Influence of thickness on fatigue crack growth properties of titanium Ti-6Al-4V β annealed and aluminium-lithium 2050 T84

An experimental plan has been launched in order to better understand the influence of the specimen thickness on the fatigue crack growth properties of titanium alloy Ti-6Al-4V beta annealed and aluminium-lithium alloy 2050-T84.

Tests are conducted on compact tension specimens with thickness varying between 10mm and 40mm for the titanium alloy and between 10mm and 60mm for the 2050 T84 under constant amplitude (R=0.1, 0.7 and 0.1+1.7overload/1000 cycles) and spectrum loading.

Additionally some thick specimen with corner cracks are tested under the same loading conditions as those above to evaluate the behaviour of a 2D crack against a through one

The test results will be first compared to the prediction define with the fatigue crack propagation model PREFFAS. The model takes into account Elber's theory of fatigue cracks remaining closed during the loading step until a load substantially higher than the minimum load and of closing early during the unloading step before reaching minimum load, by taking into account the history of the overload/underload couples present in the loading.

However it was noted that the retardation of the crack growth rate linked to the loading overload/underload could be significantly reduced as the specimen thickness increases and for this reason a second comparison will be made with a model that does not taken into account any retardation effect, which will be called "linear model".

One of the scopes of the investigation being the definition of the thickness after which there is no significant change in the retardation effect, a first simulation was run using NASGRO retardation Strip Yield. As shown in the pictures below it looks like already at around 12mm the retardation effect has reached its minimum for both materials.