METHODS OF THE INCORPORATION OF NANOPARTICLES OF SiO_2 IN SYNTHESIS OF AQUEOUS POLYURETHANE DISPERSION; EVALUATION OF MECHANICAL PROPERTIES

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Abstract

Waterborne polyurethane dispersions (WPUDs) have a wide applicability in various industrial sectors such as coatings for textiles and leather, wood coatings, adhesives, etc. The properties of the polyurethane obtained will depend on the raw materials used for their synthesis, polyol and isocyanate, and also of the additives added in their formulation.

Nanotechnology offers an opportunity for modifying the properties of polyurethanes. Nanosilicas have been widely used for improving the properties of polyurethane materials but their use mainly has been focused in the incorporation of this nanomaterial after synthesizing the polyurethane dispersion. In this work, the addition of nanosilica during the synthesis process of WPUDs was analyzed. The synthesis of polyurethane was obtained from the reaction between a polyether polyol and IPDI as isocyanate in presence of other additives such as UV-blocking and bactericide blocking agents. The nanosilicas used were: hydrophilic nanosilicas (commercial and generated in situ) and nanosilicas modified with AMPS (aminopropyltriethoxysilane) [1-3].

For adding nanosilicas during the synthesis of WPUDs several aspects such as: the step of the reaction, the transfer medium of nanosilicas, and the dispersion method in this medium had to be analyzed and defined. Ultrasound and mechanical stirring methods (at different shear rate) were analyzed for obtaining a good dispersion of nanosilicas in the selected medium. Once different methods for incorporating silica nanoparticles were studied, a specific analysis of the incorporation of silica nanoparticles in various stages (prepolymer step or aqueous dispersion step) of the synthesis process of WPUDs was analyzed.

The aim of this paper is to show the results obtained during the analysis of the incorporation of silica nanoparticles unmodified and modified during the synthesis process of WPUDs and establish its effect on the final properties of the material obtained. For each type of nanosilica, it has been studied the incorporation procedure and analyzed their influence over the concentration and addition step in the process of synthesis. The chemical composition of the films obtained was analyzed by FTIR spectroscopy, thermogravimetric (TG) analysis and differential scanning calorimetry (DSC). To assess the physical and mechanical properties, several standardized test methods were carried out: Viscosity Brookfield measurement (UNE EN ISO 2555:2000), tensile strength and elongation at break (ISO 527-3: 1995), determination of elastic modulus and water vapor permeability of polyurethane films was evaluated according with a defined internal method based on ASTM E96 standard. The results show that there is an influence related with the modification of the nanosilica and the step at which the nanosilica is added in the synthesis process of WPUDs on the final properties of the polyurethane material.

References

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