Adam Licbarski MSc

Development of Fundamental Technology for Manufacturing Transfer Self-Adhesive Tapes with a Thickness of 1 Millimeter Using Photocrosslinking and UV-initiated Photopolymerization

Opracowanie Podstaw Technologii Wytwarzania Transferowych Taśm Samoprzylepnych o Grubości 1mm z Wykorzystaniem Fotosieciowania oraz Fotopolimeryzacji Inicjowanej Promieniowaniem UV.

Doctoral dissertation abstract

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ABSTRACT

Pressure-sensitive adhesives (PSA) are based on polymers characterized by viscosity (tack) and adhesion already at room temperature. Polymers with an amorphous (disordered) structure and a glass transition temperature lower than -30°C are suitable as self-adhesives adhesives. When it comes to the polymerization method, we distinguish between solvent-based adhesives, water dispersions and solvent-free adhesives. Taking into account the polymer base, there are self-adhesive adhesives based on acrylates, natural and synthetic rubbers, silicones, polyurethanes, polyesters, ethylene-vinyl acetate copolymers (EVA) and polyethers.

The most important properties of pressore-sensitive adhesives, which have their justification in the technology of adhesives and self-adhesive materials, include tack (viscosity, stickiness), peel adhesion (adhesion), cohesion (strength) and shrinkage, with the shrinkage mainly affecting self-adhesive materials coated on PVC foils. .

One of the most important factors determining the application properties of the adhesive is the selection of appropriate cross-linking compounds and the determination of their concentrations. Non-cross-linked self-adhesive adhesives are of no use as they are the basis for unfortunately justified complaints.

In order to obtain high cohesion and high thermal resistance, often up to 220°C, it is necessary to use cross-linking compounds that react mainly with carboxyl groups derived from acrylic acid, incorporated into the polymer chain during the polymerization process. The cohesion of PSA is the most important property of adhesives, determining their commercial use.

The most important cross-linking compounds used in practice in the technology of adhesives and self-adhesive materials are monomers with cross-linking abilities, metal chelates, multifunctional propylene imines and amine resins. Currently, UV technology is increasingly used to cross-link pressure-sensitive adhesives, where the main role is played by photoreactive monomers, oligomers and unsaturated photoinitiators.

The most important test of the cohesion of self-adhesive glue in dynamic conditions lasting for 2 hours from room temperature to 220°C is the SAFT (Shear Adhesive Failure Temperature) test. This test allows you to determine the temperature and measure the time at which the tested self-adhesive material in the form of a single-sided adhesive tape is separated from the steel plate used for measurement.

The aim of this doctoral dissertation was to investigate the extent to which it is possible to develop technological laboratory tests regarding bulk polymerization of acrylate monomer mixtures in order to obtain photoreactive syrups used to produce self-adhesive transfer tapes. Observing the development of this type of modified polymers in technological research, the course of photopolymerization was observed using the FTIR technique to study C=C double bonds.

The prepolymers obtained as a result of bulk polymerization were modified by adding multifunctional photoreactive crosslinking compounds to them, obtaining photoreactive syrups used to produce self-adhesive transfer tapes. HDDA, HDDMA and Photomer 4172 F were used as photoreactive cross-linking compounds with concentrations from 0.1 to 1.0 wt.% with respect to the total weight of the polymer mixture.

The adhesive films obtained in this way were subjected to tack, adhesion and cohesion tests at 10°C and 70°C, as well as tests according to the SAFT method. Interesting research into the extent to which it is possible, based on theoretical considerations, to develop technological dependencies of the concentration of selected cross-linking compounds for practical use in the cross-linking process of adhesives used to produce commercial self-adhesive products, turned out to be very fruitful. Bulk polymerization initiated by UV radiation allowed obtaining photoreactive syrups, which, under UV lamps on a coating machine made especially for this type of technology, obtained high-quality self-adhesive transfer tapes with phenomenal properties, high tray, phenomenal self-adhesive properties and incredible cohesion in a wide temperature range.

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