

Short-term HDPE pipe degradation upon exposure to aggressive environments

L. Alimi, K. Chaoui, W. Ghabeche, W. Chaoui

Abstract: Natural gas and drinkable water are regularly transported by underground polyethylene pipe networks in urban and rural areas. The interaction between materials such as high density polyethylene (HDPE) and contact environments is a critical factor which strongly influences pipe behaviour for short and long terms. The aim of this study is to establish separate effects of H₂SO₄, a mixture of toluene-methanol and distilled water on the mechanical properties of HDPE pipes. Two testing geometries representing the pipe wall are considered: (1) orthogonally machined filaments and (2) ASTM standard specimens. Tensile tests are carried out on both specimen types using a computer controlled Zwick machine. It is observed that chemical environments degrade mechanical properties causing a structural weakening especially those specimens exposed to organic solvent and acid. For instance, filaments show a reduction in elastic modulus of 64% after 7 days of exposure to toluene and methanol. Compared to standard specimens, the obtained properties are much higher indicating that geometry has an effect on the measured values. Fluctuations in mechanical properties are most probably caused by crystallinity gradients all the way through the pipe wall. This type of results allowed establishing the linear relationship between the elastic modulus and the yield stress and is intended to contribute to a better understanding of properties heterogeneity effects when exposed to unfavourable environments.

Keywords : polyethylene pipe, environmental stress effect, short-term degradation, yield stress-Young's modulus correlations, failure strain, OIT