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Creative management of waste from production of sugar - glycine betaine as the future for the agrochemicals and surfactants market

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Due to the urgent need to limit the negative impact of new chemicals on the natural environment, it is recommended to obtain new chemical substances from renewable natural sources and the products should be characterized by high biodegradability. Moreover, their synthesis should be carried out using non-toxic reaction media that preferably should be reused. An attractive and cheap raw material that meets these requirements is glycine betaine, which can constitute as much as over 25% of the waste mass in the production of sugar from sugar beets. It is a fully biodegradable and non-toxic substance demonstrating significant potential as a source of multifunctional ionic compounds with various types of activity. By attaching an alkyl substituent to the carboxylate group in glycine betaine (so-called *O*-alkylation), it is possible to synthesize specific group of quaternary ammonium salts (QASs) containing an ester group (so-called esterquats). The susceptibility of the obtained betaine esters to fast hydrolysis toward low-toxic substances, minimizes the risk of pollution of the natural environment compared to analogous fully synthetic QASs. Moreover, adjustability of long alkyl substituent determines the possibility of using betaine alkyl esters as more environmentally friendly alternatives to commonly applied nowadays cleaning and disinfecting agents as well as agrochemicals, such as herbicides. Currently known methods of synthesis of alkylated derivatives of glycine betaine require the use of toxic reagents. Additionally, majority of them are time-consuming and require the use of many unit processes. Therefore, using the EasyMax™ 102 reactor an attempt was made to improve the process and establish more favorable synthesis conditions in the context of commercial production. Optimization of *O*-alkylation of betaine allows to shorten the process and reduce the costs of synthesis, reduce energy expenditure as well as overall negative impact of the process on the environment. The conducted research paves the path to scale the process of betaine esters synthesis on a large laboratory and industrial scale.

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