Abstract

According to the Waste Framework Directive 2008/98/ES and the Czech law on waste 185/2001 Sb., waste prevention is the main priority in waste management. Using biodegradable plastics seems to represent a suitable approach in fulfilling the strategy.

The subject of this diploma thesis is biodegradable lightweight polyurethanes (PURs), which might represent suitable materials for repellent fences in agricultural landscapes. Biodegradation processes are assumed to begin in the agricultural soil after their lifetime. The biodegradability of new lightweight PURs (BIO 8-10), presented as material mineralization, was tested in agricultural soil under laboratory conditions according to the ASTM International standard method D5988-03. After the nine-month experiment the material with the highest biodegradability (BIO 10) containing starch (28 wt. %) was mineralized to 42.0 ± 4.2 %. Cellulose (the positive control) was completely mineralized; thus, the validity criterion (positive control mineralization > 70 %) was accomplished.

After the biodegradability test, degradation products (residual PURs) were separated from the soil by a two-step method using fluidisation and flotation, according to a modified procedure described in Nuelle et al. (2014). The procedure enabled a subsequent analysis of PUR residues with Fourier transform infrared spectroscopy (FT-IR). The FT-IR analysis confirmed the assumed hydrolysis of ester and urethane bonds, which is crucial for the disintegration of the tested materials.

According to new research, plastic disintegration into small fragments (microplastics (MPs)) represents potential risks not only for water organisms but also for earthworms, indispensable soil ecosystem engineers. MPs potential risks increase during adsorption of organic pollutants on MPs surface. Within this diploma thesis, a laboratory experiment focused on adsorption of polycyclic aromatic hydrocarbons (PAHs) from contaminated soil on PUR surface was conducted with a conventional (PUR-C) and the new PUR (BIO-10). The highest concentration (8206.0 ± 2719.2 ppm) was measured at the BIO-10 after three-month exposure. However, due to a low extraction yield, the PAH concentrations are assumed to be approximately four times higher.

Key words: biodegradation, lightweight polyurethanes, degradation products, microplastics, adsorption of polycyclic aromatic hydrocarbons