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PROTECTIVE COATINGS FOR GALVANIZED MEMBERS

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The present invention relates to a process for applying protective coatings to galvanized members.

It is known that when galvanized sheets or the like are stacked under conditions where moisture is present between superimposed sheets or reaches the edges of the stack, the sheets will show unsightly white corrosion products, or "bloom," over considerable areas in a matter of a day or two. This white bloom, or corrosion product, detracts from the value of the galvanized sheets and renders their sale and use less desirable for many purposes.

Numerous treatments have been suggested for preventing such white bloom developing. However, no reasonably economical treatment has been available which would prevent such white corrosion products from developing in 4 or 5 days at most. It would be desirable to have available an easily applied, low cost treatment which would prevent appreciable white corrosion products in forming between wet galvanized sheets for at least 15 days.

The object of this invention is to provide a process for treating galvanized sheets as they emerge from the galvanizing bath with an aqueous phosphoric acid solution to deposit on the surface a predetermined amount of the phosphorus oxide compound per unit area.

Other objects of the invention will in part be obvious and will, in part, be apparent. For a better understanding of the nature and objects of the invention, reference should be had to the following detailed description.

In accordance with the present invention, it has been discovered that highly protective coatings that resist formation of white corrosion products may be applied to galvanized sheets by spraying on the freshly galvanized sheets as they emerge from a galvanizing bath and are at a temperature of at least 400° F., an aqueous solution of orthophosphoric acid, metaphosphoric acid and pyrophosphoric acid (or mixture of two or all three) at a concentration equivalent in phosphorus oxide content to that of a .2% to 35% of orthophosphoric acid, to deposit on the galvanized sheets from 1/8 to 10 pounds of H₃PO₄ per 10,000 square feet of surface. The heat of the galvanized sheets evaporates the solvent and promotes a reaction of the phosphoric acid with the hot zinc surface. Such protective coating will protect the zinc for from 15 to 30 days when stacked and kept wet.

It appears that reactions between phosphoric acid and zinc at temperatures substantially below 400° F. do not result in a coating which compares in protective quality to the protective coatings of this invention, since they are only sufficient to prevent white oxide corrosion products from forming for not over 5 days. Furthermore, the process of the present invention is carried out rapidly since the applied aqueous solutions dry out rapidly and only a few seconds are required.

The phosphoric acid solutions can include up to 50% based on the weight of H₃PO₄, for example, of the ammonium salt thereof. The ammonium salt may be in-

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duced as diammonium phosphate or its equivalent of ammonium hydroxide.

After the galvanized sheets have been treated with the phosphoric acid they may be given an added protective treatment by applying chromic acid or a chromate salt to provide a chromate film thereon. Thus an aqueous sodium dichromate or potassium dichromate solution of a concentration of 1/2% or more can be applied to the sheets. After drying, the sheets will better withstand the effects of moisture on a stack of the sheets.

The phosphoric acid solutions in a concentration of from 5% to 15% give the best results. The solvent is preferably water, though monohydric alcohols may be present. Thus ethyl, propyl and methyl alcohol in water form suitable solvents. Water is inexpensive and non-inflammable and will ordinarily be the preferred solvent.

The phosphoric acid solution is applied to the galvanized sheets in the form of a fine spray or mist. From 10% to 20% of the spray will normally contact the freshly galvanized surface. If electrostatic precipitation is employed a much higher proportion of the spray will deposit on the sheet. It is desirable to have the spray contact the sheet as soon as possible after it emerges from the galvanizing bath.

The optimum amount of solution applied will vary from 2000 to 10,000 square feet of surface per gallon of 10% phosphoric acid solution.

The following examples illustrate the practice of the invention:

Example I

There is applied to galvanized sheets at a temperature of about 600° F., a 10% aqueous orthophosphoric acid solution at the rate of 32 gallons per 100,000 square feet of surface. It was estimated that there was deposited from 1/4 to 1/2 pound of H₃PO₄ per 10,000 square feet of surface. There was no visually observable deposit on the sheets. The treated sheets could be stacked wet for over 20 days without observing any white corrosion deposits.

Example II

To galvanized sheets emerging from a galvanizing bath there was sprayed an aqueous solution comprising 10% orthophosphoric acid plus 2% diammonium phosphate, at the rate of 1 gallon per 4000 square feet of surface. The treated sheets showed no visible coating. On stacking several sheets wetted with water, they withstood up to 30 days before exhibiting white corrosion products on the surface. Untreated galvanized sheets showed such white products in 1 to 2 days.

Freshly galvanized sheets were treated with aqueous 10% metaphosphoric acid and 10% pyrophosphoric acid solutions, respectively, at the rate of Example I, following the process of Example I. Equally satisfactory protective coatings were obtained.

Example III

The sheets of Example I were treated with an aqueous .5% solution of chromic acid and dried.

On tests for development of white corrosion products, stacks of the sheets withstood over 20 days before showing any white areas.

It will be understood that the above examples are illustrative and not limiting.

I claim:

1. In the process of producing a protective coating on a galvanized sheet which will reduce and greatly delay the formation of white oxide products between sheets when wet, the steps comprising applying to the surface of a sheet emerging from a galvanizing bath while the sheet is at a temperature of at least 400° F., a thin film of an acid solution consisting essentially of at least

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one acid from the group consisting of orthophosphoric acid, metaphosphoric acid and pyrophosphoric acid, the concentration of acid in the solution providing phosphorus oxide at a concentration equivalent to that of .2% to 35% orthophosphoric acid, the applied film depositing the equivalent of from $\frac{1}{8}$ to 10 pounds of H_3PO_4 per 10,000 square feet of surface, the heat of the sheets evaporating in a few seconds the solvent from the applied thin film of the acid solution effecting a highly protective phosphate reaction product on the sheet surface which product is not visually observable.

2. The process of claim 1 wherein the solution is an aqueous solution and contains up to 50%, based on the weight of the phosphorus acid, of the ammonium phosphate salt.

3. The process of claim 1 wherein the phosphorus acid treated surface is subsequently further coated with a dilute aqueous solution containing a chromium compound selected from the group consisting of chromic acid and alkali metal chromates and dichromates.

4. The process of producing a protective coating on galvanized sheets which will reduce and greatly delay the formation of white oxide products between sheets when wet, the steps comprising spraying the surface of a galvanized sheet as it emerges from a galvanizing bath while the sheet is at a temperature above 400° F. with an aqueous solution of at least one phosphoric acid selected from the group consisting of orthophosphoric acid, metaphosphoric acid and pyrophosphoric acid at a concentration of from 5% to 15% of the acid, the aqueous acid being applied at a rate of 1 gallon of 10% acid to from 10,000 to 2000 square feet of surface, the heat in the

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sheets evaporating in a few seconds the water in the applied sprayed coating and effecting a reaction resulting in a highly protective and visually non-observable phosphate film.

5. The process of claim 4, wherein up to 50% of the acid is present in the form of the ammonia salt thereof.

6. Galvanized sheets bearing on their surfaces a protective coating of phosphorus oxide equivalent to from $\frac{1}{8}$ to 10 pounds of H_3PO_4 per 10,000 square feet of the surface, the coating having been applied by the process of claim 1.

7. Galvanized sheets bearing on their surfaces a protective coating of phosphorus oxide equivalent to from $\frac{1}{8}$ to 10 pounds of H_3PO_4 per 10,000 square feet of the surface, the coating having been applied by the process of claim 5.

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