

## **Content of zinc, copper and manganese in biomass of Virginia fanpetals (*Sida hermaphrodita* Rusby) fertilized with sewage sludge composts**

Zawartość cynku, miedzi i manganu w biomacie ślazuwca pensylwańskiego (*Sida hermaphrodita* Rusby) nawożonego kompostami osadów ściekowych

**Wiera Sądej, Anna Skorwider-Namiołko**

*Chair of Environmental Chemistry, University of Warmia and Mazury in Olsztyn, Poland*  
e-mail: wiera.sadej@uwm.edu.pl

There has been a rapid growth in the stream of sewage sludge generated over the recent years in Poland, which is a consequence of both constructing new wastewater treatment plants and better opportunities to expand and refurbish the existing installations. At the moment, the target in sewage sludge use is to submit most of it to thermal recycling. This applies mainly to municipal sewage sludge originating from large urban agglomerations. The biological methods still serve the purpose of recycling sewage sludge in small wastewater treatment plants. Composts produced from sewage sludge, owing to their fertilizing properties, can be used for example to nourish soil under energy crop plantations. Our research dealing with this issue is based on a three-year pot experiment in which Virginia fanpetals (*Sida hermaphrodita* RUSBY) was a tested plant. Different types of sewage sludge were examined, i.e. stabilized fresh sewage sludge, sewage sludge composted for 6 months, sewage sludge composted with straw for one and for six months and sewage sludge originating from purification of dairy wastewater. Sewage sludge was applied once, before seeding Virginia fanpetals, in the first year of the experiment. Doses of sewage sludge were established according to their content of N-total. Each year, after harvested yields were determined, the collected plant material was dried, comminuted and mineralized in order to determine its content of trace elements. The total content of Zn, Cu and Mn was determined by the AAS method in acetylene-air flame, on an atomic absorption spectrometer Varian AA240FS. The samples were mineralized in a microwave oven Mars-5, in Teflon vessels HP 500, according to the EPA 3052 method.

Concentrations of zinc, copper and manganese in municipal sewage sludge and sewage sludge composts were several-fold lower than the permissible amounts in sewage for agricultural use. The effect of the applied fertilizing substances on the content of the analyzed elements in the biomass of Virginia fanpetals was varied and dependent on the type of sewage sludge compost and the research year. Irrespective of these factors, both fresh and composted sewage sludge affected more strongly the content of zinc, whereas their influence on copper and manganese was weaker. Compared to the control, the average increase in the levels of the three elements ascribed to the applied sewage sludge substances, for the three-year period of time, was as follows: Zn 29.6–254.4%, Cu 2.3–102.2%, manganese 14.3–45.3%. Regardless of the demonstrated differences, it was impossible to plot an unambiguous tendency illustrating changes in the content of any of the elements. The highest concentrations of zinc, copper and manganese and the highest uptake of these elements by the yields of Virginia fanpetals were determined after fertilization with sewage sludge left to mature for 6 months. Composting sludge with straw led to a decrease in the content of the analyzed elements in the end product, but in regard of their content in plants, the effect of particular types of sludge or sludge composts was unequivocal. With respect to zinc, a higher content of this element was found in Virginia fanpetals biomass after an application of sewage sludge composted with straw than after a soil treatment with fresh stabilized sewage sludge. A reverse relationship was detected for copper and manganese.