QUASI-BRITTLE CRACK GROWTH IN HOT WATER PIPE MATERIALS

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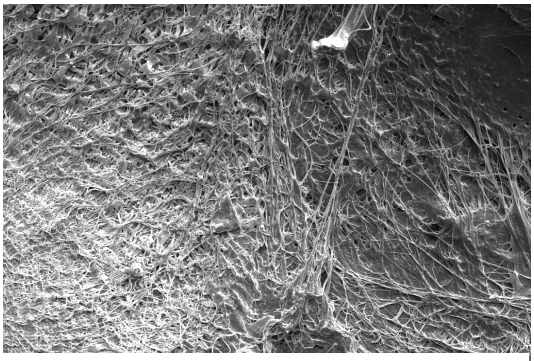
Due to well-balanced mechanical properties, low risk of failure and affordable prices pipes made from polymers have become irreplaceable in modern infrastructure. Beside various other applications, such as transportation of drinking water, oil and gas they are also used in hot water installations (e.g. underfloor heating, showers …). To avoid high cost maintenance or even worse repairs, it is important to understand the failure and damage mechanisms of the materials used in these applications.

Usually, pipes in pressure applications fail in one of three different failure modes. Either after short times and high stresses in a ductile failure mode, at lower stresses and longer times in a so called quasi-brittle failure mode or after very long times and depletion of stabilizers due to large scale chemical ageing and concomitant material degradation. The focus of this work was placed on the second failure mode of quasi-brittle crack growth, which usually consists of crack initiation and propagation.

To examine this failure mode, polybutylene specimens were tested in the style of the "cracked round bar" (CRB) test method which has been developed and standardized for polyethylene pipe grade materials (ISO 18489). Additionally, crack growth kinetics under fatigue loads have been monitored using a compliance calibration method.



Partial fracture surface of polybutylene tested in fatigue [1]

Results showed that the CRB-method can be used to characterize quasi-brittle failure in polybutylene pipe materials, as long as fitting test-parameters are chosen. Similar testing has also been applied to crosslinked polyethylene. However, due to the material constitution this material class has proven to be more challenging in testing and further inquisition is necessary.

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[1] David Höller, "*Analyse des Risswachstumsverhaltens von Polybuten und vernetztem Polyethylen mittels dem zyklischen Cracked Round Bar- Test*", Master's Thesis, Montanuniversitaet Leoben, 2017