

AN INVESTIGATION OF HEAT TREATMENT EFFECT ON THE MECHANICAL PROPERTIES OF THE ALUMINIUM ALLOY

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Abstract

The alloy ADC12 also is used to make die-casting components. Heat treatment is used to improve the mechanical properties and can give crack after treatment cause improper cooling rate. When the cooling rate is too slow, undesired grain boundary precipitation occurs, and when the cooling rate is too high, distortion will occur. There have several problems statement that can cause of cracking and fracture during produce the part which are the material has high hardness and brittle. Improper heating to the austenitizing temperature may result in thermally generated stress, resulting in the opening of a flaw into a fracture. Solution treatment and ageing process was applied to ADC12. The UTS of ADC12 drop after solution treatment from 320.60 MPa to 12.43 MPa. The UTS significant increase after apply ageing process to solution treated ADC12 with temperature 135°C and it reach the highest elongation length which 14% at 10 hours holding time. The elongation decreases after applied ageing process at 240°C with different holding time. It shows that, temperature and holding times are the factor effect changes of mechanical properties of ADC12. From the result, it showed that the mechanical properties of ADC12 are reliably achieved by following solution treatment: 8 hours at 450°C and quenching into the water. Then applied ageing process in 10 hours at 135 °C and slow cooling in the oven. Thus, it showed that solution treatment could reduce the UTS and hardness of ADC12, but enhance the elongation. With the aging treatment. It could increase the hardness of the solution treated ADC12.

1 Introduction

The automotive industry is an example of a typical industrial product that uses a wide range of materials and technology. Body components are typically created from steel sheets that are rolled and thermally method to form the required properties. The heavier part components are manufactured through a process historically characterized by stamping, welding, and coating leading up to the assembly process. Some materials may need to go through treatments that change their grain structure throughout the production process. In automotive industry, heat treatment widely uses to change the material properties for strengthen the material. Heat treatments are a method of changing material's physical characteristics and improving them for usage in a variety of industries by applying controlled heating and cooling techniques.

Heat treatment is one of the most essential metal manufacturing processes, which is used to improve the mechanical properties of an alloy casting by controlling factors. There are three stages of heat treatment which is heat stage, soaking stage, and cooling stage. In heat treatment cycle, the metal will heat slowly to desired temperature and then cooled in liquid medium. In the cooling stage, there many ways to do depend on the material and types of cooling medium. Oil, water, brine, and air are all examples of quenching medium. The cooling rate, which may be as high as 8.3 C/s, can affect the mechanical and metallurgical

characteristics of the metal to obtain the exact design parameters required by the part for a given function (W.D. Callister, 2014).

Heat treatment several techniques which are annealing, ageing, solution, tempering and quenching. Solution treatment is the heating of a material to temperatures adequate for the dissolution of its soluble phases, followed by holding the material for a period before quenching, causes the substance to maintain the properties of the solution. In recent year a lot of study has be made about strengthening behaviour of Al alloy during solution and ageing process. As the solution temperature and holding time rise, more S and phases dissolve into the Al matrix, accelerating grain formation. (Lu Sub, 2021). Heat treatment ageing is the process of raising the temperature of an alloy to modify its characteristics. Through a succession of heat treatments, the technique accelerates changes in the characteristics of an alloy. Parameter for ageing process important to change the aluminium properties. Changes in treatment parameters result in the existence of very tiny particles, which might be inclusions, intermetallic phases, or light precipitates, and are responsible for the hardness and mechanical property anomalies (Victor, 2021)

Quenching is that the soaking of a metal at a high temperature, on top of the recrystallization phase, followed by a fast-cooling method to get bound fascinating material properties. Not all metal can be quench because quenching also can give impact to metal such as crack and warp at certain area. It happens