

1

3,274,078

PROCESS FOR TREATING THE SURFACE OF ALUMINIUM OR ALUMINIUM ALLOY WITH AN ORGANOHYDROGENPOLYSILOXANE

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No Drawing. Filed Sept. 11, 1962, Ser. No. 222,963

Claims priority, application Japan, Oct. 6, 1961,

36/35,865

3 Claims. (Cl. 204—35)

This invention relates to a process for treating the surface of a metal consisting essentially of aluminum, and more particularly to a process for treating the surface of the metal to reduce the tendency of ice to adhere thereto.

It is well known that it is desirable for ice trays for use in refrigerators to be made of electrolytically anodized aluminum. However, owing to the strong tendency of ice to adhere to the surface of anodized aluminum, it is necessary to coat such a surface with a durable film for minimizing adhesion of ice thereto. For example, a process for treating the surface of aluminum has been proposed, wherein an organosilicone compound containing a silicon bonded hydroxy radical is applied to the surface of anodized aluminum and then an over coating comprising a polyorganohalogenopolysiloxane is applied to the treated surface. While this process of surface treatment substantially reduces the tendency of ice to adhere to the surface of aluminum it is complicated and costly, as it requires two separate steps, viz., the step of applying a base coating and the step of overcoating.

Accordingly, an object of this invention is to provide a simple process for treating the surface of a metal consisting essentially of aluminium which can not only improve anti-corrosion and anti-wearing properties of the surface but also permanently minimize the tendency of ice to adhere to it.

A more specific object of this invention is to provide a novel process for treating the surface of a metal consisting essentially of aluminium to minimize the tendency of ice to adhere thereto without requiring the step of providing a base coating. The novel process comprises forming an anodic film on the surface of the metal by electrolytically anodizing the metal in an organic or inorganic acid such as oxalic acid or sulfuric acid and applying to the anodized surface a film of a particular organopolysiloxane having the property of resisting the adherence thereto of ice.

This invention is based on the discovery that the substantial number of OH groups remaining in anodic film just after it has been formed effects a dehydrogenation reaction with an organohydrogenopolysiloxane which is applied thereon by painting or by impregnation immediately after said anodizing process, thus firmly anchoring said organohydrogenopolysiloxane to the anodic film through chemical bonding.

Thus, this invention relates to a process for treating the surface of a metal consisting essentially of aluminum characterized by electrolytically anodizing said surface to form an anodic film thereon, applying an organohydrogenopolysiloxane on the anodized surface immediately subsequent to the formation thereof, and then heating.

The following are several examples of this invention, but it is to be understood that this invention is not to be limited thereto but can be carried out in various other ways without departing from the true spirit as defined in the appended claims.

Example 1

An ice tray of aluminium, 2S Alco grade for use in household refrigerators was electrolytically anodized in

2

a bath of sulphuric acid in a manner well known in the art to form an anodic film of 15 microns thickness on the surface of the ice tray. Immediately after the anodizing step, the ice tray was washed with water, and water was removed from the surface of the ice tray by wiping. Then the ice tray was immersed in 25 percent benzene solution of methylhydrogenopolysiloxane for about one minute. After removal from said solution, the ice tray was air dried to evaporate off benzene, and was treated with steam at a pressure of at about four atmospheres for about 20 minutes to form a smooth transparent film on the surface of the ice tray. Ice cubes made in this ice tray mounted on an evaporator maintained at -6° C. were easily removed with relatively small force, and even after repeated removal of 100 times or more, it was found that the ice cubes were released as easily as the first time with equally small force. Anti-wearing and anti-corrosion tests made on the above ice tray in accordance with the JIS Japanese Industrial Standard H 8601 testing method showed that these properties were over 350 seconds and 70 seconds, respectively, which are to be compared with 230 seconds and 50 seconds, respectively, of a prior ice tray having anodic film only.

Example 2

An ice tray of a machined die cast aluminium, 13 Alcoa grade was electrolytically anodized to form an anodic film of 20 microns thickness and washed with water, and the water remaining on the surface of the ice tray was wiped off. Immediately thereafter, a 12.5 percent xylene solution of a methylhydrogenopolysiloxane was applied to the surface of the ice tray and dried. Then the ice tray was heat treated in boiling water at 100° C. for about 40 minutes to obtain a smooth transparent film. Ice cubes made in this ice tray at -5° C. were removed with relatively small force, and it was found that the ice releasing property remained substantially unchanged after repeated removal of over 200 times. Antiwear property and anti-corrosion property were again improved as in Example 1.

Example 3

An evaporator made of aluminium blank, 3S Alcoa grade commonly utilized in household refrigerators was electrolytically anodized in a suitable manner to form an anodic film of 25 microns thickness. Immediately following the anodizing step, the evaporator was washed with water, and, after removal of water by using absorbent cotton impregnated with a 12.5 percent toluene solution of methylhydrogenopolysiloxane, was heat treated in an air drying furnace maintained at 120° C. for about 15 minutes to obtain a smooth transparent film. An ice block made on this evaporator at -7° C. was easily removed with relatively small force, and it was found that the ice releasing property remained substantially unchanged after repeated removal of over 300 times. Again, wear resistive and corrosion resistive properties were improved as in the foregoing examples.

Example 4

The same ice tray as in Example 1 was anodized in a bath of sulphuric acid to form an anodic film of 15 microns thickness, washed in water, and water was removed from the tray. Immediately thereafter the ice tray was dipped in a 9.5 percent benzene-butanol solution of ethylhydrogenopolysiloxane. After removal from the solution, the ice tray was subjected to a heat treatment similar to that of Example 1. This ice tray was mounted on an evaporator maintained at -7° C., and test of ice cube removal was repeated 100 times. Even at the end of the test, ice cubes were released as easily as at the first

3

time with substantially the same small force. In this case, too, anti-wearing property and anti-corrosion property were improved as in the foregoing examples.

Example 5

An ice tray of die cast aluminium similar to that of Example 2 was similarly electrolytically anodized to form an anodic film of 20 microns thickness and washed with water. After drying, a 9.5 percent benzene solution of phenylhydrogenpolysiloxane was applied to the surface of the tray and dried. Then the tray was dipped in boiling water at 100° C. for about 40 minutes. The finished ice tray was mounted on an evaporator maintained at -7° C. to freeze water contained therein, and test of ice cube removal was repeated 100 times. It was found that releasability of ice cubes was substantially the same throughout the test and that the anti-wear and the anti-corrosion properties were also improved as in the foregoing examples.

On the other hand, ice trays made of aluminium or its alloy which were electrolytically anodized in usual manner to form an anodic film and treated by steam to seal interstices in the anodic film and thereafter provided with a film of methyl-, ethyl- or phenylhydrogen-polysiloxane, as in the proceeding examples, showed marked decrease in the ice cube releasability after repeated removal of only 20 times.

While this invention has been described in connection with preferred examples thereof, it will be understood that this invention can be modified in various ways without departing from the true spirit and scope of the invention as defined in the appended claim. For example, edges of airplane wings, components, of ship parts, and the like, may also be treated with the process of this invention.

What is claimed is:

1. Process for treating the surface of a metal consisting essentially of comprising the steps of forming a porous film of aluminum oxide by electrolytically anodizing said metal, applying an organohydrogenpolysiloxane onto said porous film of aluminum oxide immediately after said

4

anodizing step and then heating said thus-treated metal surface.

2. A process for treating the surface of a metal consisting essentially of aluminum, which comprises the steps of forming an anodic film by electrolytically anodizing said metal, applying a solution of an organohydrogenpolysiloxane selected from the group consisting of methylhydrogenpolysiloxane, ethylhydrogenpolysiloxane, and phenylhydrogenpolysiloxane onto said anodic film immediately after said anodizing step and then heating said surface, thus-coated, in order to chemically bond organopolysiloxane to said metal surface.

3. A process for treating the surface of a metal consisting essentially of aluminum which comprises the steps of forming an anodic film on the surface of said metal by electrolytically anodizing said metal, washing with water and drying the thus-treated metal surface, applying an organohydrogenpolysiloxane selected from the group which consists of methylhydrogenpolysiloxane, ethylhydrogenpolysiloxane, and phenylhydrogenpolysiloxane to said thus-treated metal surface and heating the organohydrogenpolysiloxane coated metal surface in order to chemically bond said metal surface with said organohydrogenpolysiloxane.

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