

„Cohesion of Solvent-Based Acrylic Pressure-Sensitive Adhesives (PSA)”

Author: mgr inż. Henryk Rogoziński

Dissertation supervisor: prof. dr hab. inż. Zbigniew Czech, DSc, PhD

Dissertation co-supervisor: Paula Ossowicz-Rupniewska, PhD

Acrylic pressure-sensitive adhesives in the form of self-adhesive materials such as single-sided, double-sided and transfer adhesive tapes are used in many industries, such as the automotive, aerospace, construction and medical materials industries, among others. Solvent-based self-adhesive acrylic adhesives should have very good self-adhesive properties (tack, adhesion) and excellent internal strength of the adhesive joint (cohesion). All three main properties mentioned above (tack, adhesion, cohesion) should be considered together, although the most important property is cohesion. Its lack or inadequate cohesion leads to costly complaints, including deletion of the considered self-adhesive products from the portfolio. The cohesiveness of solvent-borne pressure-sensitive adhesives can be increased in many ways. Crosslinking agents used in the technology of self-adhesive acrylics are typical metal chelates such as aluminum acetylacetonate (AlACA), commercial propylene imine such as Trazidin VN and crosslinking agents that crosslink at elevated temperatures, usually at 140°C, such as e.g. the Cymel 303 LF amino resin. Although in the technology of adhesives and self-adhesive materials, percentages by weight (wt.%) are used when preparing appropriate adhesive compositions, but it was decided in the doctoral thesis to calculate the used crosslinking agents in their molar concentrations, considering the conversion of adequate molar concentrations into percentages used in practice. For the tray, adhesion and cohesion tests, four solvent-based acrylic adhesives were synthesized, differing mainly in the concentration of acrylic acid in individual combinations, which is reflected in the concentration of carboxyl groups in the finished acrylate copolymer, which react to carboxylic groups by re-linking the re-linking agents to the re-linking test groups. The synthesized polyacrylate adhesives had 3; 3.5; 5.0 and 7.0 wt.% acrylic acid.

Various combinations of crosslinking compounds AlACA, Trazidin VN and Cymel 303 LF with adequate weight concentrations corresponding to the molar ratios of individual crosslinking agents for acrylic PSA with different concentration of acrylic acid carboxyl groups for various coat weight on their tack, peel adhesion, shear strength and SAFT tests were tested.

Analyzing all the obtained results of the properties of the tested pressure-sensitive adhesives, especially cohesion, containing selected crosslinking agents, it can be concluded that the most effective crosslinker is propylene imine Trazidin VN. The drawback of using Trazidin VN is the pot-time of such a composition within a few hours. Technologically, this type of drawback can be eliminated by dosing the cross-linking compound to the adhesive directly before its coating. When using Trazidin VN, no by-products are formed during the cross-linking process. The second also effective crosslinker is AIACA, with the use of which there is no problem with its storage, and the properties of the adhesive, especially cohesion, remain impeccable. The least effective crosslinker, despite increasing its concentration, turned out to be Cymel 303 LF melamine resin, which produces methanol as a by-product of the crosslinking process.

11. 09. 2021

Henryk Rogoziński