Synthesis, Characterization and Application of Polyurethane/epoxy Hybrids as Anticorrosion Coatings

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Abstract:

This study focuses on the development of anticorrosion coatings based on polyurethane (PUA) and its hybrid formulations incorporating epoxy resin (PUAE). Polyurethane (PUA) was synthesized through a polyaddition reaction using diphenylmethane diisocyanate (MDI) and polyols (Polypropylene glycol, PPG with different molecular weight) at NCO/OH ratio of 2.5. The polyurethane hybrids (PUAE) were produced by combining MDI, PPG, and varying epoxy resin (E) contents of 5%, 10%, and 15% by weight. Various formulations were designed to examine the influence of epoxy content on the physico-mechanical properties of PUA coatings. IR spectroscopy confirmed the completion of polymerization and provided polymer characterization. Viscosity, mechanical properties, and corrosion/chemical resistance of the PUA and PUAE coating were found to be significantly affected by varying epoxy resin content. Increased epoxy content resulted in reduced elongation at break, pot life, and drying time. Conversely, tensile strength, adhesion, hardness, and viscosity showed improvements with increasing epoxy content. The enhancement in PUAE mechanical properties is attributed to the increased hard segments, hydrogen bonding between urethane groups, and the formation of a crosslinked network at higher epoxy concentrations. Moreover, the hybrid coatings demonstrated superior corrosion and chemical resistance compared to pure polyurethane coatings. The formulation containing 15% epoxy exhibited the highest resistance to solvents, chemicals, and corrosion.

Keywords:

polyurethane; hybrid; corrosion; epoxy; mechanical; resistance.