Destruction of dissolved organic contaminants by a combination of Fe(0), UV radiation and a boron-doped diamond electrode

K. P. SEDLAZECK [1], D. VOLLPRECHT [1], P. MÜLLER [2], R. MISCHITZ [2], S. NEUHOLD [1], R. POMBERGER [1]

[1] Montanuniversitaet Leoben, Chair of Waste Processing Technology and Waste Management, Franz-Josef-Straße 18, 8700 Leoben, Austria

[2] ferroDECONT GmbH, Peter-Tunner-Straße 19, 8700 Leoben, Austria

Organic substances represent the most abundant group of pollutants at contaminated sites. Consequently, they are present in polluted groundwaters which are commonly treated by activated carbon. Varying external conditions like the development around the area of the contaminated site or the geologic situation, but especially internal conditions such as a large variety of contaminants challenges researchers to develop new or improve existing remediation technologies. For this reason, we combined a boron-doped diamond electrode (BDD), zero-valent iron in a fluidized bed reactor (Fe(0)) and ultraviolet radiation (UV) to create an alternative treatment method. This innovative combination exploits synergy effects and is a nonselective treatment method. We chose dissolved tetrachloroethene, MTBE and clopyralid as test substances for our experiments. For the future, it is planned to conduct experiments with other (emerging) contaminants as well.

The treatment methods were tested alone, in any combination of two as well as in combination of all three of them to identify emerging synergy effects. Additionally, the influence of adding H_2O_2 or $H_2O_2 + H_2SO_4$ was investigated. If possible, original groundwater samples from Austrian contaminated sites were used for the experiments.

The treatment methods alone were able to decrease the tetrachloroethene concentrations, yet, the decomposition rate was not very sufficient. The BDD treatment led to the highest abatement, but a simultaneous production of metabolites was observed. The effectivity of the treatment was enhanced by combining any two methods and adding of H_2O_2.

Combining all three methods without the addition of H_2O_2 or $H_2O_2 + H_2SO_4$ did not yield such high removal rates, however, adding of the chemicals led to the highest removal efficiencies in all investigations. Overall, the system unveiled a high potential for the removal of organic contaminants and also offers a large potential for further research.