Temperature of Aluminum Being Anodized

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The temperature is measured by infrared thermometer. Even if the bath temperature is kept at constant level, the temperature of aluminum being anodized changes by agitation in the anodizing bath. Therefore, the temperature control of aluminum being anodized by agitation is more important than that of anodizing bath. Effects of vibratory agitation on chemical conversion film and sterilization of water are also reported.

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1. Introduction

The temperature of the aluminum board being anodized has been measured with the infrared rays thermometer. The temperature of the aluminum board being anodized is higher than the temperature of anodizing bath. This temperatures fluctuate has become small by stirring the anodizing bath. This fact means that the stir of anodizing bath is important in the anodizing process. And the temperature of various equipments of the anodizing factory was also measured with the infrared rays thermometer. Information retrieval of the hard anodizing of 380 alloy is also carried out based on these experiment results. Moreover, the authors reports on the related other experimental result. These studies are the chemical conversion coating on aluminum and the water sterilization processing by the vibration type stir machine which is used in the anodizing experiments.

Contents of this paper are as follows.

(1) Result of temperature measurement of aluminum board being anodized.
(2) Discussion on the measured temperature.
(3) Temperature measurement result of various equipments in the anodizing factory
(4) Japanese information which relates to temperature of anodizing aluminum.
(5) Japanese information related to anodizing of 380 alloy.
(6) Effect of vibration type stir machine on chemical conversion coating processing and water sterilization processing.

2. Result of temperature measurement of aluminum board being anodized

Photo.1 shows the electrolysis tank used for the anodizing experiment. The vibration type stir machine is built in the tank of 400 liters. Photo.2 shows the infrared rays thermometer used for experiment of the temperature measurement. Photo.3 shows the experiment of measuring the temperature of the aluminum board.

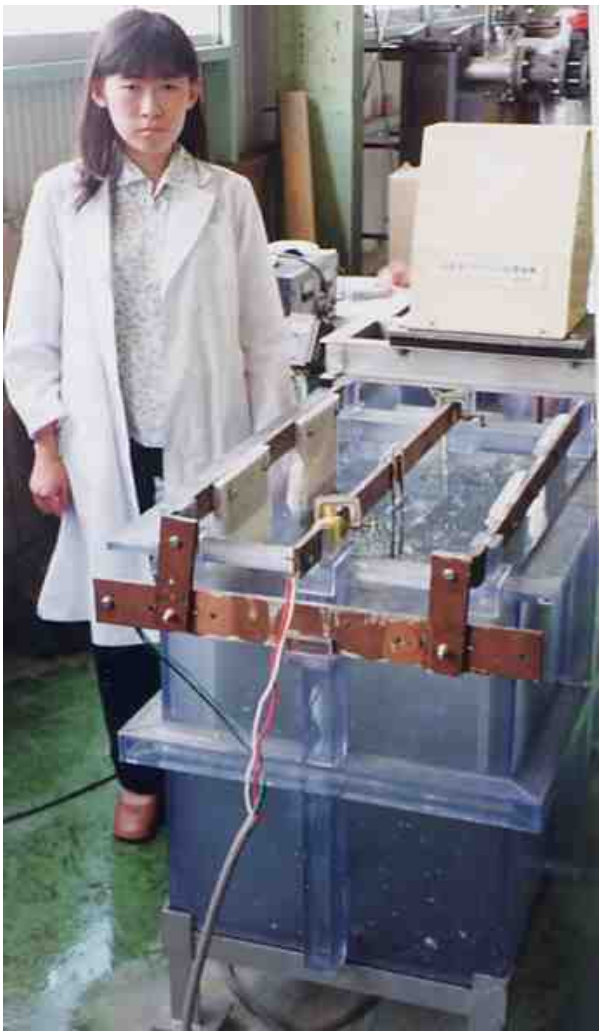


Photo.1 The tank for the anodizing experiment and the vibration type stir machine built in the tank

Photo.2 Infrared rays thermometer used for the experiment

Photo.3 Situation of the temperature measurement experiment

Table 1 shows the temperature measurement result of the sample being anodized at 10°C. When anodizing bath was strongly stirred by the vibration type stir machine, the temperature of the aluminum sample was almost same as bath temperature. When anodizing bath was not stirred, the temperature of the aluminum sample was higher than the temperature of anodizing bath. This temperatures fluctuate was large when the current density of the anodizing electrolysis was large. Moreover, temperature difference between "the temperature of the aluminum sample being anodizing in the not stirred bath" and "the temperature of the aluminum sample being anodized in stirred bath" was large when the current density of the anodizing electrolysis was large.

Table 1 Temperature of samples being anodized in the low temperature bath (10°C).

Current Density	In the not stirred bath	In the stirred bath	Difference of temperature
1A/dm^2	15°C	10°C	5°C
2A/dm^2	21°C	10°C	11°C
3A/dm^2	24°C	11°C	13°C

Table 2 shows the temperature of the aluminum sample being anodized in the 28°C bath. When anodizing bath was strongly stirred with the vibration type stir machine, the temperature of the aluminum sample was almost as same as bath temperature. When anodizing bath was not stirred, the temperature of the aluminum sample was higher than the temperature of anodizing bath. The higher the current density of the anodizing aluminum, the larger this temperatures fluctuate was. Moreover, "the temperature of the aluminum sample being anodized in the not stirred bath" and "the temperature of the aluminum sample being anodized in the stirred bath" differ large, when the current density of the anodizing aluminum is higher. When the aluminum sample is anodized at 3A/dm2 in the not stirred bath at 28°C, the temperature of the aluminum sample is 36°C. When Table 1 and Table 2 were compared, the difference between the temperature of the sample in the not stirred bath and the temperature of the sample in the stirred bath was large in case of the low temperature bath, and was small in case of the high temperature bath.

Table 2 Temperature of sample being anodized in the high temperature bath (28°C).

Current Density	In the not stirred bath	In the Stirred bath	Difference of temperature
1A/dm^2	31°C	28°C	3°C
2A/dm^2	33°C	28°C	5°C
3A/dm^2	36°C	29°C	7°C

3. Discussion on the measured temperature.

The difference of the temperature of the aluminum sample shown in Table 1 and Table 2 can be explained in a schematic chart of the interfacial temperature change of Figure 1. When aluminum is anodized in the bath, joule heat is generated on the aluminum sample. Joule heat is diffused by the natural convection of the anodizing bath, when anodizing bath is not stirred. And this heat diffuses in the bulk solution slowly. Therefore, the temperature of the aluminum sample is higher than the temperature of anodizing bath. On the other hand, joule heat is diffused by the compulsion convection of anodizing bath, when anodizing bath is stirred. And the heat diffuses in the bulk solution promptly. Therefore, the temperature of the aluminum sample almost becomes the same with the temperature of anodizing bath. This difference is clear in an imitative chart of Figure 1.

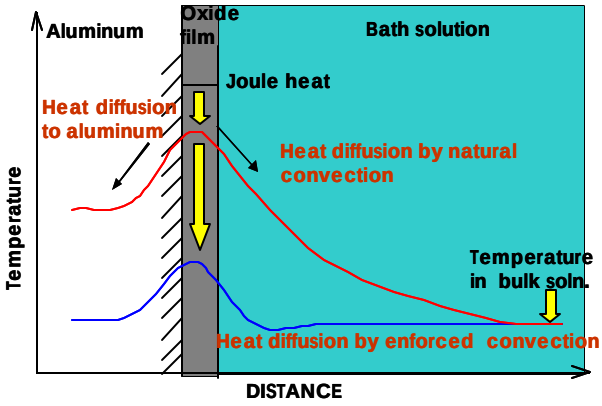


Fig.16 Discussion on temperature at solid/solution interface.

Fig.1 Imitative chart of temperature change at the interface

The temperature of the aluminum samples being anodized in the not stirred bath and the temperature of the aluminum samples being anodized in the stirred bath respectively differ. This difference is large when the current density is large. This reason can be explained in an imitative chart of Figure 2. Joule heat generated by anodizing aluminum is large, when the current density of anodizing is large. Therefore, the temperature of the aluminum sample being anodized in the not stirred bath is high. However, when anodizing bath is strongly stirred, the temperature of the aluminum sample almost becomes the same as bath temperature as shown in Figure 2. Joule heat diffuses in the bulk solution promptly even if joule heat is much. Consideration to temperatures fluctuate by "Low temperature bath" and "High temperature bath" is explained in Figure 3.

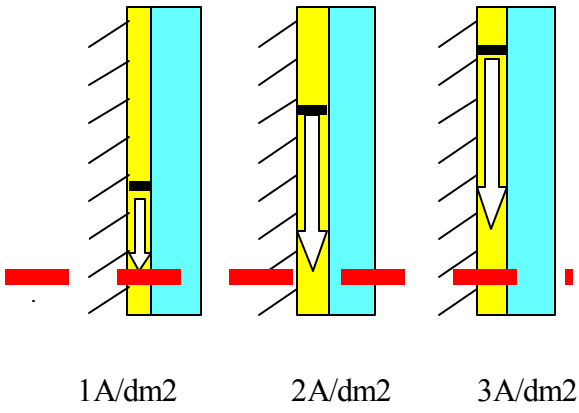


Fig.2 Consideration to temperatures fluctuate by current density

The amount of joule heat generated by the anodizing aluminum is the same in the low temperature bath and in the high temperature bath. In the case of high temperature bath, "Temperature of the aluminum sample being anodized in the not stirred bath" and "temperature of aluminum sample being anodized in the stirred bath" differ small, because the natural convection of bath is violent in the high temperature bath. While, in the case of cold bath, the temperatures fluctuate of "the aluminum sample being anodized in the stirred bath" and "aluminum sample being anodized in the not stirred bath" is large, because the natural convection of bath is dull in the low temperature bath.

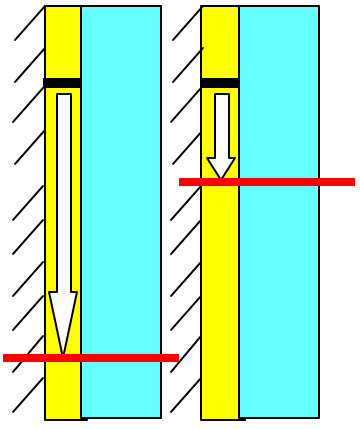


Fig.3 Consideration to temperatures fluctuate by "Low temperature bath" and "High temperature bath"

Table 3 shows the quality of the oxide films anodized in the same equipment as that used for temperature measurement.

Table 3 Quality of anodized aluminum film

No.	Anodizing condition			Quality of Oxide film	
	Curren Density A/dm2	Time Minn.	Bath Tempe rature,. °C	Thick ness ì m	Hardness Hv
1	2	60	10	45	580
2	2.5	25	10	21	550
3	4	60	15	77	500
4	4	90	15	103	450
5	3	10	28	10	200

4. Temperature measurement result of various equipments in the anodizing factory

Because the aluminum sample was completely dipped in the surface finishing bath, temperature measurement of the being treated aluminum in processing lines is measured on the exposed part of rakking frame bar. The temperature of the exposed part of the rakking frame dipped in the alkaline etching tank was higher than that of the alkali etching solution, though the temperature of the exposed part of the rakking frames dipped in acidic degreasing tank and that in rinsing tank were almost the same as temperature of those solutions respectively. In the case of anodizing tank, temperature of the rakking frame was higher than that of anodizing bath. However, the temperature of the cathode in the anodizing bath was the same as bath temperature. The contact part of the copper electric bar on the tank edge and the rakking frame was considerable high temperatures. In this case, its heat was due to the contact resistance. The temperature of the rakking frame in the AC coloring bath were the same as that of electrolytic coloring bath. The temperature of solution and the rakking frame was the same in nickel acetate sealing bath. These measurement results are shown in from Table 4 to Table 6

Table 4 Temperature measurement result in anodizing aluminum factory (Part 1)

Site of temperature measurement	Temperature
acid cleaning bath	Bath Temperature = Temperature of rakking frame
water rinsing bath	Bath = rakking frame
alkaline etching bath	Bath < rakking frame
Anode/ anodizing	Bath < rakking frame
Cathode/ anodizing	Bath = cathode
Contact part of buss bar / rakking frame	Considerably high temperature
Two steps coloring bath(AC coloring bath)	Bath = rakking frame
nickel acetate seal bath	Bath = rakking frame

Table 5 Temperature measurement result in anodizing aluminum factory (Part

Site of temperature measurement	Temperature
Seam pipe covered with heat insulation sheet	Higher temperature than room temperature
Exposed part of steam pipe	Near 100°C
Pump for circulating the anodizing bath	Near 50°C
Chiller	Same as room temperature
Cooling tank	Same as room temperature
Anode terminal and cathode terminal of rectifier	A little higher than room temperature
Inlet and outlet of heat exchanger	Same as room temperature
Steam sealing tank covered with heat insulation sheet	A little higher than room temperature
Outlet of steam sealing tank	Near 150°C

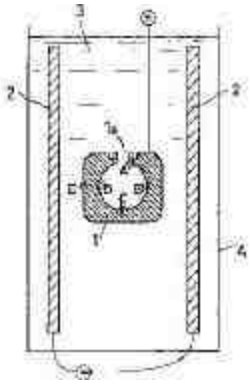
Table 6 Temperature measurement result in anodizing aluminum factory (Part

Site of temperature measurement	Temperature
Anodizing in the oxalic acid bath	Bath = Rakking frame
Manual type buffing	A little higher temp. than room temperature
Automatic buffing	Very higher temp. than room temperature
NC Mill	Very higher temperature

5. Japanese information which relates to temperature of anodizing aluminum

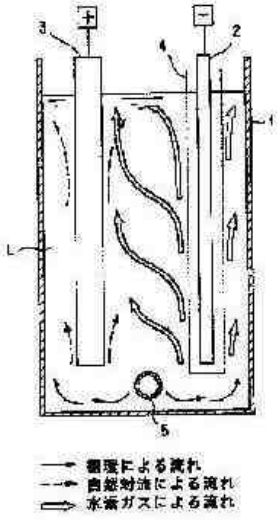
Some Japanese patents are introduced below.

(1) Publication number : 2001-152392
Date of publication of application :05.06.2001
Applicant :TOYAMA PREFECTURE
ALKALI RESISTANT ALUMINUM OXIDE COMPOSITE FILM AND PRODUCING METHOD THEREFOR
Abstract: PROBLEM TO BE SOLVED: To produce a composite film having an inorganic composite oxide having extremely excellent alkali resistance on the surface is made possible.□SOLUTION: A zinc aluminate, an aluminum-rare earth element composite oxide or their compound on the surface of a porous aluminum anodically oxidized film by subjecting the same to heating treatment at 130 to 300°C in a state of being dipped into an aqueous solution of an organic solvent having a hydroxyl group and containing zinc acetate, the acetate of rare earth elements or the like, is provided.
(2) Publication number :11-012795
Date of publication of application :19.01.1999
Applicant :SHOWA ALUM CORP
METHOD FOR ANODIC OXIDATION OF ALUMINUM MATERIAL
Abstract: PROBLEM TO BE SOLVED: To enable the formation of hard alumite film at high temp. side in comparison with the conventional method and to attain the reduction of electric power cost and the simplification of an equipment by dipping an aluminum material to be treated having smaller treating area than the electrolytic area of a cathodic material into electrolytic solution and executing an anodic- oxidizing treatment. SOLUTION: Into the electrolytic solution 3 for anodic-oxidizing treatment of sulfuric acid, etc., incorporated in an electrolytic vessel 4 providing the cathodic material 2, e.g. the tubular aluminum material 1 having an opening hole 1a is dipped. At this time, the treating area of the aluminum material 1 is set to the small area, such as about 50-90% of the electrolytic surface of the cathodic material 2. Successively, the temp. of the electrolytic solution 3 is set to about 14-22°C and the anodic-oxidizing treatment is executed at about 1.0-1.4 A/dm2 current density. By this method, the exothermic quantity on the surface of the aluminum material 1 at the time of anodic-oxidizing is small and local temp. rising is restrained and the hard alumite film having the uniform high hardness in each part and about 12-20 ìm film thickness, is formed without needing the cooling to about 0-10°C with a freezer, etc.



(3) Publication number :10-324998
Date of publication of application :08.12.1998
Applicant :YKK CORP
METHOD FOR CONTROLLING OXIDIZED FILM THICKNESS IN FORMATION OF ANODICALLY OXIDIZED FILM OF ALUMINUM SHAPE MATERIAL
Abstract: PROBLEM TO BE SOLVED: To provide a method for easily controlling an anodically oxidized film thickness by a relatively simple method of decreasing the variations in the film thickness by positively utilizing the gaseous hydrogen generated at the time of anodic oxidation for controlling the film thickness and more particularly changing the form of

CGF. SOLUTION: The anodically oxidized film thickness is controlled by controlling the surface temp. of the aluminum shape material 3 by utilizing the thermal diffusivity of the electrolyte by the flow of the bubbles of the gaseous hydrogen generated from a cathode at the time of the anodic oxidation of the aluminum shape material 3. More specifically, the sizes of the bubbles of the gaseous hydrogen flowing in the shape material direction and the stage of the density in the liquid, etc., are controlled by changing the micropore diameters of a barrier 4 disposed on the peripheral of the cathode 2 or the distribution and/or configuration form thereof, by which the sizes of the bubbles of the gaseous hydrogen and the state of the density in the liquid, etc., are partially controlled in accordance with the characteristics of the anodically oxidized film thickness distribution at the time of the current anodic oxidation. The surface temp. of the shape material is thereby controlled and the relatively easy control of the anodically oxidized film thickness is made possible.



(4) Publication number :09-176892
Date of publication of application :08.07.1997
Applicant :RICOH CO LTD
ANODIZATION METHOD AND DEVICE THEREFOR
Abstract: PROBLEM TO BE SOLVED: To provide a novel anodization method by which a film is formed with the physical properties such as hardness controlled stepwise or gradually from the aluminum base material side toward the surface layer (oxide film) or vice versa.
SOLUTION: A metallic base material is electrolyzed stepwise or continuously by using □2 kinds of electrolytes each consisting of sulfuric acid, oxalic acid, chromic acid, etc., and having a concn. different from one another, the base material is electrolyzed stepwise or continuously with the electrolytes having a different temp. from one another or the base material is electrolyzed stepwise or continuously with the electrolytes having the different concn. and temp. to impart a hardness difference stepwise or alternately from the base material toward the surface oxide layer or vice versa.

Japanese technical papers are introduced as follows. Please pay attention on the terminology. “380 Alloy" is called “ADC12(Aluminum Die Cast Alloy 12)" in Japan.
(1) Recent technology of hard anodizing of aluminum.
By Motohiko Arai
ALUTOPIA, VOL.31, NO.5, PAGE.9-14, 2001
Engineer of anodizing company reports the resent technology of hard anodizing based on his experience. When the Kolcolor Process was introduced from USA in Japan, he worked for it 35 years ago.
(2) Hardness of integral color anodized film by sulfuric acid bath.
By Seiju Maejima and Kenzou Okada
Aluminum society magazine, NO.1, PAGE.15-21, 1994
Mr. Maejima worked for long time in the anodizing laboratory of the company.
(3) Energy-saving effects in the high temparature electrolytic bath.
By Koudou Irie
ALUTOPIA, VOL.16, NO.11, PAGE.62-63, 1986
The author is sale engineer of chemicals company for aluminum surface finishing.

The next paper is English paper concerning bath temperature of anodizing aluminum
(1) Short-term weathering resistance of architectural anodic finishes.

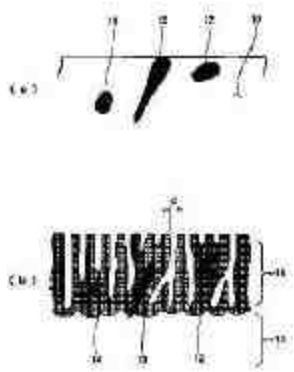
By ELLARD B R, SHORT E P
Alum Ind. VOL.9, NO.2, PAGE.28-30, 1990
The author is an engineer of Alcan International.

6. Japanese information which relates to anodizing of 380 alloy

Japanese patents related to the anodizing 380 alloy of aluminum are introduced. Please be careful on the name of alloy. “380Alloy" is called as “ADC12 (Aluminum Die Cast Alloy 12)" in Japan.

(1) Publication number :2000-144491
Date of publication of application :26.05.2000
ANODIC OXIDATION TREATING METHOD FOR Si ALUMINUM ALLOY

Abstract: PROBLEM TO BE SOLVED:
To provide an anodic oxidation treating method for an Si aluminum alloy capable of obtaining a porous coating film having large pore size and capable of obtaining a flat oxidized film even if Si is present. SOLUTION: The fig. (a) is the cross-sectional fig. of an AC8C aluminum alloy casting, in the base material 10 of which Si particles 12, 13 and 14 are dispersed into aluminum from the right to the left. The fig (b) shows the state after anodic oxidation treatment, and the outer surface of the base material 10 is dissolved by the corroding action of potassium fluoride to expose the Si particles 12 and 13. These Si particles 12, 13 and 14 are dissolved by the action of potassium fluoride and are made small, so that an oxidized film 16 satisfactorily grows in spite of the presence of the Si particles 12, 13 and 14. As a result, the upper end of the oxidized film 16 is made flush, by which the facial roughness is made small, and the film thickness is made approximately certain. Since the electrolytic soln. contains sodium phosphate, the pore size (d) is made sufficiently large.



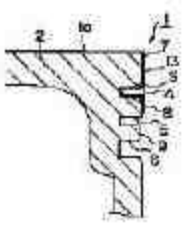
(2) Publication number :09-001319
Date of publication of application :07.01.1997
SURFACE TREATMENT METHOD OF ALUMINUM ALLOY CASTING OR ALUMINUM ALLOY DIE CASTING

Abstract: PURPOSE:
To improve the decoration effect by achieving the anode oxidation, dyeing and sealing after melting and removing Si in the surface chill layer of a product, or squeezing defective cast parts to prevent generation of blackened part or irregular dyeing when the surface treatment is achieved on an aluminum alloy casting or a die cast product.
CONSTITUTION: In a grinding process, defective cast parts such as pin holes, blowholes, shrinkage cavity on or close to the surface of a work are squeezed by the blasting by the scale ball or steel grit. Then, in the surface property adjusting process he surface of the work is treated with the solution containing fluorine acid or fluoride compounds, Si in the surface chill layer is melted and removed, the surface is smoothed by the chemical or electrolytic polishing, and then, the anode oxidation, dyeing and sealing are successively executed. The surface property treatment may be achieved using the solution containing phosphoric acid and nitric acid in addition to the treatment with fluorine acid solution.

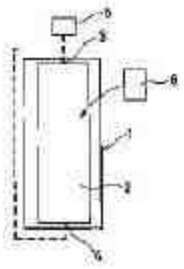
(3)Publication number :08-151953
Date of publication of application :11.06.1996
PISTON FOR INTERNAL COMBUSTION ENGINE AND MANUFACTURE THEREOF

Abstract: PURPOSE:
To strengthen the wear resistance of a groove part while a surface can be smoothed of the ring groove

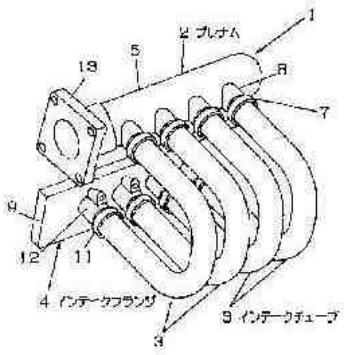
part, where a compression ring is inserted, without worsening manufacturability.
CONSTITUTION: In a land part 2 of an aluminum alloy-made piston main unit base material 1 manufactured by casting, a remelting quench hardening layer S is formed, to form a ring groove part 4 by cutting in the remelting quench hardening layer, also to coat by treatment with an anodization coating layer 13 a surface of this top ring groove part 4 or the surface of the top ring groove part 4 and a crown surface 1a of the piston main unit base material.



(4) Publication number :07-207467
Date of publication of application :08.08.1995
SURFACE TREATMENT OF
ALUMINUM ALLOY
Abstract: PURPOSE:
To remove smut from the surface of an Al alloy casting or an Al alloy and to form a mat surface.
CONSTITUTION: An Al alloy casting or an Al alloy is etched with a treating soln. contg. phosphoric acid, nitric acid and acidic ammonium fluoride as essential components. Since acidic ammonium fluoride is blended, smut can surely be removed and dimensional loss is reduced. The surface is made mat by the etching and the mat surface is protected by anodic oxidation for forming alumite.
(5) Publication number :06-081192
Date of publication of application :22.03.1994
ANODIC-OXIDATION TREATMENT OF AL AND AL ALLOY
Abstract: PURPOSE:
To provide an anodic-oxidation treatment method of Al and an Al alloy enabling to excellently keep the surface roughness of a work piece after the anodic-oxidation treatment.
CONSTITUTION: In a method performing an anodic-oxidation treatment to the surface of an Al or an Al alloy in an electrolytic liquid 2 using an Al anode or an Al alloy anode 3, the anodic-oxidation treatment is performed by putting an dummy material 6 into the electrolytic liquid 2. By this method, the surface roughness of an Al forged product is kept excellently.



(6) Publication number :06-058214
Date of publication of application :01.03.1994
MANUFACTURE OF INTAKE
MANIFOLD
Abstract: PURPOSE:
To save labor of flux application and improve external appearance and surface treatment characteristic by using Al solder material which includes flux in soldering of each component.
CONSTITUTION: A product made of Al, Si, flux fluoride is provided, wherein an amount of Si is 3 to 15wt.% in respect to an amount of total elements other than the flux fluoride. The ratio of the amount of the elements other than the flux fluoride in respect to the amount of the flux fluoride is 9.9:0.1 to 70:30. Al solder material including flux whose density is a value of 90% or more of a theoretical value is arranged on a connection part between an intake tube 3 made of Al estensive material and a plenum made of Al extensive material, and an intake flange 4 made of Al cast material. Soldering is carried out by heating them. It is possible to manufacture a product having components excellent of soldering performance and surface treatment characteristic.



The following three patents are those of surface finishing of aluminum alloy by spark discharge method not by the conventional anodizing method.

(7) Publication number :2000-054193

Date of publication of application :22.02.2000

FORMATION OF CERAMIC FILM ON ALUMINUM SUBSTRATE SURFACE

Abstract: PROBLEM TO BE SOLVED:

To form a ceramic film contg. no alkali metals and having excellent characteristics by executing a spark discharge with an aluminum substrate as an anode in an electrolytic bath contg. colloidal silica and a nitrogen-contg. compd. and substantially contg. no alkali metal ions.

SOLUTION: Energizing is executed with an aluminum substrate as an anode in an electrolytic bath contg. about 1 to 200 g/l colloidal silica and about 5 to 500 g/l nitrogen-contg. compd., and in which the concn. of alkali metal ions is controlled to □100 ppm, preferably to zero, and spark discharge is executed between it and a cathode. As for the colloidal silica, preferably, the silica particle size is controlled to about □100 nm, particularly to about 1 to 10 nm. Moreover, as the nitrogen-contg. compd., an amine compd. or aliphatic amine in which the atomic number of nitrogen in the molecules is controlled to about 1 to 5, and the carbon number is controlled to 0 to about 10 is preferable. The spark discharge is executed by using an insoluble cathode of stainless or the like at a bath temp. of about 10 to 70°C, a current density of about 0.2 to 10 A/dm2 and under a voltage of about 350 to 600 V, and the ceramic film is formed to about 2 to 200 ìm thickness.

(8) Publication number :06-033262

Date of publication of application :08.02.1994

SURFACE COATING METHOD OF ALUMINUM OR ALUMINUM ALLOY BASE BODY

Abstract: PURPOSE:

To form a multilayer film excellent in insulating property by applying electrodeposition coating on a ceramic coating film formed by an anodic spark discharge method on the surface of an aluminum metal base body.

CONSTITUTION: A ceramic coating film is formed by an anodic spark discharging on the surface of an Al or alloy base body. Further, an electrodeposition coating film is formed on the ceramic film. By this method, excellent insulating property can be imparted to an Al die-cast or cast product. As for anodic spark discharging method, such a method is preferable that the Al base body is dipped in the electrolytic bath of an aq. soln. containing water-soluble or colloidal silicate and/or oxoacid, or suspension of ceramic fine particles in the soln. As for the electrodeposition coating, it is preferable that the ceramic film is sufficiently washed with deionized water or the like, hydro-extracted and dried, and then dipped in a cation electrodeposition coating material.

(9) Publication number :05-086485

Date of publication of application :06.04.1993

FORMATION OF CERAMIC FILM

Abstract: PURPOSE:

To provide the method for forming ceramic films having a high insulation breakdown voltage and an excellent insulating characteristic even at the time of winding to a coil, etc., on a metallic base body.

CONSTITUTION: The method for forming two layers of the ceramic films on the metallic base body, such as aluminum electric wire, by a spark discharge generated when the metallic base body is energized as an anode in an electrolytic bath consists in forming the 1st film by the spark discharge in the 1st electrolytic bath contg. silicate and/or oxygen acid salt, then forming the 2nd film by the spark discharge in the 2nd electrolytic bath contg. ceramic particles in a suspended state.

Information on some Japanese home pages is introduced as follows. However, some attention is necessary. “380Alloy" is called “ADC12

(Aluminum Die Cast Alloy 12)" in Japan and “Spark discharge method ”is called “Anodizing”. All these home pages are written in Japanese.
Anodic oxidation technology invented by our company development

Left: White anodized aluminum(380 alloy)
Right: Oxalic Acid bath (380 Alloy)
http://www.fuji-mg.co.jp/new_page_1.htm

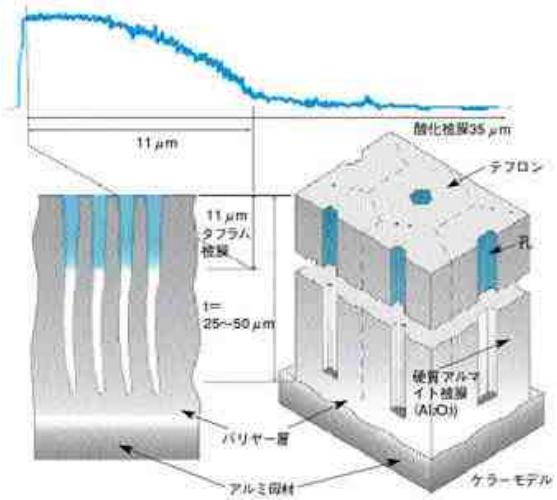
ADC12• • • 250HV or more

http://www.uedaalmite.co.jp/tafmite.html

(3) ADC12, 15ì film, and 500 Hours ⟨⟨ OK⟩⟩
http://www.miyaki-jp.com/kashia03.html

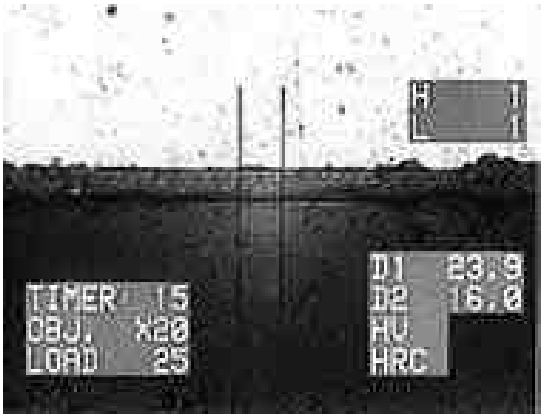
(4) Special, hard anodized aluminum (SHA)
ADC12 by which alloy can be processed; 3300×1300×1000
http://www.denkahimaku.co.jp/jigyou/alumi/alumi.html#koushitu

(5) Pores of anodic oxide film are filled with fluorocarbon resin.

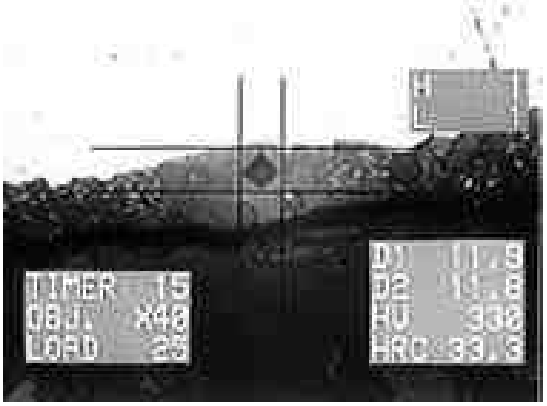


http://www.ulvac-techno.co.jp/ch/ch_03.html

(6) It is 16ìm (micron) film on aluminum alloy of ADC12. The hardness of film is 330 Hv.



Thickness of 16ìm



Hardness of 330 Hv

http://www.hardcoat.co.jp/html/hc12.html

(7) Anodizing of ADC12 by our company's hard anodizing technology
http://www.nacl.co.jp/products/products2.html

(8) New surface treatment technology by plasma electrolysis of aluminum alloy.
http://www.uedaalmite.co.jp/kepla-coat.html

Japanese papers are introduced as follows. "ADC12" written in the paper title is the same meaning as "380 Alloy".
(1) Anodic oxidation method of aluminum die casting alloy,ADC12.
By K. UTAKA et. al.(HITACHI Co.Ltd.)
Proceedings of ZAIRYOU TO KANKYOU, VOL.46th, PAGE.291-292, 1999
ADC Alloy is treated by Boemite Treatment Method, and then anodizing. Good film is formed.
(2) Surface fishing of aluminum products
------ Fishing rig and surface treatment
By T. ARAI (KOKUSAN KAGAKU KOUGYOU),
ARUMINIUMU PURODAKUTU, VOL.11, NO.5, PAGE.9-11, 1998
Anodizing in the high concentration bath and at high current density are recommended.
(3) Surface Treatment of Aluminum Die casting.
By M. SAKAGUCHI (OKUNO Chemicals)
KINKI ARUMINIUMU KENKYUKAISI, NO.188, PAGE.1-5 , 1997
Chill-Layer of die cast alloy is stripped by chemicals and aluminum alloy is anodized.
(4) Reforming of aluminum anode oxide film by material heat treatment.
M. Maejima (Fujikura)
Aluminum society magazine, NO.5, PAGE.15-20, 1996
Anode oxidation processing of ADC12 is difficult. The reason is that Si dissolves to the supersaturation.
(5) Anodic oxidation of Al die casting (ADC12).
By Shigeo Hoshino (Musashi Institute of Technology)
Aluminum surface treatment society magazine for car, VOL.1996, NO.1, PAGE.8-17, 1996
The effects of silicone are discussed in detail.
(6) Anodic Oxidation of Aluminum Alloys Die Castings.
By M. Tamura et. al.
Kouchi Pref. industrial technology center research report, NO.26, PAGE.22-24, 1995
The anode oxidation processing to aluminum alloy was examined. And shot blasting is recommended.
(7) Anodizing of ADC 12 Aluminum Die-casting Alloy.-----Effect of Alloying Elements and Preparation Method on The Film Formation.
By H. Takahashi, K. Shiga, Keiichi Watanabe, and M. Seo.
HYOUMENGIJUTU, VOL.44, NO.6, PAGE.542-548, 1993
Electrochemical study by measuring electrode potential.
(8) Effect of Casting Conditions on the Anodic Oxidation Behavier of Aluminum Die-Casting (ADC-12).
By Y. Fukuda (Mertex)
Kinki aluminum surface treatment society association magazine, NO.161, PAGE.1-6, 1993
Review on anodizing of ADC12
(9) Effect of combining sol-gel with aluminum oxide film on the improvement of corrosion resistance.
By K. Wada et. al.
Aluminum society magazine, NO.9, PAGE.103-104 1992
Sol-Gel coating is applied on anodized aluminum.
(10)The Effects of Heat Treatment of ADC12 Aluminum Die Casting Alloy on the Formation of Anodic Oxide Films in a Sulfuric Acid Solution.
By K. Watanabe et. al.
HYOUMENNGIJUTU, VOL.42, NO.9, PAGE.933-940, 1991
(11) SH coat for anodizing aluminum alloy die-casting.
By S. Kumagaya et. al.
ALTOPIA, VOL.19, NO.4, PAGE.49-57, 1989
Report from the anodizing factory on ADC12
(12) SH court method
By S. Iwata et.al.
ALTOPIA, VOL.13, NO.12, PAGE.37-42, 1983
Report from the company where anodizing process for ADC12 was invented.
(13) Anode oxidation of aluminum die casting alloy
By K.Okubo
ALTOPIA, VOL.11, NO.11, PAGE.9-15, 1981

Report by research engineer of local government. He invented hard anodizing method.
(14) Anodizing of Aluminum Alloy Die Castings by SH Coat Process.
By Tadashi Tsukiyasu
JITUMU HYOUMENN GIJUTU, No.6, Page 298-301, 1980
Anodizing of ADC12 in the sulfuric acid bath where an organic compound is added.

7. Effect of vibration type stir machine on chemical conversion coating processing and water sterilization

Effects of vibration type stir machine on the chemical conversion processing and water sterilization were studied. In the first experiment, aluminum substrate is treated in the zincate bath and rinsed in the rinsing bath agitated by vibration type stir machine. After that, copper is electroplated on the zincate film. Pine hole is little as shown in Photo.4.

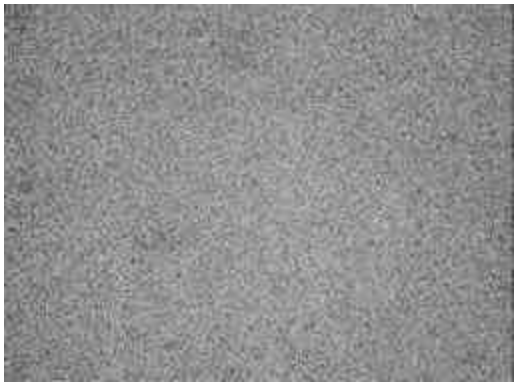


Photo.4 Surface of the sample

The second experiment is sterilization of water. Dr. Ryushin Omasa of the president of Japan Techno Co. Ltd. had developed the vibratory agitator by the vibration of the titanium metal wings to avoid corrosion of the wings in the metal finishing bath several years ago. Recently, Dr. Omasa covered titanium metal wings of the vibratory agitator with titanium dioxide by anodizing treatment method. And, Dr. Omasa invented the method of sterilization processing in water and wastewater treatment by this improved vibratory agitator using the effect of photocatalyst of titanium dioxide film. Photo.5 shows the photograph of this device.

Photo.5 Sterilization equipment by photocatalyst function of titanium oxide film

8. Conclusion

The conclusion of this paper is that temperature of aluminum sample being anodized is more important than that of anodizing bath. The temperature of aluminum sample being anodized largely depends on the bath agitation. If the bath agitation is not enough, good oxide film is not formed on aluminum.

Hard anodizing is usually carried out in the cold bath. And 380 alloy is also anodized in the cold bath. Therefore agitation of these anodizing bath is important

Table 1 Result of sterilization processing of water

Kinds of bacillus	Original solution	Afte 3 minutes	Afte 5 minutes
E. coli JCM 1649 T	3.7 x 10 4 /ml	Less than 30/ml	Not detected
E. coli O 157	3.7 x 10 4 /ml	Less than 30/ml	Not detected
S. enteritidias JCM 1652	4.0 x 10 4 /ml	Not detected	Not detected
S. ayreus JCM 2413	2.8 x 10 4 /ml	Less than 30/ml	Not detected