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Mechanical properties of three stage heat treated Austempered ductile iron

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With engineering properties comparable to those of steel, austempered ductile iron (ADI), commonly used on mines and in structural applications, has high tensile strength, moderate elongation, acceptable wear and corrosion resistances. Its microstructure is made of ausferrite retained austenite and martensite. This could be a result of either a heat treatment process or of micro-alloying. In the view of developing the materials for improved properties, multi stages heat treatment process has been suggested. This paper aims at understanding the effect of the microstructural constituents present in the ADI material on a further heat treatment - ageing at 260 C, conducted with ferritic and pearlitic spheroidal graphitic (SG) cast iron. Each sample was austenitized at 900 C for 30 minutes, austempered at 370 C for various durations (ie 30 minutes, 60 minutes and 90 minutes) then aged at 260 C also for different durations (ie for 1 hour, 2 hours, 3 hours and 4 hours). Metallographic examination of the two stage heat treated ADI, at 500x magnification and the X-Ray Diffraction (XRD) were conducted to determine the types and the quantity of phases present in the heat treated samples. It was observed that prolonging the aging time (from 1 hour to 4 hours) led to a decrease in the hardness values in the ferritic SG cast iron for all the austempered durations, hence leading to an increase in the impact toughness. With the pearlitic SG cast iron, austempering for 30 minutes and 90 minutes showed a similar trend in the decrease of the hardness values from 1 to 2 hours and again from 3 to 4 hours, thus showed an increase in the impact toughness from 1 to 2 hours and again from 3 to 4 hours. It is concluded that the two stage further heat treatment affected the hardness and the toughness of the ADI.

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