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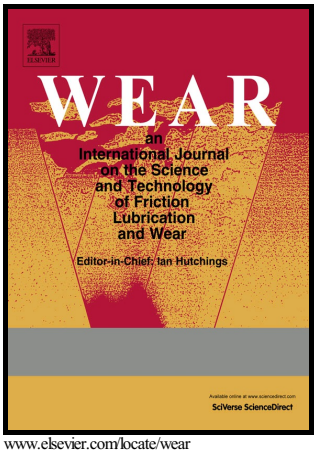

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Erosive wear of filled vinylester composites in water and acidic media at elevated temperature

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ABSTRACT

Due to their good corrosion properties, fibre reinforced polymer composites are often used instead of metals for example in hydrometallurgical processes. However, the erosion performance of polymer composites is rather poor when compared to metals. This study focused on the effect of mineral fillers on the erosion performance of vinylester composites. The erosion rates were tested both in water and in acidic environments at high temperature. To improve the erosion performance of the filled composites in these environments, to increase the filler particle hardness was an effective method. Within similar filler materials, better adhesion to the matrix improved the erosion performance, regardless if it was achieved by adhesion promoters or better mechanical interlocking. The hardness of the matrix was found to be disadvantageous for filled composites, although for pure vinylesters higher hardness decreased erosion rate. At the high service temperature, softer matrix accommodated more deformations and better absorption of energy of the impacting erosive particles. Consequently, improved adherence of the filler particles into the matrix and slower erosion rate was observed.

Keywords: erosion, vinylester, FRP, glass fibre, mineral fillers

1. Introduction

At elevated temperatures and corrosive environments, fibre reinforced polymer composites (FRPs) are often used instead of metals. In hydrometallurgical processing, materials are constantly exposed to temperatures up to 95°C and to 5-15% sulphuric acid (H_2SO_4) solutions which makes corrosion resistant vinylester based FRPs a natural choice for structural parts. During service, there are also hard mineral particles with varying chemical composition in the H_2SO_4 solution, exposing the structural materials to erosion. Erosive acidic slurry removes material from the surface changing the mechanical response of the materials [1] which is further enhanced by the ageing of polymer matrix due to elevated temperature and the corrosive medium. Since the erosion resistance of polymers and their composites is in general poor compared to metals, a resin rich corrosion layer is used to protect the load bearing FRP layers from chemical and erosive attack in the hydrometallurgical process tanks [2].

In the literature, there are few studies on the erosive wear of vinylester based FRPs [3-7], and hardly any at elevated temperatures or in a slurry. Typically, the effects of the test material (e.g. filler or fibre type, fraction, orientation, and adhesion to the matrix) and the test parameters (e.g. temperature, particle velocity, impingement angle, and used abrasive material including its size and shape) have been studied by an air jet erosion tester. In our earlier publications we have reported the slurry erosion performance of unfilled vinylester FRPs to study the effects of test parameters in aqueous [5] and acidic [6] high temperature environments.