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Development of physical-biological filters for groundwater remediation of tetrachloroethene and naphthalene

THERESA UGOCHUKWU UKWAMEDUA[1], SIMON LEITNER[1], GERHARD SOJA[2,3], **DR. KATHARINA MARIA KEIBLINGER, PHD**[4], FRIDTJOF SOBANSKI[1], CELIA FERNÁNDEZ BALADO[1], CHRISTINE STUMPP[5] AND ANDREA WATZINGER[1]

[1]Institute of Soil Research (IBF), University of Natural Resource and Life Science Vienna (BOKU)

[2]Institute for Chemical and Energy Engineering (IVET), University of Natural Resources and Life Sciences (BOKU)

[3]Austrian Institute of Technology

[4]University of Natural Resources and Life Sciences Vienna, Department of Forest and Soil Sciences, Institute of Soil Research

[5]Institute for Soil Physics and Rural Water Management (SoPhy), University of Natural Resources and Life Sciences Vienna (BOKU)

Presenting Author: katharina.keiblinger@boku.ac.at

Hydrophobic organic solvents such as tetrachloroethylene (PCE) and naphthalene are volatile organic compounds that account for a large number of soil and groundwater contaminated sites in Europe, as well as Austria. Hence, the overall goal of this study is the development of a physical-biological ex-situ filter for their effective removal. A combined approach of physical adsorption to charcoal and on-site degradation by microbial consortia was designed for that. Charcoal versions comprised internally produced biochars and the gold standard, activated carbon. Microbial consortia were made available by in-house consortia as well as cultures from an industrial partner operating in bioaugmentation.

Lab work comprised various characterization methods including hydraulic and chemical characterization, adsorption isotherms and kinetics, batch and column experiments, monitoring adsorption and dehalorespiration of chlorinated ethenes by purge&trap gas chromatography coupled with mass spectrometry, and isotope-ratio mass spectrometry (GC/MS-C/IRMS).

Results so far revealed that PCE-sorption to biochars most significantly increased with their production temperature. Though, pursued biochars had to be selected due to their practical use and the European Biochar Certificate threshold values. In addition, high adsorption capacity may influence bioavailability compromising the overall project goal of compound degradation. Microcosm experiments showed various degradation patterns of PCE facilitating the selection of most vital consortia (two in-house cultures and the consortia KB-1Â® from SiREM) which all showed complete dehalorespiration of PCE to ethene. Isotope enrichment in the carbon of PCE was observed for both, adsorption and dehalorespiration but with major differences ranging from $\delta^{13}C$ (stable isotope ratio of ^{13}C to ^{12}C within PCE) shifts of +0.5 ‰ for adsorption and up to +25 ‰ for dehalorespiration.

The effect of biochar on dehalorespiration of PCE is currently being investigated on a batch scale and is planned to be transformed to column experiments in the near future. Pending tasks also include repeating the work carried out with the second main compound naphthalene.

We will present an overview of the underlying project CHARBAK as well as up to date project results.