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SOLUTION AND METHOD FOR STRIPPING OXIDE FILMS FROM ALUMINUM AND ITS ALLOYS

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This invention relates to solutions for stripping oxide films, and particularly anodic oxide films and all aluminum oxide films, from aluminum and its alloys. While the invention is comparatively simple, for the purpose of setting it forth very clearly I shall explain at some length its advantages when used in industry.

The native material from which aluminum is obtained is impure bauxite containing 50%–75% aluminum oxide. From this bauxite aluminum oxide is prepared. By electrolysis the aluminum oxide is decomposed and results in the production of molten aluminum metal.

In industry this aluminum metal is alloyed with copper, iron, silicon, magnesium, nickel, manganese, etc., to give desirable aluminum alloy compositions. Also, aluminum is used in the commercially pure state in sheet form and in tubular form, and is also hot-rolled on each side of a sheet of alloy in some cases, the trade designation for this form by the Aluminum Company of America being "Alclad." The advantage of "Alclad" is that the commercially pure aluminum sheets on each surface give the material unusually high corrosion resistance. Pure aluminum is much less susceptible to corrosion than alloyed aluminum. For this reason alloys, when used in aircraft construction, must be anodically treated to form a smooth, atmospherically impregnable, oxidized surface. The anodizing process is an electrochemical operation, producing aluminum oxide films usually well over .00002" thick on the surface of the aluminum being treated. There are several known solutions for anodizing aluminum, the one most generally used for aluminum alloys with less than 5% copper being a chromic acid solution. For use on alloys containing over 5% copper, a sulphuric acid anodic treatment is used.

In aircraft anodizing it frequently is necessary to strip parts of their anodized surface, because of poor previous anodizing, or mistakes. Also, it is necessary frequently to strip aluminum racks, which are used to hold the parts, as the aluminum oxide surface will not conduct electric current and for continued use of such racks it is necessary to remove the oxide film. For instance, it takes from 30 to 45 minutes to chromic acid anodize parts, which are suspended in the solution on an aluminum rack. In the process the rack also becomes anodized. This rack connects the parts to the source of electric current used. After the process cycle is completed, in order for this rack to be used as an electrical conductor again it must be stripped of its aluminum oxide coating. This is one of the uses of a stripping solution.

Also, in the spot-welding of aluminum it is necessary to remove all atmospherically or anodically produced oxides from the surface of the

metal before it can be spot-welded, as the electrodes cannot establish a complete current through the material if the surfaces are non-conductive.

This is another use of a stripping solution for removal of aluminum oxide.

It frequently becomes necessary to remove corrosion (oxidation) from parts that have corroded, either from atmospheric or chemical reasons. An example of the latter reasons would be, for instance, if nitrate or chloride salts would get on a piece of aluminum, the reaction would produce sodium hydroxide, which attacks aluminum vigorously. Removal of corrosion in this case would be imperative to prevent deeper oxidation of material.

In the foregoing paragraphs I have endeavored to show a use for a desirable stripping solution, one which would satisfactorily dissolve aluminum oxides from the surface of aluminum and its alloys, without etching or attacking the underlying surface.

There are several solutions that are used for this purpose, some alkaline and some acid.

Alkaline solutions will attack aluminum and its oxides vigorously, and even though the solution does contain an inhibitor, alkaline solutions do leave an etched surface. It is impossible to use alkaline stripping agents on parts that have been machined or held to a close tolerance. Also, if not completely removed from parts, or assemblies, where the solution might be pocketed in a recess or hole, the results would be a very badly etched and corroded condition, and probably breaking down of the piece or assembly structurally.

I have seen the attempted use of several acid solutions, previous to the development of my new solution, but the results were always negligible. Acid solutions heretofore used take from 15 to 45 minutes to strip and then the results are not entirely satisfactory.

By the use of my new stripping solution I remove oxide films, whether produced electrochemically or by atmospheric oxidation, completely in from 3 to 10 minutes, depending on the thickness of film. Acid stripping solutions heretofore used in industry frequently have produced an etched or weakened surface of the part stripped, but where my stripping solution is used there is no etching or breaking down of the surface, and this is an extremely important feature where precision parts are stripped, in which even micrometer variations as to dimensions would render the stripped parts unfit for further use. A further advantage of my stripping solution is that after the stripped parts are removed therefrom and rinsed, their surfaces will not again oxidize in the atmosphere as fast as when stripped in solutions heretofore used. This has been affirmed

by actual tests. Specimens taken from my stripping solution were left in ordinary atmosphere for as long as 36 hours and still showed no evidence of oxidation to the extent that they could not be satisfactorily spot welded, while specimens taken from other known stripping solutions were oxidized and unsatisfactory for spot welding in from 8 to 20 hours' exposure to atmosphere; that is to say, after being stripped with my new solution, parts are passivated against further corrosion for a longer period than when other stripping solutions are used.

A still further advantage of my new solution is observed when parts containing recesses or holes are stripped. In such cases frequently a small amount of the stripping solution is entrapped in such recesses and retained there for a short time, and while my solution will etch the metal somewhat if pocketed in a recess for 24 hours or longer, actual tests show that it does so much more slowly than the alkaline solutions react.

The chemicals used to produce my new solution are available, and although the initial cost of making up a bath of my formula is higher than other known formulas, the solution is actually cheaper in operation because my solution does not break down nearly as quickly as others, and will strip from two to three times as much area of aluminum before it actually breaks down. In operating an amount of my solution, say 50 gallons or more, it can easily be rejuvenated two or three times by additions of the various ingredients before it is finally necessary to dump it and make up a fresh bath.

In operation it has been found that the best results are obtained from a solution composed of the following ingredients in the proportions here set forth:

	Per cent
Water	84.6
Sulphuric acid, 66° Bé	8.2
Phosphoric acid	5.2
Chromic acid	2.0

This solution operates most satisfactorily at a temperature of from 160° F. to 180° F. The parts

to be stripped are immersed from 3 to 10 minutes. They are then removed and rinsed in clear, cold water, after which they are dipped in hot water (preferably from 160° F. to 200° F.) for the purpose of accelerating the drying process.

While I have set forth above the ideal range of proportions of ingredients in my new solution, it is to be understood that the invention is not limited to exactly these proportions, but the ingredients may vary somewhat proportionately without departing from the spirit of the invention. For instance, the solution would still be effective if the sulphuric acid content were to range from 3% to 15%, the phosphoric acid from 5% to 25%, and the chromic acid from 1.5% to 10%, but such variations would slow down the rate of stripping effectiveness.

In my solution the sulphuric acid is the most active element in removing the oxide film, and its action is rapid enough that if it were not checked it would attack the structure of the aluminum while removal of the oxide film is taking place, and for this reason the phosphoric acid is introduced, since it slows down the action of the sulphuric acid on the aluminum after the oxide has been removed, and at the same time the phosphoric acid also is effective in helping to remove the oxide film. The chromic acid is purely an inhibitor and prevents the sulphuric and phosphoric acids from injuring the aluminum.

I claim:

1. A solution for stripping oxide film from aluminum and its alloys, consisting of approximately 8.2% sulphuric acid, approximately 5.2% phosphoric acid, approximately 2% chromic acid, and approximately 84.6% water.

2. A method for stripping oxide film from parts made of aluminum and its alloys which comprises immersing said parts in a solution consisting of approximately 8.2% sulphuric acid, approximately 5.2% phosphoric acid, approximately 2% chromic acid, and approximately 84.6% water, then rinsing said parts in clear, cold water, and then dipping said rinsed parts in hot water.

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