

Abstract

Solid particle erosion is a major concern in coal fired power plants around the world. Failure due to solid particle erosion has an impact on power plants to produce electricity especially in South Africa where load shedding has had a significant bearing on the economy.

The aim of this research is to perform solid particle erosion experiments on commercially available erosion protection materials and then rank these materials in terms of its erosion resistance, this will enable the coal fired plant design and/or maintenance team to select the most appropriate erosion protection material/s for different coal fired power plant applications. The erosion value is defined as the volume loss of specimen material divided by the total mass of abrasive particles that impacted the specimen. The erosion value is reported as (mm^3/g).

Five pre-selected wear resistant materials were selected for this research. All experiments were performed using an ambient temperature solid particle erosion rig. The aluminium oxide (Al_2O_3) abrasive was selected for the experiments based on Quantitative Evaluation of Minerals by Scanning Electron Microscopy (QEMSCAN) results.

For carbon steel and VRN 400 (ductile materials), the maximum erosion value was observed at an impact angle of 30° and as the impact angle increases from 30° to 90° , the erosion value decreases. For 92% and 96% alumina tile (brittle materials), the maximum erosion value was observed at an impact angle of 90° and as the impact angle increased from 30° to 90° , the erosion value increased. For 316L stainless steel (semi-ductile material), the maximum erosion value was observed at an impact angle of 60° .

During the Scanning Electron Microscopy (SEM) analysis it was observed that room temperature erosion of carbon steel materials is due to cutting wear and plastic deformation. For brittle materials, pitting/pores was observed and as the impact angle is increased from 30° to 90° , the pitting/pores are observed to be more prominent and for semi-ductile materials, similar morphologies to ductile materials was noted.

The ranking of the pre-selected materials for each material in terms of best erosion protection material to worst erosion protection material from this research is as follows:

At 30° impact angle: 316L stainless steel > 96% alumina > VRN 400 > 92% alumina > carbon steel

At 60° impact angle: VRN 400 > 316L stainless steel > 96% alumina > carbon steel > 92% alumina

At 90° impact angle: VRN 400 > 316L stainless steel > carbon steel > 96% alumina > 92% alumina