

Abstract

Vermicomposting is recently becoming a rather popular environmentally friendly technique for stabilizing biowaste, including sewage sludge. There is an effort to utilize the sewage sludge as fertilizer on agricultural land. But apart from nutrients, the sludge also contains harmful pollutants, which subsequently after its deposition on fields can be taken up by plants and organisms contaminating the food chains. Micropollutants, the substances that can be found throughout the environment in trace concentrations, are one of the pollutants occurring in sludge. It is for example pharmaceuticals and personal care products, per- and polyfluoroalkyl substances, or pesticides. Their negative effects are known – they can be for instance endocrine disruption, antibiotic resistance, or the development of cancer. Although the deposition of sewage sludge on fields as a fertilizer is one of the main introduction routes of micropollutants to the environment, the content of micropollutants before deposition is not monitored nor regulated.

This dissertation focuses on the fate of micropollutants during vermicomposting, especially in sewage sludge substrates. The vermicomposting method was applied to stabilize coffee spent grounds and sewage sludge obtained from distinct wastewater treatment plants mixed with straw. The research covered diverse scales and layouts, including an outside pilot-scale experiment. Contrary to the treatments without the earthworms, the vermicomposting of the spent coffee grounds led to a significant decrease in caffeine in the substrate. In the pilot-scale experiment, the total operating removal efficiency of all the detected micropollutants was 35% and 34%. In the small-scale laboratory experiments, there was a significant decrease of diclofenac, metoprolol, mirtazapine, telmisartan, and triclosan contrary to the no-earthworms control. The most bioaccumulative micropollutants in earthworms were caffeine, carbamazepine, cetirizine, citalopram, diclofenac, triclosan, perfluorooctane sulfonic acid (PFOS), perfluorotridecanoic acid (PFTrDA), perfluorododecanoic acid (PFDoDA), and perfluoroundecanoic acid (PFUnDA).