United States Patent Office

3,232,855

Patented Feb. 1, 1966

3,232,855

PROCESS FOR ELECTROLYTIC POLISHING OF ALUMINUM

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No Drawing. Filed Jan. 30, 1962, Ser. No. 169,948
Claims priority, application Japan, Mar. 15, 1961, 36/8,732
3 Claims. (Cl. 204—140.5)

This invention relates to a process for electrolytic polishing, and more particularly it relates to a process for developing pear grained aluminum surface. An electropolishing agent of the present invention characteristically contains alkali gluconate and alkali hydroxide.

The term "pear appearance" used in the specification means that the surface is similar to a pear skin or uneven, and it is to be construed in somewhat broader sense, including coarsely uneven and finely uneven surfaces with or without luster in both cases.

In the prior art for finishing aluminum surface in pear appearance, a method of spraying sand, Alundum, Carborundum or other particles onto the surface and a method of brushing the surface with a rotary wire brush are widely employed. These prior methods, however, are disadvantageous because they usually stain the aluminum surface to be polished.

As the result of our studies it has now been found that where electrolysis is carried out by using an electrolytic solution containing more than 1.7 molal concentration of alkali hydroxide in water and alkali gluconate and aluminum anode, good pear appearance can be developed on the surface of aluminum. Preferred as alkali hydroxide is sodium hydroxide or potassium hydroxide. In some cases, a part or the whole of the alkali hydroxide may be substituted with barium hydroxide, sodium carbonate or potassium carbonate, although the optimum result will be obtained by the use of sodium or potassium hydroxide. Alkali hydroxide is suitable at any molal concentration of more than 1.7 moles/1000 g. of water. Although more than 10 moles of alkali hydroxide makes the solution viscous, alkali hydroxide saturated solution may be used if a highly viscous solution state is permissible. Where the alkali hydroxide concentration is less than 1.5 M., the aluminum anode surface tends to be developed smoothly rather than having a pear grained surface. Preferred alkali gluconates are sodium gluconate, potassium gluconate, calcium gluconate or the like. Among these, sodium and potassium gluconates are preferable because of their high solubility when compared with calcium gluconate. Particularly sodium gluconate is recommendable because of its easy availability. If alkali gluconate is absent in the electrolyte, the aluminum surface is not developed to pear appearance but becomes a lusterless white color. The higher the gluconate concentration, the more a lustrous uniform pear appearance can be obtained. Suitable gluconate concentration may range from 0.1 M. to saturation. Pear appearance can be developed more or less at a relatively low gluconate concentration, if the concentration is within the above-indicated critical range. An electropolishing solution of the present invention may, of course, contain other ingredients, such as chromates, non-ionic surface active agents, etc., without preventing the development of pear appearance on aluminum surface. The electrolyzing temperature can be within the range of 0° to 100° C. From the technical viewpoint, however, a temperature of from 15° to 60° C. is preferred because heating or cooling means are made unnecessary. The use of a high temperature facilitates to increase electroconductivity of the solution used, and under this circumstance it is possible to increase an electric current density at a low voltage. The current density may vary depending upon the composition of the solution, temperature and other conditions for electrolysis. Usually it is found that the electric current density is maximum at the starting period of electrolysis and then gradually lowers to show an approximately constant value 30 to 120 seconds after initiation of the electrolysis. Over the range of 3 to 100 amperes per square decimeter as constant value the aluminum surface can be polished to pear appearance. Practically, an electric current density of 5–40 amperes per square decimeter is suitable. The time required for electrolysis is 0.5 to 30 minutes and practically 1.5 to 2.5 minutes is sufficient.

The aluminum may be either pure or somewhat impure. However, aluminum being more than 98% pure is particularly suitable. Pure aluminum can be polished to a little more lustrous pear appearance as compared with impure aluminum, but there is no substantial difference in other features. A suitable cathode for electropolishing according to the present invention is aluminum, iron or carbon electrode. In order to carry out conventional electropolishing it is necessary to buff and degrease the aluminum surface prior to the electropolishing. However, in the present invention, the aluminum surface can be successfully polished to pear appearance directly without buffing and degreasing. Scars on the aluminum surface can be polished or, even if they remain, are not

Run No.	Electrolyte					Temp. (° C.)	Final current density (A/dm.²) [1]	Time (min.)	Remark
	Sodium gluconate (mol)	Caustic soda (mol)	Hexaoxyethylene lauryl ether (mol)	Sodium chromate (mol)	Water (kg.)				
1	1	3			1	30	10	3	White-colored, finely coarse surface.
2	0	5			1	30	15	3	Do.
3	0.5	2			1	30	15	2	Semi-lustrous, coarse pear appearence.
4	1	3			1	30	15	2	Lustrous, somewhat coarse pear appearence.
5	2	3			1	30	15	2	Lustrous pear appearence.
6	2	5			1	30	15	2.5	Do.
7	2	5			1	15	10	3	Do.
8	2	10			1	20	15	2	Do.
9	2	15			1	40	10	3	Do.
10	2	5			1	50	60	2	Do.
11	2	4			1	80	30	3	Do.
12	2	5	0.001		1	20	15	4	Do.
13	2	5		0.1	1	30	15	3	Do.
14	2	5	0.001	0.1	1	20	15	3	Do.

[1] Amperes per square decimeter.

noticeable because they usually are overlapped with roughness of pear appearance. However, if several scars, are present, buffing may be required. If the aluminum surface is stained with a considerable amount of grease, it should be preferably degreased. Buffing and degreasing treatments can be effected by simple procedures which are known.

The examples showing the nature of the present invention in details are summarized in the above table.

In all these runs, 99.7%-pure aluminum plate was used. Similar results can be obtained when 0.5 M. sodium chromate and/or 0.03 M. nonionic surface active agents are added to the electrolytic solution used in any of these runs. Runs No. 1 and 2 which were entirely free of gluconate are control experiments showing the effect of the present invention. In Runs No. 5 to No. 9 which employed more than 2 M. gluconate and more than 3 M. caustic soda, lustrous, beautiful pear appearance was obtained. The aluminum having been polished to pear appearance can be successfully stained by subjecting same to an anodic oxidation in a sulfuric acid solution and then immersing in a dye solution.

What I claim is:

1. Process for effecting "pear-like" appearance on aluminum which comprises immersing aluminum in an electropolishing aqueous solution consisting essentially of water, at least 0.1 mol per kilogram of water of alkali metal gluconate and at least 1.7 mol per kilogram of water of alkali metal hydroxide, and electrolyzing, wherein the aluminum is the anode, at a current density of 3 to 100 amperes per square decimeter until "pear-like" appearance on said aluminum is attained.

2. Process of claim 1 wherein the electrolysis is effected for 0.5 to 30 minutes.

3. Process of claim 1 wherein said current density is 5 to 20 amperes per square decimeter and said electrolysis is effected for 1.5 to 2.5 minutes.

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