

'Photoreactive water dispersions based on acrylics crosslinked with UV radiation'

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Self-adhesive materials (PSA) can be defined as viscoelastic materials which, in a solvent-free state, remain permanently sticky at room temperature. The PSA products are known as tapes, labels, films, etc. There based on such types of PSA adhesives as: acrylics, silicone, polyester, nature and synthetic rubbers, polyether, ethylene-vinyl acetate copolymers (EVA), and polyurethanes. PSAs based on acrylates are synthesized in the form of solvent-based, solvent-free (so-called hot-melts) or water-borne systems. The industrial applications of UV-cross-linked materials have grown enormously over the past decade. The increasing success of UV cross-linking technologies in a wide variety of industrial products and processes can be attributed to the productivity and environmental benefits of such technologies. Three properties are most important in characterizing the nature of self-adhesive materials: tack, peel strength, measured at a specific angle (adhesion), and shear strength (cohesion). They are tested in accordance with the AFERA and FINAT standards, i.e. tack according to AFERA 4015, adhesion according to AFERA 4001 and cohesion according to FINAT FTM 8.

The aim of this doctoral dissertation was the synthesis of photoreactive water-based pressure-sensitive adhesives based on acrylates, which can be cross-linked with UV radiation and which can be used for the production of self-adhesive materials, such as: one-sided, double-sided and carrier-free tapes, labels, and protective films.

All developed dispersions were synthesized by radical emulsion polymerization, based on butyl acrylate with ammonium persulfate as the initiator. In the first part of research, polymerizations were carried out with two unsaturated copolymerizable photoinitiators: 4-acryloyloxy-benzophenone (ABP) and the commercial Visiomer 6976; in amounts of 0.1 - 1.0 wt.%. In the second part, syntheses were carried out in the presence of standard external photoinitiators: Irgacure 184 (1-hydroxycyclohexylphenyl ketone) and Darocure BP (benzophenone), with the use of functional monomers: tert-butylcyclohexyl acrylate (TBCHA), tetrahydrofurfuryl acrylate (THFA) and polycaprolactone acrylate (CAPA), 1,6-hexanediol diacrylate (HDDA), trimethylolpropane triacrylate (TMPTA) and trimethylolpropane trimethacrylate (TMPTMA) in amounts of 0.1 - 3.0 wt.%. The influence of the type and amount of photoinitiators, the concentration of functional monomers and the dose of UV radiation on tack, adhesion and shear strength of cross-linked PSA pressure-sensitive adhesives were investigated. The dispersions with high cohesion values were selected and mixed with the rosin resin in an amounts of 5 - 25 wt.% to improve the tack and adhesion values. For the majority of self-adhesive compositions, a slight decrease in adhesion and tack was observed with the increase in the dose of cross-linked UV radiation, which was accompanied by a high increase in cohesion, and thus an increase in thermal resistance. The conducted tests showed that the results obtained with ABP are more in line with expectations than with Visiomer 6976.

Based on the obtained results, detailed tests were carried out for ABP samples with the addition of rosin resin. Also, higher and consistent with the expectations measurement results of the application parameters were obtained for the samples with the Irgacure 184 photoinitiator. It has also been shown that the use of TBCHA, THFA, TDA and CAPA functional monomers allows to obtain high thermal resistance of the coatings.

Self-adhesive products obtained in dissertation can be entered to production tapes, labels, banners, and a range of peelable and consumable products. The only disadvantage, as in the case of classic PSA dispersion adhesives, is that they are not water- and moisture-resistant.

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