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PII: S0167-8442(16)30170-7
DOI: http://dx.doi.org/10.1016/j.tafmec.2016.09.014
Reference: TAFMEC 1774

To appear in: *Theoretical and Applied Fracture Mechanics*

Received Date: 30 June 2016
Revised Date: 15 September 2016
Accepted Date: 27 September 2016

Please cite this article as: P. Miguel Bravo Díez, M. Preciado Calzada, D. Cárdenas Gonzalo, J. Calaf Chica, Change of mechanical properties of AM60B alloy with heat treatments and its correlation with small punch tests, *Theoretical and Applied Fracture Mechanics* (2016), doi: http://dx.doi.org/10.1016/j.tafmec.2016.09.014

CHANGE OF MECHANICAL PROPERTIES OF AM60B ALLOY WITH HEAT TREATMENTS AND ITS CORRELATION WITH SMALL PUNCH TESTS

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ABSTRACT

AM60B alloy, injected by high pressure die casting process (HPDC), is one of the most widely used alloys for its ease of processing and low price. There is an industrial interest in the use of heat treatments in order to increase the elongation before failure of the alloy. This paper aims to correlate the results of tensile test of heat treated specimens with small punch tests (SPT's). It is also intended to find out if the different characteristic values of such tests for different mechanical properties are sensitive enough to detect changes produced by heat treatments or injection process parameters and if the correlation factors are sufficiently stable. In addition, this study is also focused on the validation of the applicability of such miniature tests for high pressure die casting magnesium alloys, since this process introduces a significant number of defects and thus a variability of the mechanical properties is expected.

KEYWORDS: AM60B, AZ91D, small punch test, high pressure die casting, squeeze casting, heat treatments.

1 INTRODUCTION

Magnesium alloys injected at high pressure are of great industrial interest because of their price and ease of processing. The magnesium alloys most commonly used for high pressure die casting (HPDC) are the AM60B alloy and AZ91D alloy. AM60B alloy has a moderate resistance at room temperature and greater ease of processing and ductility than AZ91D alloy, with AZ91D alloy having a higher specific resistance but lower ductility due to its higher aluminum content.

It is of great interest to the industry to improve injection processes and use thermal treatments to increase the capacity of plastic deformation and consequently the energy absorption capacity. In this aspect porosity is a drawback.

In recent years there have been many studies on the application of the miniature punch test (SPT - Small punch test) for alloys. In these studies, the values of mechanical properties obtained by tensile tests are correlated with the characteristic values of the miniature punch tests, subsequently allowing expressions which predict the mechanical properties when only miniature punch tests are performed. These tests are used to predict properties such as the tensile strength and elongation at break [1-3], creep [4] and fracture toughness [5, 6], as well as others.

Furthermore, studies have also been done using miniature punching shear tests for AM60B alloy in which the maximum strength and the elastic limit of tensile test and punching shear tests have been correlated [7], in addition to hardness and maximum strength [8].

This paper presents the correlation between the results of tensile test specimens and SPT's for magnesium alloys AM60B and AZ91D injected using HPDC (High Pressure Die Casting) and alloy AM60B injected using "Squeeze Casting", with and without heat treatment. Specimens of