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Characterization of Alloyed Grey Cast Iron Quenched and Tempered for a Smooth Roll Application

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Abstract : In the brick industry, smooth double roll crusher is used for medium and fine crushing of soft to medium hard material. Due to opposite inward rotation of the rolls, the feed material is nipped between the rolls and crushed by compression. They are subject to intense wear, known as three-body abrasion, due to the action of abrasive products. The production downtime affecting productivity stems from two sources: the bi-monthly rectification of the roll crushers and their replacement when they are completely worn out. Choosing the right material for the roll crushers should result in longer machine cycles, and reduced repair and maintenance costs. All roll crushers are imported from outside Algeria. This results in sometimes very long delivery times which handicap the brickyards, in particular in respecting delivery times and honored the orders made by customers. The aim of this work is to investigate the effect of alloying additions on microstructure and wear behavior of grey lamellar cast iron for smooth roll crushers in brick industry. The base gray iron was melted in an induction furnace with low frequency at a temperature of 1500 °C, in which return cast iron scrap, new cast iron ingot, and steel scrap were added to the melt to generate the desired composition. The chemical analysis of the bar samples was carried out using Emission Spectrometer Systems PV 8050 Series (Philips) except for the carbon, for which a carbon/sulphur analyser Elementrac CS-i was used. Unetched microstructure was used to evaluate the graphite flake morphology using the image comparison measurement method. At least five different fields were selected for quantitative estimation of phase constituents. The samples were observed under X100 magnification with a Zeiss Axiover T40 MAT optical microscope equipped with a digital camera. SEM microscope equipped with EDS was used to characterize the phases present in the microstructure. The hardness (750 kg load, 5mm diameter ball) was measured with a Brinell testing machine for both treated and as-solidified condition test pieces. The test bars were used for tensile strength and metallographic evaluations. Mechanical properties were evaluated using tensile specimens made as per ASTM E8 standards. Two specimens were tested for each alloy. From each rod, a test piece was made for the tensile test. The results showed that the quenched and tempered alloys had best wear resistance at 400 °C for alloyed grey cast iron (containing 0.62%Mn, 0.68%Cr, and 1.09% Cu) due to fine carbides in the tempered matrix. In quenched and tempered condition, increasing Cu content in cast irons improved its wear resistance moderately. Combined addition of Cu and Cr increases hardness and wear resistance for a quenched and tempered hypoeutectic grey cast iron.

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