Distribution of Heavy Metals in Plants Growing in Constructed Treatment Wetlands

Jan Vymazal[1]*, Tereza Dvořáková Březinová*[1] *and Lenka Kröpfelová*[2]

[1]Czech University of Life Sciences Prague, Czech Republic

[2]ENKI, o.p.s., Třeboň, Czech Republic

Heavy metals do not represent a significant threat in domestic sewage from small municipalities and therefore, they are not a target for treatment. However, they do occur in measurable concentrations. The major aim of this study is to evaluate the distribution of heavy metals and metalloids in both aboveground and belowground biomass of plants growing in constructed wetlands treating domestic sewage. The results presented in this study were obtained during the period 2002-2016 at five constructed wetlands. The study includes sixteen samplings for *Phragmites australis* (common reed) and ten samplings for *Phalaris arundinacea* (reed canarygrass). In addition, for *P. australis* also five natural unpolluted stands were sampled for aboveground biomass. The samples were taken from a 0.25 m^2 quadrant (0.5 x 0.5 m). The aboveground biomass was clipped at the ground level and divided into stems, leaves and flowers. The belowground biomass was dug out from the same quadrant to the depth of 0,5 meters. In the laboratory, the belowground biomass was gently washed and divided into roots and rhizomes in big jars to prevent the loss of fine roots. The biomass was dried at 60°C to a constant weight and weighed. The biomass was then homogenized using a cutting mill and mineralized in nitric acid in a microwave under high temperature and pressure. The concentrations of heavy metals (Cd, Cr, Cu, Ni, Pb and Zn) were determined using the atomic absorption spectroscopy and concentrations of other heavy metals and metalloids (Al, As, Co, Fe, Mn, Mo, Se, Sn) were analyzed using ICP MS analyzer. The results were expressed as standing stock in mg/m^2. The results revealed that distribution of studied heavy metals and metalloids among aboveground parts is similar in *P. australis* and *P. arundinacea*. In *P. australis*, the average amounts in leaves, stems and flowers amounted to 53, 43 and 4%, respectively, while for *P. arundinacea* the respective values were 49, 47 and 4%. However, the substantial difference was observed for belowground parts. In *P. australis*, 44% and 56% of the metals and metalloids were sequestered in roots and rhizomes, respectively, in *P. arundinace* the respective values were 69% and 31%. This difference is apparently caused by different structure of the belowground biomass of both plants. While *P. australis* has more biomass located in the rhizomes, rhizomes of *P. arundinacea* are small but root network is very dense. The distribution of heavy metals and metalloids between aboveground and belowground biomass varies among elements but not too much among plants species monitored in this study. The highest amounts in the aboveground biomass were found for molybdenum (72 and 77% for *P. australis* and *P. arundinacea*, respectively) followed by selenium and zinc. On the other hand, the highest amount in the belowground biomass was found for cobalt (89 and 88% for *P. australis* and *P. arundinacea*, respectively) followed by iron and chromium.