EFFECT OF LOADING RATES ON THE FRACTURE TOUGHNESS OF HDPE PLASTICS

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ABSTRACT

Polyethylene, a thermoplastic, was developed industrially in England fifty years ago. Polyethylene is widely use in making grocery bags, shampoo bottles, children's toys, and even bullet proof vests. A molecule of polyethylene is a long chain of carbon atoms, with two hydrogen atoms attached to each carbon atom. Sometimes some of the carbons, instead of having hydrogens attached to them, will have long chains of polyethylene attached to them. This is called branched, or low-density polyethylene, or LDPE. When there is no branching, it is called linear polyethylene, or HDPE. Linear polyethylene is much stronger than branched polyethylene, but branched polyethylene is cheaper and easier to make.

The objective of the study is to analyse changes of fracture behaviour of HDPE at different loading rate. Defect assessment against fracture-initiated failure is carried out using fracture characterising parameters determined under tensile, quasi-static and intermediate rates of loading. For these situations the rate sensitivity of the material to fracture is considered. Fracture toughness tests (COD) have been conducted on HDPE over a range of loading rates. The effect of increased loading rate is to reduce the crack-opening displacement whilst changing the fracture behaviour, such transition from ductile to brittle. We learn that HDPE behaves in ductile manner in the quasi- static test, but it also behave in a brittle fashion by increasing the rate of speed of the test. These fracture touglmess tests are designed to characterise the touglmess of plastics in terms of the critical stress intensity factor, K_K at fracture initiation.

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