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The Effect of Heat Treatments on the Corrosive Behavior of Aluminum-Zinc Alloy

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Abstract

Included This search a study Feature Corrosion For an alloy Aluminum 7020 The container On 4% zinc And the1% Magnesium distance Treat it Superficially" With rays The laser And compare it By sample From The alloy as such Poured In two ways Included One of them immersion Samples With solution saline ingredient From3.5% NaCl With Water distilled With periods Time zone Different (5,8,15) day Where Done account. Rate Corrosion in a way Loss the weight And in units(mdd),As for Other She included account Rate Corrosion using Device polarization And using solution Acidic ingredient From Acid HCL Turns out From Results that Rate Corrosion Nope The two methods is being Less distance Transaction By laser And that Returns to me breadth Bezel Immortality distance Transaction By laser.

Keywords*: heat treatments, corrosive behavior, aluminum, zinc, alloy.*

Introduction

Aluminum alloys are very important alloys because of their wide use in many fields of technology, such as the aerospace and automotive industries, as they have many advantages that qualify them for these uses, such as their low density, good resistance to corrosion and high thermal conductivity (***Vanhile, 1992***). The performance of some engineering parts requires a set of properties that are difficult to be available in a single microscopic installation, so they use unconventional thermal treatments to improve the properties of these parts..The laser is one of the most important and broadest unconventional methods used for surface treatment of alloy materials. The treatment with laser beams was used during the sixties and its use expanded in surface hardening operations to treat complex parts that are difficult to harden by traditional methods, due to the advantages of the laser beam of many benefits, including its distinction of the absence of contact between the tool and the material in addition to the advantage of on-site hardening of many complex parts. Laser surface fusion is prepared (Laser Surface Melting)Among the important treatments with wide use in many different industrial applications of materials that do not harden by martensitic transformation, such as cast iron, some stainless steels, titanium, tool steels, and aluminum alloys .. The surface smelting hardening process needs a high power density (**10 5 W / Cm** 2)Top From That Used at Heating, and surely Arrangements To this the operation similarity That Which at Hardening By transformation Metaphase And welding, In Except Use Package Laser Focus or Close From Focus above the roof To be Brother-in-law As Working this is The package On melting layer Superficial Thin (Thin Surface Layer) at when is being

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the roof covered up With gas idle or Non Effective (**ODD, 1987**), that Because Package The laser Non Focus No Give density Ability Necessary To lift heat Most Materials above Point Fusion. As well as About that Focus With lenses Visual is being Wanted For production And control On density Ability And space Region Affected Thermoplastic (**Heat Effected Zone Area**)., Can Hardening Surface Metal Entire Work Blows Laser Multiple And it was Ladakh of So as to cover Space Required Has Gets Revision calendar To overlap (**Overlap**) Than it causes Down Years old at Hardness Microbiome For regions Interlaced. Has Done Overcome On this is the problem as such we indicated to me use Package Laser the same Focus Flour. that Hardening Superficial Increase From resistance Wear and tear As well as About that the change at Valuable Hardness And installation Microscopy for him Effect Large at improvement resistance the roof To eat Quotient at during the work, And well To improve Isotropic Mechanical For parts The machines Mannequin For stresses Reciprocating High as such at Gears (***JFReady, 1987***). Produce About Operation Smelting Superficial By laser Which Is characterized by Rates cooling High structure Accurate Soft Than Lead to me homogeneity More To install Subject Molten It excels This Installation Banh frequently What is being Harden And more resistance To eat From the roof Non Labs (***ODD, 1987***). that Applications Industrial For the process Smelting Superficial By laser As well as About Hardening she Structuring Surfaces or Building Superficial Surface structuring And seals (**Sealing**) And plumbing Superficial (**Surface Alloying**) And yank (**Nitrating**) And the son-in-law Quenching (**melt Quenching**) And welding (**Welding**), And theLaser Liquid– Phase Epitaxy (**LPE**) And theLaser Chemical Vapor Deposition (**CVD**) (***HGRubahn, 1999***).

Practical Section: deals This the classroom Definition By tests Which Conducted On The alloy 7020 And used Form Wide at Domains Industrial ,Done explained Devices Used Which Include Device Smelting Superficial By laser And device polarization And how account Rate Corrosion Premium On checkup Samples Microscope Photosynthesis.

Chemical Analysis: Done Procedure Analysis Chemical For the alloy Used And compare it In the alloy Standard using Device run Technology Metal Scan Desktop Metals Analysis (**2500 series - England 2004**).

Existing at The institute Specialist Industries Engineering.

Table (1) Analysis Chemist For the alloy Used

Elements	Standard value	Measured value
Si	<= 0.35	0.121
Fe	<= 0.40	0.290
Cu	<= 0.20	0.200
Mn	0.05 - 0.5	0.0764
Mg	1 -1.5	1.25
Cr	0.10 - 0.35	0.228
Zn	4 - 5	4.56
Ti	0.08	0.0319
Al	REM	REM

Samples' preparation for to microscopic examination:

- Done Prepare Samples to examine Microscopy at laboratory Prepare Samples And that With followers Steps next:
- Procedure Operation Smoothing wet Using paper smoothing from Carbide Silicon the Degrees (220, 320, 500, and 1000) On Straight.
- Done Procedure Operation refine Using solution Alumina the size Darling (1) Micron with Plot Cloth Own Alumina Placed on Disk Dizziness To device Refinement.
- Wash Samples Well With water and alcohol Then Dry up Mediated Device drying thermal.
- Procedure Operation Show off Using solution show Formed From AcidHF15% distance that Wash off Samples With water And alcohol And dried.

- Examination Microscopy Flour For samples Using Microscope Photosynthesis.

Microscopic examination: Done use Microscope Photosynthesis (Visual) From Type (Reichert) And fitted With a camera Digital, Office Program Special On Device the computer Possible From Through it Capture photo For the structure Microscopic Strongly Zoom in Different distance Their appearance On Monitor Display Own Calculator As gave This Connectivity Possibility Top From Hand control By lighting And contrast Whimsical And borders Crystalline And shape (1-2) Represent system Photography Used at search.

Prepare Samples To test of Corrosion: Done Prepare Samples And that Cut it up to me Samples Dimensions mm (10 × 10)And thickness (mm7) about For samples Custom To conduct Test polarization Conducted on her Operation Attribution On The cold distance that Complete Assignment Samples On The cold Using powder Plastic Confuses With Matter Hardened And by 2: 1 Then Blends Mixture And poured On the sample Positioned at Mold Plastic Then Are done Directed by the sample From Mold Attribution distance passage around 30 Accurate, Then Complete Prepare it as such We mentioned at Paragraph Above.

Transaction By laser: Done Prepare Samples Before Transaction Ballers And that Smooth it out Borch From Carbide Silicon The Volumes (120, 320, 500, 1000) Then Conducted Operation Refinement Using powder Alumina The size Darling (1) Micron Then Follow that wash Samples With water And alcohol And dry them distance that Done Treat it By laser Card (1) Jules And it blows Overlapping Included Each Surface the sample.

Laser System: Done use system Laser Ndimium- glass Impulse (Pulsed Nd-Glass Laser) the Stage one, Made up from the parts Chairperson the following:

- Room the laser.
- Equipped capacity Give
- Circle Water Cooling

and resurrect this is the system Radius Card Could that Reach to me (1J) And bumped up a beat (1Sec), and along wavy (1064) nmAnd shape (2-2) Represent picture for the system The laser Used at search.

Method of weight loss: Are called this is The knocking Sometimes The way Gravity Which Are used Form Wide To find Rates Corrosion The year Especially That Which it causes Loss Perceptible By weight at when Difficult Use this is Way To find Rates Corrosion Topical And who Difficult Hypersensitivity By weight the lost Little or Zero. Includes Knock account Rate Corrosion in a way Loss the weight Steps the following:

- Chopping Samples Dimensions mm (20 × 20) and with your thickness (2.5 (mm Complete Prepare Samples By conducting Operations Smoothing and refinement without show.
- Done Weight Samples with a scale sensitive it symbolizes For weight Initial By symbol W_o In mg.
- According Space Superficial Mannequin For solution ((A Pal(creamy^2)
- Immersion Forms at the middle Solution for a while Time zone enough ((tMeasured in days Until Gets Corrosion Done Use solution saline ingredient From3.5% NaCl with Water distilled.
- Upload Forms from the middle (Solution) eater Then Wash off With water Distilled To remove Effects Solution Then Dry up And cleans From Outputs Corrosion.
- Weigh Forms Forms a second (W) Then Calculates amount the change by weight.

$$W = W_o - W\Delta$$

According Rate Corrosion Significance (mdd) Which Represent the weight the lost B(mg) for every Alone space B(dm^2) And for a while immersion Counted B: (days)

$$Mdd = \Delta W\ At \text{ ………………………………………… } 1\text{-}3$$

Be Units Rate Corrosion The way Gravity As for love/M^2.day it symbolizes for him Bgmd, or milligrams/creamy^2.day It symbolizes for him By symbol mddAnd is done Transformation this is Units according to The equation
gmd = 0.1mdd ...

Device polarization:

Done checkup resistance Corrosion For samples in a way polarization And that using Device From Type Parastat2273, hot pleat Existing at Circle Research Materials laboratory Corrosion Ministry Sciences And technology, Done Prepare Solution Acidic The private Device at Baker [ml 250], Done put water Distilled And acid HCL in the rate of 2% mix Solution Device Magnetic rotary For a period Half hour Then put at Device and shape (2-3) Represent picture the device Used at search. Done account Rate Corrosion Device polarization in a way Complete curve Tafel and he do not know With a drawing Logarithm density the current Significance Hyper Effort ,if she was Values the current Few Then Relationship Be Nonlinearity But Quickly It turns out to me Relationship Linear At a plus Valuable Hyper Effort ,Are called Region Which Turn out In which Relationship Linear District Tafel Which Region Which Are equal In which Approximately Valuable Currents Authority With Valuable Currents Real .Appear Area Tafel On Limit whether For interactions Elevator The Mahdatiyah Paint Relationship between effort pole The Worker And density the current Cathode For the two regions Nonlinearity And linear Which curve polarization Cathode ,Then Paint Relationship Graphical between effort pole The Worker And density the current Elevator Which curve polarization Elevator Same Method the previous. Depends method Complete curve Tafel On D Complete The two lines Ex who They appear On Polarization curves Cathode And elevator Until Intersect at Point Represent Its coordinates Stream Corrosion (Icorr) And effort Corrosion (ECORR)Please , please this is Way On method Loss the weight at Measure Rates Corrosion Because she Knock Measure Speed And she can Measure Rates Eat Low very ,As for Negatives this is Way Lie at Term Broad From Effort Which Must be Use it to reach to me Area Relationship Linear (Area Tafel).

Results

Results of Microscopic Structure

Note From the shape(1) that Structure Microscopic For the alloy as such Poured Existence Shrubbery From Aluminum It shows Utektech Painted The Conqueror within Regions Interfaces For shrubs With Existence Particles Spherical Black As for distance Transaction By laser, it is observed shape(2) We find that the surface topography is wavy, the surface is flat and free from cracks, and dendritic composition of rough particles can also be observed (**Barbucci, 1997**) At the boundaries of the laser melted zone, in addition to the blurring of the affected area Heat affected Zone This is due to the short pulse time of the laser beams, which in turn reduces the thermal propagation as well due to the shallow absorption depth of the ray photons of metals. , It can be seen that the crystalline boundaries of the original composition of the alloy were removed after laser treatment (**TM Yue, 2003**).

Shape (1) the microstructure of the alloy used as it was poured.

Shape (2) Alloy microstructure after laser treatment

Corrosion rate calculation

Weight loss method

Immersion results in a solution Nacl:

most Species Corrosion Foveal Happen or occur With Ions Halides(F^{-}, Br^{-}, Cl^{-}, I^{-})Some of these ions are like Cl^{-}Exists in water in varying proportions , minerals and alloys that are characterized by burrism form an insulating layer on their surface when they come into contact with oxidizing solutions and in the absence of salt ions, this layer reduces the rate of corrosion, but once salt ions are attacked with chlorides, this layer breaks down locally and shatters causing local corrosion, including pitting corrosion If the dissolved metal ion diffuses, cracks and fractures in this layer will be filled(Are attacking) With more effective ions, which helps the growth of corrosion and increases the speed of its spread , the metallurgical composition expresses the shape of the mineral grains, their shape, direction, the pattern of their distribution, the shape and amount of deposits in the crystal boundary regions or within the grains such as carbides, or the presence of insoluble impurities such as oxides and others, and the presence of phases, their size and type, the phases act To create more than one area with a different voltage, which is an undesirable state , so the type and condition that it must be in must be determined so that it is suitable for use in the required medium and achieves high corrosion resistance.

Note from the table (1) The corrosion rate of the time submerged samples 5 Days for both samples before and after laser treatment are high and close in value, and then begin to decrease after a time 8 Days, and at a greater rate, for the sample treated with laser, and it decreases more after immersion time 15 A day, and at a higher rate, for the sample treated with laser as well"Because of the formation of the immortality layer, and this is what the pictures illustrated in the two figures(3), (4) The researcher has indicatedKGWatkins Et al. Indicate that the alloy thermal treatment by laserAL-5.9Zn-2.6Mg-1.6Cu Do not increase pitting corrosion effort Epit, Significantly even lead to a decrease in the free corrosion effortfree corrosion potential Causing an increase in latency)K. Watkins, 1996(. He also noted the researcher TM. Yue,Et al to me that resistance Corrosion For an alloy Aluminum-zinc(7075) Transaction By laser And submerged at solution saline For a period 30 day she Larger By five Times From resistance Corrosion For the alloy Non Transaction (**TM Yue, 2003**) .

Table (1) consequences Corrosion after immersing Samples Safely Different

Time (day)	**Rate Corrosion Before Transaction By laser(mdd)**	**Rate Corrosion distance Transaction By laser(mdd)**
5	**840**	**838**
8	**603.75**	**571.25**
15	**576**	**465.3**

Shape (3) picture Corrosion distance immersion the sample For a period 15 day Before Transaction By laser

Shape (4) picture Corrosion For the alloy Used distance Immersion 15 day distance Transaction By laser

Method Complete curve Tafel

Polarization : from Notice The two shapes 5)And the(6) We find that Values density the current ICORRmay be Decreased distance Transaction By laser From Values2.173 Before Transaction Laser to 1.245distance Transaction By laser Where Dropped Rate Corrosion distance Transaction By laser 2.487From to me1.401 (mmpy)It appears that Clear From During photo Corrosion For samples at The two shapes (7), (8) Note From curve Tafel For both The two samples From The alloy Existence Area Active(Active Region) start this is Region From effort poise equivalent to me effort Metal

Started Decomposition Metal According The equation 1

$$Al = Al^{+3} + 3e^{-} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Offset a plus at Logarithm density the current On body Relationship Linear At the point A start points From Surface Metal By activation Dynamic Which Qualify it To interact With Oxygen For a start To synthesize Noe Class Protective Oxidation On Surface , class Oxidation at Region A Is generated Two types From Interactions she Interactions oxidation the elevator Which Working On a plus Corrosion And decomposition Which Trying that Increase Logarithm density the current a plus Centrifugal With a plus Hyper Effort And genre The second Interactions formation Class Oxidation Which Interactions Certain To erode And melting the elevator Because she Trying that Protect Surface the elevator . And be calendar Interactions decrease density the current Because Over the current Electrophoresis at this is Case Requires Effort high above So Started Line Rectal at the point ABy declination About His integrity The more Increased Rates formation Class Protective Increased deviation But at the point A still Valuable Interactions Causing Corrosive Larger Than Lead to me continuation Relationship Linear between density the current And hyper Effort Upwardly But Average Slowed down Until the point B Which Are equal In which Interactions oxidation the elevator With Interactions Obstructive to her So Not possible that Continue Relationship Linear Y a plus at Hyper Effort distance the point B lead to to me a plus Rate formation Class Protective And overcome it On Interactions Eat the elevator And it happens This At effort Negative critical and he effort far About effort Poise And offset him drop Values density the current Form Large And surprising . Are called Valuable Rated voltage the interview To drop atheism at the current Voltage Vlada (Flada potential) Which Represent Voltage Negativity (Passivation potential) It symbolizes to her By symbol Ep Be Interactions Obstructive Corrosive she Controlling Operations Ongoing On Surface the elevator Than Lead to me Spread Class Protective On all parts Surface the elevator Until the point P Where Become Surface Metal covered up In full By class Protective as such Shuts down all Pores Existing at Class At Effort To the point P , That Proven density the current With a plus Hyper Effort Will work On a plus fish Class Protective distance that Covered all parts the roof Is increasing fish Class With a plus Rated voltage Until

Become Class More Fragility However Continuation at a plus Rated voltage Talk Refractions And cracks at Class Protective Fragile And therefore decay Negativity Which Be responsible About happening cases failure Topical Such as Corrosion Foveal or Stress (**Sami, 2010**) . l have pointed out researcher Roosz Et al to me Behavior Corrosion For the alloy Al-6% Zn-2% Mg distance Transaction By laser Has Notice Improvement Remarkable at resistance Corrosion distance Transaction (**TM Yue, 2003**).

Shape (5) Show curve Tafel For the alloy 7020as such Poured, Center Corrosion solution Acidic Concentrated 2% HCL.

Shape (6) Show curve Tafel For the alloy 7020distance Transaction By laser, Center Corrosion solution Acidic Concentrated 2% HCL.

Shape (7) the corroded surface of the alloy as cast by the polarization method.

Shape (8) Represent the roof Corrosive To sample Multiplied By laser in a way polarization

Conclusions

1. Led Transaction Superficial By laser to me a change at Structure Microscopic For the alloy Used Addition to me a change Topographic the roof.
2. A plus Rate Corrosion With a plus time Immersion For both Samples Transaction And is Transaction By laser.
3. Led Transaction Superficial By laser to me expansion Bezel Immortality For samples The Examined in a way polarization Than Arrange on him decrease at Rate Corrosion for samples Transaction By laser.
4. Clarify from Results that Rate Corrosion For samples Transaction By laser is being Convergent With Samples Non Transaction at the day's First For immersion Then Decreasing For samples Transaction By laser About Non Transaction And that Returns to me breadth layer Immortality.

Recommendations

1. Passed Samples with solution Acidic and compare it With Solution Saltier.
2. Use Citrus fruits Different in a way Immersion and method polarization and calculate Rate Corrosion for every of which.

3. a study Effect Transaction Superficial By laser On Valuable Hardness Fikriyah For the alloy Used.
4. Procedure Test (stress corrosion cracking) SCC For samples And find out Effect Transaction By laser On Cracks Formed distance Test Corrosion.
5. A study Effect energy Beam the laser On Rate Corrosion For the alloy Used And that using Energies Different to raise the laser.

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