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Investigation of Molecular Structure of Porous Epoxy Thermosets via Swelling and Glass Transition Behavior MAJID SHARIFI, KAUSTUBH GHORPADE, VIJAY RAMAN, GIUSEPPE PALMESE, Department of Chemical and Biological Engineering, Drexel University, Philadelphia, Pennsylvania 19104, USA — Many of the excellent properties of highly crosslinked polymers are due to their molecular structures. In this study, network structures of three epoxy systems, Epon828-PACM, Epon836-PACM, and Epon1001F-PACM were investigated via equilibrium swelling theory. Each systems 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 polymerized in moderate dilute environments, i.e. up to around 60% solvent by vol. whereas in extremely dilute environments, i.e. above 60%, the computed M_c values are exponentially increasing. This drastic increase in M_c was investigated by T_g measurement of the polymer phase (on supercritically dried specimens). The measured M_c could not predict the corresponding T_g values according to Fox equation. Due to the highly porous nature of the resulting thermosets after supercritical drying, a modifying factor, based on the probability of finding elastic chains in a porous network, was incorporated in the conventional swelling model (Bray-Merrill equation). It was shown that the adjusted M_c values of each thermoset and the corresponding T_g s are acceptably match via the well-known Fox equation. The modified M_c values indicate that, polymer networks produced in presence of miscible inert phases have relatively uniform molecular weight between crosslinks, irrespective of the amount of that inert phase.

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