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Study of tensile and hardness properties of Al-19 Si-3 Cu alloy in As cast and T6 heat treated condition

[1]Neelakanthareddy. Y.B [2]Harish Mudegannavar , [3]Siddesh N Bevinahalli
[1,2,3]Mechanical Engineering Department, RTE Society's Rural Engineering college, Hulkoti.
*Email: neelakanthareddy41@gmail.com

ABSTRACT

Aluminium alloys have been widely used in the Automotive and Aerospace industries as they can be heat-treated to enhance the superior properties of strength, workability, thermal ,electrical conductivity and corrosion resistance while maintaining low weight. Heat treatment processes applied to Aluminium, alloys are homogenization, annealing, and precipitation hardening involving solution treatment, quenching, and aging either at room temperature (natural aging) or elevated temperature (artificial aging). Heat treatment processes should be performed in well-equipped furnaces under the appropriate thermal conditions to achieve the temperature-time cycle uniformity.

The initial strength of alloys in this group is enhanced by the addition of alloying elements, which, either between themselves or in conjunction with aluminium, form compounds, which show increasing solid solubility in aluminium with increasing temperature.

The excellent wear resistance of hyper eutectic aluminium alloy is based on the primary Si particles which are distributed in the base metal. When the primary Si volume fraction increases, the smaller size has excellent wear resistance characteristics. However, this trend always does not match.

INTRODUCTION

Aluminium alloy is one of the most commonly used lightweight material in human daily life because of its remarkable properties. First, it is lightweight, aluminium alloy weighs only 1/3 as much as equal volumes of general used iron or steel. With its relatively low density, aluminium alloy exhibits high specific strength. The high strength-to-weight ratio of aluminum alloy is extremely attractive, especially in the aerospace and automotive industries.

Hypereutectic aluminium–silicon alloys have wide range of excellent mechanical and thermal properties due to which they are well-known, used materials for manufacturing parts of automobile, aircraft and electronic equipment. They are extensively used for engine parts (propeller casing) and air compressor cylinder and machining, which are generally required in producing automobile parts (rims, disc brakes, etc.). Hypereutectic aluminium–silicon alloys are said to be the most difficult to machine among the various aluminium alloys as the occurrence of prime coarse crystal-free silicon causes rapid tool wear because of their hardness. Brittle intermetallic phases deteriorate the mechanical properties of Al–Si alloy, which are generally formed by combining iron into aluminium and silicon (mostly iron is present in little quantity in aluminium alloy). Out of these intermetallic phases observed in aluminium alloy it is generally expected that plate-type shapes are the most harmful to mechanical properties (e.g., elongation).

Most aluminum alloys may be machined speedily and easily. The metal may be turned,

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milled, bored, or machined. Another advantage of their flexible machining characteristics is that aluminum alloy rod and bar, particularly the free machining alloys such as 2011 and 6262, may readily be employed in the high-speed manufacture of automatic screw machine parts. Almost any method of joining is applicable such as riveting, welding, brazing, or soldering. A wide variety of mechanical aluminium fasteners simplify the assembly of many products. Adhesive bonding of aluminium parts has been successfully employed in many applications including aircraft components and ship building applications.

An Al-Si alloy with Si content less than 12.5% or near eutectic compositions is commonly used in various applications. Hypereutectic Al-Si alloys are being used in the automobile industry and in other fields where high wear resistance, high specific stiffness; thermal stability and excellent dimensional stability are required. Typical uses of hypereutectic Al-Si alloys are pistons, cylinder liners, piston rings, connecting rods, pump and hydraulic components. Since Si immensely improves the wear resistance of these alloys because of its high hardness, it has been concluded that higher Si content leads to better wear resistance. Silicon also improves the flow-ability of Al-Si alloys due to its high latent heat of fusion and also increases the fluidity of the melt due to the release of considerable amount of heat during solidification. Ingot metallurgy of Al-Si alloys with Si content less than 12.5% (by mass) or near eutectic compositions give rise to the formation of coarse grain dendritic morphology of primary phase and severe segregation of alloying elements, which are attributed to the slow solidification rate. This characteristic has led to the materials with inferior strength, stiffness and other mechanical properties.

For the improvement of Tensile properties of hypereutectic Al-Si alloys, a modification in composition is necessarily made by adding alloying elements like Cu, Mg, Fe, Mn etc. to these alloys. Addition of Cu and Mg increases the strength of the alloy through formation of intermetallic phases. However, this also leads to reduction in ductility of the cast materials. Recently, focus has been shifted to the continuous improvement in elevated temperature strength of hypereutectic Al-Si alloys.

EXPERIMENTAL PROCEDURE

- Determination of composition of aluminium alloy
- Quenching of the alloys
- Heat treatment of alloys of different intervals (Ascast,2hr,4hr,6hr)
- Preparation of specimens according to ASTMA standards
- Experimental analysis of tensile strength of the specimens using UTM machine
- Conducting hardness test (Brinell hardness, rockwell hardness) to determine the hardness of alloys
- Comparing the mechanical properties of different interval specimens

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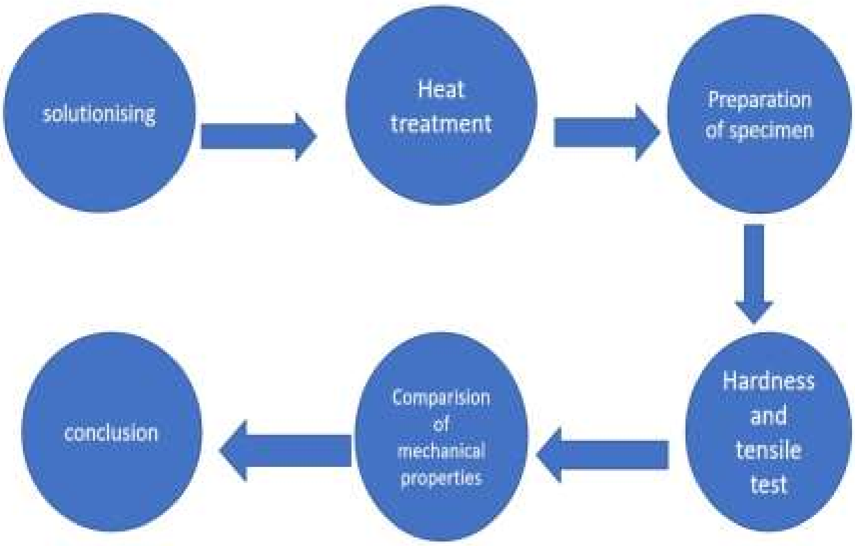
METHODOLOGY



First of all we have to do the solutioning of aluminium alloy because the purpose of the solutionizing procedure is simply to take the alloying elements into solution, which will eventually strengthen the particular aluminium alloy. The problem with aluminium solutioning is that the required solutionize temperature is very close to the liquidus temperature, where grain boundary melting can initially begin. And then have to do heat treatment for different intervals (like 2hr 4hr 6hr) then prepare specimen according to ASTM standards. Finally do the hardness and tensile test for different interval aluminium alloys, and then compare their mechanical properties with each other.

RESULTS AND DISCUSSSION

Sl. No	Heat treated	Ultimate tensile stress in (mpa)	Ultimate tensile stress in (mpa)	Average UTS in (mpa)	Brinell hardness number	Brinell hardness number	Average BHN
1	Ascast	130	137	133.5	73	88	80.5
2	2hr heat treated	150	143	146.5	77	86	81.5
3	4hr heat treated	167	152	159.5	90	89	89.5

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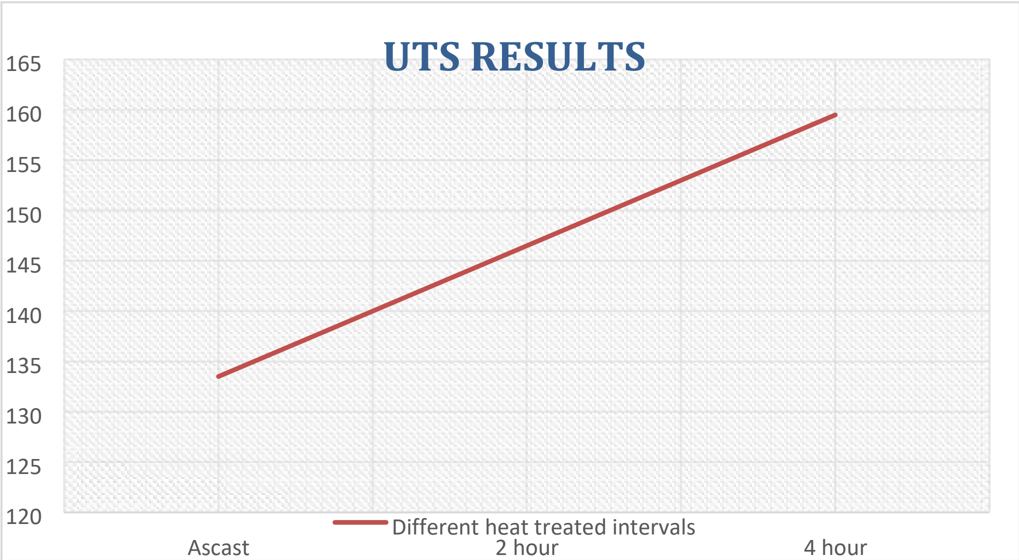
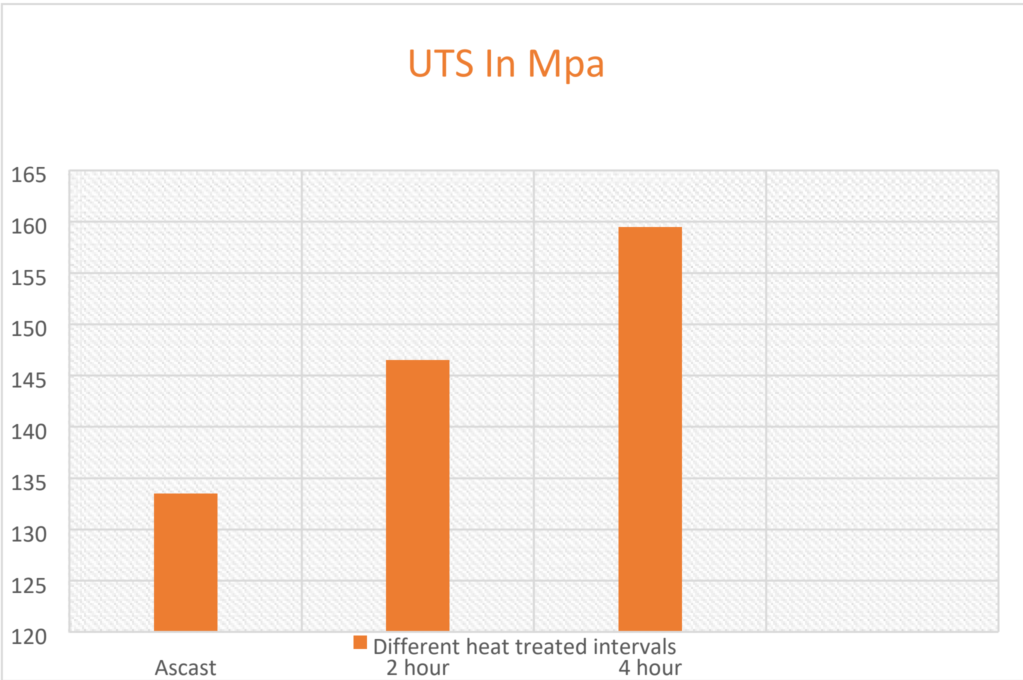
DIFFERENT TIME HEAT TREATED INTERVALS VS ULTMATE TENSILE STRESS





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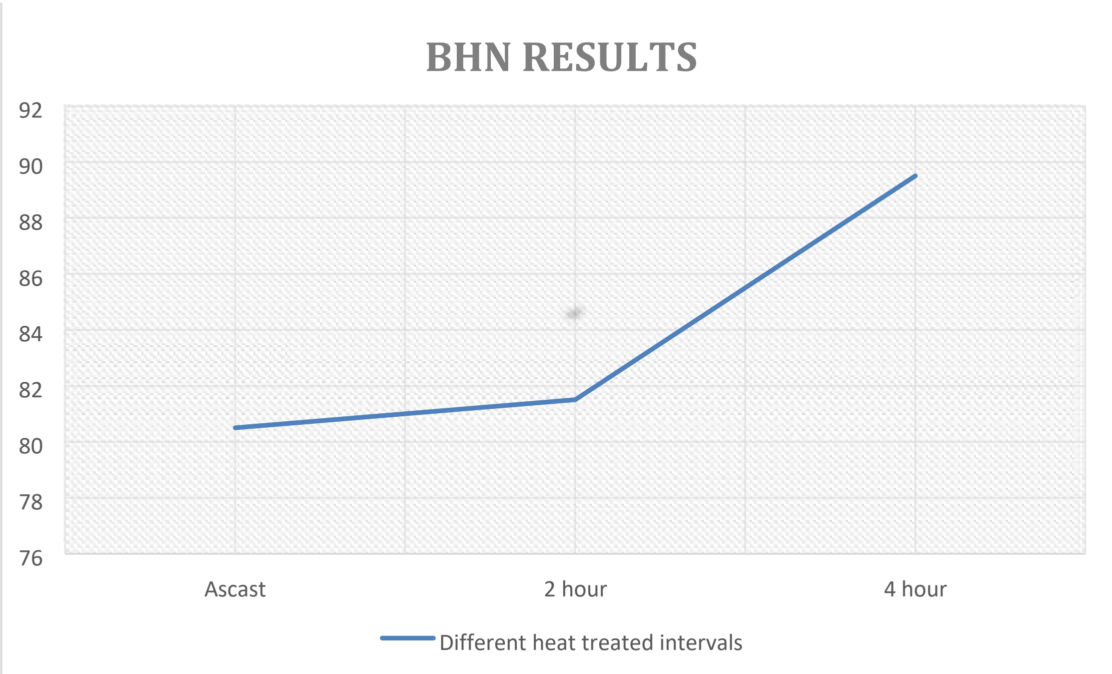
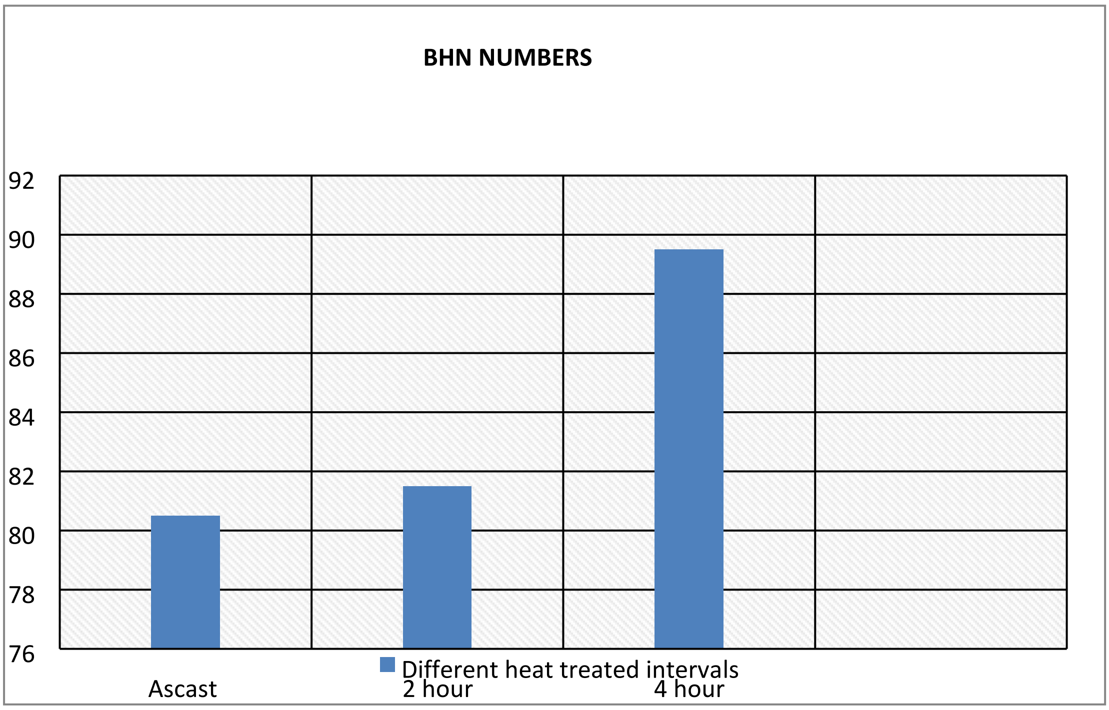
DIFFERENT TIME HEAT TREATED INTERVALS VS BRINELL HARDDNESS NUMBER





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CONCLUSION

Cast aged alloy shows higher tensile strength than ascast alloy.ie 4 hour heat treated alloy has greater tensile strength than 2 hour heat treated than further it is greater than ascast alloy. Cast aged alloy shows higher brinell hardness number than ascast alloy.ie 4 hour heat treated alloy has greater brinell hardness number than 2 hour heat treated than further it is greater than ascast alloy. cast aged materials show more resistant to indentation for a given load, the indentation left in surface is smaller. Cast aged alloy tends to be stronger than ascast alloy according to the above mentioned results.

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