

Non Destructive Ultrasound Testing for the Determination of Elastic Characteristics of AlSi7Zn3Cu2Mg Foundry Alloy

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Abstract : Characterization of materials used for various mechanical components is of great importance in their design. Several studies were conducted by various authors in order to improve their physical and/or chemical properties in general and mechanical or metallurgical properties in particular. The foundry alloy AlSi7Zn3Cu2Mg is one of the main components constituting the various mechanisms for the implementation of applications and various industrial projects. Obtaining a reliable product is not an easy task; several results proposed by different authors show sometimes results that can be contradictory. Due to their high mechanical characteristics, these alloys are widely used in engineering. Silicon improves casting properties and magnesium allows heat treatment. It is thus possible to obtain various degrees of hardening and therefore interesting compromise between tensile strength and yield strength, on one hand, and elongation, on the other hand. These mechanical characteristics can be further enhanced by a series of mechanical treatments or heat treatments. Their light weight coupled with high mechanical characteristics, aluminum alloys are very much used in cars and aircraft industry. The present study is focused on the influence of heat treatments which cause significant micro structural changes, usually hardening by variation of annealing temperatures by increments of 10°C and 20°C on the evolution of the main elastic characteristics, the resistance, the ductility and the structural characteristics of AlSi7Zn3Cu2Mg foundry alloy cast in sand by gravity. These elastic properties are determined in three directions for each specimen of dimensions 200x150x20 mm³ by the ultrasonic method based on acoustic or elastic waves. The hardness, the micro hardness and the structural characteristics are evaluated by a non-destructive method. The aim of this work is to study the hardening ability of AlSi7Zn3Cu2Mg alloy by considering ten states. To improve the mechanical properties obtained with the raw casting, one should use heat treatment for structural hardening; the addition of magnesium is necessary to increase the sensitivity to this specific heat treatment: Treatment followed by homogenization which generates a diffusion of atoms in a substitution solid solution inside a hardening furnace at 500°C during 8h, followed immediately by quenching in water at room temperature 20 to 25°C, then an ageing process for 17h at room temperature and at different annealing temperature (150, 160, 170, 180, 190, 240, 200, 220 and 240°C) for 20h in an annealing oven. The specimens were allowed to cool inside the oven.

Keywords : aluminum, foundry alloy, magnesium, mechanical characteristics, silicon

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