coating serving to retard oxidation and to maintain uniformity of the surface. These desirable conditions are provided by the thin solvent film resulting by the use of my method.

From the foregoing it will be evident that my invention involves a two-step treatment, i.e., coating a metal surface with an organic solvent and rinsing the solvent coated surface with water carrying a wetting agent.

When a fluid coating of a liquid organic solvent exists upon a metal surface and the surface is immersed in water carrying a wetting agent there exists a typical condition of two mixed liquid materials, i.e., a liquid chemistry condition. The solvent liquid being lighter than water tends to float upon the water and, thus, some of the solvent disassociates itself from the metal surface and accumulates at the surface of the water. However, due to the relative surface tension characteristics of the water and the solvent, a thin layer of non-fluid solvent remains adhering to the surface of the metal when the free or excess solvent liquid has left the metal surface. When there remains only a very thin uniform layer of non-fluid solvent on the metal the conditions existent are surface chemistry conditions rather than liquid chemistry conditions and the remaining thin non-fluid film of solvent is not removed from the metal.

Thus, the layer of solvent remaining on the surface of the metal is extremely thin and extremely uniform in thickness, possibly even approaching a monomolecular layer under ideal conditions. The result of this condition is the provision of an extremely uniform surface condition of a metal which will result in an extremely uniform reaction of the metal surface to a subsequent treating solution or to other subsequent conditions such as, for example, exposure to air and/or moisture. Thus, my method provides an extremely uniform surface condition for subsequent chemical or electro-chemical treatment and an extremely uniform surface condition following chemical or electrochemical treatment.

What is claimed is:

1. The method of treating a metal surface comprising treating the metal surface with an organic solvent to displace material from the surface, and thereafter rinsing the solvent coated surface with water carrying a wetting agent which is not a soap to remove residual solvent coating in excess of a uniformly thin film thereof.

2. The method in accordance with claim 1 in which the organic solvent is in the form of an emulsion.

3. The method of treating a metal surface comprising treating the metal surface with an organic solvent to displace material from the surface, rinsing the solvent coated surface with water to remove free residual solvent coating, rinsing the solvent coated surface with water

carrying a wetting agent which is not a soap to remove residual solvent coating in excess of a uniformly thin film thereof.

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