THE EFFECTS OF TEMPERATURE, HUMIDITY AND AUTOMOTIVE FLUIDS EXPOSURE ON A GLASS FIBRE/POLYURETHANE COMPOSITE

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In this study the effects of operational environments (temperature, humidity and automotive fluids) on the long-term durability of a glass fiber reinforced polyurethane are investigated. Variation of mass, flexural strength and viscoelastic response are evaluated in order to observe the changes in the material. Although all samples reach a saturation plateau, following the Fick's law of diffusion, samples in water at 70°C do not saturate even after 13 months of exposure. In accordance to Arrhenius's law, instead of saturation, degradation is expected [1]. Three point bending (3PB) tests and Dynamic Mechanical Analysis (DMA) measurements of the saturated specimens in automotive fluids at room temperature show insignificant changes in bending strength and glass transition temperature (Tg), while the same properties decrease linearly with increased humidity and temperature. After drying the samples, DMA scans show that the changes in Tg and storage modulus are reversible; therefore no chemical reaction occurs in the presence of moisture/temperature. One automotive fluid causes a secondary peak around 30-40°C, which could be due to the formation of a new phase or of a 'skin-core' structure [2].

[1] K. Berketis, D. Tzetzis, P.J. Hogg, The influence of long term water immersion ageing on impact damage behaviour and residual compression strength of glass fibre reinforced polymer (GFRP), Materials & Design, Volume 29, Issue 7, 2008, p. 1300-1310

[2] Yan-min Pei, Kai Wang, Mao-sheng Zhan, Wen Xu, Xiao-jun Ding, Thermal-oxidative aging of DGEBA/EPN/LMPA epoxy system: Chemical structure and thermal–mechanical properties, Polymer Degradation and Stability, Volume 96, Issue 7, July 2011, p. 1179-1186