2-Ethylhexyl acrylate/4-acryloyloxy benzophenone copolymers as UV-crosslinkable pressure-sensitive adhesives

Zbigniew Czech
Technical University of Szczecin, Polymer Institute, K. Pulaskiego 10, 70-322 Szczecin, Poland, e-mail: psa_czech@wp.pl

Received: 2 April 2003/Revised version: 9 June 2004/ Accepted: 16 June 2004

Summary

It has been previously shown that copolymer of 2-ethylhexyl acrylate with an 4-acryloyloxy benzophenone can be used as PSA. This paper presents synthesis and application of solvent-based polymer system for the preparation of acrylic pressure-sensitive adhesives (PSA). 2-Ethylhexyl acrylate benzophenone copolymers, having molecular mass in the range of 120 000 to 380 000 Dalton were prepared by free-radical solution polymerization. These copolymers were tacky but possessed insufficient cohesive strength after UV-crosslinking to be useful as PSAs. These copolymers resulted in materials having a balance of cohesive and adhesive characteristics required of a good PSA. Some of the parameters affecting the pressure-sensitive adhesive properties of the copolymer are: amount of the 4-acryloyloxy, molecular mass of the polymeric components, UV-reactivity and such properties like tack, peel adhesion and cohesion.

Keywords: 2-ethylhexyl acrylate, 4-acryloyloxy benzophenone, UV-crosslinking, tack, peel adhesion, cohesion.

Introduction

Conventional solvent-based acrylic pressure-sensitive adhesives (PSAs) are generally copolymers of C_4 – C_8 alkyl acrylates and polar monomers, such as acrylic acid or hydroxyacrylate. Optionally modifying monomers like methyl or ethyl acrylate and vinyl acetate may also be incorporated in the copolymer structure. Optimum cohesive and adhesive properties of the copolymers are attained by a proper balance of its molecular mass (usually very high), polarity, and the glass transition temperature ranging from -25 to -70°C. The acrylic PSAs are generally applied onto the desired substrates as solvent or water based coatings and subsequently dried.

Solvent-based acrylics pressure-sensitive adhesives are synthesized in organic solvents viscoelastic polymers with permanent tack and the balance of two properties adhesion and cohesion [1]. In the long history of technology, pressure-sensitive adhesion and self-adhesive articles as we know them are a fairly recent concept. The history of PSAs was described by Villa [2]. The diverse crosslinking methods of PSA acrylics has been discussed in [3]. Ultraviolet-crosslinked solvent-based PSA acrylics are one component systems. UV-crosslinked acrylic PSA systems were described in [4-7]. Photoinduced crosslinking is a rapidly expanding technology on PSA area resulting from new properties and quality of chemical crosslinking bonding. This crosslinking
process and a new class of UV-crosslinkable PSA acrylics founded interesting application for production of self-adhesive tapes, foils and dental materials.

The presence of a hydrogen donor molecule (usually an amine) is necessary, when the benzophenone or multifunctional saturated benzophenones for UV-induced crosslinking process are used. In the case of application of unsaturated benzophenones the crosslinking reaction can be conducted in the presence of oxygen [4].

The crosslinking mechanism of UV photoreactive PSA acrylics containing 2-ethylhexyl acrylate and 4-acryloyloxy benzophenone has been thoroughly investigated and it is presented schematically in Figure 1 [8].

![Figure 1. UV-crosslinking of PSA acrylics containing of 4-acryloyloxy benzophenone.](image)

The behavior of any pressure-sensitive adhesive can be reduced to three fundamental and interconnected physical properties: tack, peel adhesion and cohesion [9].

**Tack** of PSA is not an exactly defined, physical characteristic, it may be defined as a separation energy. Nevertheless tack is still considered and rated by many as how well a pressure-sensitive adhesive sticks to the finger following only slight pressure and short dwell time.

**Peel adhesion** is the force required to remove a PSA-coated material from a specified test surface under standard conditions (10).

**Cohesion** is a real measure of the internal structural resistance of the polymer. Generally, the mechanical and physical (tack, peel adhesion) properties of PSA acrylics are dependent on its cohesion.

**Experimental**

**Materials**

The following experiments were conducted to study the influence of amount of 4-acryloyloxy benzophenone on the following properties of the synthesized PSA such as viscosity, molecular mass, tack, peel adhesion and cohesion. The investigated PSAs were synthesized with between 0.1 to 3.0 wt.-% of 4-acryloyloxy benzophenone and rest of 2-ethylhexyl acrylate by polymerization in a typical organic solvents like ethyl acetate and acetone in rate 80 : 20 with 0.1 wt.-% of thermal initiator AIBN. The solid content was about 50 wt.-%.