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Tack of acrylic pressure-sensitive adhesives (PSAs)

Influence of selected factors on tack properties of model acrylic pressure-sensitive adhesive (PSA) has been studied. In tack experiments loop tack test based on FINAT FTM9 standard procedure was used. Loop tack test is the most common method of tack determination in pressure-sensitive tapes industry. The investigated factors were: coat weight and crosslinking agent concentration (aluminium acetylacetate, AlACA); separation speed, substrate surface free energy (PTFE, PE, PP, PC, ABS, PMMA, stainless steel, glass), substrate roughness, dehesivity (release) of the release liner, contact time and contact force of the PSA tape with the substrate surface. For better understanding roles governing initial adhesion (tack) the dynamical viscoelastic properties of model acrylic PSA were determined and thermodynamical work of adhesion (W_a) was calculated. In the case of steel substrate the peel adhesion at 180^o and cohesion (holding time) were determined. The fracture mechanics of model acrylic PSA while peeling form steel substrate was studied.

The conducted trials have shown that crosslinking increased: the storage modulus (G'), the loss modulus (G") and terminal relaxation time (τ_R) of model acrylic PSA. The above-mentioned changes in rheological properties of model acrylic PSA were resulting with loop tack and peel adhesion deterioration in contrary to the cohesion (holding time) which was significantly improved. The experiments curried out in the next step of the study revealed that an increase of the separation speed improves tack. Relationship between separation speed and tack properties has been associated with viscoelastic properties of model acrylic PSA.

Tack values measured on different substrate materials were increased in following order: PTFE < PP < PE < steel < ABS < PC < glass < PMMA. The tack performance of the model acrylic PSA reached optimum when used substrates having SFE in between 35 and 42 mJ/m^2. A strong relationship between tack and thermodynamical work of adhesion was pointed. The tack properties of model acrylic PSA were found to be strongly depend on the factors associated with viscoelastic energy dissipation. The studied PSA systems displayed the highest dissipation on high-surface-energy substrates.

Adhesive tapes containing model acrylic PSA prepared with the lowest crosslinker additives and the highest coat weights displayed higher tack on the rough substrate (PP_{ch}) in comparison to the smooth one (PP_g). The differences in tack properties on both surfaces were related with the total contact area of the adhesive and substrate (A_{tot}). The use of a release

liner having a low dehesivity (release value) reduced tack, because, a damaged PSA surface loses its adhesion properties.

An increase of the contact force and contact time was resulting with the respective tack increases. The influence of both experimental parameters on tack has been linked with the viscoelastic properties controlling bonding efficiency of model acrylic PSA.

Key words:

acrylic pressure-sensitive adhesives (PSAs), tack, surface free energy (SFE), roughness, viscoelasticity, dissipation, wettability, contact time, contact force