Enhancing the adhesion strength of polyurethane coatings by dispersing layered silicates via sonication and high-shear mixing method

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Polymer Bulletin (2020): https://doi.org/10.1007/s00289-020-03100-y

Shareable fulltext nonprint link: rdcu.be/b7hOK

Abstract

Low adhesion strength of polyurethane coating to a steel substrate is often attributed to poor steel preparation. However, the ratio of diisocyanate/polyol and dispersion of fillers within a polyurethane coating matrix influence the adhesion strength, optical and corrosion resistance properties. Poor dispersion of nano-fillers in a polymer coating matrix can lead to low adhesion strength, because close packing of nanoparticles often hides the hydroxyl groups required to form polar–polar bonds with the steel surface. This study combines sonication and high-shear mixing methods with shorter mixing times to prepare polyurethane nanocomposite coatings with various clay concentrations while keeping the ratio of diisocyanate/polyol constant. Fourier-transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM) and X-ray diffraction, thermogravimetric analysis and pull-off are used to characterize polyurethane nanocomposite coatings. FTIR results confirm that sonication and high-shear mixing successfully prepare polyurethane-based coatings. TEM shows uniformly dispersed clay particles in polyurethane matrices. The adhesion strength improved on addition of 1–5 wt% C30B organoclay, with the highest improvement (34.4%) at 3 wt% loading. The corrosion resistance of polyurethane coatings was improved by the incorporation of organoclays into their matrices. Onset degradation temperature is also delayed by 4.1–8.5% as the clay concentration increased from 1 to 5 wt%.