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Effects of Alloying Element on Compressive and Wear Properties of Multi-component White Cast irons for Steel Rolling Mill Rolls

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Abstract. Multi-component white cast irons containing Cr, Mo, W and V have been widely popularized as roll materials for hot rolling mills because of their excellent wear resistance. Work rolls of multiple rolling mills applied usually to hot strip finish rolling are required to endured the contact pressure occurred by rolling force between work roll and buck-up roll or intermediate roll. And the wear resistance is required as a primary performance. In this research, influence of carbon (C), chromium (Cr), molybdenum (Mo), tungsten (W) and vanadium (V) contents on compressive properties and hot wear properties were investigated using Fe-2mass%C-5mass%Cr-5mass%Mo-5mass%W-5mass%V-5mass%Co alloy as basic chemical composition and changing Carbon from 1mass% to 3mass% and other elements from 0mass% to 10mass%. MC and M_2C carbides are crystallized from a molten metal in a wide region near the basic chemical composition. Martensitic matrix is obtained in a wide region near carbon-balance (C_{bal}=C%-(0.060Cr%+0.063%Mo+0.033%W+0.235%V)) of −1% ～+1%. In that place, hardness is over $600HV_{298N}$. Macro-hardness and matrix hardness show basically similar tendency but macro-hardness is higher than matrix hardness in the case of pearlite matrix. 0.2% compressive proof strength was found to increase with an increase in hardness and also found that the relation is $\sigma_{0.2\%}$ (MPa)=$3.52HV_{298N}$-588 for irons with martensitic and fine pearlitic matrices. The equation Pmax=$1.65\sigma_{0.2\%}$ was obtained between Hertzian contact pressure and compressive proof strength. In order for rolls to endure the contact pressure of 2.6GPa, the compressive proof strength over 1.6GPa is necessary and the multi-component white cast irons with macro-hardness over $600HV_{298N}$ can be said to be appropriate roll materials for recent hot strip finishing mills applied by heavy load. Wear resistance is basically better in cast irons with high hardness and high fracture toughness.

Keywords: *Multi-component white cast iron, Rolling mill roll, Alloying element, Microstructure, Hardness, Compressive proof strength, Hertzian contact pressure, Wear.*