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METHOD OF TREATING GALVANIZED METAL TO INHIBIT CORROSION

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FRESHLY GALVANIZED STEEL STRIP
(HOT DIP)

COOLING

IMMERSE IN SOLUTION
OF BORAX, PHOSPHORIC
ACID AND NITRITE.

Example:
Borax 0.8 - 1.0%
Phosphoric Acid 0.3 - 0.5%
Sodium Nitrite 0.15 - 0.25%

WIPE OFF
EXCESS SOLUTION

DRY
(HOT AIR)

PROTECTED PRODUCT

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METHOD OF TREATING GALVANIZED METAL TO INHIBIT CORROSION

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This invention relates to protective coatings or treatments for galvanized iron or steel.

After iron or steel in various forms, e. g. sheet or strip, has been galvanized it has a characteristic bright metallic luster, with the zinc coating usually assuming the familiar crystalline appearance or pattern. However, under certain storage conditions the galvanized products are subject to dampness or continued humid conditions, or galvanized sheets, for instance, may be stored in such way that moisture is trapped between them. In such circumstances, a formation known as "white rust" or wet storage stain or humid storage stain develops on part or all of the surface and destroys the original galvanized luster. For example, wet storage stain may occur during shipment or storage of galvanized sheets because of condensation resulting from changes in temperature and humidity or it may occur when galvanized sheet or formed parts are left unsheltered and are wet with rain. If the moisture on the galvanized surface dries rapidly there may be no stain, but if the moisture remains for a time the wet storage stain is very likely to result. The stain is a white or gray corrosion product which in at least some cases has appeared to be primarily a basic zinc carbonate of variable composition.

The present invention is directed to the inhibition of the staining and discoloration which results from the formation of this zinc corrosion product which although not appreciably damaging the galvanized surface for a number of purposes, nevertheless seriously detracts from its appearance and original luster, and may impair the utility of the galvanized material or article in certain cases.

Coatings have been developed which have sought to inhibit the formation of the wet storage stain with varying degrees of success but frequently the coatings have had drawbacks of their own. One such type of coating has been that which is derived from treatment with liquids consisting principally or in part of hexavalent chromium solutions. These treatments have been useful in reducing the formation of wet storage stain but are considered objectionable because the chromium salts impart an undesirable yellowish color to the galvanized sheet.

Some coatings have included sodium silicate or similar substances which form a film on the galvanized surface that must be removed if the surface is to have any paint adhesion quality.

In accordance with the present invention, it has been discovered that by treating freshly galvanized surfaces with a bath consisting of a dilute solution of borax, phosphoric acid and sodium nitrite, and thereafter wiping the aqueous liquid from the surface and drying the surface, remarkable protection is achieved against the development of wet storage stain or white rust. The treated sheets or other articles are highly resistant to the occurrence of this particular type of corrosion, and retain their metallic luster, essentially undiminished, over long periods, even under adverse conditions of moisture or wetness. Furthermore, the treatment does not result in any

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yellowish or other significant coloration of the galvanized surface, and the appearance is therefore highly satisfactory from the standpoint of a variety of uses. The coating or modification of the surface that results from the treatment is not found to interfere with painting or other treatments or operations which may be applied to galvanized products.

The accompanying drawing is a flow sheet illustrating an example of a complete process of treating freshly galvanized steel strip, utilizing the invention.

As will be seen, the treatment consists essentially in immersing the zinc coated sheet or other article in an aqueous solution, which consists of water in which there is dissolved small quantities of borax, phosphoric acid and sodium nitrite. Whereas a small or modest extent of protection may be obtained with solutions containing only a mixture of borax and phosphoric acid, it has been discovered that the sodium nitrite provides a very large and unexpected increase in corrosion resistant properties, i. e. resistance to the specific type of corrosion defined above as white rust or wet storage stain. The nitrite, according to present understanding, appears to be related in function to both of the other ingredients, and to be at least somewhat critical in its concentration. Thus with solutions containing borax in amount of about 1% (or between, say ½ to 2%) and phosphoric acid (measured as 85% acid) in amounts less than 1% (e. g. about ½% or somewhat less), it appears that sodium nitrite is of no particular benefit below about 0.10% and may tend to be deleterious in amounts of more than about 0.4%, all of these proportions being by weight.

The actual treatment is relatively simple. For instance, where the steel or iron has been galvanized by a hot dip process, i. e. by giving the metal a molten dip comprising metallic zinc, the sheet or other article with the solidified and adhered zinc coating is appropriately cooled (at least to prevent any boiling effect in the aqueous solution) and is then passed through or otherwise dipped in the treating liquid. Such treatment may involve only a matter of a few seconds. The bath is a solution as described above, containing the three essential ingredients (borax, phosphoric acid and nitrite). Upon withdrawal of the article from the bath it is conveniently wiped to remove excess solution; for instance, in the case of sheet or strip, the excess liquid may be removed by squeegee action, as with a flexible rubber member. The wiped sheet or other article is then dried, conveniently with hot air, thereby completing the treatment. No rinsing is employed.

Galvanized metal so treated has been found to resist white rust or wet storage stain remarkably well, both under practical conditions and under special tests that are recognized as applicable to determine effectiveness of inhibition of such corrosion.

For instance, galvanized sheet material treated in accordance with the present process has been compared with identical galvanized surfaces lacking such treatment, by use of the modified Neish cooker test, being a steam application test described in a paper by R. A. Neish entitled "Measurement of the Susceptibility of Galvanized Surfaces to Humid Storage Stain," published in the periodical "Corrosion," vol. 10, No. 12, pages 440 to 442 (1954). This test is specifically set forth as the "modified steam test" in said paper, and involves holding the test samples above boiling water in a closed vessel at atmospheric pressure, for a predetermined time, e. g. one minute plus a cooling interval of five minutes after removal of the heat source. Whereas galvanized sheet without protective treatment showed a heavy coating of white rust on this test, sheet samples that had been treated by the present process, retained their brightness and luster at the end of the test.

By way of specific example of the invention, steel strip issuing from a continuous galvanizing line, wherein the strip was coated with zinc by the hot dip process, was appropriately cooled and passed through an aqueous solution, at room temperature, consisting of water containing:

	Percent by weight
Borax	1.0
Phosphoric acid (85%)	0.4
Sodium nitrite	0.2

As the strip left the bath, aqueous solution was wiped off, i. e. by simple squeegee action, and the strip was advanced past hot air blowers to dry it. The treated galvanized product thus resulting showed no appreciable diminution of its bright metallic luster or change in color. As stated above, both practical tests in actual, damp storage conditions, and tests by the steam cooker method, have demonstrated that the treatment is highly effective in the inhibition of wet storage stain. In operation, it is found that preferred results are obtained by keeping the borax concentration between about 0.8 and about 1.0%; the phosphoric acid (85%) concentration between about 0.3 and 0.5% and the sodium nitrite content between about 0.15 and 0.25%.

It is to be understood that the invention is not limited to the specific proportions and the like as hereinabove set forth but may be carried out in other ways without departure from its spirit.

I claim:

1. The method of treating a galvanized metal surface to inhibit wet storage stain which comprises exposing the surface to a dilute aqueous solution of borax and phosphoric acid, containing sodium nitrite in amount of at least about 0.1%, the borax being in greater amount than the phosphoric acid, and drying the treated surface.

2. The method of treating a galvanized metal surface to inhibit wet storage stain which comprises exposing the surface to a dilute aqueous solution of borax and phosphoric acid, containing sodium nitrite in amount from about 0.1% to less than 0.4% by weight, the borax being in greater amount than the phosphoric acid, wiping excess solution from the surface, and drying the surface.

3. The method of treating a galvanized metal surface to inhibit wet storage stain which comprises: exposing the surface to a solution consisting of water, borax less than 2% by weight, phosphoric acid, and sodium nitrite between 0.1% and less than 0.4% by weight, the phosphoric acid being in greater amount than the sodium nitrite and the borax in greater amount than the phosphoric acid; and wiping excess solution from the surface and drying the surface, without rinsing the same.

4. The method of producing a coating to inhibit wet storage stain on a galvanized metal surface comprising: immersing the galvanized surface to be coated in an aqueous solution containing borax in the range of 0.8% to 1.0% by weight, phosphoric acid in the range of 0.3% to 0.5% by weight and sodium nitrite in the range of 0.15% to 0.25% by weight, removing the surface from the solution, wiping excess solution from the surface and rapidly drying the surface.

5. A solution for coating galvanized surfaces to prevent the formation of wet storage stain comprising an aqueous solution containing borax in the range of 0.8% to 1.0% by weight, phosphoric acid in the range of 0.3% to 0.5% by weight and sodium nitrite in the range of 0.15% to 0.25% by weight.

6. In the continuous production of hot dipped galvanized steel strip, the process of producing a coating on the strip after the strip has been galvanized comprising: cooling the strip received from the hot dip; passing the strip into an aqueous solution of about 1% by weight borax, about 0.4% by weight phosphoric acid, and about 0.2% by weight sodium nitrite; wiping excess solution from the strip; and blowing warm air on the strip to dry it rapidly.

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