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Performance evaluation and failure analysis of conical picks used in a Botswana (Ngwato) mine

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ABSTRACT

A coal mine in the central district of Botswana is experiencing premature failure of conical picks which mine 150–350 tons of coal/pick rather than 400 tons/pick specification. This has adverse implications on business productivity and profitability due to the need to replace the picks with new ones. This study employed physical observation of mining operation; macroscopic and microscopic examinations; weight loss analysis; micro-hardness, and fractography analyses of one hundred and ninety-three (193) worn-out and five (5) new picks to investigate root causes of its failure and failure mechanisms with a view to identifying mitigation measures to avoid recurrent failure. It was observed that the picks situated at the extreme right and left ends of the cutter drum failed most frequently. Common modes of failure discovered for Botswana coal mine picks include one-sided wear of the pick body, pull-out of pick's carbide tip, slimming steel body and even wear of carbide tip, and carbide tip deformation. Furthermore, cracking and crushing of tungsten carbide (WC) grains, cavity formation and pitting, coal intermingling, abrasion wear, long and deep cracks, rock channel formation, and corrosive degradation were identified as the failure mechanisms. Recommended mitigation measures to avoid repeated failures include the use of structurally stable materials at elevated temperature and characterised with improved hardness, toughness and wear resistance for pick manufacturing; exploring manufacturing technology that imparts improved bonding in the constituent materials without degrading material properties; redesigning of pick's flange; and inspection of pick's free rotation of the pick before starting any shift.

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