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Technical Solution for the Removal of PFAS in Water

Jurgen Buhl (buhl@cornelsen-umwelt.de) and Martin Cornelsen (cornelsen@cornelsen-umwelt.de) (Cornelsen Umwelttechnologie GmbH, Essen, Germany)

Background/Objectives. Close to the airport in Nuremberg (Germany) it was planned to tunnel under an existing road. Investigations that were required in advance showed that PFAS (per- and polyfluorinated alkyl substances) were detectable in the groundwater down gradient of that airport site. In 2010 further investigation on site identified a fire-fighting training area as the source area with PFAS contamination in soil and groundwater. The maximum level of PFAS in the groundwater measured about 777 µg/L (about 48% PFOS) with an average value in the wells in that area of about 357 µg/L. The groundwater itself showed a pH of about 5.6 and was characterized by elevated concentrations of dissolved iron (up to 33 mg/L). Furthermore, VOCs, BTEX and hydrocarbons were detectable at moderate concentrations (less than 150 ppb). The ground consists of fine sand layer on top of bedrock (sandstone).

Approach/Activities. The owner of the airport and the state of Bavaria developed a strategy for evaluating the most appropriate remediation technique for this kind of contamination. Several techniques that could be suitable for treating that water were selected and tested in the lab. Among these techniques was granular activated carbon of different qualities, ion exchanger, nanofiltration and reverse osmosis. The tests performed in 2012 and 2013 with contaminated water had involved both town water and water from the site. At the end of that test procedure a solution showed the most promising results that catches the PFAS and generates micro floccs. The formation of micro floccs allows the use of filtration as a process for removing the PFAS. This technique that generates micro floccs was selected for performing field tests and for collecting additional data. The field test took place then from September until November 2014 with a flow rate of less than 0.5 m^3/hr. After the data from the lab tests could get confirmed the next step was the installation of a full-scale treatment system in September 2015. Due to the groundwater chemistry the final treatment plant did consist of reactor with dosing system and stirrer, filtration, stripping (VOC, BTEX), granular activated carbon and storage tank for sludge. The plant is suitable for the required flow rate flow rate of about 1.5 m^3/hr.

Results/Lessons Learned. The process of generating micro floccs and the corresponding filtration are representing the first pre-treatment module of that plant. Data from September until December 2015 have shown the following results: PFAS concentrations between 390 and 480 µg/L were detectable at the inlet of the plant. This pre-treatment module has removed more than 90% of the PFAS. Sludge and PFAS were collected together in the storage tank. As the concentration of the remaining PFAS was much lower after that pre-treatment module it was not required to initiate any change of the granular activated carbon. Without pre-treatment eight carbon changes would have been expected within that period.

In 2015 another extended field test was performed with similar equipment and the same technique on an airport site in Dusseldorf where firefighting activities due to an aircraft crash had caused contamination with PFAS in ground and groundwater some years ago. At PFAS concentrations of about 35 µg/L removal rates of about 70 to 80% could get achieved.