Slow crack growth in acrylic-based polymers: quasi-static embrittlement leads to improved fatigue resistance?

Frederik Van Loock*†[1], Daan Smallenburg[1], and Leon E. Govaert[1]

[1]Mechanical Engineering Dept - TU Eindhoven – Netherlands

Abstract

There is an ongoing effort to use mechanically recyclable thermoplastic matrices instead of conventional (crosslinked) thermoset matrices for fiber-reinforced polymer composites. However, outstanding questions remain regarding the durability of these novel thermoplastic polymers. In this work, we examine the effect of crosslinking and monomer contamination due to the mechanical recycling process on the subcritical crack growth of acrylic-based polymer systems. We make use of the double torsion testing technique (in quasi-static indentation and relaxation modes) at different temperatures to characterize one or more regimes of stable crack growth. Paris law slopes are identified, and the observed differences in crack growth behavior between the material systems are highlighted through stress-lifetime plots. We complement the static double torsion test data with fatigue crack growth behavior measured using cyclically loaded compact tension tests. Our aim is to explore possible relations between resistance to subcritical (fatigue) crack growth and the polymer's ductility when tested in uniaxial tension.

*Speaker

†Corresponding author: f.van.loock@tue.nl