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A viscoelastic-viscoplastic model to describe creep and strain rate effects on the mechanical behaviour of adhesively-bonded assemblies

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Abstract

Most of the adhesives used in the marine industry are polymers with a mechanical behaviour which is strongly influenced by the strain rate. Therefore, it is important to predict with accuracy their viscous behaviour. To describe their mechanical behaviour in a bonded joint, a viscoelastic-viscoplastic constitutive law is proposed here. The viscous effects on the elastic behaviour is described using a spectral distribution, which divides the viscous strain as the sum of the strains of several viscous mechanisms, each of them with a different characteristic time and weight. The viscoplastic component of the model permits a better description of the strong non-linear behaviour of the adhesives. The parameters of the constitutive law are obtained using an inverse identification procedure coupled with a finite element model. Two creep tests, in two loading directions, are needed in order to identify the viscoelastic part. The viscoplastic part is identified using monotonic tests. In order to validate the behaviour law and the identification procedure, the adhesive *Huntsman™Araldite* 420*A/B* has been investigated and modelled. All the experimental tests have been conducted using the modified Arcan device.

Keywords: A. Epoxides; D. Mechanical properties of adhesives; D. Creep / mechanical relaxation;

1 Introduction

Composite materials have found many applications in naval and other marine structures over the past 50 years. In order to join the composite to other parts of the structure, adhesives represent an interesting solution. They can reduce the weight (avoiding bolts and fasteners) and decrease the stress concentrations that can be catastrophic for the strength of the structures [1].

Different tests can be used to characterize the adhesive directly in the bonded joint as shown by *Adams et al.* [2]. Single or double lap joints are an interesting solution to this