

UNITED STATES PATENT OFFICE

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METHOD AND SOLUTION FOR TREATING
ZINC SURFACES TO INHIBIT FORMA-
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This invention relates to a method of treating the surfaces of zinc or galvanized articles to prevent the formation of "white rust," the articles resulting from such treatment and the solution with which they are treated.

Galvanized products, i. e., sheets or articles fabricated therefrom, when first made, have a bright silvery appearance which is an important factor in their sales appeal. This appearance is materially impaired, however, by the occurrence of so-called white rust during storage and shipment. Surface treatments are known for improving the adherence of paint to zinc or zinc-coated articles but they interfere with welding and soldering besides undesirably changing the original appearance of the product. It is the object of my invention, therefore, to provide a process for the treatment of galvanized products which protects them against white rust without altering their original appearance or impairing weldability or solderability. Heretofore, the only practical treatment for prevention of white rust has been the oiling of sheets but this makes piles of sheets tend to skid and interferes with soldering and painting.

In a preferred practice of my invention, I form on the surfaces of the products an exceedingly thin film composed of an inhibitor for white rust and a medium or vehicle for the inhibitor which wets the zinc surface. More particularly, I bring a solution of the inhibitor and the vehicle into contact with the products under conditions such as to cause sufficient reaction between the film and the zinc surface to insure firm attachment of former to the latter but not sufficient to alter the original appearance of the zinc coating. The inhibitor is an alkali-metal salt such as the dichromate, borate or nitrite. The medium is preferably sodium silicate, e. g., the waterglass of commerce. The film may conveniently be applied by spraying the products with, or dipping them in, a dilute solution containing the inhibitor and the medium, draining or wiping the excess liquid therefrom and then drying the products whereby the solute is deposited as a microscopic film uniformly distributed over the surface of the zinc coating. Galvanized steel strip may be effectively treated by drawing it in single thickness through a bath of the solution, then between wringer rolls to remove excess liquid, and then through a hot-air dryer.

If the galvanized strip or sheet has been coated by the "hot-dip" process and has been quenched immediately before treating, no con-

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trol need be exercised over the temperature of the treating bath. The residual heat of the strip holds the solution between 100 and 120 F., thus aiding in drying the film on the strip after it leaves the tank. While the above temperatures represent a preferred range, the solution may be operated at room temperature if desired. Both the strip and the solution should, however, be below 212 F. in order to prevent the formation of a visible grey-white film. This grey-white film results from a too vigorous reaction between the metallic zinc and the silicate which is unnecessary and undesirable.

The treating solution may comprise from .1 to 1% of the inhibiting salt, i. e., alkali-metal dichromate, borate or nitrite; from 10 to 40 ml. of any commercial waterglass of about 40° Baumé per liter of solution; and the balance water. The preferred solution composition is from .3 to .5% sodium dichromate, 20 ml. of 42° Baumé waterglass per liter of solution and the balance water.

I mix the desired amount of waterglass with water in a tank, dissolve the proper quantity of dichromate in a little water placed in a separate container, and then add the dichromate solution to the waterglass solution while mixing thoroughly. The concentrations listed above permit a fairly wide choice, nevertheless, the amount of dichromate should never be great enough to cause the waterglass solution to gel.

The waterglass solution acts primarily as a vehicle for applying the desired inhibitor to the surface of the metal and holding it there. It also has the important property of wetting the metallic surface. Although the solution is not permitted to react sufficiently with the zinc to produce visible coatings, sufficient reaction occurs so that the film becomes integrally united with the surface. The wetting property of the waterglass solution as mentioned above is particularly important. Presently known chemical treatments utilize mechanical methods, or a combination of chemical and mechanical methods, to remove the oxide skin from the metal to be treated and are dependent on complicated chemical reactions to produce a protective coating. Water solutions containing the inhibitor alone do not wet the metallic surface satisfactorily and will not form the desired protective films.

The corrosion conditions to which galvanized sheets, for example, are subjected, approximate those attending immersion in stagnant water and are a result of the condensation of water vapor. The amount of water which may con-

dense on a pile of galvanized sheets is indeed surprising. I have tested inhibitors such as the alkali-metal dichromates, borates, and nitrites but I find the dichromate is to be preferred for best corrosion resistance. For commercial use I prefer a solution containing approximately 0.5% of sodium dichromate. As the concentration of dichromate is increased, the films gradually become yellowish in color and amounts greater than 1% do not appear to improve the corrosion resistance further. I have measured this corrosion resistance in several different ways, but one of the simplest methods is to pour a little water on a galvanized steel panel disposed horizontally and then to place another panel over the first so that the water is held between the two panels. Make-up water may be added from time to time. Untreated hot-dip galvanized steel strip will form a heavy layer of "white rust" within from four to five hours, whereas such galvanized material treated according to the process described above endures this test for several days before any visible evidence of corrosion occurs. It is not unusual for some samples to endure the test for thirty days without such evidence.

Galvanized surfaces that have been treated as described above are not well suited for the immediate application of paints, lacquers, and enamels. I have found, however, that this important property may be easily obtained. It is only necessary to rinse the surfaces with water and then dry them before applying such finishes. The rinse removes any free alkali from the very thin protective film and the residual film greatly enhances the adherence and protective properties of organic coatings. As an example, a lacquered panel representing any specific pretreatment may be coupled with an untreated and unlacquered galvanized panel and immersed in a 3% solution of sodium chloride. This is a simple but effective test that depends upon the principle of electro-endosmosis. The metal discolors as it corrodes and the adherence of the lacquer is lost. The results are as follows:

Sample pretreatment before lacquering	Days to failure
Galvanized panel, not treated.....	9.
Galvanized panel treated as disclosed herein but not rinsed.	1.5-3.
Galvanized panel treated as disclosed herein and rinsed.	No sign of failure in 28 days of exposure.
Proprietary phosphate treatment.....	Do.

The rinsing step may be applied at any time after the protective film has originally dried, but I prefer that this final rinse and drying step immediately precede the painting or lacquering operation.

Products fabricated from galvanized sheets may be treated by dipping in the solution disclosed above, draining and drying in any convenient manner.

It will be apparent from the foregoing that my process produces a protective film satisfactory for general use on galvanized products. The film is adequate for preventing the formation of white rust during shipping and storage, and can be produced in such a manner as to be invisible, or nearly so. The treated galvanized

sheets can be easily soldered with commercial fluxes, and are exceptionally suitable for the application of paints and lacquers after a simple rinsing. The process is simple, rapid, economical and has proved practical for the treatment of large tonnages of galvanized strip in a continuous fashion. Production operations have shown that once the process has been set up it may be continued in an entirely automatic manner, and does not require any attention other than periodic analysis to determine the need for additions of the compounds dissolved in the bath.

Although I have disclosed herein the preferred embodiment of my invention, I intend to cover as well any change or modification therein which may be made without departing from the spirit and scope of the invention.

I claim:

1. In a method of retarding the formation of white rust on zinc surfaces, the steps including applying to the surfaces a dilute aqueous solution of an alkali-metal salt of chromic acid and sodium silicate, and drying the applied solution to form a microscopic film on said surfaces.

2. In a method of retarding the formation of white rust on zinc surfaces, the steps including applying to the surfaces an aqueous solution of from .1 to 1% of an alkali-metal salt of chromic acid and from 10 to 40 ml. of waterglass of about 40° Bé. per liter of solution and drying the applied solution to form a microscopic film on said surfaces.

3. In a method of retarding the formation of white rust on zinc surfaces, the steps including applying to the surfaces an aqueous solution consisting essentially of from .3 to .5% of an alkali-metal dichromate and about 20 ml. of about 42° Bé. waterglass per liter of solution, and drying the applied solution to form a microscopic film on said surfaces.

4. A solution for the treatment of zinc-surfaced articles to retard the formation of white rust thereon consisting essentially of from 10 to 40 ml. of about 40° Bé. waterglass per liter of solution, from .1 to 1% of an alkali-metal salt of chromic acid and the balance water.

5. A solution for the treatment of zinc-surfaced articles to retard the formation of white rust thereon consisting essentially of about 20 ml. of about 42° Bé. waterglass per liter of solution, from .3 to .5% of an alkali-metal dichromate, and the balance water.

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