

ADDITION OF GRAPHENE OXIDE DURING WATERBORNE POLYURETHANE SYNTHESIS FOR IMPROVING ITS ADHESION PROPERTIES

Different carbon-based fillers have been added to increase the performance of polyurethane adhesives, mainly carbon nanotubes, activated carbon and carbon blacks, an improvement of the thermal and the mechanical properties have been obtained. However, the addition of carbon fillers increases the viscosity and the stiffness, and decreases the wettability of the polyurethane adhesives. It would be desirable to add lower amounts of filler and avoid the increase in stiffness of the polyurethane adhesives, the use of graphene derivatives can be of interest.

The addition of graphene derivative to waterborne polyurethanes for obtaining composites with improved thermal, mechanical and conductivity properties have been demonstrated. However, the influence of the addition of graphene derivatives on the adhesion properties have been scarcely studied, and the most studies on the improved adhesion of polyurethanes by adding graphene derivative have been devoted to coatings. For improving the adhesion of waterborne polyurethane dispersions (PUDs), in this study different small amounts (0.01-0.10 wt %) of graphene oxide (GO) were mixed with the polyol and these GO+polyol mixtures were added during prepolymer formation step (in-situ polymerization) in the synthesis of the waterborne polyurethane dispersions for creating covalent bonds between the prepolymer and the functional groups on the GO surface, an approach for improving the adhesion of waterborne polyurethane adhesives which has not been considered yet.

GO sheets were homogeneously dispersed into the polyurethane matrix, and the addition of 0.02-0.04 wt% GO increased the T-peel strength of plasticized poly(vinyl chloride)/PUD/plasticized poly(vinyl chloride) joints whereas the addition of 0.05-0.10 wt% GO increased the single lap-shear strength of stainless steel/PUD/stainless steel joints. The improved adhesion of the PUDs containing GO was ascribed to the creation of covalent interactions between the surface groups on the GO sheets surface and the NCO groups of the isocyanate during prepolymer formation, creating new urethane groups; during the phase inversion, the covalently bonded GO sheets were embedded between the polyurethane chains, this changed the degree of phase separation between the hard and the soft segments. For amounts of GO higher than 0.04 wt%, some GO particles cannot be covalently bonded to the prepolymer during the PUD synthesis but they were "trapped" between the polyurethane chains during the phase inversion step. As a consequence, the properties of the PU+GO films were different in the PU films containing 0.01-0.04 wt% GO and the ones containing 0.05-0.10 wt% GO.

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