ISGC 2019
May 13th - 17th

N°816 / PC
TOPIC(s) : Waste valorization / Polymers

PET waste and crude glycerol as a feedstock for value products

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PURPOSE OF THE ABSTRACT

Utilization of polymer waste is one of the most important problems in the modern world. For its properties polyethylene terephthalate (PET) is widely used as a feedstock for packing material. Since 1990-s PET world production greatly increased and in 2017 it was 28 million tons [1]. Currently, this type of waste is mainly reprocessed by physical and mechanical methods (extrusion, re-melting). However these methods decrease the properties of the polymer, so such secondary product has limited application [2]. On the other hand, chemical re-processing allows to create polymer with properties comparable to virgin product. Saponification (or alkaline hydrolysis) and glycolysis are one of the most promising ways of PET recycling. It makes it possible to create monomers for polyesters production. At the same time, the popularity of biodiesel leads to the accumulation of its by-product ? raw glycerol containing potassium soaps, methanol, fatty acid methyl esters, moisture and other compounds [3]. Pure glycerol separation from this mixture by neutralization with subsequent vacuum distillation [4] is currently economically irrational for high energy costs, so this type of waste has not found wide application. Crude glycerol also can't be used as a feedstock for value chemical because of a lot of impurities, which decreased yields of key products (acrolein, ethanol, polyesters and so on) [5-7]. So in this work method for cooperative utilization of PET waste and crude glycerol from fatty acid methyl esters production is presented.

Depolymerization of PET with crude glycerol was carried out in a three-neck glass reactor equipped with a mechanical stirrer and a thermometer. As a feedstock were used only crude glycerol and waste PET, obtained from bottles of soft drinks, with particles size of 2.5x0.5 cm. Crude glycerol contained 61,4 wt.% of glycerol, 8,5 wt.% of FAMEs and 30,1wt.% of soaps (as potassium stearate) and trace amounts of methanol. The analysis of the obtained products was performed using potentiometric titration, gas chromatography, IR and NMR spectrometry.

It was determined that dipotassium terephthalate (DPT) is the main product of this process. It was confirmed by IR and 13C-NMR spectra of the samples. Also was noticed that other types of plastic (polyethylene and polypropylene) as well as dyes doesn't affect on process performance.

It has been discovered that crude glycerol from biodiesel production facilities is efficient depolymerising agent for PET utilization. It allows to produce DPT, purified glycerol and fatty acid ethylene glycol esters, which can be used as lubricants. Also it has been noticed that this method is non sensitive to contaminants.

The reported study was funded by RFBR according to the research project ? 18-29-24009\18.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

polyethylene terephthalate | polymer waste | crude glycerol | depolymerization

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