

MULTISCALE APPROACH TO DETERMINE THE MECHANISMS LEADING TO SELF-HEATING OF LAMINATED COMPOSITES

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Increase of temperature observed during a cyclic test

• The study of fatigue behavior is time-consuming tests.

Self-heating tests permit to reduce the time associated to this investigation [1].

• For composite materials, the self-heating curve is usually :

- piecewise linearly approximated as following two or three regimes
- the stress at transition is associated with a fatigue lifetime equal to 10⁶ cycles.

Objectives :

Context

- nature of the mechanisms responsible of the dissipation
- Inked between dissipation and fatigue





OExperimental investigation of the behavior of the neat resin mechanical behavior

Oldentification of a non-linear viscoelastic model

OPrediction of the behavior of the laminate thanks to successive change of scale (sequential approach)



 $\sigma_{max}/mean(X_t)$

Results on the neat resin

Oldentification based on: tensile tests, progressive loading/unloading tensile tests and progressive creep/recovery tests (anhysteretic tests)

OValidation using self-heating tests



Prediction on a quasi-isotropic laminate



The dissipation is mainly due to the one of the 45 and -45° plies

- The viscoelastic model permits to reproduce in a correct manner the dissipation of the laminate
- Even if damage occurs in the 90° plies, since its dissipation is low, it has a low effect on the dissipation of the laminate
 - The first part of the S-N curve is characterized by linear viscoelastic mechanisms. In a second part, the non-linear mechanisms become significant. This threshold could be considered as the fatigue limit.



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