

## ABSTRACT

In the field of material research, polymers, which are synthesized with the use of renewable resources, have gained much attention in the recent decades. Their use has both environmental and economical benefits. Basic research in the field of production, modification, improvement of properties and new applications of these polymers are extremely important. Due to numerous hydroxyl groups, which can be chemically modified, carbohydrates are one of the most important renewable raw materials. In the present doctoral thesis, a glucose-based vinyl surfmer, i.e. butyl polyglucoside maleic acid ester (BGMAH), was synthesized and then used in the emulsion polymerization of pressure sensitive adhesives (PSA). In the emulsion polymerization process, BGMAH has a function of emulsifier and vinyl monomer. Later, the hydrophilic monomers (acrylamide and acrylic acid) and cross-linking agent (N,N'-methylenebisacrylamide) was added to the emulsion PSA formulation in order to prepare copolymers, which have not only functional properties of the PSA, but also the swell ability in the solvent and at the same time could be used for transdermal drug delivery.

In the first part of the doctoral thesis, the glucose was modified and characterized. The chemical structure of the synthesized BGMAH was confirmed using Fourier transform infrared spectroscopy (FTIR) and a series of 2-D homo- and heteronuclear NMR spectra. Its surfactant properties were confirmed by determining the critical micelle concentration. Further, the emulsion polymerization of BGMAH with n-butyl acrylate (n-BA) was investigated. The semi-batch emulsion copolymerization was monitored in situ using FTIR spectroscopy. The particle size and its distribution of the emulsions and the gel phase of the polymers were determined. The glass transition temperatures were assessed using differential scanning calorimetry (DSC) and dynamic mechanical analysis (DMA). The obtained emulsions were tested for potential application in pressure sensitive adhesives by measuring the adhesion properties of copolymer films (peel strength, tack and shear resistance). It was found that synthetic acrylic monomers could be replaced by the modified glucose in the emulsion polymerization formulation. The adhesion properties were improved when BGMAH was added in reaction mixture.

In the second part of the doctoral thesis, acrylamide (AM), acrylic acid (AA) and N,N'-methylenebisacrylamide was added to the PSA emulsion formulation from the first part of the research in order to prepare the PSA hydrogels, which could be used as potential patches for transdermal drug delivery. The influence of BGMAH, AM and AA concentration on the final polymer properties was investigated. Batch emulsion polymerization was monitored in situ using FTIR spectroscopy. The structure of the synthesized copolymers was assessed by investigating the copolymer's thermal properties. Rheological and adhesion properties (tack and peel strength) were determined. Dynamic swelling of PSA hydrogels in water and solution of nicotine with concentration of 50 g/L was investigated gravimetrically. Swelling kinetics and diffusion of water and solution of nicotine in hydrogels were also studied. Nicotine release behavior was evaluated using UV spectroscopy. It was found that the addition of hydrophilic monomers and cross-linking agent have deteriorated the adhesion properties and at the same time enabled the swelling behavior of prepared polymers. The release of nicotine was less-Fickian. PSA hydrogel with the composition of 20 wt% of

BGMAH, 8 wt% of AM, 6 wt% of AA and 66 wt% of n-BA has good swell ability and adhesion properties for skin-contact applications.

**Keywords:** renewable resources, glucose, emulsion polymerization, pressure sensitive adhesives, PSA hydrogels