Therefore, tuning of torsional rigidity greatly impacts on emission and charge transport properties, being a very powerful tool on the way to high performance emissive organic semiconductors.

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CHEMICAL RECYCLING OF POLYMER WASTES BASED ON POLYLACTIDE

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Plastic recycling is strategically important issue in many countries. Russia is not an exception. The 21st century, certainly, can be called the century of plastic, because there is a great number of different products, which are made from this lightweight, durable, and relatively cheap material. The manufacture of products based on polymers and capable of decomposition by microorganisms is currently being developed. However, biodegradable plastic is rather expensive. So, the best options are recycling of polymer wastes and reuse of these materials. Obtaining monomers from polymer wastes is a pressing challenge nowadays [1].

Polylactide (PLA) is the linear aliphatic polyester, the monomer of which is lactic acid. It represents thermoplastic, transparent, and colorless polymer. The reasons of its extensive use are such properties as biodegradability and biocompatibility. Polylactide is used for production of different films and covers, for 3D printing and in medicine [2]. The process of obtaining lactide is multistage and energy-intensive, which predetermines the low yield of the product, significant loss of lactide during its purification, the formation of a large amount of waste, the high cost of the polymer. This situation could be improved by the recycling of substandard waste based on PLA. This type of polymer can be easily subjected to recycling, in particular, chemical one [3], where the low-molecular fractions (lactic acid and lactide) are produced as a result of polymer chain destruction.

The aim of this work was to obtain lactide by thermocatalytic depolymerization of polymer wastes based on polylactide.

The objects of research were commodity polylactide and polylactide with inorganic pigments, namely, with Fe_2O_3 and TiO_2. The process of obtaining raw-lactide was conducted over 30 minutes on the laboratory set up for the vacuum distillation at the temperature of 250 °C and the pressure of 10 mbars in the presence of the catalyst ZnO. The purification of raw-lactide was held twice by the method of recrystallization from ethanol. The identification of the product was carried out by the method of IR-spectroscopy. The effectiveness of the process was evaluated by the yield of raw-lactide and pure lactide and the purity of the monomer was assessed by its melting point.

The research showed that polymer blends could be subjected to destruction as easily as commodity polylactide, with the formation of monomer 3,6-dimethyl-1,4-dioxan-2,5-dion (or lactide). The material balance of the process was compiled (Table 1). It showed that the yield of commodity polylactide

Table 1. Influence of polymer blend composition on the yield of raw-lactide (β_{r-l}), gas products (β_{gp}), and pitch (β_p)

Polymer blend	β_{r-l}, %	β_{gp}, %	β_p, %
PLA	82.63±8.13	3.97±1.61	13.40±6.52
PLA+Fe_2O_3	66.57±31.79	2.43±2.16	30.99±30.80
PLA+TiO_2	90.84±10.74	2.44±1.36	6.72±10.43

Table 2. Influence of polymer blend composition on the yield of lactide (β_l) and its purity

Polymer blend	β_l, %	T_m, °C (after recrystallization)	
		First	Second
PLA	41.87±5.95	85–88	88–90
PLA+Fe_2O_3	37.80±35.12	84–94	94–96
PLA+TiO_2	70.00±0.65	82–92	86–93

amounted about 70 %, on average.

The percent of the yield is rather high, therefore, obtaining of lactide from polymer wastes and its reuse are rational. The data of IR-spectroscopy demonstrate the existence of functional groups specific to lactide, what corresponds to the literary data [4]. The melting point (T_m) of obtained monomers increases after the second recrystallization (Table 2), but it doesn't reach the required values, namely, 95–96 °C. M-lactide is also a part of gaseous products (together with lactic acid), because its boiling point is 10–20 degrees lower than that of L- and D-monomers and other lactic acid isomers under the conditions of our experiment.

The cleanest isomer of lactide (with T_m = 94–96 °C) was obtained by depolymerization of polylactide with Fe_2O_3. In other cases in concert with individual L- and D-monomers m-lactide (T_m = 54 °C) was also present. Even small impurities of this monomer decrease considerably the melting point of L- and D-lactide.

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OPTIMIZATION OF THE LINEAR ALKYL BENZENE SULFONIC ACID MANUFACTURING USING THE MATHEMATICAL MODELING METHODS

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To date, the consumption of synthetic detergents (SD) based on surfactants annually increases in the whole world. Linear alkyl benzene sulfonic acid (LABSA) is the main component, which is used for the production of SD. These substances are chemical compounds of the alkyl aromatic series with a saturated unbranched hydrocarbon chain of 10-13 carbon atoms and one or more sulfonic groups. LABSA is a typical representative of anionic surfactants obtained by sulfonation of linear alkyl benzene (LAB) with sulfuric anhydride. The largest producer of linear alkyl benzene sulfonic acid in Russia is LLC KINEF. Nevertheless, industrial capacities don`t have enough powers to provide the market with a sufficient quantity of the desired product. Therefore, there is already a deficit of LABSA in the domestic market, which is filled with less effective surfactants or imported, more expensive analogues.

The purpose of this work was the modeling of the optimal sulfur supply process in LABSA technology and creation of optimization recommendations for the production of high quality linear alkyl benzene sulfonic acid (LABSA content is not less than 96% by weight, content of non-sulfonated compounds is not more than 2% by weight). The research was based on the analysis of technological data and the results obtained with the help of a mathematical model.

In previous research works, a direct dependence was established between the content of undesirable aromatic compounds in the feedstock and the