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A comparison of destructive behaviors of distilled water, salty water, sulfuric acid and heat on glass/vinyl ester composites

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Abstract. In the present paper, the destructive behavior of distilled water, salty water, sulfuric acid, and heat on glass/vinyl ester composites was investigated by experimental methods. Hetron 922 vinyl ester resin and two types of mat and woven glass fibers as the reinforcements were used to fabricate composite test samples. All samples were immersed in distilled water, salty water, and sulfuric acid with three different concentrations. The tests were performed at 20°C and 70°C for the exposure duration of 1, 2, 4, and 8 weeks. Bending tests were performed after aging for all composite samples to check the degradation of the bending modulus and strength. The results show that the effect of distilled water, in comparison with salty water, on the degradation of composite samples was significant. On the other hand, almost non-sensitivity of concentrations of salty water on the weight gain of specimens has been observed. In addition, it was also observed that the degradation of samples at 70°C temperature is much more than that of at 20°C. Also, it was observed that the flexural modulus of virgin specimens exposed to salty water (2% concentration) has been recovered just after two weeks of immersion. Furthermore, in some cases, composite samples under the sulfuric acid solution have lost almost 80% of their mechanical properties.

Keywords: aging; composite materials; distilled water; environmental conditions; salty water; sulfuric acid

1. Introduction

Polymeric composite materials are sensitive to some destructive factors such as thermal aging, moisture, immersion in distilled and salty water, chemicals, etc. Recent experiences prove that the destructive effects of the environmental conditions on these materials are not deniable (Miyano *et al*. 2004, Garrido 2013). Many experimental studies have been carried out in this field (Shokrieh and Bayat 2007, Tsotsis *et al*. 2001, Davalos *et al*. 2012, Amaro *et al*. 2014, Boinard *et al*. 2000, Aktaş 2008), but there is a lack of comparison of the destructive behavior of distilled water, salty water, sulfuric acid and heat on composite materials, simultaneously (Kim *et al*. 2008, Martin 2008, Imielińska 2004, Boisseau 2012). Polymeric composites absorb water and other environmental fluids, which can have negative effects such as swelling, reduction of resin glass transition temperature, and physical and mechanial properties degradation (Amaro 2014). In previous studies, various concentrations of salty water (mainly seawater) were investigated by researchers (Abd El-Baky 2018, Heshmati *et al*. 2017). Also, the distilled water (or pure water) was considered as low-

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