Engineering Failure Analysis

Analysis of failure characteristics of screen plates of ring hammer crusher used in coal handling applications

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The screen plate, a critical component within a ring hammer crusher (also known as a ring granulator or rolling ring crusher), plays a vital role in the secondary crushing of coal. Functioning both as a platform for coal crushing and as a sieve to achieve the desired coal size, it is essential to understand and examine its failure characteristics to enhance its mechanical and wear resistance properties in coal handling applications. This study thoroughly explored the failure modes, mechanisms, and underlying causes of screen plate failures. Microscopic techniques such as optical microscopy (OM), scanning electron microscopy (SEM), Vickers microhardness test and spectrochemical analysis were utilised to identify the failure mechanism. Failure modes identified from the macroscopic analysis were discharged hole widening, hole wall break-off, plate edge crack, plate fracture, one-sided edge slimming, and general surface wear of the screen plate. The fractographic and wear track analysis identified the principal failure mechanisms of three-body abrasive wear, two-body sliding abrasion wear, shear-induced fatigue fracture and brittle shear fracture. The root causes of the failures are the rotor's direct impact, defects in the parent material, the presence of hard materials in the coal and the use of unsuitable steel grade in the screen plate manufacturing. The service life of the screen plate can be improved through proper material selection, uniform crusher feeding, surface modification of the surface of the "as purchase" screen plate with appropriate wear-resistant materials, and adherence to good maintenance practices.