

Dry sliding wear characteristics of epoxy composites filled with steel industry slag and sludge particles: A comparative study

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Abstract

Composite materials are being developed to replace conventional materials for many reasons such as high specific strength, higher fracture toughness, good resistance to heat/cold/moisture, low density, low cost and ease of fabrication. Composites with these properties can be a replacement in place of metals and wood. Polymers have found wide range of applications in various engineering fields due to their high strength and low density as compared to monolithic and metal alloys. Use of industrial wastes such as slag and sludge particles as filler in polymers has not been very common in the field of composite research. Owing to the very high cost of conventional filler materials in polymer composites, exploring the possibility of using low cost minerals and industrial wastes for this purpose has become the need of the hour. Therefore the present work describes the processing and studies the dry sliding wear characteristics of Linz - Donawitz sludge (LD sludge) filled epoxy composites. Composites with different weight proportions (0 wt. %, 5 wt. %, 10 wt. %, 15 wt. % and 20 wt. %) of LD sludge are fabricated by solution casting technique. The tensile, flexural, and micro-hardness properties of these composites are evaluated as per ASTM test standards and are then compared with those of a similar set of blast furnace slag (BF slag) and Linz - Donawitz slag (LD slag) (wastes generated in iron and steel industries) filled epoxy composites. The dry sliding wear characteristics of epoxy - LD sludge composites have also been studied as per ASTM G 99 test standard and the experimental results are compared with the reported sliding test results under similar test conditions by previous investigators. A systematic experiment using Taguchi's experimental design has lead to determination of significant process parameters that predominantly influence the specific wear rate of the composites. The effects of various operational variables on the sliding wear behavior of these epoxy composites with and without LD sludge reinforcement are studied. The comparative study indicates that epoxy - LD sludge composites exhibit relatively superior mechanical and wear properties than other two type of composites considered in this study.