Post-Doctoral Position

Analysis of the effects of transfer and storage phases on the behavior of bonded joints for SYLDA5 structures

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Context :

A post-doctoral fellowship is available at LBMS-ENSTA Bretagne (www.lbms.fr) in the field of the characterization of thermal and aging effect on the behavior of bonded joints for aerospace applications. The present fellowship, funded by the CNES, is a part of a project developed at the LBMS (J. Y. Cognard, N. Carrere and R. Creac'hcadec) in collaboration with IFREMER (P. Davies, Brest) and with CNES (F. Lavelle) on the optimization of bonded joints for aerospace applications.

Project :

The use of bonded joints represents a key point for various industrial applications that require a signification reduction of weight. It is particularly the case of the aerospace industry for which the reduction of weight represents an absolute necessity. The structural design of launch vehicles is complex and must take into account lot of constraints. One of them concerns the high range of thermo-mechnical loadings during the transport, the storage before the launch and the different spectra of thermo-mechanical loads encountered throughout the launch phase. In order to study these different points a study has been launched in collaboration with the CNES. The aim of this study concerns (i) the influence of the process of the bonded joint (degree of polymerization of the adhesive, thickness ...), (ii) the influence of the residual stresses due to the process (hygro-thermal residual stresses due to the process), (iii) the effect of aging during the transport and the storage (post-curing of the adhesive, relaxation of the residual stresses due to thermal effects, viscosity or water absorption) and (iv) the effect of thermo-mechanical non-proportional loading during the launch and in-service life. Two aspects will be under investigation: (i) the experimental investigation of the different phenomena and (ii) the development of a model that permits to model the adhesive during the whole life of the structure. These objectives are very ambitious, this is the reason why, a PhD. Thesis has began in November 2012 which concerns mainly the effect of the process and of the post-curing on the behavior of the adhesive. The proposed post-doctoral position

is focused on the influence of the thermo-mechanical effects on the strength of the joint (residual stresses and thermo-mechanical loading during the in-life service).

The experimental characterization of the themo-mechanical and long term behavior will be based on the use of the Arcan test device. Indeed, a specific modified Arcan test has been proposed these last few years (common work between ENSTA Bretagne, UBO and IFREMER). This modified ARCAN device permits to drastically reduce the edge effects that lead classically to premature failure. This device permits to characterize the non-linear behavior of the adhesive up to the failure. This experimental device has also been recently extended to cyclic and thermal loading. Moreover, the adhesive could be characterized under different aging conditions obtained thanks some experimental device available at IFREMER. The aim is to propose a characterization of the adhesive under a large range of thermo-mechanical.

Finally a model, that takes into account all the mechanisms evidenced thanks the experimental results, will be proposed. This model based on a thermo-visco-elasto-visco-plasitc behavior will be proposed in order to take into account (i) the residual stresses, their evolutions as a function of the temperature and of loading and (ii) the viso-elastic and visco-plastic of the adhesive. This bahviour will be coupled with a damage model based on strength and energetic criterion.

Bibliographie

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