World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:13, No:08, 2019

Thermo-Mechanical Approach to Evaluate Softening Behavior of Polystyrene: Validation and Modeling

Authors : Salah Al-Enezi, Rashed Al-Zufairi, Naseer Ahmad

Abstract : A Thermo-mechanical technique was developed to determine softening point temperature/glass transition temperature (Tg) of polystyrene exposed to high pressures. The design utilizes the ability of carbon dioxide to lower the glass transition temperature of polymers and acts as plasticizer. In this apparatus, the sorption of carbon dioxide to induce softening of polymers as a function of temperature/pressure is performed and the extent of softening is measured in three-point-flexural-bending mode. The polymer strip was placed in the cell in contact with the linear variable differential transformer (LVDT). CO₂ was pumped into the cell from a supply cylinder to reach high pressure. The results clearly showed that full softening point of the samples, accompanied by a large deformation on the polymer strip. The deflection curves are initially relatively flat and then undergo a dramatic increase as the temperature is elevated. It was found that increasing the pressure of CO₂ causes the temperature curves to shift from higher to lower by increment of about 45 K, over the pressure range of 0-120 bars. The obtained experimental Tg values were validated with the values reported in the literature. Finally, it is concluded that the defection model fits consistently to the generated experimental results, which attempts to describe in more detail how the central deflection of a thin polymer strip affected by the CO₂ diffusions in the polymeric samples.

Keywords : softening, high-pressure, polystyrene, CO_2 diffusions
Conference Title : ICCEABMB 2019 : International Conference on Chemical Engineering Analysis and Basic Material Balances
Conference Location : Dublin, Ireland
Conference Dates : August 15-16, 2019