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SOLUTION AND METHOD FOR COATING ZINC SURFACES

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This invention relates to the production of a coating on zinc surfaces which is highly adherent, long-lived, attractive in appearance, resistant to corrosion and abrasion and affords a very satisfactory base for paint.

This is a continuation-in-part of my application Serial No. 648,025, filed February 15, 1946, now abandoned, for "Coated Zinc and Process of Producing the Same."

Zinc surfaces such as those of galvanized sheets exhibit good corrosion resistance in certain locations but have only a limited life when subjected, for example, to industrial atmospheres containing carbon dioxide or sulphur, or to sea air. It has accordingly been proposed to form a protective coating on zinc surfaces by treating them with a solution of salts of chromic and formic acids. I have invented an improved solution and method for producing on zinc surfaces a coating which is not only corrosion resistant but is highly adherent, has a long life even under adverse conditions and imparts a coloration materially enhancing the appearance so that painting is unnecessary. A particular feature of the invention is that it affords a choice in the color of the coating and a range of shades in each color.

In a preferred embodiment and practice of the invention, I subject the surfaces to be treated to contact with a novel film-forming solution by dipping, spraying or the like. The solution contains chromic acid or a water-soluble salt thereof, or both, and an organic acid chosen from the group consisting of tartaric, succinic and citric acids. The solution preferably contains also a small amount of one or more mineral acids or salts thereof chosen from the group consisting of hydrochloric, sulphuric, nitric and phosphoric acids. The coating produced by the invention appears to be a durable film composed largely of insoluble chromate deposited by the interaction of the chromate ions of the solution and metal ions from the zinc surface. The organic acid determines the color of the coating or film formed and the shade thereof may be varied by changing the organic acid concentration. The mineral acid also modifies the color of the film. The solution may be applied at room temperature or may be heated to a moderate temperature, say 140° F. The length of contact of the solution with the surface varies inversely with the temperature, i. e., from about 60 seconds at room temperature to about 30 seconds at 140° F.

In order to impart a more exact understanding of the invention, the following specific examples of solutions for forming a protective coating of

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attractive color on zinc surfaces are given. The percentages of the several components are by weight and, in each case, the balance of the solution is water.

EXAMPLES

I

	Per cent
Chromic acid	5.0
Citric acid	1.0
Hydrochloric acid	0.5

II

	Per cent
Chromic acid	4.0
Sodium chromate	2.0
Succinic acid	1.0 to 5.0
Zinc nitrate	1.0

III

	Per cent
Chromic acid	5.0
Tartaric acid	1.0
Hydrochloric acid	0.5
Phosphoric acid	3.0

IV

	Per cent
Chromic acid	5.0
Tartaric acid	1.0
Sulphuric acid	2.0
Nitric acid	2.0

V

	Per cent
Chromic acid	5.0
Succinic acid	2.0
Hydrochloric acid	0.5
Phosphoric acid	3.0

Instead of zinc nitrate specified in Example II, I may use other nitrates such as sodium nitrate or nitrates of alkaline earth metals or nitric acid. Similarly I may use water-soluble salts of the mineral acids instead of the acids themselves, since it is the acid anion which forms the coating film. Mineral acid salts of sodium and potassium are specially suitable as substituents for the acids. Water-soluble chromates or dichromates such as those of sodium or potassium may be used to replace some or all the chromic acid.

The organic acids, tartaric, succinic and citric, may be used individually or a mixture of two or more may be employed. Salts of these acids such as those of potassium or sodium may be used instead of the acids but are not as desirable.

The presence of all three acids, chromic, organic and mineral, or their water-soluble salts,

is desirable in order to obtain adequate color and corrosion resistance.

In practice of the invention it has been found that the chromic acid content of the coating solutions should be preferably in the range of 2.5% to 18.0%, or the equivalent in chromium when using chromates. Dichromates may be considered as forming chromic acid-chromate mixtures on going into solution.

The organic acid additions, or respective anion additions from salts thereof, should be preferably in the range of 0.5% to 9.0% by weight depending to a great extent on the concentration of chromic acid in the coating solution and the shade of color desired.

The mineral acid additions, or respective anion additions from salts thereof, should be preferably in the range of 0.1% to 8.0% by weight, the amount depending on the amounts of chromic acid and organic acid anion present and the shade of color desired.

Temperature and time of treatment are important factors in employing the invention for obtaining both desirable and adherent coatings. Room temperature of about 80° F. is preferable in most cases, but in some cases it is necessary to go to elevated temperatures of 160° to 180° F. to accomplish results. Fifteen seconds to two minutes immersion time is sufficient to promote desirable coatings in all cases.

Instead of immersing or spraying the zinc body in the chromate producing solution, the solution may be brushed or flowed thereon, or otherwise brought into contact with the zinc body.

The resulting chromate coatings on the zinc are highly resistant to atmospheric and salt water corrosion. Adherence of the coatings to the zinc surface is good, as indicated by results of bend and abrasion tests. The adherence and appearance of the chromate coatings are enhanced by the presence of the additional constituents present in the solutions; namely organic acid and mineral acid anions. The function of the organic acid anion is, apparently, reduction or partial reduction of chromates at the metal-solution interface. A wide range of visible corrosion-resistant coatings varying from a light gold color through brown to a medium green are obtainable by the process of this invention. These coatings are especially suitable for galvanized steel products used in construction for roofing or siding.

The term "zinc" as herein employed is intended to include zinc coatings, rolled zinc sheets, galvanized material and zinc alloys.

Among the advantages of the invention, I may mention that it affords a wider range of color in the coatings and is more adaptable to producing corrosion-resistant coatings to suit the need, such as coatings to withstand high-moisture atmospheres, sulphur gases and other industrial fumes, expansion and contraction due to heating and cooling, salty seashore atmospheres and abrasion due to dust or other particles. Other qualities which can be imparted by the process include bright surfaces which will reflect light, dull surfaces which will absorb light, and surfaces which serve as good paint bases. The applied coating is found to be an excellent base for paints and the like, should it be desired to paint, or similarly cover, the zinc surface after the treatment described.

The compounds and amounts thereof may vary as indicated. However, close control is maintained to produce desired qualities, especially combinations of qualities. For instance, in the case of Example III, the solution described produces a medium green protective coating on zinc surfaces, but if the tartaric acid and phosphoric acid components are not controlled to specified amounts, the green coating will deteriorate rapidly under certain conditions such as exposure to moisture condensates.

The invention also affords a greater range of adaptability to needs in coloration and corrosion resistance. The organic acid additions control, to a large extent, the color, adherence and corrosion-resisting qualities of the coatings and each acid imparts separate characteristics. These are not generally interchangeable for duplicating results.

Although I have illustrated and described but a preferred embodiment of the invention, changes therein may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In a method of forming a corrosion-resistant and-abrasion-resistant coating on a zinc surface, steps including subjecting the surface for a period of from 15 seconds to 2 minutes, to contact with a solution, acid in character, composed of from 4 to 18% of a compound selected from the group consisting of chromic acid and sodium and potassium salts thereof or mixtures but including at least 4% chromic acid, from .5 to 9% of a compound selected from the group consisting of tartaric acid, succinic acid, citric acid and sodium and potassium salts thereof or mixtures, from .1 to 8% of a compound selected from the group consisting of hydrochloric, sulphuric, nitric and phosphoric acids and sodium and potassium salts thereof or mixtures, and the remainder water, the salts in each case being used in anionic equivalent amounts of the amount of acid specified, and maintaining the temperature of said solution at a value between room temperature and 180° F.

2. A solution adapted to form a corrosion-resistant and abrasion-resistant coating on a zinc surface composed of from 4 to 18% of a compound selected from the group consisting of chromic acid and sodium and potassium salts thereof or mixtures but including at least 4% chromic acid, from .5 to 9% of a compound selected from the group consisting of tartaric acid, succinic acid, citric acid and sodium and potassium salts thereof or mixtures, from .1 to 8% of a compound selected from the group consisting of hydrochloric, sulphuric, nitric and phosphoric acids and sodium and potassium salts thereof or mixtures and the remainder water, the salts in each case being used in anionic equivalent amounts of the amount of acid specified, and the solution being acid in character.

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