Succinic acid esters as intermediates for the synthesis of polyamide 44

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Succinic acid is predicted to be one of the future platform chemicals that can be derived from renewable resources.

The development of a process chain from natural resources to new polymers like polyamide 44 is the main research objective of the scientists group »C4-GAIN« at Fraunhofer UMSICHT. This project is funded by the BMELV/FNR (FKZ 220-249-05).

One part of the process chain is the conversion of succinic acid to its dialkyl esters and their following polycondensation to polyamide 44. Dialkyl esters of natural organic acids are known as environmentally friendly, non toxic solvents, and they also represent interesting monomers for syntheses of polyamides or polyesters. In the esterification of succinic acid the formation of byproducts like monoesters and anhydride must be considered. As the experiments showed, diethyl esters of succinic acid could be produced under optimised reaction conditions with a yield of more than 98 %. Furthermore, it could be revealed, that the following polymerisation can utilise the raw effluent from the esterification reaction without further purification.

Polyamide 44 was synthesised by polycondensation of succinic acid diethyl ester with 1,4-butanediamine. Its melting point was measured as high as 305 °C due to the high density of hydrogen bonds between the amide groups in the polymeric chains. The IR-spectra show, that unwanted side-reactions in the polycondensation, like e. g. the typical chain interruption reactions caused by formation of imides, can effectively be suppressed, if diethyl esters are used as monomers.