Reusing Manufacturing Wastes as Crack Retardant

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Abstract

Global production uses millions of metric tons of metals. The waste of these metals can be recycled to increase the economic benefit and lessen the negative impact on the environment. In this work, manufacturing waste is used as a reinforcement material for epoxy to improve the fracture toughness and the stress intensity factor, where the machining chip is used with different weight fractions 5, 10, 15, and 20 wt. % and each percentage is added with three-chip lengths 0.6, 0.8, and 1.18 mm. Three-point bending test of a notched sample is used to test crack behaviour in addition to using Fourier transform infrared spectroscopy (FTIR), X-ray fluorescence (XRF), Differential Scanning Calorimeter (DSC), and Scanning Electron Microscope (SEM) to show the effect of the chip on structure, bonding, glass transition temperature (Tg), dispersion and fracture surface of the epoxy. Results show that adding the machining wastes in the form of chips can enhance crack behaviour, and it is greatly dependent on the amount and size of the chip. On the contrary, these chips change the glass transition temperature and change the fracture surface from brittle to ductile, thereby reducing the velocity of crack growth.

Keywords: Reusing, wastes, chip, fracture toughness, stress intensity factor, composites materials.

1. Introduction

In general, society interacts with the environment in two ways: as a source of natural resources and as a disposal site for solid, gaseous and liquid pollutants [1]. Technology advancement and population growth have pushed people toward consumerism, which has led to exponential industrial growth with negative