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EFFECT OF HOSTILE SOLUTIONS ON THE VISCOELASTIC BEHAVIOUR OF CARBON/EPOXY LAMINATES

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ABSTRACT

The open literature is not sufficient to establish a full knowledge about the effect of hostile environments on time-dependent behaviour of CFRPs. Therefore, this work aims to study the effect of acid and alkaline solutions on the viscoelastic properties of carbon/epoxy laminates, after immersion into such solutions. For this purpose, hydrochloric acid (HCl) and sodium hydroxide (NaOH) solutions were used, and the influence of temperature, solution's concentration as well as exposure time were analysed in order to identify significant differences on the stress relaxation behaviour. The effect observed was conveniently quantified and the Kohlrausch-Williams-Watts (KWW) function was used as model to fit the stress relaxation data.

Keywords: CFRP, environmental degradation, failure, stress relaxation.

INTRODUCTION

Composite materials are used in many engineering areas, and there is a clear indication that this tendency is to continue as consequence of their high specific strength and stiffness, competitive cost and dynamic properties. However, due to the viscoelastic behavior of the organic polymer matrix, applications for long periods of time can be seriously affected in structures manufactured by polymeric matrix composites (Tang, 2015).

In this context, it is becoming common the replacement of the traditional metals by composite materials in components subjected to highly corrosive environments. For such conditions, literature reports that the mechanical properties are strongly dependent of the solutions' concentration and temperature (Mortas, 2014) as well as the exposure time (Amaro, 2013). Therefore, this study intends to evaluate the effect of acid and alkaline solutions on the stress relaxation behaviour of carbon/epoxy laminates, where parameters like exposure time, solution's concentration and temperature will be analysed in detail.

RESULTS AND CONCLUSIONS

The results from the stress relaxation tests are shown in Figure 1 and Figure 2. In terms of exposure time, typical curves are presented for NaOH solution, but they are also representative of the ones obtained for HCl solution. Relatively to the temperature of the solution, the results obtained are compared against the control samples and the exposition only to the temperature without immersion into the solutions.

From Figures 1 and 2 it is possible to observe that both parameters present some influence on the stress relaxation behaviour, but the temperature effect (for the same exposure time) shows to be more relevant as consequence of the higher degradation of the composite.

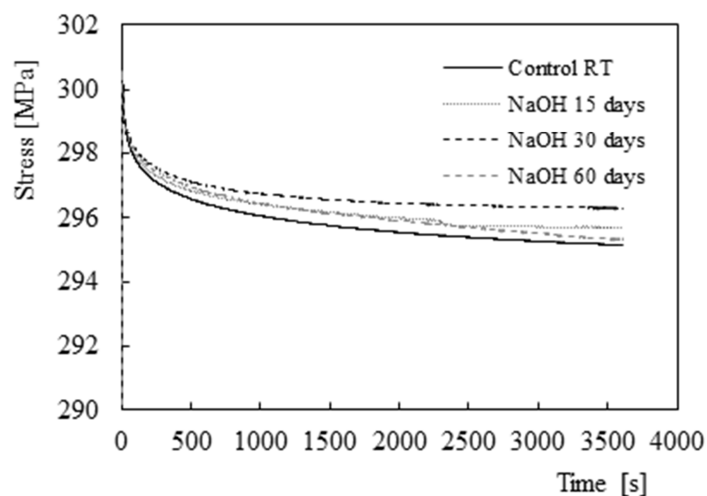


Fig. 1 - Effect of the exposure time for samples immersed into NaOH solution.

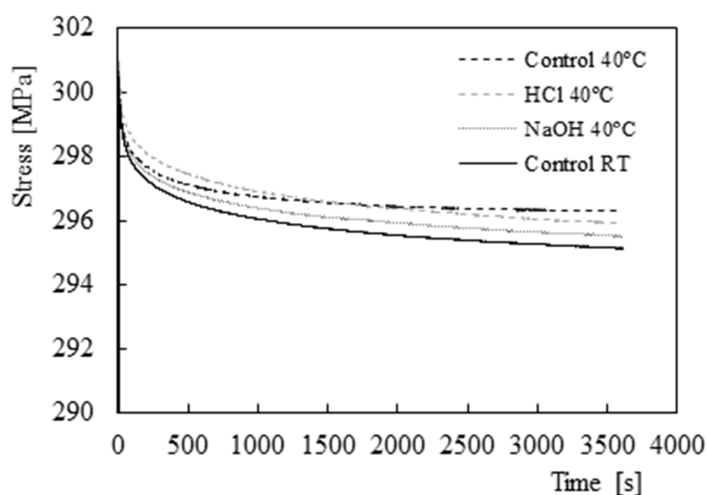


Fig. 2 - Effect of the temperature.

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