VDT model, application to wound carbon/epoxy composite exposed to fire

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Résumé

Hydrogen is an alternative to fossil energy sources, but its storage remains a key issue for the high scale deployment of fuel cell applications. Composite overwrapped pressure vessels represent a reliable technology, thanks to the high specific mechanical properties and low weight of carbon fibres. To address the topic of the thermomechanical behaviour of these structures in the case of accidental events like a fire exposure, a wide experimental campaign has been performed at the sample scale (±45◦ (EC45), 90◦ (EC90) and quasi-isotropic (ECiso) samples). These samples have been exposed to different heat fluxes and stopped at different characteristic times. Finally, residual mechanical properties are characterized by tensile tests [1]. The evolution of the longitudinal modulus of elasticity shows that the energy density is the main factor leading to the mechanical degradation, provided that the sample has undergone an inflammation and transformed to char. In a second step, to characterize the kinetics of damage during a coupled loading involving both a mechanical load and a fire exposure, a specific test device was developed. This device combines a mechanical testing machine submitting specimen to 4 points bending creep under controlled displacement and a cone calorimeter as a heat source. This set-up aims to analyze the mutual influence of a mechanical stress and degradation modes of the resin.
The study presented in this communication aims to model the thermomechanical behaviour using microplan model [2]. This model considers the anisotropic damage, friction sliding and will be improved by introducing temperature effect. Char thickness will be considered as completely damaged area. The friction sliding is considered as plasticity mechanism. The results are compared to experimental data from a tensile and 4 points bending test campaign performed on samples under different thermal conditions.

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