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Heat Treatment in Aluminium.

→ Introduction to Heat Treatment.

Heat treatment is a process used to alter the physical and chemical properties of a material to enhance their mechanical properties for specific applications. It involves heating of a material to a controlled temperature, holding it for some amount of time and then cooling at a controlled rate. It improves characteristics such as hardness, strength, toughness, ductility and corrosion resistance.

→ Types of Heat treatment of Aluminium.

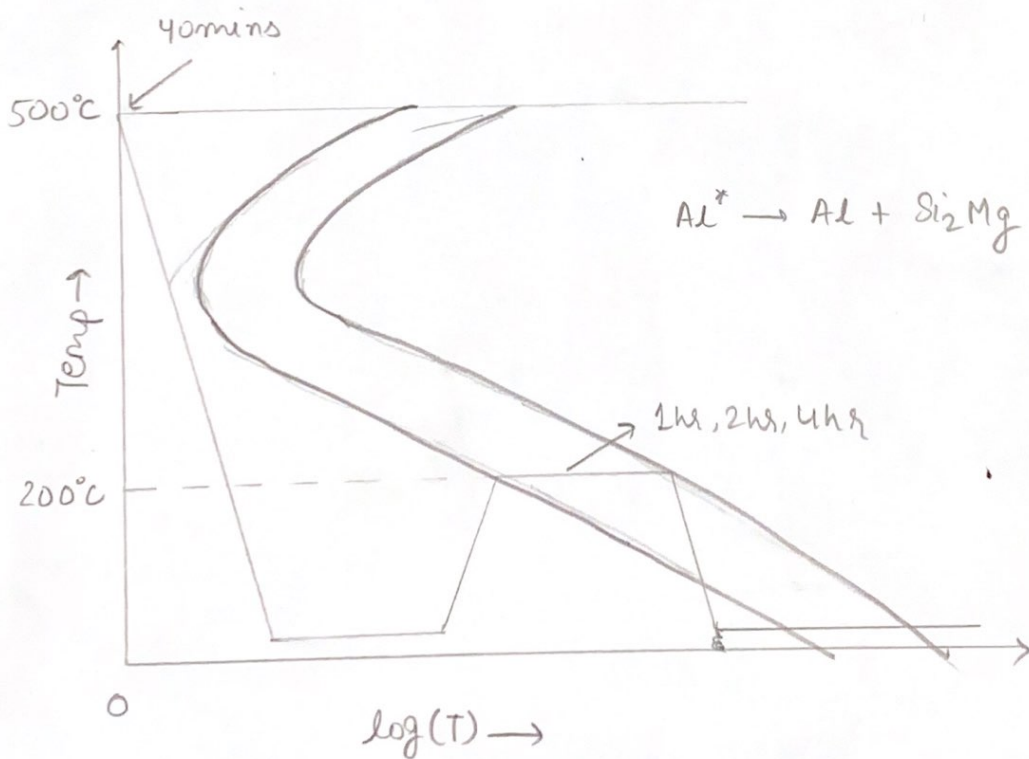
There are four types of heat treatment process:

- ① Annealing - It is a type of heat treatment in which metal ~~to~~ is heated to a certain temperature and then allowed to cool in the furnace itself. It is frequently utilized to soften a metal for cold working to improve properties like conductivity.
- ② Ageing - It is a process of allowing the material to sit at room temperature for an extended period of time to enhance its mechanical strength and other properties.

3. Homogenizing - It refers to the process of uniformly distributing impurities and alloying elements within a batch of Alumina powder or an alumina-based ceramic material. It is just done under melting point.

4. Precipitation Hardening - It is a strengthening process which involves formation of tiny particles of secondary phase within the material matrix. The process begins within the addition of a small amount of a solute element such as Mg, Zr or Y.

→ Schematic of Heat Treatment with 'TTT' diagram



→ Applications and Limitations of Heat Treatment.

Applications of Heat treatment are :

- (i) Relieve Internal stress
- (ii) Improve corrosion resistance
- (iii) Increase ductility and toughness
- (iv) Improve hardness, strength and increase wear resistance

Limitations :

- (i) It can damage some materials.
- (ii) It can be expensive.
- (iii) Can cause distortion in materials.

→ Methodology

These are the processes we performed for the material :

1. Heat treatment - firstly we heated in tube furnace to a temperature of 480°C for 20 min. After that quenched it in water and perform ageing by again heating upto 200°C for 1-2 hrs and quenching.
2. After that we polished our material using diff. particle size sand paper like 220, 400, 600, 1500 and finally 2000. The sample is rotated by 90° everytime we changed the paper so that grain size is aligned and also scratches.

3. After sand paper polishing we did cloth polishing which was of velvet cloth. Here we use diamond paste 3-4 micron shifted to 0.5-1 micron as there was more scratches.

4. After that we did Etching process in which we used Keller's Reagent which comprises of 95ml di-water 2.5ml HNO_3 , 1.5ml HCl and 1ml HF .

→ Hardness Measurement Test

For Hardness Test, we used Vicker's Hardness test in which sample is placed on a Vicker's testing machine. Then automated diamond indenter makes indent on it by applying force of 25gf. After making groove we measure the diagonal length of groove automatically by application and then hardness value were calculated using formula.

$$HV = 1.854 \times \text{force} \times (\text{diagonal})^2$$

from this force formula,

$$\text{Average H.V} = 95.5$$

→ Result and Conclusion.

After analyzing our image we come to conclusion that ~~was~~ there was precipitate of copper in our material therefore the Heat treatment used was precipitation hardening.

From the hardness testing Hardness came out to be 95.5.