

# Investigation on the effect of Bio-quenchants on the mechanical properties of Aluminium 6063 Alloy

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**Abstract:-** Heat treatment process has become a common technique for enhancing the mechanical properties of the metals. In this research paper, heat treatment process has been carried out using various bio-quenchers on Aluminium 6063 alloys. The effects of Tensile Strength and Hardness on the various bio-quenchers on Aluminium 6063 alloys were investigated and compared with each other.

**Keywords:-** Aluminium 6063; Heat treatment; Bio-quenchers; Quenching; Ice Water; Brine Solution; Tensile Strength; Hardness.

## I. INTRODUCTION

Aluminium is known for its high corrosion resistance and light weight. Alloys of Aluminium have a major composition of Aluminium followed by Magnesium, Silicon, Manganese, Copper, Iron, Chromium, Zinc, and Titanium. The mechanical properties of Aluminium alloys are affected by working temperature. Solid solution strengthening has been used to improve the strength of these alloys series at temperatures above 100 to 300°C. The initial strength of 6xxx series alloys is enhanced through alloying with element such as copper, magnesium, zinc, and silicon. Because, these alloying elements in various combinations show increasing solid solubility in Aluminium with increasing temperature, it is possible to subject them to heat treatments, which will improve strength. Such treatments include Annealing, Normalizing, Quenching, and Tempering. Aluminium Alloys are majorly classified as casting alloys and wrought alloys which can also be sub-divided into heat-treatable and non-heat-treatable metals. In this research paper quenching of the Aluminium 6063 alloy was carried out using various bio-quenchants.

## II. MATERIALS

Aluminium 6063 alloys (Al – Si – Mg) are commonly used materials for aerospace industries, because of its high tensile strength and lighter weight. The major composition metals of Aluminium 6063 alloys are Aluminium, Magnesium, and Silicon. It has good mechanical properties which are heat treatable and

weldable. Density of the Aluminium 6063 Alloy is 2.68g/cm<sup>3</sup>.

Metals	Composition (%)
Silicon	0.2 – 0.6
Iron	0 – 0.35
Copper	0 – 0.10
Manganese	0 – 0.10
Magnesium	0.45 – 0.9
Chromium	0 – 0.10
Zinc	0 – 0.10
Titanium	0 – 0.10
Others	0.05 – 0.15
Aluminium	97.5 – 99.93

**Table 1. Compositions of Al 6063 alloy**

Depends on solution treatment process, the tensile strength and hardness varies. Un-heat treated Aluminium 6063 Alloys have tensile strength of 131 Mpa.

## III. HEAT TREATMENT PROCESS

The heat treatment process carried out in this research paper is quenching using various bio-quenchants like brine solution, water, ice water. The Aluminium 6063 alloy was procured in the form of bar. It was later machined to the required dimension. According to the ASTM standard, the dimension of the specimen for tensile test is 100 x 25 x 6mm.



**Fig 1. Aluminium Bar**



**Fig 2. Machined Aluminium bar**



**Fig 3. Universal Testing Machine**

The stress vs strain graph for the ice water treatment is as shown in the figure 4.

Quenching is the process of heating the metals near its re-crystallization temperature and cooling rapidly using quenchant. In this, Aluminium 6063 alloy was heated at 250°C for one hour and quenched in the bio-quenchant.

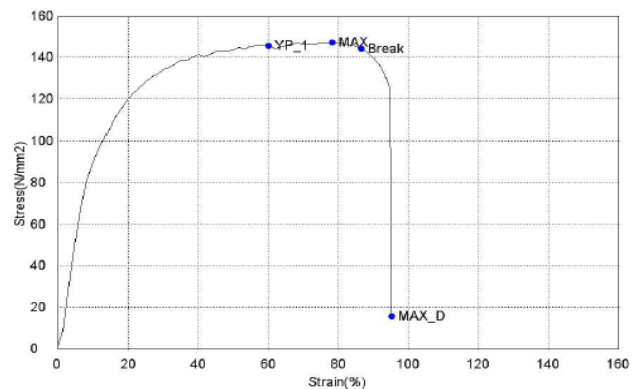
**Testing**

After completing the heat treatment process the specimens were tested to find out the tensile strength and hardness. Tensile testing was carried out in Shimadzu AGX-S plus Universal Testing Machine with cross head speed of 20mm/min. Hardness of the heat treated Aluminium 6063 alloy were tested using Rockwell hardness testing machine.

**IV. EXPERIMENTAL DETAILS**

**Tensile Strength**

Tensile strength of Aluminium 6063 Alloys was tested and the results were evaluated using Shimadzu AGX-S machine. The photographic view of the machine is as shown in fig. 3.



**Fig 4. Stress vs strain graph for ice water treated Aluminium 6063 alloy.**

The stress vs strain graph for the brine water treatment is shown in the figure 5.

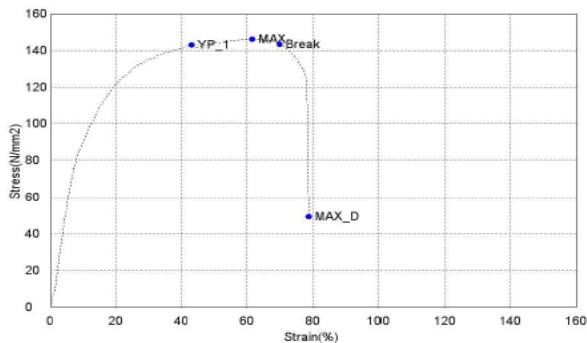


Fig 5. Stress vs strain graph for brine solution treated Aluminium 6063 alloy.

The stress vs strain graph for the water treatment is shown in figure 6.

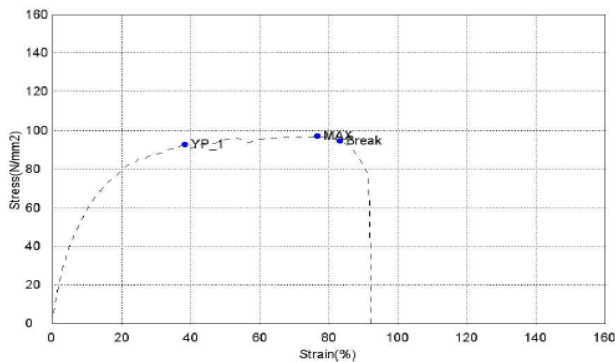


Fig 6. Stress vs strain graph for water treated Aluminium 6063 alloy.

**Hardness**

The hardness of the Aluminium 6063 alloys were tested in Rockwell Hardness tester. The B scale had been chosen for the Aluminium where, the size of the steel ball indenter is 1/16". Three trials had been taken at different locations of the specimen and the average value is calculated.

**Results**

The results for the tensile test and the hardness test are shown in the table 2. Comparison of the tensile stress of Aluminium 6063 alloy when heat treated using different bio-quenchants is shown in fig.7 and of the hardness is shown in fig. 8

	Ice water	Brine solution	Water
Tensile strength (N/mm <sup>2</sup> )	147.235	146.215	97.2699
Hardness (RHB)	57.33	56.33	57.33

Table 2. Mechanical properties of heat treated Al 6063 alloy

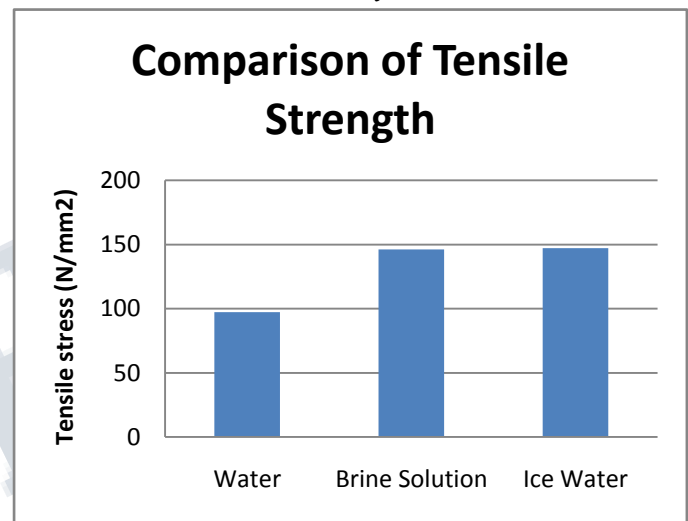


Fig 7. Comparison of tensile strength.

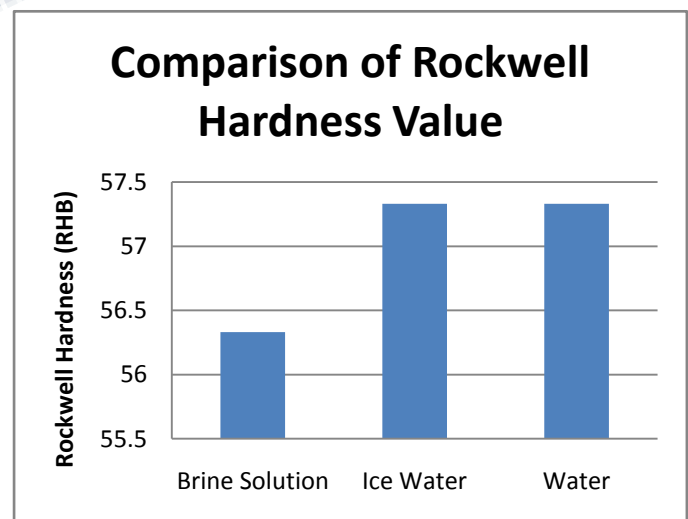


Fig 8. Comparison of hardness

## V. CONCLUSIONS

1. The tensile strength of ice treated Aluminium 6063 alloy is more than brine water and water treated Aluminium 6063 alloy.
2. The Rockwell hardness of ice water and water treated Aluminium 6063 alloy are equal which is more than that of brine water treated Aluminium 6063 alloy.

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