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Characterrization Al-4.5%Cu Alloy and Study of Wear Resistance

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Abstract*— *This investigation gives a selective approach to best, growth the consumption of aluminium, many other metals including copper & iron. The reasons for this are its high strength to weigh ratio, excellent corrosion, high electrical and thermal conductivities, low and high scrap value. These properties, together with its stable price and virtually in the foreseeable future, engineers to find new ways by which the potential of this metal may be used.

Effect of grain refinement the microstructure and mech. Properties of Al-4.5wt%cu alloy grain refined with Al-3Ti-0.15C. Grain size of Al-4.5Wt%Cu alloy can be reduced by addition of 0.6% Al-3Ti-.15Cu grain refiner. Hardness of alloy was observed to increased with increase grain refiner quantity. In order to further improve the mech. Properties .

Keywords— cold rolling, optical microscope, tensile testing machine etc

I. Introduction

The main alloys of importance in engineering and aerospace applications are the aluminum alloys. Steels and nickel alloys. The growth in consumption of aluminum during the last thirty years has been more than that of many other metals including iron and cooper. When the electrolytic reduction of alumina (Al_2O_3) dissolved in molten cryolite was independently developed by Charles Hall in Ohio in Paul heroult in France in 1886 the first internal-combustion-Engine-powered vehicle where appearing and aluminum would play an role as an automotive material of increasing engineering value because of it’s excellent properties. Electrification would require immense quantity of light-weight conductive metal for long distance-transmission and for construction of the tower needed to support the overhead network of cables which deliver electrical energy for sites and station of power generation. Within a few decades the wright brothers gave birth to an entirely new industry development of structurally reliable, strong, and ultimately for missile bodies, fuel cells, and satellite components etc.

The aluminum industry’s growth was not limited to these developments as the first commercial applications of aluminum were novelity item such as mirror frames, house numbers, and serving trays, cooking utensils, were also a major early market. In time, aluminum grew in diversity of applications to the extent that every aspect of modern life would be directly or indirectly affected by its use

II. Material and Methodology

Aluminum has a density of only 2.7 g/cm3, about one-third as much as steel (7.83 g/cm3).or bass (8.53 g/cm3). It has excellent corrosion resistance in most environments, including atmosphere, water (including salt water), petrochemicals, and many chemicals systems. Aluminum is a soft, lightweight metal with normally a dull silvery appearance caused by a thin layer of oxidations that forms quickly when the metals is exposed to air. Aluminum oxide has a higher melting point than pure aluminum. It is nontoxic (as the metal), nonmagnetic.

(I) Aluminum and its alloys

As pure aluminum is low in strength so its applications are limited, in order to increase the strength of pure aluminum, alloying of aluminum is of much importance by adding elements like copper, silicon, magnesium etc. alloying increases the tensile strength and hardness due to solid solution hardening and/or second phase (precipitations) hardening, strength and hardness get increased as a result of restriction on the dislocation movement

The aluminum base alloys may in general be characterized as eutectic systems which contains intermetallic compounds or elemnts as the excess phases. Because of the relatively low solubilities of most of the alloying elements in aluminium and the complexibility of the alloys that are produced, anyone aluminium base alloy may contain several metallic phases, which are quite complex in composition. These phases usually are appreciably more soluble near the eutectic temperatures making it possible to heat-treat some of the alloys by solution and aging heat treatments. All the properties are, of course, influenced by the effects of the various elements with which aluminium is alloyed.

(II)Al-4.5wt%Cu Alloy

The binary aluminium-copper alloys are one of the oldest casting alloys. Al-4.5wt%cu alloy belongs to the family of 2xx.x series of aluminium alloys. Copper is the principle alloying element in this group .

With respect to the Al-4.5 wt.% Cu alloys ,the structure in the as – cast state consists of aluminium ,with a very heterogeneous distribution of copper in solution ,with dendritic morphology and lamellar mixture of phase a and micro constituent $CuAl_2$ located between dendrite arms and grain boundaries.

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Al-4.5wt%Cu alloy are generally not utilized in the as-cast condition ,being instead submitted to solution heat treatment and controlled precipitation of $CuAl_2$ to improve mechanical properties .These alloy require solution heat treatment to obtain optimum properties in heat-treated condition mechanical properties are similar to mild steel.

(III)Calculation for Al-4.5wt%Cu alloy

AL -4.5WT%cu alloy was 7.kg . since size of was limited, so AL-4.5 %CU alloy was made in three lots of 2.5 kg . since the composition of master alloy was AL-33wt% CU, and composition of alloy was AL-4.5 wt% CU.
Therefore amount of master alloy (x)=(2500x4.5)/33=340gm.
Therefore amount of aluminium =2500 – 340 =2160 gm.
Since there are some aluminium losses , so amount of Aluminium was taken 5% extra , therefore total amount of aluminium = (2160+108)=2268gm

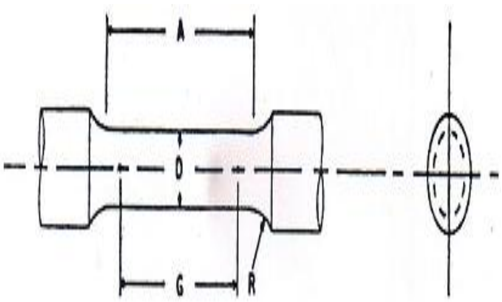
(IV)Casting of Al-4.5wt%Cu Alloy

After weighting , pieces of aluminium and master alloy were kept in a crucible with dross cleaning flux added to it and then kept in silicon carbide furnance, silicon carbide rods work as heatihg element . After complete homogenization foil was added in the melt . then the melt was casted in cylindrical form.

Fig.1-The molten metal

(ii)Tensile Testing

Tensile testing was carried out on Tinius Oslen Tensometer .Tensile specimen were held between two grip Strain rate was kept at 0.5mm/min. specimen used in present work A=27.2mm,D=5.05mm,G=25.5mm and R 1in 1.



Fig,2Speciman

Fig.3-Specimens after tensile test

III. Results

The microstructures of as cast Al-4.5wt%Cu alloy and grain refined. The microstructure of consists of very heterogeneous distribution of copper in solution. After grain refinement of Al-4.5wt%Cu alloy by the addition of 0.2%Al3Ti-.15C grain refiner, the dendritic microstructure of Al-4.5wt% alloy the changed in fine equated grain structure fig,4.a .it can be observed from fig. 4b and fig. 4c that three is further reduction in the grain size, as 0.4% and 0.6% grain refiner is added respectively, however the difference between grain size in these two case is not high .As0.8% grain refiner was added to Al-4.5wt%Cu alloy are reverse effect in its microstructure was observed .Addition of 0.8% grain refiner in the formation of coarse grain structure fig. 4d

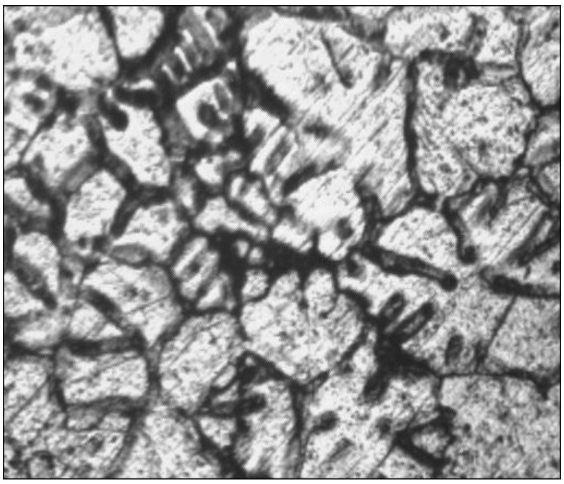


Fig.4a: After addition of 0.2% grain refiner

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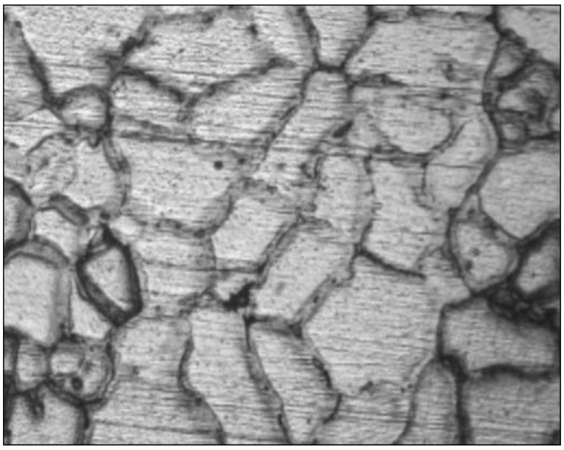

Fig.4b: After addition of 0.4% grain refiner

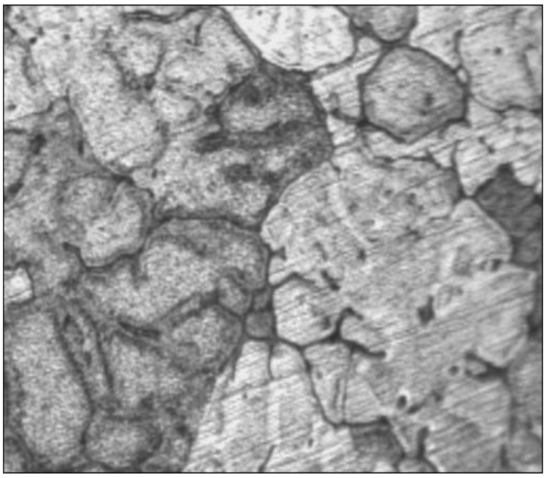

Fig.4c: After addition of 0.6% grain refiner

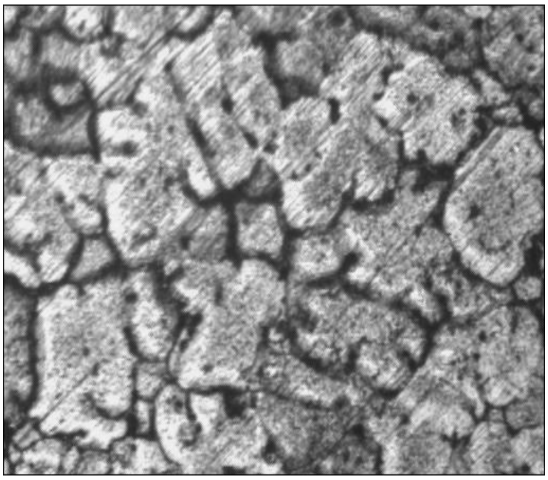

Fig.4d: After addition of 0.8% grain refiner

Effects of grain refinement on mechanical properties of Al-4.5wt%Cu alloy-

Grain refinement refers to the formation of fine equiaxed grain structure in aluminium and its alloy casting,which otherwise solidify with a coarse columnar grain structure by heterogeneous nucleation.it inserd the high yield and ultimate tensile strength, high toughness and improved hard ness value of products.

As 0.2% grain refiner was added to melt its yield strength was increased to a value of 153.2 MPa from 144.8 MPa. After 0.4% grain refiner was added to melt its yield strength was increased to a value of 163.3 MPa. After 0.6% grain refiner was added to melt its yield strength was increased to a value of 176.9 MPa.

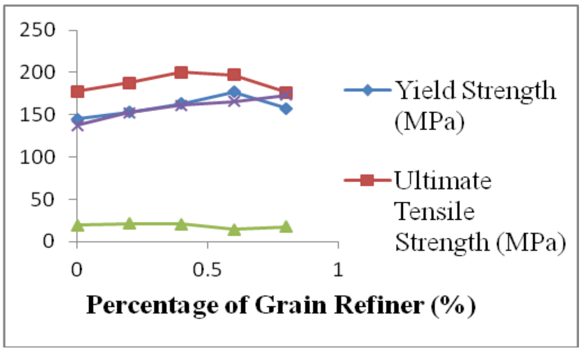

Fig.5a: Graphical representation of Al-4.5wt%Cu alloy

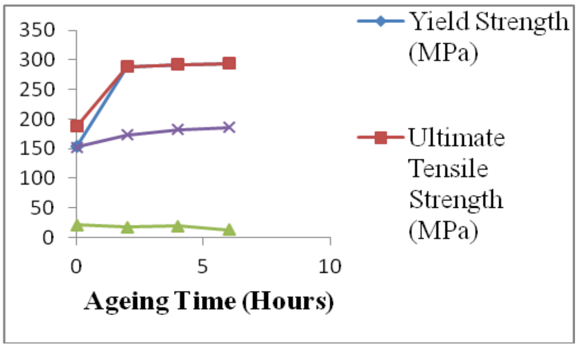

Fig.5b: Graphical representation of effect of ageing time on mechanical properties of Al-4.5wt%Cu alloy grain refined with 0.2% Al-3Ti-0.15C grain refiner.

IV. Conclusion

Grain refinement is common industrial practice to obtain higher mechanical properties of aluminium alloy.

Grain refinement of Al-4.5Wt%Cu alloy is by heterogeneous nucleation and growth of grains.

The tensile properties of Al-4.5wt%Cu alloy can be optimally improved by grain refinement by addition of 0.6% Al-3Ti-0.15C.Further increase of grain-refiner quantity does not provide any more significant improvement.

Hardness of the alloy was observed to be increased with increase grain refiner quantity.

In order to further improve the mechanical properties of grain refined Al-4.5wt%Cu alloy, precipitation hardening of this alloy can be carried out. Grain refinement provides significant improvement in the mechanical properties of grain refined Al-4.5wt%Cu alloy.

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References

i. *D.K. Dwivedi, Adhesive wear behavior of cast aluminium-silicon :Overview,Materials and Design 31(2010) page. 2517-2531*

ii. *M.J. Shabani,M.Emamy and N.Nemati,Effect of grain refinement on the microstructure and tensile properties of thin 319 Al Casting, Materials and Design 32 (2011) Page1542-1547.*

iii. *Sindey H.Avner,,introduction to Physical Metallurgy,Tata McGraw-Hill publishing company limited, Edition 1997 page no. 192.*

iv. *S.G. shabestari and F.shahri, influence of Modification ,Solidification conditions and Heat Treatment on the Microstructure and Mechanical properties of A356 aluminum Alloy, Journal of materials Science,2004.39,Page 2023-2032.*

v. *ASM Handbook Volume -2 ,properties and selection Non Ferrous Alloy and Special-purpose Materials*

vi. *S.G.Roberts, Engineering C-High performance Alloy: I.J. Polmear,Metallurgy of the light Meatals,Third edition,Arnold Hodder Headline PLC,London.*

vii. *I.J. Polmear, A Century of Age Hardening,Materials Vol-28(2004)Prasad B.K. Structure and property related changes in hypoeutectic Al-Si alloys induced by solutionizing, mater Trans JIM1994,34(12)873-8*