ABSTRACT

In ductile iron, research has been going on continuously throughout the world to improve the various properties to suit the selected application. As cast irons, ductile irons have excellent damping capacity and castability.From ductile iron, the austempered ductile iron was developed in the last two decades. Austempered ductile iron has excellent hardness, toughness and moderate wear resistance combined with damping capacity due to graphite spheroids in ausferrite matrix.

To increase the wear resistance, Carbidic Austempered Ductile Iron (CADI) withcarbides and ausferrite with moderate sacrifice in toughness was developed. The present work focuses on the study about CADI and to find out cost effective methods to manufacture.

Carbidic Austempered Ductile Iron by alloying with chromium and molybdenum and pouring into moulds i) without chills, ii) by using chills at the bottom of the mould and iii) using chills at the bottom and sides of the mould.

For this research work thirty different test castings with different percentages of copper, chromium and molybdenum without chill and with two different chill arrangements were produced.All the thirty test castings produced were characterised for composition, microstructure, hardness, tensile strength, impact toughness and SEM.

The as cast characterisation has led to the following conclusions

1. Stable alloy carbides up to 33% are formed with 1% chromium and 0.6% Molybdenum along with 0.5% copper.

2. Chilling of the material increases the rate of solidification and in turn it increases the as cast carbide content and retards the formation of spheroids of graphite.

The samples without chromium and molybdenum but with 0, 0.5% copper were austenised at 925ºC and austempered at 300ºC and 325ºC.

DOE was used to reduce the number of experiments and the number of trials was reduced to nine.The stability of the carbides were verified by heat treatment of the copper, chromium and molybdenum alloyed samples at 1000ºC which confirms that the carbides were stable even at high temperatures.For samples selected as per DOE austenising at 925ºC and austempering at 300º and 325ºC was carried out.

The characterisation leads to the following major conclusions

1. Increase in tensile strength was not observed for Cr and Mo alloyed ductile Iron.

2. Hardness as high as 506 VHN with excellent wear resistance and moderate increase in toughness was obtained for 0.5 % Cu, 1.0 % Cr and 0.6 % Mo alloyed CADI austempered at 300 ºC.

3. The ausferrite combination with as cast carbides and austempered at 300 ºC was better, based on wear resistance, hardness and toughness compared to other combinations even though the fracture surface was brittle.

Finally, the developed compositions suitability to actual usage for a limited time was verified by producing teeth for excavator bucket and subjecting it to field trials.