Structure and Dynamics of Polyester Polyols in the Bulk and Under Severe Confinement

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In recent years, there is a great need for the development of improved waterborne systems for coating applications that follow the strict European legislative framework on chemicals. The main properties of such a coating should be the ability for good film formation, an efficient stain, scratch, imprint and block resistance, improvable wetting properties, etc. Good candidates can be novel water-based PURs produced by polyols and polyisocianates with the polyol structure being the key factor to obtain a waterborne coating with the desired properties. [1] On the other hand, nanocomposites consisting of polymers and layered silicates are considered as a new generation of composite materials due to their unique properties, which render them candidates for numerous applications; especially intercalated nanohybrids, where polymer chains form a 1-2nm film within the inorganic galleries provides the opportunity to investigate polymer structure and dynamics close to surfaces. [2]

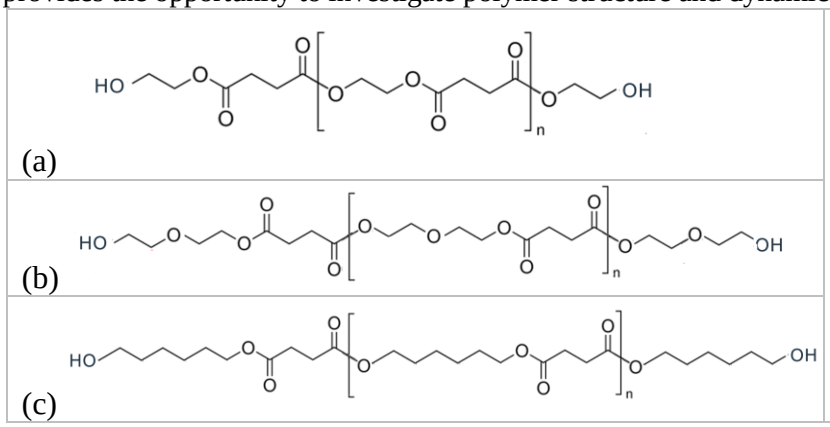

Figure 1: Chemical formulae of (a) poly(ethylene glycol) succinate, (b) poly(diethylene glycol) succinate and (c) poly(hexanediol) succinate

In this work, the structure and dynamics of three different linear polyester polyols are investigated in the bulk and under severe confinement when mixed with a hydrophilic layered silicate. The polymers are poly(diethylene glycol) succinate, poly(hexanediol) succinate, and poly(ethylene glycol) succinate (Figure 1), whereas the inorganic material is Na^+-MMT. The polymers molecular characterization with Nuclear Magnetic Resonance (NMR) and Infrared Spectroscopy was followed by the investigation of their solubility in different solvents. Their thermal behavior was investigated with Differential Scanning Calorimetry (DSC) and their thermal stability with Thermogravimetric Analysis (TGA). X-ray diffraction (XRD) was utilized to verify the intercalated structure of the hybrids whereas Dielectric Spectroscopy was utilized to investigate the dynamics, for temperatures covering the regimes of both sub-T_g local processes and segmental (alpha-) relaxation. Similarities and differences were found between the three systems depending on the polymer structure whereas the structure and the dynamics of both the bulk and the confined systems were compared with respective results obtained from non-linear hyperbranched polyesters. [3]

References

[1]. M. J. van Ginkel, "Facts in Formulating Water Based Industrial Wood Coatings", Neoresins (2002).
[2] T. J. Pinnavaia, G.W. Beall, Polymer-Clay Nanocomposites; John Wiley & Sons, West Sussex (2000)
[3] K. Androulaki, K. Chrissopoulou, D. Prevosto, M. Labardi and S. H. Anastasiadis *ACS Appl. Mater. Int.* **7**, 12387 (2015).

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