Performance of high-chromium white cast iron in mining component

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Under mining working conditions high tribo-mechanical properties of materials are required, such as: high fracture resistance under cyclic loading conditions, good abrasion and corrosion properties, and high impact loading resistance. In this regard, high-chromium white cast iron is a material highly used in mining, mineral processing, metallurgical and cement industries, mainly due to its very high abrasive wear resistance combined with relatively low production cost.

In this work, the identification of the most relevant degradation mechanisms that eventually caused the failure in working components subjected to severe wear conditions were analysed. Specifically, wear protection buttons were extracted from a mining cable shovel bucket exposed to several hundred thousand load cycles during the extraction of mainly copper ore in the Boliden Aitik mine. Multiple cracks nucleated at the surface of the button and propagated into the component produced severe worn of material (chipping). Once defined the most critical failure mode, the relevant mechanical properties that determine the wear resistance of the studied part was identified, this information was useful for the development of experimental set up at lab scale. In this regard, contact fatigue test was performed to evaluate the crack nucleation and propagation resistance under Hertzian loading condition. Three maximum loads were applied under monotonic and cyclic loading conditions using a spherical indenter tip: 1000 N, 2500 N and 5000 N. Two qualities of high-chromium white cast iron were evaluated, the first one richer in carbon content (3.3 % C and 17.5% Cr) and second one richer in chromium (2.4 % C and 19.8% Cr). Results were analysed in terms cracks appearance and eventual propagation of cracks observed at the edge of the residual imprints.

Keywords: High-chromium white cast iron, contact fatigue, mining, buttons.

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