Cavitation on a thermoplastic matrix for a UD composite subject to transverse compression (Brazilian test)

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PA6GF70 pultruded composite

- Variability in local GF content
- Variability in GF diameter
- Two populations of void
Morphology, size and distribution of initial macropores

H.A. Cayzac, PhD Thesis PSL University
Mines ParisTech (2014)
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Brazilian tests on a rod

"Brittle" failure by transverse compression
Voiding in the matrix: measurement and modelling

Void (blue dots) = Damage

Nucleation/Growth/Coalescence

(a) $\frac{\Delta \varepsilon}{\varepsilon_0} = 0.56\varepsilon_R$

(b) $\frac{\Delta \varepsilon}{\varepsilon_0} = 0.94\varepsilon_R$

Poulet et al., *Polymer Testing* (2016)
μCT and FE simulation of the Brazilian test

Graph:

- $\sigma/\sigma_{\text{sat}}$ vs $\Delta \psi/\psi_0$
- $\phi_0$ vs crack length/diameter

Images:
- Macroscopic
- μCT resolution 1px = 5 μm
µCT and FE simulation of the Brazilian test

$\sigma / \sigma_{\text{rupt}}$

$\tau_{\text{th}} / \tau_{\text{th,0}}$

$\tau_{\text{th}} / \tau_{\text{th,0}}$

$\mu / \mu_{\text{0}}$

$\phi / \phi_{\text{0}}$

$a / \phi_{\text{0}} \rightarrow \text{crack length/diameter}$

Macroscopic

$\mu$CT resolution 1px = 5µm
μCT and FE simulation of the Brazilian test

\[ \frac{\sigma}{\sigma_{\text{max}}} \leftrightarrow \frac{a}{a_{\text{max}}} \]

Macroscale 1

\[ \Phi \text{ at } a_{0} \]

EF \\sigma_{\text{max}}

EF \\Phi_{a0}

\[ \mu \text{CT resolution 1px} = 5 \text{µm} \]
μCT and FE simulation of the Brazilian test

\[ \frac{a}{\phi_0} \rightarrow \text{crack length / diameter} \]

Macro $\frac{a}{\phi_0}$
Tomo $\frac{a}{\phi_0}$
FF $\frac{a}{\phi_0}$
EF $\frac{a}{\phi_0}$

μCT resolution 1px = 5μm

Mid-height through the thickness