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# ALUMINUM ETCH BATH ADDITIVE

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## ABSTRACT OF THE DISCLOSURE

The process for etching aluminum using a caustic soda bath utilizing peroxide compound as an additive to reduce the adverse appearance on the surface after viscosity of the bath associated with dissolved aluminum has reached a certain level. The peroxide compound additives are water-soluble and include hydrogen peroxide, hydrates of hydrogen peroxide, and alkali metal and ammonium salts of perborate, percarbonate and persulfate.

## FIELD OF THE INVENTION

This invention relates to additives for aluminum etching baths, and more particularly to additives which are introduced after the dissolved aluminum in the bath increases to a certain level in order to produce uniform surfaces.

## BACKGROUND OF THE INVENTION

Alkaline etching processes for aluminum are well known. The alkaline etching baths, normally consist of an alkali metal hydroxide, a chelating agent, and agents which promote wetting and frosting of the aluminum article.

During etching, the amount of dissolved aluminum in the bath increases. As the dissolved aluminum in the bath increases, the bath viscosity increases, and the article is given a different type of etch. The bath then produces undesirable effects, such as spangled appearance (galvanizing) of the aluminum surface. For this reason, heretofore etching practice has been to discard the bath after the amount of dissolved aluminum reached a certain level. For instance, in etching aluminum sheet, the bath ordinarily is discarded after the level of dissolved aluminum attains 25 grams to 26 grams per liter because of the poor results in the surface appearance.

The etching bath attacks aluminum surfaces more violently at the areas of metallurigical defects and causes accentuation of these areas on the surface. For example, extruded aluminum articles often have areas which are softer or harder than other areas, and with a high viscosity bath, for instance, caused by high levels of dissolved aluminum, there is a difference in the etching rate on these areas. The result is a rough appearance.

## SUMMARY OF THE OBJECTIVES OF THE INVENTION

An important objective of this invention is to narrow the variation in the surface appearance of etched aluminum.

Another objective of this invention is the reduction or elimination of the adverse appearance, for example the spangled (galvanizing) effect, on the aluminum surfaces during etching.



Another objective of this invention is to reduce or eliminate the rough surface of metallurgical imperfect aluminum during etching.

These and other objects of the invention will become more apparent from the following description and appended claims.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Briefly stated, it has been discovered that the addition of peroxide compounds to the alkaline bath for etching aluminum after the dissolved aluminum increases to certain levels reduces the defects occurring heretofore with the high viscosity etching baths associated with the dissolved aluminum in the bath.

The etching bath contains an alkali metal hydroxide, usually caustic soda or sodium hydroxide, which etches the aluminum article by the following reaction:

$$2H_2O+2NaOH+2Al \rightarrow 2NaAlO_2+3H_2$$

The aluminum article to be etched is usually dipped into the etching bath for a period of time sufficient to etch the surface, usually from 5 to 15 minutes, although shorter or longer periods can be used.

In carrying out the etching process, the aluminum article is cleaned in an acid cleaner, or alkaline cleaner, and rinsed preparatory to treating with the etching bath.

In addition to the alkali metal hydroxide, the etching bath also may contain a sequesterant which holds the excess dissolved aluminum and allows soft precipitates. The sequesterant may be chosen from several known to the trade, such as alkali metal salts of gluconates, glucoheptonates, or sorbitol.

The bath also may contain a wetting agent for more rapid draining of etch solution from the aluminum article as it leaves the bath. Wetting agents may be used to provide a foam blanket to inhibit misting of the alkali hydroxide solution. The bath further may contain a fluoride ion to help provide a more frosty etch.

During etching the bath temperatures many range broadly from ambient to boiling point. Ordinarily the temperatures are maintained within the range from about 120° F. to about 140° F.

As will be apparent from the chemical equation above, the etching process involves removing aluminum from the surface by forming the compound sodium aluminate. The sodium aluminate is dissolved in the bath and may be converted to aluminum hydroxide and/or aluminum oxide by further reactions.

As the amount of dissolved aluminum (in the form of the above mentioned compounds) in the bath increases, the viscosity of the bath also increases, and there is an accompanying adverse change in the etched surface. For this reason the practice has been to discard the etching bath after the viscosity of the bath resulting from the dissolved aluminum reached a point that produced the adverse appearance.

We have discovered that the addition of water soluble peroxide compounds to the etching bath containing high levels of dissolved aluminum prevents the adverse changes in appearance in the etched surface so that the bath need not be discarded as heretofore and much higher levels of aluminum in the bath can be tolerated. Also, we have discovered that the addition of peroxide compounds to the bath improves the appearance, or reduces the adverse

effects, of etched articles with metallurgical defects. Moreover, peroxide compounds in the bath appear to reduce the amount of smut formed on the aluminum surface.

The water soluble peroxide compounds that are added to the etching bath include the inorganic peroxides, for example, hydrogen peroxide, and hydrates of hydrogen peroxide; the organic peroxides, for example, the alkali metal and ammonium salts of perborate, percarbonate, and persulfate, such as, sodium perborate, sodium percarbonate, and sodium persulfate.

The peroxide compounds are ordinarily added to the bath after the dissolved aluminum has reached the levels that produce the undesirable results described hereinbefore, for example, after the amount dissolved aluminum has reached a level of at least about 25 grams to 26 grams per liter of bath. The dissolved aluminum level at which the peroxide compounds should be added varies, of course, with the particular operation and some operations can tolerate much higher levels of dissolved aluminum than others. For example, in etching sheet aluminum, the peroxide compounds will be added beneficially after the dissolved aluminum reaches about 26 grams per liter. In the case of etching extruded aluminum articles, the peroxide compounds will be added beneficially after the dissolved aluminum reaches about 40 grams per liter.

The addition of the peroxide compounds allows the etching bath to be used with greater amounts of dissolved aluminum, for example, until the viscosity increases to a point at which significantly increased amounts of the bath are carried out with the article as it is removed. This point of "carry out" of the bath may occur, for instance, when the dissolved aluminum reaches levels of at least about 150 grams per liter.

In referring to "dissolved aluminum" contained in the bath in the specification and appended claims, it should be clear from the chemical equation above that this refers to the aluminum content of the compounds sodium aluminate as well as other aluminum compounds resulting from the etching process that are solubilized in the etching bath. Aluminum metal in its elemental form will not occur in the etching bath in any significant amount, if at all. For the purposes of convenience, however, the amounts of aluminum in the bath are expressed as the element, even though the aluminum in the bath occurs only as a compound.

The following examples are given to further illustrate the invention, and not as limitations thereof.

## EXAMPLE 1

Articles of aluminum were cleaned in a non-silicated, inhibited, alkaline cleaner for eight minutes at 160° F., then rinsed. The aluminum article was then immersed in the etch solution with the following composition:

| | Grams/liter |
|---|---|
| Sodium hydroxide | 58.4 to 101.9 |
| Sodium gluconate | 1.5 to 3.0 |
| Sodium persulfate | .47 to 22.4 |
| Dissolved aluminum | 22.4 to 119.8 |

The aluminum article was immersed in the etch solution for 5–12 minutes at 130°–140° F. After desmutting, the surface appearance of the aluminum articles run at these conditions was very uniform. By contrast, the aluminum articles run in a standard bath without the peroxide additive had varying surface appearance as the dissolved aluminum content of the bath increased.

## EXAMPLE 2

Aluminum articles were cleaned in an acid cleaner for 6 minutes at 125° F., then rinsed. The aluminum article was then immersed in the etch solution with the following composition:

| | Grams/liter |
|---|---|
| Sodium hydroxide | 58.4 to 101.9 |
| Sodium glucoheptonate | 1.5 to 3.0 |
| Sodium percarbonate | .47 to 22.4 |
| Dissolved aluminum | 22.4 to 119.8 |

The aluminum article was immersed in the etch solution for 5–12 minutes at 130°–140° F. After desmutting, the surface appearance of the aluminum articles under these conditions was very uniform.

## EXAMPLE 3

Aluminum articles were cleaned in a silicate inhibited alkaline cleaner for 8–10 minutes at 160°–170° F. The articles were well rinsed in clear water and immersed in the etch solution with the following compositions:

| | Grams/liter |
|---|---|
| Sodium hydroxide | 58.4 to 101.9 |
| Sorbitol | 1.5 to 3.0 |
| Hydrogen peroxide | .075 to 2.24 |
| Dissolved aluminum | 22.4 to 119.8 |

The aluminum article was immersed in the etch solution for 5–12 minutes at 130°–140° F. After desmutting, the surface appearance of the aluminum articles under these conditions was very uniform.

## EXAMPLE 4

Aluminum articles with various metallurgical defects were obtained. These various aluminum articles had been labeled rejects when processed through a standard etch bath.

These aluminum articles were then processed through an alkaline aluminum etch bath as outlined in Example 1. After desmutting the surfaces were very uniform.

To further evaluate these surfaces these aluminum articles were color anodized and again the surfaces were very uniform.

These aluminum articles were then processed through an alkaline aluminum etch bath as outlined in Example 1. After desmutting the surfaces were very uniform.

To further evaluate these surfaces these aluminum articles were color anodized and again the surfaces were very uniform.

Subsequent to etching for appropriate time periods, the aluminum article is removed from the bath and the ingredients flushed away by a water wash.

While we do not wish to be bound by any theory, it is our opinion that the peroxide compounds added to the etching bath react with the freshly exposed aluminum surface to form an oxide thereon. The oxide containing surface then slows or modifies the rate of attack of the etch on the aluminum resulting in a more uniform surface appearance.

Other modes of applying the principles of the invention may be employed, change being made as regards the details described, provided the features states in any of the following claims, or the equivalent of such, be employed.

We claim:

1. The process for etching aluminum which is adapted to reduce the undesirable effects on the etched surface resulting from dissolved aluminum in the etching bath, comprising the steps of:

contacting aluminum surfaces with a bath containing the water solution of an alkali metal hydroxide and dissolved aluminum resulting from the etching process,

said bath further containing at least one water soluble peroxide compound in amounts sufficient to at least partially offset the adverse effects of said dissolved aluminum on the etching process.

2. The process of claim 1 in which said peroxide compound comprises hydrogen peroxide.

3. The process of claim 1 in which said peroxide compound is selected from the class consisting of the alkali metal and ammonium salts of persulfate.

4. The process of claim 1 in which said peroxide compound is selected from the class consisting of the alkali metal and ammonium salt of perborate.

5. The process of claim 1 in which said peroxide compound is selected from the class consisting of the alkali metal and ammonium salt of percarbonate.

6. The process of claim 1 in which said dissolved aluminum is in amounts of at least about 25 grams per liter.

7. In the process for etching aluminum by contacting aluminum surfaces with an etching bath containing alkali metal hydroxide, and in which aluminum is dissolved in the etching bath after a period of time, the step comprising adding at least one peroxide compound to said etching bath after the dissolved aluminum level in said bath reaches at least about 25 grams per liter.

8. The process of claim 7 in which said peroxide compound comprises hydrogen peroxide.

9. The process of claim 7 in which said peroxide compound is selected from the class consisting of the alkali metal and ammonium salt of persulfate.

10. The process of claim 7 in which said peroxide compound is selected from the class consisting of the alkali metal and ammonium salt of perborate.



11. The process of claim 7 in which said peroxide compound is selected from the class consisting of the alkali metal and ammonium salt of percarbonate.

12. The composition for etching aluminum comprising alkali metal hydroxide, at least about 25 grams per liter of dissolved aluminum, and at least about 0.1 gram per liter of at least one water soluble peroxide compound.

13. The composition of claim 12 in which said peroxide compound comprises hydrogen peroxide.

14. The composition of claim 12 in which said peroxide compound is selected from the class consisting of the alkali metal and ammonium salt of persulfate.

15. The composition of claim 12 in which said peroxide compound is selected from the class consisting of the alkali metal and ammonium salt of perborate.

16. The composition of claim 12 in which said peroxide compound is selected from the class consisting of the alkali metal and ammonium salt of percarbonate.

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