

WATERBORNE POLYURETHANE-UREA PSAs WITH TAILORED PRESSURE SENSITIVE ADHESION PROPERTY

Several PSAs are obtained from solvent-born formulations that although effective, they have environmental and health concerns, limiting their application in food and medical areas, so there is a need for developing waterborne-based PSAs. Previous studies on the development of waterborne polyurethane dispersions intended for PSAs are synthesized with hydroxyl-terminated polybutadiene (HTPB) and propylene glycol polyether polyols, but the most of them needs a crosslinker [1, 2]. In a different approach, Chen et al. [3] have synthesized waterborne polyurethane PSAs intended for transdermal drug delivery, they were synthesized by reacting polyethylene glycol (PEG)-modified copolyether polyol and hexamethylene diisocyanate, and they found that the holding power, 180° peel strength and repeating peel-stick property increased as the NCO/OH ratio increased, but the tack property decreased; the optimal properties of the waterborne polyurethane PSAs, i.e., improved hydrophilicity, adhesion properties, and biocompatibility, were obtained by using NCO/OH ratios of 2.0—2.2. Another approach for developing waterborne polyurethane PSAs consisted on the synthesis of hybrid acrylic/polyurethane PSAs [4] they need the addition of bisphenol A chain extender and increased amount of a chain transfer agent. In general, the already developed waterborne polyurethane PSAs showed insufficient cohesion and adhesion properties, i.e., the ones showing high tack and peel strength have poor cohesion, and the ones showing high cohesion have low tack and peel strength. There is a need of synthesizing new polyurethane PSAs with adequate tack, peel strength and cohesion, i.e., with improved cohesion and adhesion properties.

In this study, the prepolymer method was used for synthesizing different waterborne polyurethane PSAs with isophorone diisocyanate, copolymer of ether and carbonate diol polyol and different amino-alcohols chain extenders. Apart of the novelty of the use of new reactants for synthesizing waterborne PSAs, it has been demonstrated that the number of hydroxyl groups in the amino-alcohol chain extender and the degree of cross-linking during the chain extension stage of the synthesis allowed the design of PSAs with different tailored properties. Three amino-alcohols with different number of OH groups chain extenders - amino-2-propanol (AP), bis(2-hydroxypropyl)amine (HPA) and tris(hydroxymethyl) aminomethane (THAM) – were used. The waterborne polyurethane-urea dispersions were characterized by pH, particle size distribution, and viscosity, and the polyurethane-urea films were characterized by attenuated total reflectance infra-red (ATR-IR) spectroscopy, differential scanning calorimetry (DSC), thermal gravimetric analysis (TGA), and plate-plate rheology (temperature and frequency sweeps). Polyurethane-urea pressure sensitive adhesives (PUU PSAs) were prepared by placing the waterborne polyurethane dispersions on polyethylene terephthalate (PET) films and they were characterized at 25 °C by creep test, tack and 180° peel test.

The waterborne polyurethane-urea (PUU) dispersions showed mean particle sizes between 51 and 78 nm and viscosities in the range of 58-133 mPa·s. PUU films showed glass transition temperatures (T_g s) lower than -64 °C, and they showed a cross of the storage and loss moduli between -8 and 68 °C depending on the number of OH groups in the amino-alcohol chain extender. Different types of PUU PSAs (removable, high shear) were obtained by changing the number of OH groups in the amino-alcohol chain extender. The tack at 25 °C of the PUU PSAs varied between 488 and 1807 kPa and the 180° peel strength values ranged between 0.4 and 6.4 N/cm, and their holding times were between 2 minutes and 5 days. The new PUU PSAs made with amino-alcohol chain extenders seemed very promising for designing environmentally friendly waterborne PSAs with high tack, and improved cohesion and adhesion property.

ACKNOWLEDGMENT

This research was partially funded by UBE Chemical Europe, grant number UBE2-17Y.

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