Abrasive Wear Mechanisms of Sand Particles Intruding into ATM Roller-Scraper Tribosystem

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Abstract: The roller-scraper tribosystem of Automatic Teller Machine (ATM) plays an important role in reliable cash requests. However, the abrasive wear of the polymer tribosystem becomes a prominent problem when operating in sandy environment. The wear behavior of the tribosystem in a simulated sandy environment has been experimentally studied previously. However the abrasive wear mechanism of roller-scraper tribosystems is still unknown to new design. The wear rates of polymer rollers were examined comprehensively and several jumping variations were found in the full data extent. Three wear stages were classified by the magnitude of wear rates, and different dominant wear mechanisms corresponding with different particle diameter were found by examining the worn surfaces. Accordingly a presumption was proposed that wear mechanisms in different stages were correlated with sand particles of different diameter. In a verification experiment, three typical wear mechanisms including cutting, ploughing, and wedging were found corresponding with different wear stages by SEM examination. A theoretical analysis was carried out with a simplified sphere particle intrusion model and the transfer conditions for different wear mechanisms were studied referring to the slip-field theory. As a main result, three typical wear models versus μ (friction coefficient of particle/roller), and r (particle radius) were mapped with variant H (Hardness of the polymer roller) and f (ratio of contact shear stress to bulk shear stress). The result illuminated the abrasive wear mechanism during particle intrusion. Particularly, the critical transition conditions gave the basis for improving the wear performance of roller-scraper tribosystems in a sandy environment.

Key words: Tribosystem, Abrasive Wear, Mechanism

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