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Effect of Impact Angle on Erosive Abrasive Wear of Ductile and Brittle Materials

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Abstract : Erosion and abrasion are wear mechanisms reducing the lifetime of machine elements like valves, pump and pipe systems. Both wear mechanisms are acting at the same time, causing a “Synergy” effect, which leads to a rapid damage of the surface. Different parameters are effective on erosive abrasive wear rate. In this study effect of particle impact angle on wear rate and wear mechanism of ductile and brittle materials was investigated. A new slurry pot was designed for experimental investigation. As abrasive particle, silica sand was used. Particle size was ranking between 200-500 µm. All tests were carried out in a sand-water mixture of 20% concentration for four hours. Impact velocities of the particles were 4,76 m/s. As ductile material steel St 37 with Brinell Hardness Number (BHN) of 245 and quenched St 37 with 510 BHN was used as brittle material. After wear tests, morphology of the eroded surfaces were investigated for better understanding of the wear mechanisms acting at different impact angles by using optical microscopy and Scanning Electron Microscope. The results indicated that wear rate of ductile material was higher than brittle material. Maximum wear was observed by ductile material at a particle impact angle of 300. On the contrary wear rate increased by brittle materials by an increase in impact angle and reached maximum value at 450. High amount of craters were detected after observation on ductile material surface Also plastic deformation zones were detected, which are typical failure modes for ductile materials. Craters formed by particles were deeper according to brittle material worn surface. Amount of craters decreased on brittle material surface. Microcracks around craters were detected which are typical failure modes of brittle materials. Deformation wear was the dominant wear mechanism on brittle material. At the end it is concluded that wear rate could not be directly related to impact angle of the hard particle due to the different responses of ductile and brittle materials.

Keywords : erosive wear, particle impact angle, silica sand, wear rate, ductile-brittle material
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