Study of the Erosion Behavior for Metallic and Polymeric Materials Coated and Uncoated

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Extended Abstract

The objective of this research is to study impact erosion on different materials. Solid Particle Erosion (SPE) is a progressive loss of materials that results from the repeated impact of the erodent [1]. Erosion has received closer attention in the last few decades especially in the oil and gas industry [2]. The damage that erosion causes to equipment costs companies millions of dollars. In this study, a mixture of liquid (water) and solid (sand) particles are allowed to impinge on a surface with two sand concentrations (1000mL and 2000mL), a fixed liquid flow rate, and a constant impact angle. The materials tested include 4140 steel, 6061 aluminum, copper coated and uncoated epoxy, High Density Polyethylene (HDPE), High Impact Polystyrene (HIPS), Polycarbonate (PC), Polypropylene (PP), Polyvinyl Chloride (PVC), and Carbon Fiber Reinforced Epoxy (CFRE). Mass loss measurements and hardness measurements were taken to observe if there was a correlation with wear resistance. A Kurt J. Lesker Nano 36 Series DC magnetron sputtering machine was used for the depositions of 400 nm of copper onto the epoxy samples and a profilometer was used to ensure the coating thickness was 400 nm. Erosion tests were performed by an erosion test fixture designed and built by Mercer Undergraduate Students. By weighing samples before and after testing with an analytical balance, the mass loss due to erosion was observed. The hardness of each sample was measured with a Rockwell Hardness Tester. Brittle materials (Coated and Uncoated Epoxy and CFRE) showed the effects of erosion more than ductile materials (steel, aluminum, and majority of the polymers) at 90 degrees which is what was expected [3]. The copper coating of 400 nm appears to provide protection to epoxy at lower sand concentrations but not higher sand concentrations. PC and PP have the best erosion resistance at higher and lower sand concentration while the CFRE performed the worst at both concentrations. The PC and PP offer a less expensive replacement to metals in erosive environments. However, at this time there appears to be no correlation between hardness and wear resistance.

References

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