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COMPOSITIONS AND METHOD FOR
ELECTROPLATING ZINCAllan E. Chester, Highland Park, Ill., assignor to
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DelawareNo Drawing. Application December 6, 1950,
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10 Claims. (Cl. 204—55)

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This invention relates to new and improved compositions for use in the electrodeposition of zinc, and to a new and improved method for electrodepositing zinc from acid zinc plating baths.

One of the objects of the invention is to provide new and improved compositions which when added to acid zinc plating baths in relatively small amounts will produce new and improved results in the electrodeposition of zinc from such baths.

A further object of the invention is to provide compositions of the type referred to which will produce new and improved results in the color of the electrodeposited metal.

Another object of the invention is to provide compositions of the type referred to which will increase the brightness of the electrodeposited metal.

Another object of the invention is to provide a new and improved method of electrodepositing zinc at relatively high rates of deposit over a wide range of current densities. Other objects will appear hereinafter.

In accordance with the invention, it has been found that new and improved results in the electrodeposition of zinc are obtained by incorporating into acid zinc plating baths compositions or concentrates containing a water soluble salt of sulfonated lignin (also referred to herein as a water soluble lignin sulfonate), dark molasses and trifluoroacetic acid.

These concentrates are preferably prepared by mixing together the water soluble salt of the sulfonated lignin and molasses in hot water, filtering the solution and adding trifluoroacetic acid.

The compositions of the invention when added to acid zinc sulfate baths in very small amounts (e. g., 1 ml. to 80 ml. of concentrate per liter of bath) will produce bright zinc plates directly out of the bath without the necessity for any secondary treatments. The brightness of the zinc will vary depending upon the quantity of the concentrate added to the bath.

The acid zinc plating baths may be prepared by dissolving zinc sulfate ($\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$) in water in proportions corresponding to 100 to 450 grams of zinc sulfate per liter of solution and adjusting the pH within the range of 1.5 to 6 with sulfuric acid. It is preferable also to add 1 to 15 grams of aluminum sulfate to the acid sulfate bath. The aluminum sulfate forms a film of colloidal alumina in the vicinity of the anode and retards or prevents acid attack on the zinc anode.

The compositions herein described are especial-

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ly advantageous when added to a zinc sulfate plating bath containing a zinc aldionate, for example, zinc gluconate.

Other auxiliary ingredients may be added to the bath as, for example, sodium acetate in quantities up to about 15 grams per liter and zinc chloride in quantities up to about 100 grams per liter.

The bath can be operated over a wide range of current densities. Depending upon the agitation available current densities within the range of 5 amperes to 5000 amperes per square foot may be used. It is preferable, however, to operate the bath at current densities within the range of from about 20 to 100 amperes per square foot.

Bright zinc plates may be obtained directly out of the bath at ordinary temperatures, e. g., 70° F. or at higher temperatures, preferably not exceeding 160° F.

The invention will be further illustrated but is not limited by the following examples.

Example I

A concentrate was prepared by mixing together the following ingredients:

79.5 lbs. Marasperse N (sodium salt of sulfonated lignin having a pH of 7)
1557 lbs. dark molasses
456 cc. trifluoroacetic acid

In mixing the foregoing ingredients 180 gallons of hot water was added to a tank together with the molasses. The Marasperse N was added and the solution was stirred and filtered. Thereafter the trifluoroacetic acid was mixed with the filtrate and the product was poured into carboys ready for use.

Example II

This example illustrates the use of the product of Example I in the electrodeposition of zinc from an acid zinc plating bath. An electrolyte was prepared by mixing the following ingredients:

240 grams zinc sulfate ($\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$)
10 grams zinc gluconate
15 grams aluminum sulfate
5 ml. of the concentrate of Example I

and water sufficient to make one liter of bath.

The pH of the bath was adjusted to pH 6 with sulfuric acid and the zinc was plated out of this bath at a current density of 40 at a temperature of 70° F. without agitation.

An excellent bright plate was obtained directly out of the bath.

In a similar manner zinc was plated from other zinc sulfate acid plating baths containing vary-

ing proportions of zinc sulfate, zinc gluconate, aluminum sulfate and the addition agent of Example I within the range of 100 to 450 grams of zinc sulfate per liter of solution, 5 to 40 grams per liter of zinc gluconate, 1 to 15 grams of aluminum sulfate per liter of solution and 1 to 80 ml. of the addition agent of Example I per liter of solution. The brightening of the zinc was found to be substantially a straight line function with increasing quantities of the addition agent.

The invention may be employed for piece work plating or for continuous plating of steel articles, strips, wire and sheets.

It will be understood that the ingredients in the concentrate may be varied somewhat. Thus, the quantity of trifluoroacetic acid may be one-half as much to four times as much as that given in Example I.

The dark molasses is employed in the composition for its grain refining properties. Any equivalent material may be substituted.

The lignin sulfonate possesses a surface tension reducing effect. However, it also seems to behave in a particular way in combination with the trifluoroacetic acid to produce the desired brightening effect.

It will be recognized that the plating bath contains only a fraction of a per cent of the brightening agent.

The invention provides a simple and inexpensive method for brightening zinc plates directly in an acid zinc plating bath. It also provides a simple way of controlling the amount of brightness merely by varying the quantity of the addition agent added to the bath.

The zinc gluconate herein referred to may be prepared as described in my application, U. S. Serial No. 180,500, filed August 19, 1950. In a similar manner other zinc aldonates may be prepared and used in conjunction with the compositions of the present invention to prepare acid zinc plating baths for the electrodeposition of bright zinc plates. Such aldonates also include those derived from mannonic, arabonic, galatonic, xylonic and other aldonic acids. The invention contemplates the use of one or more of these aldonates or mixtures thereof, including mixtures of the lactone forms, for example, the zinc gluconate derived from the delta gamma lactone form of gluconic acid.

The term "acid zinc sulfate bath" is used herein to describe acidic plating baths in which the zinc is present principally as zinc sulfate but can also be present in minor amounts in one or more other forms.

The invention is hereby claimed as follows:

1. A composition for use in a zinc sulfate plating bath consisting essentially of a water soluble lignin sulfonate, dark molasses and trifluoroacetic acid, said composition when added in sufficient amount to an acid zinc sulfate plating bath being capable of producing a bright zinc plate by electrodeposition directly from said bath.

2. An addition agent for use in a zinc sulfate plating bath consisting essentially of about 79.5 lbs. of a sodium salt of sulfonated lignin having a pH of 7, and 1557 lbs. dark molasses and 456 cc. trifluoroacetic acid dissolved in about 180 gallons of hot water.

3. An acid zinc plating bath comprising zinc sulfate dissolved in an acidic aqueous liquid containing a water soluble lignin sulfonate, dark molasses and trifluoroacetic acid in quantities effective to produce a bright zinc plate by electrodeposition directly from said bath.

4. An acid zinc plating bath comprising zinc sulfate and a zinc aldonate dissolved in an acidic aqueous liquid containing a water soluble lignin sulfonate, dark molasses and trifluoroacetic acid in quantities effective to produce a bright zinc plate by electrodeposition directly from said bath.

5. An acid zinc plating bath comprising zinc sulfate and a zinc gluconate dissolved in an acidic aqueous liquid containing a water soluble lignin sulfonate, dark molasses and trifluoroacetic acid in quantities effective to produce a bright zinc plate by electrodeposition directly from said bath.

6. An acid zinc plating bath consisting essentially of 100 to 450 grams of zinc sulfate, 5 to 40 grams of zinc gluconate, 1 to 15 grams of aluminum sulfate and 1 to 80 ml. of the addition agent claimed in claim 2 together with sufficient water to form a liter of solution.

7. A method of electrodepositing bright zinc directly from an acid zinc bath which comprises electrodeposition zinc from an acid zinc sulfate bath containing a water soluble lignin sulfonate, dark molasses and trifluoroacetic acid in quantities sufficient to produce a bright zinc plate.

8. A method of electrodepositing bright zinc directly from an acid zinc bath which comprises electrodepositing zinc from an acid zinc sulfate bath containing a zinc aldonate, a water soluble lignin sulfonate, dark molasses and trifluoroacetic acid in quantities sufficient to produce a bright zinc plate.

9. A method of electrodepositing bright zinc directly from an acid zinc bath which comprises electrodepositing zinc from an acid zinc sulfate bath containing a zinc gluconate, a water soluble lignin sulfonate, dark molasses and trifluoroacetic acid in quantities sufficient to produce a bright zinc plate.

10. A method of electrodepositing bright zinc directly from an acid zinc bath which comprises electrodepositing zinc from an acid zinc sulfate bath containing aluminum sulfate, a water soluble lignin sulfonate, dark molasses and trifluoroacetic acid in quantities sufficient to produce a bright zinc plate.

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