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ABSTRACT

Composites utilising long fibres as reinforcement are the most effective from the point of view of the toughening effect. A brittle matrix reinforced by brittle fibres was investigated in this work. Polysiloxane resin was used as matrix precursor in the studied composite, while continuous basalt fibres served as reinforcement. An optimised pyrolysis process conducted at 650°C under nitrogen atmosphere turned the polymeric precursor into the so-called hybrid matrix consisting of nano-domains of pyrolytic SiOC glass and of non-transformed polysiloxane polymer. The pyrolysis temperature of 650°C was found to be optimal, resulting in the fracture toughness attacking the level of 20 MPa.m$^{1/2}$ and the strength the value of 1 GPa. The main aim of this paper is to investigate microstructural changes occurring during long-term (1000 hours = 41.7 days) exposition to an oxidative air atmosphere at temperatures from 250°C to 600°C and to describe the effect on the mechanical properties of the studied hybrid-matrix composite. The increasing exposition temperature leads to a significant embrittlement of the composite, while the elastic properties (modulus) remain unchanged. Chemical or microstructural changes in the basalt fibres were not detected after the long-term exposition to the tested high temperatures. Nevertheless, fibre embrittlement can be estimated from the tests. Both matrix and fibre-matrix interface were found to suffer from the applied exposition. Distinct changes in chemical composition as well as in microstructure were observed for the matrix. Hence, the observed embrittlement of the composite can be ascribed partially to the changes in the hybrid matrix and the fibre-matrix interface, and partially to fibre embrittlement.