

EFFECT OF INTERMOLECULAR INTERACTIONS ON PHASE COMPATIBILITY AND MATERIAL PROPERTIES IN ORGANIC-INORGANIC COMPOSITE BLENDS

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Abstract

The concentrated solutions of cellulose acetate (CA) in tetrahydrofuran (THF) with different content of tetraethyl ortosilicate (TEOS) (1.0-2.0 (wt.%/wt.)) were analyzed in terms of the intermolecular interactions by dynamic viscometric measurements and Fourier-transform infrared spectroscopy (FTIR) analysis. For all studied systems the flow behavior is governed by hydrogen and covalent bonds that have an impact on the dynamic viscosities and flow activation energy (E_a), implicitly. Thus, was observed that the flow activation energies increase with the increasing of TEOS content in CA solutions. This means that, besides to polymer/solvent interactions, which established between the cellulose acetate and tetrahydrofuran, new hydrogen and covalent bondings generated by silanol groups of TEOS and -OH groups of CA occurs, leading to an increase in E_a (Fig. 1).

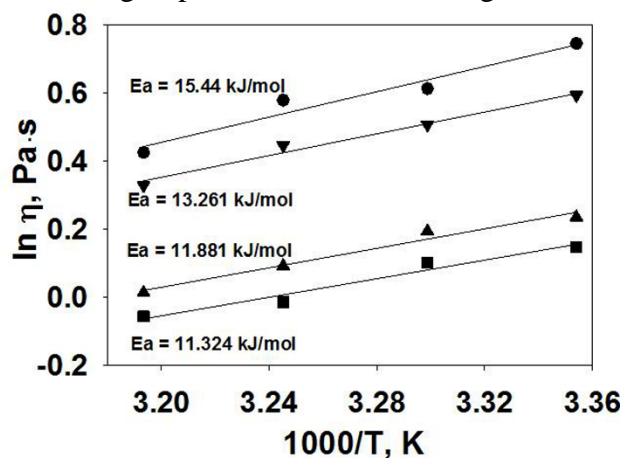


Fig. 1. Plot of $\ln \eta$ versus $1000/T$ for CA/TEOS blends at different mixing ratios: (■) CA, (▲) CA/1wt.% TEOS, (▼) CA/1.5wt.% TEOS, (●) CA/2wt.% TEOS.

A higher value of E_a corresponds to a low polymer flexibility which slows the flow process and determines the appearance of gel behavior. In addition, SiO_2 resulting from the hydrolysis and condensation of TEOS, which take place during the process of the solutions obtaining, may generates crosslinking points in the polymeric systems, increasing its rigidity and leading to high values of E_a . These results are also reflected in FTIR spectra of the films corresponding to the solutions rheological analyzed, where the shape and intensity of the peaks confirm the occurrence of some additional interactions with increasing of TEOS content in CA casting solution. It was demonstrated thus, that, for a TEOS content less than 1.00 wt.%/wt.% and greater than 1.5 wt.%/wt.%, the intermolecular interactions prevent the formation of films/membranes.

Consequently, the results of this study are essential in different fields of applicability, considering the intermolecular interactions impact in the process of the supramolecular structures obtaining.