STRAIN BEHAVIOUR OF PIPES MATERIAL UNDER DYNAMIC LOAD

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Successful application of high-density polyethylene (HDPE) for production of pressure pipes has included this material in term of 'engineering polymers'.

One stage that limits the lifetime is supercritical crack growth. The dynamic behaviour of rapid crack propagation (RCP) depends on material properties, geometry, as well as on crack speed and energy conditions.

At present there are two tests (Full-scale test FST; Small-scale-steady-state test S4) that evaluate the resistance against unstable failure of pipe. Nevertheless this tests are rather expensive and time consuming. The other possibility is the evaluation of dynamic fracture toughness G_{d} and structural parameters.

This paper is concerned with test methods (S4 test and Charpy test) for screening two of lots of HDPE resin with respect to the three performance properties – critical pressure for RCP; G_{d} and structural parameters.

Key words: *failure, polyethylene, dynamic load*

1. Introduction

Polyethylene (HDPE) and polypropylene (PP) pipes for distribution of gas and water have already been applied for a few decades. Both materials can be considered as progressive and ecological; they substitute traditional materials for production of pipes (steel, cast-iron). This progress is followed by relevant legislation. For example lifetime for the newest bimodal type of HDPE is expected to be up to 100 years. This long lifetime is guaranteed only if tubes are strained with just inner overpressure. Unfortunately, there are other factors, which can reduce pipes lifetime [1, 2].

The points at issue are above all:

– Failure of the outer surface during laying of tube (striates, notches).
– Unfit placing of the tubes (point stress, which doesn't correlate with relevant directive).
– Violent impact.

These extraordinary circumstances can evoke creation of the stress raises that can lead to formation of a crack and then to brittle failure of the whole pipe system.

If the structure under stress receive violent impact, the resulting crack may propagate through the structure at a high speed. For example, in pressurised PE gas pipe the crack could propagate at a long distance at speeds in order of 100 m/s. This phenomenon, called Rapid Crack Propagation (RCP), is a rare event in the field, but the consequences can be catastrophic. The five primary factors [3] that determine whether or not RCP may occur are: (i) nature of the impact that initiates RCP; (ii) gas pressure; (iii) temperature; (iv) geometry of the pipe; (v) material.

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