Experimental characterization and numerical modeling of a DCDC test for a thermoplastic polymer

A. Coq[1*], J. Diani[1], S. Brach[2]

[1] Laboratoire de Mécanique des Solides, Ecole Polytechnique, Route de Saclay, 91128 Palaiseau, France, arnaud.coq@polytechnique.edu

[2] IBM Zurich Research Laboratory, Säumerstrasse 4, CH-8803 Rüschlikon, Switzerland

Joints for wind turbine blades are mostly cross-linked polymers such as epoxy that cannot be recycled. This work aims to validate the mechanical strength of a new range of thermoplastic acrylic joints of the same chemical nature as the polymer matrix of wind turbine blades. The use of thermoplastic will increase the recycling of materials for this application.

We are interested here in the study of bulk thermoplastic polymer, at a glassy state for room temperature. Characterization of the mode I cracking of the polymer is performed using a hole parallelepiped sample under compressive load to which two initial pre-cracks at the poles of the hole were added in alignment with the compression loading (DCDC test) [1]. The energy restitution rate G_c is estimated using two analyses. The first one corresponds to classical finite element calculations in a linear elasticity framework, considering the initial structure with different crack lengths. However, the results depend on the speed of solicitation. Therefore, a second method will use finite element simulations including a phase field approach which is based on the regularization of the variational formulation of fracture [2]. This modeling approach has been shown to work remarkably well in tension, but its interest for fracture under global compressive load is still under question. To model the DCDC test, this numerical method will be used in the linear elasticity framework and fragile fracture. It will then be extended to the visco-plasticity case (perfect plasticity and hardening) to model ductile fracture and introduce plastic dissipation as proposed by Alessi and al. [3].

References

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