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PROCESS FOR CLEANING ALUMINUM

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ABSTRACT OF THE DISCLOSURE

A method for treating aluminum and aluminum alloys using a deoxidizer composition which is an aqueous solution of sulfuric acid, hydrofluoric acid, and an alkali metal dichromate. The aluminum or aluminum alloy thus treated is in condition for resistance welding.

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

This invention relates to a process for treating aluminum and aluminum alloys and to compositions useful in the treating process. More particularly, the invention relates to a process for cleaning aluminum and aluminum alloys prior to contact resistant welding operations and compositions useful in the cleaning process. As used herein, the terminology "aluminum and aluminum alloys" refers to the pure metal, commercial aluminum having only traces of impurities, and alloys of aluminum in which aluminum is a major constituent.

The problem of cleaning the surfaces of objects made from aluminum and aluminum alloys exists in practically all areas in which work with such materials is performed. However, where aluminum and its alloys are to undergo electric welding, the problem is particularly acute since it is impossible to achieve strong, uniform welds unless the welded surface is clean.

Many methods involving the use of strong caustic soda solutions and/or strong acid solutions will remove the oxide, Al_2O_3 , from the surfaces. These solutions, however, attack the aluminum itself and cause severe etching of the surface which increases the average electric resistance. Moreover, the strong solutions seem to leave other products on the treated surfaces which further increase the electrical resistance and thus, impede welding. The electrical resistance of an aluminum object or aluminum alloy object that is to be electrically welded should be less than 100 micro-ohms and, preferably, 50 micro-ohms or less.

A method has been developed whereby the surfaces of objects of aluminum and aluminum alloys can be cleaned and the electrical resistance thereby reduced below 50 micro-ohms. Moreover, the method does not severely mar the surface. The method utilizes novel deoxidizing compositions which also form part of the invention.

In accordance with the foregoing, it is an object of the present invention to provide a method for treating the surface of aluminum and aluminum alloys.

Another object of the invention is to provide a method for cleaning the surface of aluminum and aluminum alloys.

A further object of the invention is to provide a method for cleaning aluminum oxide from the surface of aluminum and aluminum alloys.

A still further object of the invention is to provide a method for treating the surface of aluminum and aluminum alloys to reduce the electrical resistance of the surface.

The manner in which these and other objects may be accomplished will become apparent from the following detailed description.

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According to the present invention, the surfaces of an object of aluminum and aluminum alloy is first degreased using conventional techniques. After treating the surfaces with the degreasing solvent, the object is transferred immediately to an inhibited alkaline cleaning solution and subsequently rinsed with hot water and then cold water. The surface having been thus treated is free of superficial dirt, grease, and scale. The object is next treated with a deoxidizer composition consisting essentially of an aqueous solution of sulfuric acid, hydrofluoric acid, and an alkali metal dichromate. A cold water rinse is used to remove the deoxidizer composition from the surfaces of the objects and the object is thereafter dried, usually by placing it in an oven or subjecting it to blasts of hot air. The object thus treated is in condition for resistance welding or any other operation such as painting.

For degreasing the surfaces of the object the vapors of trichlorethylene, ethylene dichloride, or other organic solvent are satisfactory. It is acceptable to accomplishing the degreasing step by immersing the object in the liquid solvent although treatment with vapors at higher temperatures (150° F. to 200° F.) expedites the removal of oil and grease films. The time required for this operation will depend on such variables as temperature of the solvent and amount of film present but will usually be within the range of five to twenty minutes.

Any of the alkaline cleaners normally used in the cleaning of aluminum and its alloys is acceptable for the alkaline cleaning solution used in preparing the surfaces for treatment with the deoxidizing solution. It is desirable to avoid the use of cleaners having soaps, aluminates, borates, silicates, and phosphates whenever possible. Solutions of active sodium oxide using about 20 grams of the oxide per liter of water are excellent. A commercial cleaner sold under the name Wyandotte Altrex is an acceptable cleaner when used in an amount of about 40 to 45 grams per liter of water although it does contain silicates. The alkaline bath will ordinarily be maintained at a temperature of about 160° F. to about 190° F. and preferably at about 180° F.

After the object is removed from the alkaline solution it is thoroughly rinsed with hot water, normally at a temperature of about 100° F. to about 140° F. and preferably at about 120° F. The time required for the hot water rinse will usually be from two to five minutes. The object is subsequently subjected to a cold water rinse, the temperature of this normally being within the range of 65° F. to 75° F. Since this is inclusive of room temperature (about 68° F.), ordinary tap water is generally suitable for the cold water rinse.

The object is now ready for subjecting it to the action of the deoxidizing solution. This solution is prepared by thoroughly mixing sulfuric acid, hydrofluoric acid, and alkali metal dichromate, and water. The solution ordinarily will contain about 8% to about 12% sulfuric acid, about 0.75% to about 1.25% hydrofluoric acid, and 5% to 7% of an alkali metal dichromate. The preferred deoxidizing solution of the invention is an aqueous solution of about 10% sulfuric acid, about 1.0% hydrofluoric acid, and about 6% sodium dichromate. The percentages given refer to the percent by weight based on the total weight of the solution including the water. The deoxidizing composition is maintained at a temperature of about 65° F. to about 75° F. when treating the surfaces of the object being cleaned. Ordinary room temperature (about 68° F.) is completely satisfactory. The surfaces of the object are usually kept in contact with the solution for 3 to 30 minutes depending upon type of alloy and amount of oxide to be removed, after which the object is thoroughly rinsed with cold water, that is, water at a temperature within the range of 65° F. to 75° F. Aluminum alloys of the 2000 and 7000 series generally require

the greater time of contact with the deoxidizer solution, that is, 15 to 30 minutes. It is essential that all of the deoxidizer composition be removed from the surface of the treated object. The object is then dried in an oven at about 150° F. or dried with hot air.

The object treated in the manner indicated above exhibits a surface electrical resistance of less than 50 micro-ohms. Moreover, the low level of electrical resistance is long lasting. Samples of 6061 aluminum alloy exhibited a surface resistance of 25 micro-ohms after treatment according to the present invention. At the end of 60 hours, the resistance had risen only to about 33 micro-ohms. Similarly, samples of 5086 aluminum alloy had a surface resistance of about 23 micro-ohms when treated as indicated above and the resistance increased to only 35 micro-ohms at the end of 60 hours.

The specific process used in cleaning the 6061 and 5086 aluminum alloy samples discussed above is outlined in Table I below.

TABLE I

Tank No.	Solution	Concentration	Solution Temperature	Immersion Time (minutes)
1	Trichlorethylene ¹		180° F.	5-20
2	Wyandotte Altrex	43 grams per liter H ₂ O	180° F.	10
3	Hot Water Rinse		120° F.	3
4	Cold Water Rinse		Room Temperature	1
5	Deoxidizer, ² H ₂ SO ₄ , HF, Na ₂ Cr ₂ O ₇	H ₂ SO ₄ , 10% (by wt.); HF, 1.0% (by wt.); Na ₂ Cr ₂ O ₇ , 6% (by wt.); H ₂ O, remainder of solution.	do	3
6	Cold Water Rinse		do	3
	Drying Operation		150° F. in oven	(³)

¹ Technical Grade.

² Sulfuric Acid, Technical Grade, 95-98%; Specific Gravity 1.84; Hydrofluoric acid, Reagent Grade, 48%; Sodium Dichromate, CP Crystals.

³ Until dry.

If demineralized water is used in the process, especially in preparing the alkaline solution and the deoxidizer composition, better results may be obtained. However, this is not essential to achieving completely satisfactory results.

The solutions used in the present invention attack steel, copper, brass, bronze, and magnesium. Therefore, devices incorporating such materials are generally not treated in the assembled stage but routed for treatment of the aluminum and aluminum alloy portions only.

Once the sequence of operations has started with any object, it should not be interrupted until completed, except that reimmersion in the hot alkaline solution is necessary if water breaks appear on the surface upon removal from the hot water rinse. A minimum of time "out of solution" is desirable with parts during the sequence; however, upon removing the parts from the various solutions and rinses, time should be allowed for the object to drain to prevent contamination of the succeeding baths.

After an object has been cleaned, it should be handled with clean cotton gloves until all resistance welding has been completed. If an object is not welded within about seventy-two hours, it should be protected from contamination.

For best results, the operating conditions and solutions specified in Table I should be adhered to as closely as possible since Table I sets forth the preferred embodiment of the invention including both the method and the deoxidizing composition.

No undue limitation should be attributed to the present invention from the above description except as reflected in the appended claims.

I claim:

1. The method of treating the surface of aluminum and aluminum alloys prior to welding, said aluminum and aluminum alloys comprising at least 50% aluminum, which method comprises subjecting said surface to the action of a deoxidizing composition for a period of about 3 to about 30 minutes, said composition consisting essentially of an aqueous solution of about 8% to about 12% sulfuric acid, about 0.75% to about 1.25% hydrofluoric acid, about 5% to about 7% of an alkali metal dichromate, and the remainder water, wherein all percentages refer to percent by weight of the total weight of composition, and thereafter rinsing said surface with water.

2. The method according to claim 1 wherein said deoxidizing composition is maintained at a temperature within the range of 65° F. to 75° F.

3. The method of treating the surface of aluminum and aluminum alloys to reduce the electrical resistance thereof prior to welding, said aluminum and aluminum

alloys comprising at least 50% aluminum, which method comprises first cleaning superficial dirt and grease from said surface and thereafter subjecting said surface to the action of a deoxidizing composition for a period of about 3 to about 30 minutes, said deoxidizing composition consisting essentially of an aqueous solution of about 10% sulfuric acid, about 1.0% hydrofluoric acid, about 6% sodium dichromate, and the remainder water, wherein all percentages refer to percent by weight of the total weight of composition, and subsequently rinsing said surface with water, the temperature of said deoxidizing composition being maintained in the range of 65° F. to 75° F.

4. The method according to claim 3 wherein said surface is dried after rinsing.

References Cited

UNITED STATES PATENTS

2,172,041	9/1939	Urban	252—147 X
2,428,749	10/1947	De Long	156—22 X
2,620,265	12/1952	Hesch	156—21
2,705,500	4/1955	Deer	134—3
2,719,796	10/1955	Kappes et al.	134—3 X
2,829,091	4/1958	Missel.	
2,867,514	1/1959	Newhard et al.	134—3 X
3,197,340	7/1965	Bellinger	134—3 X

FOREIGN PATENTS

541,570	5/1957	Canada.
574,982	4/1959	Canada.

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