Effect of Tempering Process on the Microstructure and Mechanical Properties of Ductile Cast Iron*

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Abstract

Ductile cast iron combines the principal advantages of gray cast iron (low melting point، good fluidity، castability ،machinability, high vibration damping capacity and good wear resistance) with the engineering advantages of steel(high strength، toughness ductility، hot workability and hardenability).

The aim of this work was to determine the critical temperature for each kind of the ductile cast iron ،GGG60 ،GGG50 ، GGG40 to study the effect of tempering process on the microstructure and mechanical properties of ductile cast iron and also to analyse the obtained results in order to determine the optimum heat-treatment (hardening and tempering) parameters ،mainly temperature and time which achieve the most favorable combination of mechanical properties. An experimental investigation was conducted on three grades of ductile cast iron: GGG 40، GGG 50 and GGG 60 according to DIN 1693.

The microstructure of these three grades of ductile cast iron before heat treatment was: spheroidal graphite، embedded in ferritic-pearlitic matrix، the BHN of these three grades of ductile cast iron were: 150، 196 and 255، and their ultimate tensile strength were: 456، 545 and 662 N/mm^2 (as cast condition) respectively.

The critical temperature AC was determined for each one of these three grades of ductile cast iron by measuring hardness values of quenched samples. They were quench hardened and tempered at different levels of temperature from 250 to 550 ^oC. By so doing، the matrix was changed to "tempered martensite" and a wide range of mechanical properties could be obtained at the different levels of tempering temperature. It was found possible to increase the ultimate tensile strength of these three grades of ductile cast iron to: 1195، 1260 and 1280 N/mm^2 respectively. This maximum gain in tensile strength was accomplished when the tempering temperature was in the order of 400 ^oC to 450 ^oC.

Keywords: ductile cast iron، quench hardened، tempered، microstructure and mechanical properties

* For the paper in Arabic see pages (87-98).

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