EGU22-404
https://doi.org/10.5194/egusphere-egu22-404
EGU General Assembly 2022

Effect of organic loading rate on biogas production and concentration of heavy metals and valuable elements in continuous anaerobic co-digestion of manure and reed canary grass

Nazia Zaffar, Erik Ferchau, Hermann Heilmeier, and Oliver Wiche
Technical University of Bergakademie Freiberg, Biosciences, Bio/Ecology, Freiberg, Germany (naziazaffarqau@gmail.com)

Anaerobic digestion technique and production of bioenergy from biogas is an important contribution to achieving the targets of climate protection. Concomitantly, the use of digestates as secondary raw material for the production of fertilizers and the extraction of economic valuable elements are increasingly considered. The latter requires profound knowledge on the element concentrations in digestates and how changes in process parameters affect their enrichment. In this study a lab scale continuous anaerobic digestion with different organic loading rates (ORL) were performed to explore effects of loading rate on biogas production and concentration of heavy metals (Zn, Cr, Ni) and valuable elements (Ge, REEs) in digestate. The pH was 6.8–7.2 throughout the whole process. In a 30 liter reactor with working volume of 25 liter grass (*Phalaris arundinaceae*) and manure (20/80, 30/70, 40/60, 50/50, 60/40) were added as a substrate at different OLR (1, 2, 2.5, 3, 3.5, 4 kg VS m-3 d-1). The digestate of each organic loading rate was analyzed by ICP-MS. Increasing the OLR significantly increased gas production by 64%, 12%, 8%, 16% and 20%, respectively. While biogas production increased, concentration of heavy metals (Zn, Cr, Ni) and valuable elements (Ge, REEs) decreased at each level of OLR increase except between OLR 2 and OLR 3. The increased biogas production was most likely caused by higher amounts of readily degradable organics in the fermenter, while decreasing concentrations of elements in digestates result from a dilution of initially high element concentrations in the manure with low concentrated grass biomass. In fact, we could say that the concentrations of elements in manure were by far higher compared to the grass. However, there was OLR 3 where higher inputs of biomass did not negatively affect element concentrations in digestate. Surprisingly at this OLR highest relative increase in gas production was observed. This suggests that at this loading rate enrichment of elements through losses of carbon and dilution with increasing contents of low concentrated biomass was balanced. We could demonstrate that OLR fundamentally impacts gas production and mineral element concentrations in digestate. The effects depend initially on element concentrations in biomass and gas production which potentially offers novel perspectives for optimization of biogas process towards a phytomining of valuable elements and use of digestates as secondary raw materials.