

# The Effect of Heat Treatment on Tensile and Hardness Properties of Al 6061 under T6 Condition

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**Abstract:** --- Aluminum alloy 6061 is one of the most extensively used of the 6000 series aluminum alloys. Aluminum in its purest form is too soft and reactive to be of structural use. However, its alloys such as 6061-T6 alloy, makes it structurally stronger. In the present investigation typical commercial grade Al 6061 alloy obtained from leading professional environments would be the test materials for investigations. The Al 6061 alloy has been subjected to solutionizing treatment at a temperature of 540°C for 2 hours followed by quenching in water. The quenched specimens are subjected to artificial ageing. Tensile test, and hardness tests have been conducted on the specimens subjected to heat treatment. It has been observed under identical heat treatment conditions adopted, Al 6061-subjected to heat treatment under T6 conditions exhibited a significant improvement in hardness when compared with Al 6061 before heat treatment.

**Index Terms**— Ageing, Hardness, Quenching, Solutionizing, Tensile Test

## I. INTRODUCTION

Al6061 is a versatile heat treatable extruded alloy with medium to high strength capabilities. Aluminium alloys are divided into casting alloys and wrought alloys, and are best suited for different applications. Wrought aluminium alloys, such as the 6061 alloy, are worked by extruding, rolling or forging them into specified shapes. Some alloys can be heat treated or cold worked by different methods to increase their strength and hardness, corrosion resistance, ease of fabrication and other advantages. Alloy 6061 can be easily welded and joined by various commercial methods. Since 6061 is heat treatable alloy, strength in its T6 condition can be reduced in weld region

6061-T6 aluminum is structurally stronger and more useful in manufacturing of durable products. It is commonly used in aircraft construction. The present investigation is aimed at studying the effect of quenching and ageing duration on the hardness of Al 6061 alloy. Heat treatment is an operation in the fabrication of an engineering material system. The main objective of heat treatment is to make the material system structurally and physically fit for engineering application. Solution heat treatment of aluminium alloys allows the maximum concentration of hardening solute to dissolve into solution. This process is carefully carried out by heat treatment of an alloy to a temperature at which one

single solid phase exists. Quenching is a process of rapid cooling of material system to room temperature. The cooling rate needs to be fast enough to prevent solid state diffusion and precipitation of the phase. The rapid quenching creates saturated solution and allows for increased hardness and mechanical properties of the material system. In this investigation the ageing behavior of both heat treated and un heat treated Al6061 specimens.

## II EXPERIMENTAL

### 2.1 Heat treatment

The both heat treated and unheated Al 6061 alloy specimens were subjected to heat treatment at a temperature of 540°C for a period of 2 hours using a furnace, followed by quenching in water medium. Artificial ageing treatment was carried out for 4 hour to 8hour in step of 2 hours. Tensile strength, and hardness test were carried out on both unheated and heat treated specimens. Although the term heat treatment is often used to describe the procedures required to achieve maximum strength in any suitable composition through the sequence of solution heat treatment, quenching, and precipitation hardening, The heat treatment comprises all thermal practices intended to modify the metallurgical structure of products in such a way that physical and mechanical characteristics are controllably altered to meet specific engineering criteria.

**2.2 Hardness Test**

Hardness measurements were carried out on the specimens of heat treated in order to compare with the unheated Al6061. Round specimens of 20 mm in diameter were prepared. The prepared specimens were tested using the Rockwell hardness tester. A load of 500 kgf is applied for a period of 30 seconds.

**2.3 Tensile Test**

Tensile strength measurements were carried out on the test specimens of heat treated in order to compare with the Al 6061 unheated test specimens. Tensile strength has been measured using the tensometer instrument.

**III. RESULTS AND DISCUSSIONS**

**3.1 Hardness**

The variation of hardness with increase in the ageing hours is shown in the figure 1. It is observed that with increase in the ageing duration there is a significant improvement in the hardness of the alloy

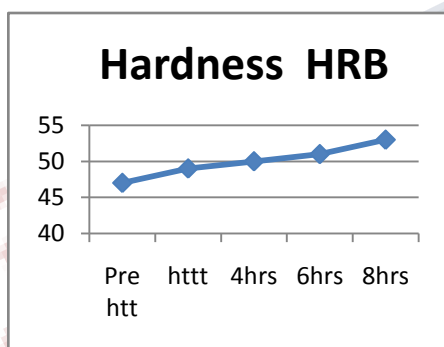


Fig 1: Variation of hardness with increase in ageing hrs

**3.2 Tensile Strength**

The variation of the tensile strength of the heat treated Al 6061 with increase in the ageing hours is as shown in the figure 2. It is observed that tensile strength of Al 6061 alloy is found to be increased after heat treatment and ageing.

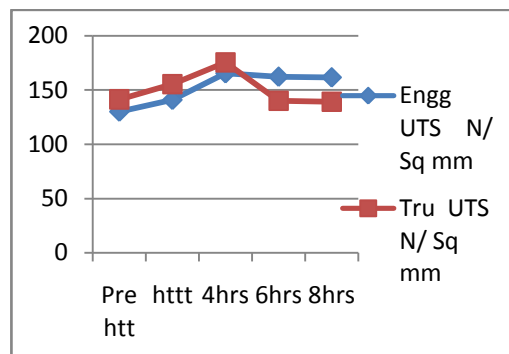


Figure .2. Variation of tensile strength with ageing time

The variation of peak load increase in the ageing as shown in the figure 3. It is evident that peak load found to be increased after heat treatment and ageing. From figure 4 observe peak and break displacement decrease with heat treatment and ageing.

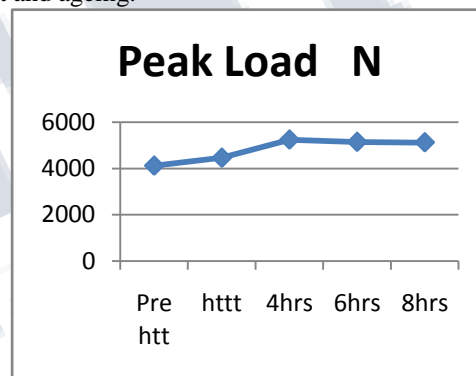


Figure .3. Variation of peak Load strength with ageing time

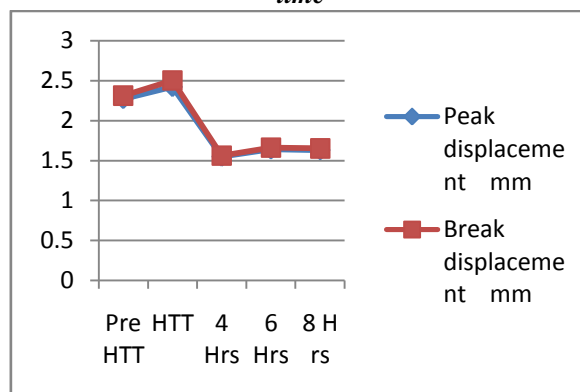
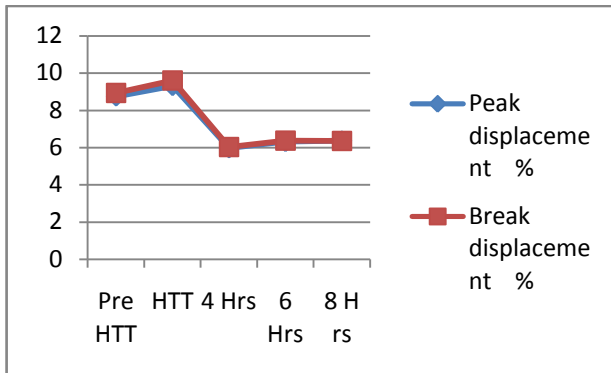


Figure 4. Variation of peak and break displacement with ageing time



**Figure 5. Variation of peak and break displacement percentage with ageing time**

#### IV. CONCLUSIONS

The mechanical and structural properties of Al6061 are improved after heat treatment. Tensile strength and hardness of Al 6061 is increased with the increase in the ageing time. The elongation of specimens decrease with heat treating and ageing. The percentage Displacement of specimen decrease with heat treatment and ageing.

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