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"Adhesion of acrylic pressure-sensitive adhesives"

ABSTRACT

The idea of the work is founded on complex examination of adhesion phenomena of acrylic pressure-sensitive adhesive, which is used in many pressure-sensitive materials. The chosen pressure-sensitive adhesive (PSA) works a model for a wide group of PSA's based on acrylic monomers. As a monomers butyl acrylate, 2-ethylhexyl acrylate, and acrylic acid are used. Aluminium acetylacetonate is used as crosslinking agent. Set of experiments were conducted, to find the function of peel adhesion form crosslinking agent concentration (0.2 wt.% - 0.5 wt.%), coat weight (30 g/m^2 -120 g/m^2), kind of substrates, time of PSA layer contact with a substrate (up to 6 weeks), surface free energy of substrate, molecular weight of adhesive and its viscosity, siliconizing level of release coat and other release coat parameters, peel angle (90° - 180°). Experiments were conducted according to AFERA 4001 or with parameters based on the method but with changed parameters as to meet research requirements. Several substrates were examined: steel, poly(methyl methacrylate), polyethylene, polypropylene, acrylonitryle butadiene styrene, poly(tetrafluoro ethylene), and polycarbonate. Surface free energy of substrates was found with exploitation of Owns-Wendt and Van Oss-Goods methods.

In order to test peel angle function a special device was designed and prepared.

Gathered results allowed finding and showing a number of dependencies, which have not been reported elsewhere. It has been highlighted, that the right choice of basic parameters during acrylic PSA production has a very significant influence on peel adhesion force of finished PSA product and the must of careful development considering the purpose and substrate destination.

For all tested substrates increase of coat weight results with rise of peel force, and the increase of crosslinking agent results with decrease of this force. It was found that the highest surface free energy is not a guarantee of the highest peel adhesion force. No adhesive or cohesive failures were observed on low free energy surface substrates: PE, PP, PTFE and prevention of failures on other tested substrates requires more detailed description.

The function of peel adhesion from peel angle is achieved together with indication of the most appropriate peel angle, exhibiting the lowest peel force and it is established to be 130°. It was alleged, that in some range of peel angle, the Rivlin equation is compliant, and from the range the fracture energy for different coat thick and crosslinking agent were calculated. The work

consists of six parts, where the second is a concise theoretical background necessary for subject consideration and the fourth part includes experiments description together with results and discussion. The fifth chapter contains of conclusions and perspectives for further research. In the sixth part experimental results are gathered in tables.