which filled with 1 mol L^{-1} KCl. 2 M NaOH solution was chosen as the background electrolyte and solvent for the substance [2].

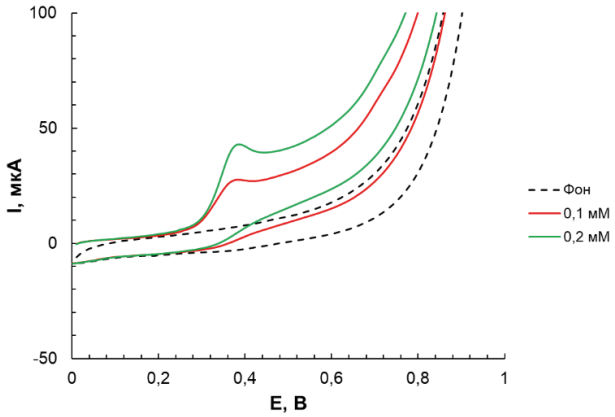

Fig. 1. *Cyclic voltammograms of oxidation – reduction of IMN on GCE in 2 mol L^{-1} NaOH, W = 100 mV/s*

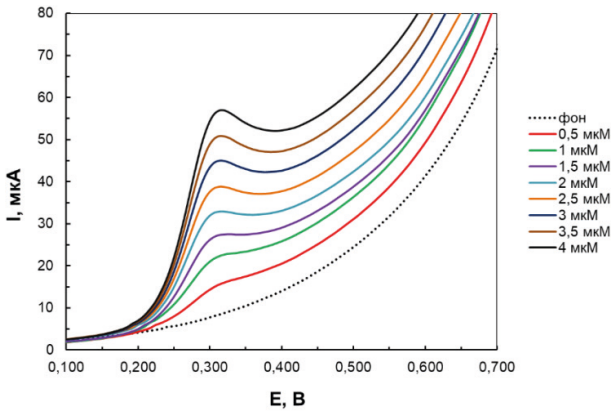

Fig. 2. *Anodic voltammograms of INM in 2 mol L^{-1} NaOH, W = 100 mV/s*

Cyclic voltammograms were recorded in the potential range of 0–1 V for searching of electrochemical signal from pharmaceutical substance (Fig. 1). According to the results, IMN is oxidized only in the anode region.

Figure 2 shows the anodic voltammograms of IMN electrooxidation, where intensity of the peak current increases with an increase of the concentration of the substance.

The dependence of the anodic peak current on the concentration is linear in the range of 0–0.4 mM (Fig. 3).

The proposed method for determining IMN will be used to develop a method for the quantitative determination of a substance in pharmaceuticals.

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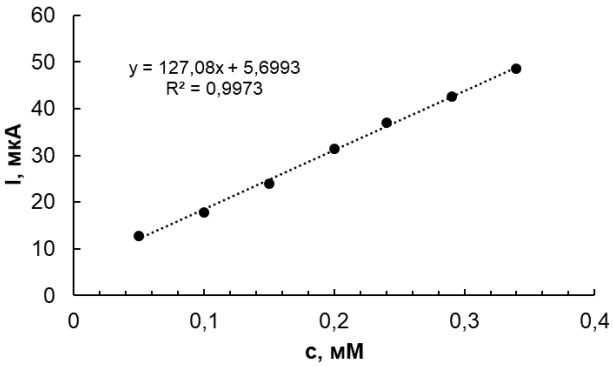

Fig. 3. *Dependence of the IMN electrooxidation current on its concentration in 2 mol L^{-1} NaOH, W = 100 mV/s*

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THE THERMAL DECOMPOSITION OF POLYLACTIDE WASTE

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Over the last years, polymers have been used in almost all areas of modern life. However, one of the most important problems here is that most polymers do not decompose in nature, which leads to sustainable environmental pollution. The development and appliance of polymers able decompose to under specified conditions is a solution to this problem. Biodegradable polymers are materials that break down into innocuous to the environment compounds during certain natural microbiological and biochemical processes. The products of complete ones decomposition are mainly carbon diox-

ide, water and humus. Such polymers easy can be recycled which allows to conserve resources and reduce environmental pollutions.

Polylactide, produced from a lactic acid dimer, is one of the most widespread biopolymers. Due to its biocompatibility and sustainability, lactide-based polymers are used in various areas of life, from the production of short-life servicing goods such as disposable tableware, plastic wrap to medical products, such as surgical sutures and pins. Synthesis of lactide is an integral part of the polylactide production. Conditions of this process, such as pressure, temperature and catalytic system, heavily affect the quality and properties of the derivable monomer.

The purpose of this work is to synthesize lactide by thermal decomposition of polylactide waste and to study structure, composition and purity of the monomer obtained.

Depolymerisation of the polylactide was performed on a vacuum distillation unit under pressure of 10 mbar and at a temperature of 180 200 °C in the presence of a ZnO catalyst in an amount of 1 % by weight. The experiment was carried out in parallel with two samples of polymer. The first sample was 3D printing filament (PA-1), and the second was products made from it, obtained by printing with a 3D pen (PA-2). The purification of raw lactide was performed by recrystallization from ethyl acetate.

The content of lactic acid in the samples was determined by titrimetric method. The lactide structure was analyzed by Infrared (IR) spectroscopy. Lactide is a substance existing in the form of two optical isomers: L-lactide and D-lactide. However, the forms of meso-lactide and racemic mixture of L, D-lactides are also known. Depending on its configuration, the substance has a different melting point (T_{melt}). The T_{melt} for L- and D-isomers is 96 °C, for racemic mixture is 125 °C and for meso-form is 54 °C. The sample obtained by depolymerization of the 3D printing filament (PA 1) has the melting point closest to the reference one after recrystallization. Studies showed that the obtained monomer with a melting point within 72–96 °C (PA-1) is a mixture of monomers, such as individual L-, D-forms and a racemic mixture. A wide temperature range of melting point indicates the presence of impurities in the analyzed substance. These can be residues of lactic acid, meso-lactide, other optical isomers, oligomer, and water.

The yield of pure lactide in terms of used polylactide under experimental conditions was 34.03 % (wt.) and 44.53 % (wt.) for new polylactide (PA-1) and polylactide waste (PA-2), respectively.

The analysis of IR spectrums of the lactide showed next results.The absorption band in the area of 3,000–2,900 cm^{-1} indicates the presence of C–H bonds in the sample, the intensive absorption band in the area of 1,700 cm^{-1} indicates the presence of a C=O bond and bands in the area of 1,450–600 cm^{-1} belong the C–O– bond. The absorption bands in the region of 3,100–3,000 cm^{-1} of the sample PA-1 are more expressed than the bands in the same region of the sample PA-2, which indicates the presence of more impurities in the sample PA-2 containing a hydroxyl groups.

In conclusion, the studies have demonstrated that the 3D printing filament and products from its are a valuable raw material for producing a mono-

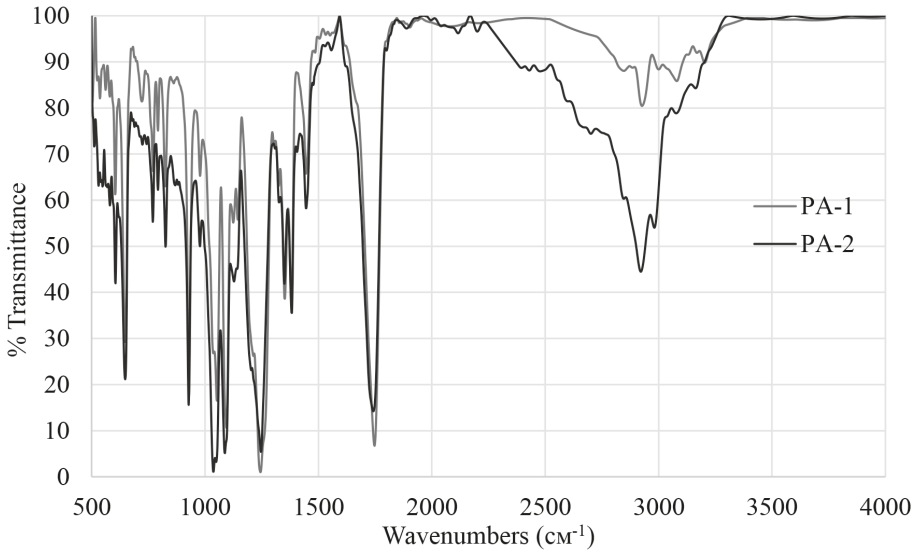

Fig. 1. *The IR spectrum of the lactide*

mer – lactide (its maximum yield reach 44.5 %). The use of zinc oxide in an amount of 1 % by weight catalyst, at a temperature about 200 °C and a pressure of 10 mbar leads to the formation of D- or L-lactide, with a little content of water, lactic acid and m-lactide as impurities.

WASTEWATER REUSE FOR IRRIGATION OF MUNICIPAL GREENS

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Wastewater reuse is one of the alternative solutions for water scarcity. However, it is also connected to certain risks, e.g. spreading of micropollutants, antibiotic resistant bacteria and genes, or pathogenic microorganisms [1]. In our work, we focus on comparison of micropollutants content in secondary effluent from municipal wastewater treatment plant (WWTP), intended for reuse, and river water, commonly used for irrigation of municipal greens.

Newly established Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse, sets several limits for quality of treated wastewater for reuse. Besides basic physico-chemical parameters, these limits include also *E. coli*, *Legionella* spp. and intestinal nematodes (helminth eggs) [2]. Czech legislation for irrigation also sets several limits for irrigation water, including basic physico-chemical parameters, microbial parameters, heavy metals, but also some specific pollutants, such as polychlorinated biphenyls or radioactivity [3]. While there is legislation regarding these different kinds of contaminants, current legislation which would set necessary limits for micropollutants (e.g. pharmaceuticals) for irrigation or different wastewater reuse is still lacking [4]. However, risks connected to their presence in water used for irrigation must be taken into account [5]. Thus, this work focuses on their monitoring, but also on possibilities of their removal from the wastewater.

Two different kinds of water were monitored – a secondary effluent from municipal WWTP and river water, which is commonly used for irrigation here in the Czech Republic. Samples of the effluent were taken as 24-hours samples, while river samples were taken as grab samples, using glass vessels. Sampling campaign was carried out from autumn 2020 to spring 2021. Micropollutants were analyzed by LC/MS/MS. In total, 31 different micropollutants, mainly from the group of pharmaceuticals, were analyzed.

Results showed that effluent from municipal WWTP has generally higher concentrations of micropollutants than the river. The highest concentration of pharmaceuticals in effluent samples was measured in 2700 ng/l for tramadol, while in river it was 130 ng/l for gabapentin. From other micropollutants, the highest concentration measured was that of sucralose – 30000 ng/l in the effluent, while in the river, it was only 1000 ng/l. These results suggest that despite certain benefits of wastewater reuse, we should take into account also potential risks for human health or ecosystems, including the spread of these relatively new contaminants onto plants, soil, and eventually groundwater.

Acknowledgments

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