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Fine-Tuning Polyol and Emulsifier Levels for Enhanced Stability and Rheology of Vegetable Oil-based Waterborne Polyurethane Dispersion

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Abstract

Waterborne polyurethane (WBPU) dispersions have garnered significant attention in recent years due to their exceptional performance, versatility, and environmentally friendly characteristics. Stringent environmental regulations on volatile organic compound (VOC) emissions have driven the development of these high-performance polymers. WBPU dispersions are increasingly used as alternatives to solvent-based coatings, with applications in wood coatings, textile and fabric coatings, leather coatings, and automotive interior coatings. In this study, WBPU dispersions were synthesized using polyols derived from jatropha oil, with varying hydroxyl numbers. Dimethylol propionic acid (DMPA) was used as the emulsifier, with its content varied between 5.4 wt% and 7.1 wt%. The vegetable oil-based polyols served as the soft segment in the polyurethane. Isophorone diisocyanate (IPDI) and DMPA were used to form the hard segment of the polyurethane. The stability and rheological properties of the resulting WBPU dispersions were characterized. The polyurethane dispersions produced had particle sizes ranging from 19.6 nm to 152 nm, with solid contents between 22.9 wt% and 26.9 wt% and viscosities in the range of 10.7 to 53.1 mPas. The JPU dispersions exhibited fluid behavior ranging from Newtonian to shear-thinning.