MECHANICAL BEHAVIOUR OF SPHERIODAL GRAPHITE CAST IRON IN THE TEMPERATURE RANGE BETWEEN –100°C AND +100°C

V.E. FIERRO[†‡], J.A. SIKORA[*], A.F. ANSALDI[†], P.J.J. RATTO[†], F.R. AGÜERA[†‡] and H.N. ALVAREZ VILLAR[†‡]

[†]*CITEFA, Dpto. Ciencia y Técnica de Materiales, Juan Bautista de Lasalle 4397, (1603) Bs. As., Argentina pratto@citefa.gov.ar*
[‡]*Universidad de la Marina Mercante, UdeMM, Rivadavia 2258, (1034) Cap. Fed., Argentina*
[*]*INTEMA, Fac. de Ing., Univ. Nac. de Mar del Plata, Av. Juan B. Justo 4302, (7600) Mar del Plata, Argentina*

Abstract— **Impact tests were done on spheroidal graphite cast iron samples, with five different microstructures. These were obtained by means of the following heat treatments: subcritical annealing, normalizing and two different austempering processes. Other samples were tested in their as-cast condition. The tests were carried out in a temperature range from –100°C to +100°C. Also, tensile tests and hardness measurements were performed to qualify the samples. Every specimen came from a single melt, cast in "Y" blocks of two different thicknesses. The impact test results showed an alteration in the fracture behaviour as a function of temperature. The transition temperature, in particular, showed a meaningful shift with the enlargement of the "Y" block. This feature can lead to lower performances than expected. The harder and tougher the matrix, the more important this shift was.**

Keywords— **Cast iron, ADI, low temperature impact properties.**

I. INTRODUCTION

For many years, the ADI (Austempered Ductile Iron) has been considered as an alternative material, substitute for steel in several mechanical components, because it offers the possibility of obtaining a broad range of mechanical properties starting from a generic spheroidal graphite cast iron melt and applying specific heat treatments.

Also, it has a lower manufacturing cost and the capacity of obtaining complex shape components as it is a cast material. Nevertheless, it is a relatively new material, so several of its properties are at present subject of study or are still unknown. In the bibliography there are few reports about the low temperature behaviour of ADI (Lunyendijk and Nieswaag, 1983; Dorazil and Holzmann, 1991).

The aim of this paper is to characterize the impact response of two different ADI grades and to compare them with the response of the other matrices (pearlitic and ferritic) obtained from the same industrial melt, in the range between -100°C and +100°C. Also, a comparison between specimens obtained from two different thickness cast blocks was done.

II. EXPERIMENTAL PROCEDURE

Two "Y" blocks (ASTM A 536-84) of 13 mm and 75 mm in thickness were cast in green sand molds. The chemical composition of the melt was slightly alloyed (Table 1). Samples for Charpy impact tests and for tensile tests were machined from the blocks. A total of 380 unnotched Charpy specimens of 10X10X55 mm (ASTM A 327M-91) and 30 tensile test specimens 6 mm in diameter (ASTM A 897M-90) were performed.

Table 1. Chemical composition of the melt (wt. %).

C	Si	Mn	S	P	Mo	Cu	Mg
3.45	3.22	0.27	0.014	0.03	0.03	0.07	0.045

To avoid troubles with the heat treatment penetration reported in the literature (Hayrynen *et al*., 1989; Faubert *et al*., 1990; Faubert *et al*., 1991) the samples were heated after the machining. Table 2 describes the codification used and the heat treatment parameters for every batch of specimens. Nodule count, nodule size and nodularity were determined (ASTM A 247-67) on metallographic samples in their as-cast condition (Table 3).