

ROLE OF RUBBER CAVITATION IN TOUGHENING MECHANISMS OF EPOXY RESINS

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The occurrence of rubber particle cavitation in rubber modified epoxy resins has generated some controversy in the literature and role of cavitation resistance in toughening mechanisms has remained an enigma. In this study, hydroxyl terminated polybutadiene (HTPB) and synthesized epoxy terminated polybutadiene (ETPB) have been used to toughen an epoxy resin. FTIR and titration techniques were used to monitor the ETPB synthesis. Mean fracture toughness, KIC, of 0.65 MNm^{-3/2} was measured for unmodified epoxy polymer. The measured toughness was increased by the addition of HTPB to 1.23 MNm^{-3/2} and ETPB to 1.80 MNm^{-3/2}. The cavitation zone of the HTPB modified sample was bigger than that of ETPB modified sample which showed the higher cavitation resistance of ETPB particles which was due to crosslinking of rubber particles, confirmed by dynamic mechanical analysis. SEM studies showed volumetric expansion of rubbery phase in slow crack growth region of both samples which proved the plastic void growth. The results showed that for this specific case, elevated cavitation resistance of ETPB does not suppress plastic void growth. The optical microscopy of crack tips showed little shear yielding. Which was due to rationally large particle size of ETPB and HTPB domains in epoxy matrix and resulted high inter particle distance which suppresses the shear yielding mechanism. SEM micrographs of fracture surface of HTPB modified samples showed No tail formation while pinning tails were present in ETPB modified samples. In ETPB particles the crack front bows when reaches to rubber particle due to its high cavitation resistance. The results showed that higher cavitation resistance activates crack pinning process in ETPB modified samples. Deflection and forking of the main crack into secondary cracks was also observed in ETPB modified samples while these phenomena were not present in HTPM modified samples.