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# Synthesis of pressure sensitive adhesive using emulsion polymerization of core-shell technique, effect of acrylic acid monomer on shear strength

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**Abstract:** Among the different polymerization processes (such as emulsion, solution, hot melt and radiation methods) that are used to synthesize pressure sensitive adhesives, emulsion polymerization is the greatest interest to industry. In this work, different values of acrylic acid monomer (0.56, 1.12, 1.67 and 2.21 wt %) have used for preparation of the adhesive base on core-shell morphology. The shear strength of the obtained adhesive continuously increased (from 397 kPa to 501 kPa) with increasing of acrylic acid concentration.

**Keywords** pressure sensitive adhesive, core-shell, emulsion polymerization, shear strength.

## Introduction

Adhesion is an area of widespread interest from both scientific and technical standpoints. Pressure sensitive adhesives (PSAs) are very important for their commercial use in applications such as labels, protective films and medical use. Pressure sensitive adhesives are viscoelastic materials that can adhere strongly to solid surfaces upon application of light contact pressure and also short contact time. PSAs are used for many applications (e.g. tapes and labels) and can be obtained using different technologies such as emulsion polymerization [1]. "Recently, waterborne PSAs have received much attention from both industry and academic as a means for complying with environmental regulations" [2]. Core–shell polymer (CSP) are structured composite particles consisting of at least two different components, one in principle forms the core and another forms the shell of the particles. This class of material has attracted much attention because of the combination of superior properties not possessed by the individual components [3].

## Experimental/ Theoretical

Acrylic acid (AA), styrene (St) and n-Butyl acrylate (n-BA), were purchased from Petro Chem Company, Dubai. The surfactants used were dioctyl sulfosuccinate (DOSS, Aldrich) as an anionic surfactant and nonylphenol ethoxylate as non-ionic surfactant (KENON 30) which were prepared from, Kimyagaran Emrooz Chemical Industries Co (Arak, Iran). Ammonium persulfate (APS, 99%, Aldrich, Lancaster, UK) and sodium bicarbonate (Merk, Germany) were used as initiator and buffer respectively. Deionized water was used throughout the study. Emulsion polymerizations were carried out in a 1-L four-necked glass reactor equipped with a circulator, a mechanical stirrer, an addition funnel and a thermometer. A two-stage semi-continuous emulsion polymerization process was used for the synthesis of the core-shell polymers. First core pre-emulsions was prepared by mixing emulsifiers, monomers (i.e. BuA, St and AA), buffer and deionized water for 15 min at room temperature. The core pre-emulsion and the APS solution were simultaneously fed into the reactor over 3 h at 76 $^{o}$C. The required amount of BA was added in the second stages to form the shell. The emulsion copolymerization of core-shell particle was carried out with the formulas according to Table1.

Table 1 Recipe used for the emulsion polymerization.

| Component | Content (g) |
|---|---|
| Monomers | 358 |
| DOSS | 4.75 |
| KENON 30 | 9.5 |
| Buffer ($NaHCO_3$) | 0.7 |
| Deionized water | 283.5 |

Initiator solution (Deionized water 30gr+ 0.6 APS).

## Results

The shear strength of the obtained adhesive increased (from 397 kPa to 501 kPa) with increasing acrylic acid concentration from 0.56 wt% to 2.21 wt% which studied (Fig. 1). Improvement of the shear strength with addition of the acrylic acid could be due to presence of COOH polar group affected on the adhesion of the PSAs [4].

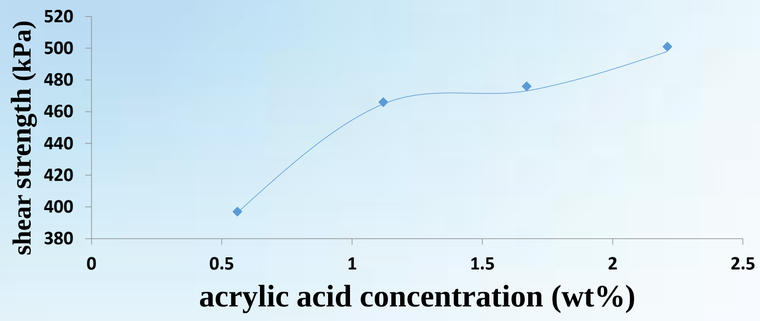


Fig. 1 Effect of acryic acid concentration on shear strength of PSAs.

## Conclusion

The shear strength of the obtained adhesive continuously increased with increasing of acrylic acid concentration.

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