Design of biobased non-isocyanate polyurethanes

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Polyurethanes are the most versatile and common polymer materials. In the synthesis of conventional polyurethanes, ether or ester polyols, diisocyanates and a low molecular weight chain extender are used. The synthesis of these substrates, their subsequent polymerization and recycling of used polyurethanes undoubtedly have a toxic effect on the environment. The very synthesis of diisocyanate, which is obtained from deadly and energy-intensive phosgene, is extremely toxic. Also, the susceptibility of diisocyanate to hydrolysis adversely affects the environment and human life. Due to the growing ecological awareness, the search for an alternative method of PU synthesis began, eliminating the use of isocyanates [1]. A balanced approach is the synthesis of isocyanate-free polyurethanes, which are obtained from cyclic carbonates and diamines. Cyclic carbonates can be obtain with 1,2-diols or can are formed by introducing CO_2 into epoxy compounds, which can be synthesized from renewable raw materials [2].

In this work, CC was synthesized from vanillin alcohol diglycidyl ether (VA) or hydroquinone (HQ). Cyclocarbonylation with carbon dioxide (CO_2) in the presence of tetrabutylammonium bromide (TBAB) catalyst was carried out at 105°C, resulting in the formation of a 5-membered cyclic carbonate. The use of waste and natural substances is consistent with the global efforts to reduce the impact of the chemical industry on the environment [2]. NIPU was obtained by reacting previously synthesized vanillin carbonates and hydroquinone with the long-chain amine polypropylene oxide and 1,12-dodecylamine (DADD). The sample series differed in the ratio of shorter to longer amine. FTIR analysis was used to control the reaction, observing changes in the absorbance of bands originating from carbonate groups (1800 cm^{-1}) and urethane groups (1720 cm^{-1}). The structure of the obtained polyurethanes and the presence of crystalline segments were investigated by WAXD and DSC.

Keywords: NIPU, thermal analysis, non-isocyanate polyurethanes, composites

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