

ABSTRACT

A series of mechanical wear and electrochemical tests were carried out on three grades of WC-Co cemented carbides to investigate the tribological and corrosive properties of the hardmetals as viable protective liners for chutes and skips. The performance of the WC-Co hardmetal was compared to three different grades of high chromium white cast irons and Hadfield steel. The cobalt binder content and WC particles size were varied: the binder content ranged from 6-12 wt% and the grain size of the WC particles ranged from 0.4-2.3 μm . The cast irons varied in their chromium content: 20.2, 22.2 and 24.5 wt%Cr. The macroscopic abrasive wear mechanisms of the materials were investigated by conducting both dry and wet rubber wheel abrasion tests. The microscopic abrasive wear mechanisms were evaluated by using the pin-on-disc tribometer. Solid particle erosion wear tests and electrochemical wear tests were included in this work to aid in ranking the performance of the investigated materials.

The WC-Co alloys performed substantially good in both wear and corrosion, followed by the HCWCI alloys. The Hadfield steel showed poorest response against all the tests. WC-12Co, which consisted of the finest grain size and highest Co content, exhibited exceptional responses to the rubber wheel abrasion test and the pin-on-disc tribometer. WC-12Co also displayed good resistance against corrosive attack in 1M H_2SO_4 . However, because of its brittle nature, WC-12Co succumbed to brittle wear mechanisms during solid particle erosion and it was the HCWCI alloys that had better responses to solid particle erosion wear. The HCWCI alloys also displayed exceptional resistance against the slurry abrasion test. The main damaging wear mechanisms that the WC-Co alloys experienced were found to be binder extrusion and WC particle fallout and the main damaging corrosion mechanism was found to be the dissolution of the cobalt binder phase. The main damaging wear mechanisms experienced by the HCWCI alloys were microploughing and carbide displacement whereas the Hadfield steel mainly experienced severe microcutting. The WC-Co alloys displayed a general trend of good resistance against wear and corrosion; however, their high density means they are heavy for the area they are required to cover. Therefore, it was concluded that the best material for the application of liners would be the HCWCI-22.2Cr alloy.