Abstract
Many of the excellent properties of highly crosslinked polymeric materials are due to their networks structures. In this study, network structures of three epoxy systems, Epon828-PACM, Epon836-PACM, and Epon1001F-PACM, were investigated via equilibrium swelling theory. Each of these systems were separately cured in presence of an inert solvent, THF, ranging from 0 to 92% by volume fraction of solvent. Experimental results showed that the conventional swelling theory is valid for specimens prepared in moderate dilute environments, i.e. up to approximately 60% solvent by vol. fraction. However, in extremely dilute environments, i.e. above 60% solvent, the computed molecular weight between crosslinks, or M_c, based on Bray-Merrill model, increase exponentially. This drastic increase in M_c values for the samples prepared in extremely dilute environments was investigated by the T_g measurement of the polymer phase (supercritically dried specimens). It was found that the measured M_c values could not predict the corresponding T_g of the systems according to the Fox and Loshaek equation, since the resulting systems produced in extremely dilute environments are highly porous after supercritical extraction/drying. Because of this, a modifying factor, based on the probability of finding elastic chains in a porous network, was incorporated in the Bray-Merrill model. The adjusted M_c values of each thermoset and the corresponding T_g values match via the prominent Fox and Loshaek equation. These modified M_c values indicate that, the polymer networks that form in presence of an inert solvent have relatively uniform molecular weight between crosslinks, irrespective of the during-cure solvent content.