

# **Synthesis and Characterization UV-Curable Waterborne Polyurethane Acrylate/ $\text{Al}_2\text{O}_3$ Nanocomposite Coatings Derived from Jatropha Oil Polyol**

## **ABSTRACT**

A new UV-curable waterborne polyurethane acrylate/alumina (UV-WPUA/ $\text{Al}_2\text{O}_3$ ) coatings were successfully developed. The waterborne polyurethane acrylate (WPUA) dispersion was synthesized by reacting jatropha oil polyol (JOL) with isochrone diisocyanate (IPDI), 2,2-dimethylol propionic acid (DMPA), and 2-hydroxyethyl methacrylate (HEMA) via in-situ and anionic self-emulsifying methods. The WPUA/ $\text{Al}_2\text{O}_3$  dispersion was formulated by various sonicating concentrations of alumina nanoparticles (0.3, 0.6, 0.9, and 1.2 wt%) into WPUA dispersion. The UVWPUA/ $\text{Al}_2\text{O}_3$  coatings were obtained with 75 wt% oligomers, 25 wt% monomer trimethylolpropane triacrylate (TMPTA), and 3 wt% of a commercial photo initiator (benzophenol) for UV-curing were used. The effect of  $\text{Al}_2\text{O}_3$  nanoparticles on WPUA coatings was analyzed by FTIR, surface morphology, and coating performance properties such as pendulum hardness, pencil hardness, scratch resistance, and adhesion test. FTIR revealed the formation of JOL, neat UV-WPUA, and UV-WPUA/ $\text{Al}_2\text{O}_3$  coatings, respectively. FESEM/EDX demonstrated that  $\text{Al}_2\text{O}_3$  nanoparticles at the lower loading (up to 0.6 wt%) were well-dispersed correlated with contact angle (CA). The hardness property can reach 63.4% at the lower concentration of the  $\text{Al}_2\text{O}_3$  addition 0.6 wt%. The adhesive strength, scratch hardness, and scratch resistance were greatly improved to 5B, 5H, and 2N, respectively. The preparation method offered in this study is an effective and convenient approach to producing UV-WPUA/ $\text{Al}_2\text{O}_3$  coatings. The enhancement of the properties with the lesser concentration of  $\text{Al}_2\text{O}_3$  nanoparticles ( $\leq 0.6$  wt%) addition in this study shows a new promising potential as surface coating application for several major industrial areas, such as marine, transportation, and biomedical field with major economic and environmental benefits.