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COATING ON ALUMINUM

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This invention relates to the production of oxide-coated aluminum surfaces, and it is particularly concerned with a method for the production of a substantially colorless, hard, adherent and adsorptive coating consisting substantially of aluminum oxide on an aluminum surface by chemical treatment without the external application of electric current. The term aluminum as used herein and in the appended claims is intended to include both aluminum in its various degrees of purity and the aluminum base alloys.

Oxide coatings have found extensive application for the protection and decoration of aluminum surfaces. This field has been extended particularly in recent years as a result of the development of the so-called anodic oxidation methods in which hard, adherent, abrasion-resistant coatings are formed on aluminum by electrolytic oxidation. These coatings are generally more or less porous and adsorbent, and can be colored, impregnated with corrosion-inhibiting substances, sealed or otherwise treated as their particular use demands. However, these methods do not lend themselves readily to the production of oxide coatings on small articles, such as buttons, eyelets, and the like, and their use is not economical in the production of certain types of articles intended for sale at relatively low prices.

While it has been recognized that the methods of producing coatings on aluminum by simple chemical treatment without the application of electrical energy would be desirable for use in the coating of small articles, the methods heretofore available, and known to the art, for providing oxide coatings on aluminum by a simple chemical treatment have not produced coatings which have a suitable combination of properties to recommend them for general use. In order to be satisfactory for general use, it is desirable that the coating produced should be sufficiently hard and adherent to resist the abrasion incident to ordinary use, and should preferably be substantially colorless and more or less adsorbent, so that it can be colored by dyeing or pigmenting.

It is an object of this invention to provide a chemical treatment method for the production of an oxide coating on aluminum having a combination of properties permitting its general use as a finishing coating. It is more particularly an object of this invention to provide a method for the production of a hard, adherent, adsorbent and substantially colorless coating consisting

substantially of aluminum oxide on an aluminum surface by simple chemical treatment without the aid of an electric current.

It is a further object of this invention to provide a coating of the above nature and properties which is resistant to abrasion and corrosion, and which is free from pits and discolorations frequently encountered with former chemical coatings applied by the usual chemical treatments. It is a still further object of the invention to provide a chemical coating bath which may be used continuously over a relatively extended period of time while continuing to maintain equilibrium conditions of reagent concentration, so that it functions uniformly over the term of its use.

I have discovered that improved coatings of the type described hereinabove can be produced on aluminum and aluminum alloy surfaces by treatment of the said surfaces with a solution containing an alkali metal oxalate. The article to be coated is preferably immersed in the solution at an elevated temperature. The reaction between the coating solution and the metal surface, which is at first fairly vigorous, gradually becomes slower and finally practically stops, generally within twenty to thirty minutes when operated at temperatures above about 85° C. The coating produced is relatively hard, adherent, abrasion-resistant and corrosion-resistant, and is relatively free from pits and streaks. It is more or less adsorbent and substantially colorless.

Satisfactory results may be obtained by using solutions containing as little as 0.1 per cent of sodium oxalate or as much as 5 per cent, but for most purposes a concentration of 1 to 3 per cent has proved most satisfactory. When the aluminum or aluminum alloy article is immersed in the solution the solution rapidly attains equilibrium conditions, and any excess of alumina caused by the action of the bath in producing the oxide coating precipitates out and settles at the bottom of the container. The temperature of the solution is usually above about 85° C., preferably at the boiling point.

I have discovered that a further improvement may be obtained by adding to the above-described alkali metal oxalate solution an alkali metal aluminate. The aluminate may be added in amount between about 0.1 per cent and 1.5 per cent but for general purposes a narrower range of from 0.5 per cent to 1.0 per cent gives the best results. The alkali metal oxalate may vary from about 0.1 to 5 per cent. I have found it preferable to use a solution in which the ratio

of the alkali metal aluminate to the alkali metal oxalate is from about 1:2 to 1:3, and when using, for example, sodium aluminate and sodium oxalate I prefer to use a solution containing from 5 about 0.3 per cent to 0.5 per cent sodium aluminate and 1.0 per cent sodium oxalate.

When using oxalate solutions containing aluminate the temperature of the solution is preferably somewhat lower than that used for a plain 10 oxalate solution of corresponding concentration. I prefer in most cases to use a solution of an alkali metal oxalate and an alkali metal aluminate at temperatures of about 85° C. to 95° C. Either the oxalate solution or the oxalate-aluminate so- 15 lution may, however, be used successfully at temperatures from room temperature to boiling by varying the time of treatment. The time necessary to produce a coating of the required thickness at the lower temperatures is, of course, 20 longer than if higher temperatures are used, and at room temperature from 10 to 20 hours may be required.

Preliminary cleaning of the aluminum surface to be coated is not essential, though it may be 25 desirable. I have found that aluminum surfaces on which there is a film of oil may be satisfactorily coated when treated according to my invention, without any preliminary treatment. It is generally preferred, however, to use a clean 30 aluminum surface. In some cases it may be preferred to preliminarily etch the surface to be coated. Particularly good results may be produced on surfaces preliminarily etched in hydrofluoric acid, followed by washing with strong 35 nitric acid.

The properties of the coating obtained by the method of my invention will vary somewhat with the composition of the aluminum or aluminum alloy surface treated, and the exact conditions of 40 treatment used. Certain aluminum alloys, by reason of the presence of elements such as iron, manganese, or copper, have a tendency to develop coloration in the coatings produced, particularly when the coating is formed relatively rapidly, as 45 when a solution of alkali metal oxalate and an alkali metal aluminate is used. In such cases I prefer to use a solution containing not more than 0.4 per cent aluminate and at least 1.0 per cent of oxalate at a temperature of 85° to 95° C.

As a specific example of the method of coating 50 aluminum according to the process of my invention I may cite the following: The aluminum to be coated was immersed in a solution containing 2 per cent sodium oxalate. The solution was maintained at a temperature of 95° C., and 55 the treatment continued for a period of about 30

minutes. After treatment the aluminum was found to be coated with a hard, adherent coating. This coating was substantially colorless and was abrasion-resistant and of good corrosion resistance. 5

As a specific example of the use of sodium aluminate and sodium oxalate in conjunction, I have used the following bath. The article to be coated was immersed in a solution containing 0.4 per cent sodium aluminate and 1.0 per cent sodium 10 oxalate. The temperature and time of treatment were the same as in the preceding example. In this case also the coating was hard, abrasion-resistant, of good corrosion resistance and substantially colorless. 15

I claim:

1. A method of producing a substantially colorless protective coating on an aluminum surface, comprising treating said surface with a solution containing an alkali metal oxalate and an alkali 20 metal aluminate.

2. A method of producing a substantially colorless protective coating on an aluminum surface, comprising treating said surface with a solution containing an alkali metal oxalate and an alkali 25 metal aluminate at a temperature of about 85° to 95° centigrade.

3. A method of producing a substantially colorless protective coating on an aluminum surface, comprising treating said surface with a solution containing an alkali metal aluminate and about 0.1 to 5 per cent of sodium oxalate. 30

4. A method of producing a substantially colorless protective coating on an aluminum surface, comprising treating said surface with a solution containing sodium oxalate and from about 0.1 35 to 1.5 per cent of sodium aluminate.

5. A method of producing a substantially colorless protective coating on an aluminum surface, comprising treating said surface with a solution containing sodium oxalate and from 0.1 to 1.5 40 per cent of sodium aluminate in which the ratio of the sodium oxalate to the sodium aluminate is from about 3:1 to 2:1.

6. A method of producing a substantially colorless protective coating on an aluminum surface, comprising treating said surface with a solution containing about 0.3 to 0.5 per cent of sodium aluminate and 1.0 per cent of sodium oxalate. 45

7. A method of producing a substantially colorless protective coating on an aluminum surface, comprising treating said surface with a solution containing sodium aluminate and sodium oxalate in a ratio of about two parts of oxalate to one 50 part of aluminate.

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