



Project: Nuremberg Airport x Cornelsen Group

Treatment of groundwater contaminated by PFAS

Nuremberg Airport faced the challenge of treating groundwater contaminated with perfluorinated compounds (PFAS) and additional co-contaminants. To achieve demanding treatment targets and maintain operational efficiency, Cornelsen implemented a modular remediation system using the **PerfluorAd®** process. The project highlights the successful combination of innovative PFAS removal technology with flexible on-site operation under complex groundwater conditions.

> 90 %



PFAS Removal Efficiency

1.18 %



PFAS–PerfluorAd Ratio

Background

AFFF extinguishing foams (Aqueous film forming foam) employed by the airport fire brigade during routine training resulted in contamination of the groundwater with Perfluorinated compounds (PFAS). In addition, the groundwater is contaminated with some chlorinated hydrocarbons, BTEX and arsenic and has a significant geogenic DOC content of approximately 10 mg/l as well as an iron content of 26 mg/l. A regulatory target value was set for treatment to $\leq 0.3 \mu\text{g/L}$ for the sum of the individual PFAS substances PFOS, PFHxS and PFOA, as well as a separate target of $\leq 0.23 \mu\text{g/L}$ for the individual PFAS substance PFOS.

Given the well understood limitations of activated carbon treatment due to very poor adsorption, the high concentrations of PFAS compounds and the associated organic and inorganic substances in the groundwater, the **PerfluorAd®** process was selected to pre-treat groundwater upstream of a conventional activated carbon stage. The efficacy of this approach was successfully demonstrated during a pilot trial during which the consumption of activated carbon was greatly reduced, thus extending the service life and greatly reducing costs.

PFAS

CKW

BTEX

Arsenic



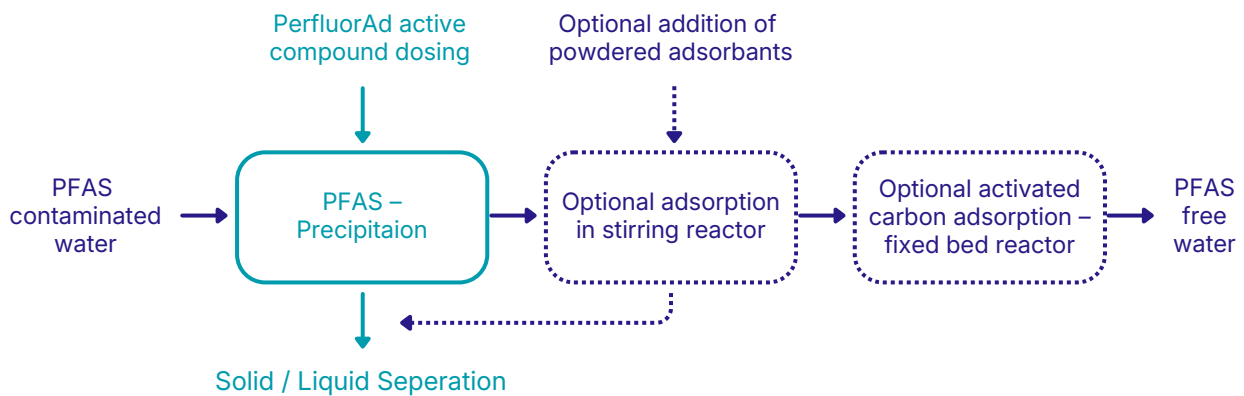
Client	Nuremberg Airport
Application	Treatment of Groundwater Contaminated by PFAS
Plant Throughput	2 m³/h
Influent Water Quality	Perfluorinated Compounds (PFAS), chlorinated hydrocarbons, BTEX, arsenic, DOC and iron
Effluent Water Quality	$\leq 0.3 \mu\text{g/L}$ (PFOS, PFHxS and PFOA), $\leq 0.23 \mu\text{g/L}$ PFOS
Removal Efficiency	> 90 %



The PerfluorAd Treatment Process

The **PerfluorAd®** treatment process is proven and ideally suited for groundwater remediation. The process entails the precipitation of PFAS by dosing PerfluorAd® liquid active compound into the water stream.

The microflocs that arise during this precipitation step are removed from the process by conventional turbidity filtration. The thin sludge that is formed is then dewatered and the residual waste which contains the PFAS transported to a high-temperature combustion system. The residual concentration of PFAS that remains in water is removed by the downstream activated carbon filter stage which, due to the significant decrease in PFAS concentrations during the PerfluorAd® stage, is considerably smaller than would have been the case if activated carbon had been used as the sole treatment stage.



Subject to the defined treatment targets, as well as changes in concentrations or associated water chemistry, the quantity of **PerfluorAd®** can be adjusted, thus making the process extremely flexible.

Performance

In practice this means that the quantity of **PerfluorAd®** used at Nuremberg Airport is reduced to the minimum necessary to safely achieve the regulatory targets for PFAS and the relevant parameters of PFOS, PFOA and PFHxS.

50 mg/l

Active PerfluorAd
dosage

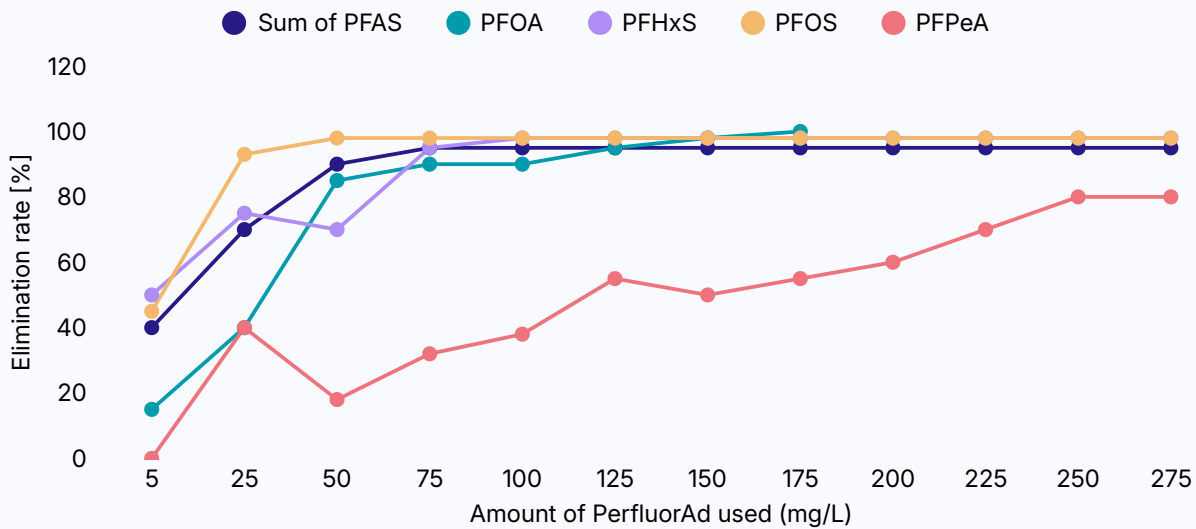
700 µg/l

Initial concentration
total PFAS

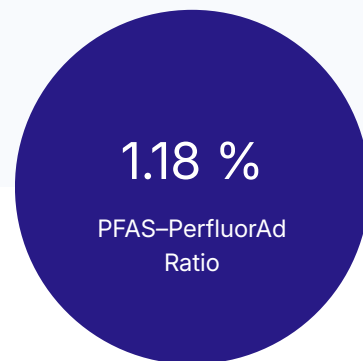
350 µg/l

Average
concentration

Efficiency/active compound ratio when applying PerfluorAd

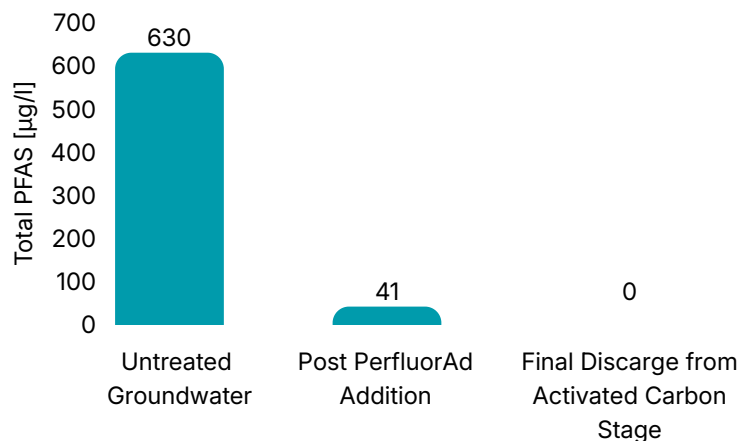


The efficiency/active compound ratio for the Nuremberg groundwater demonstrates a very high removal efficiency (>90%) for a low amount of active PerfluorAd (50mg/l). This represents a PFAS – PerfluorAd ratio of 1.18% which compares very well to the 0.01 to 0.1% PFAS-activated carbon ratio in a conventional activated carbon system.



PFAS Treatment Nuremberg Airport

This means that the direct benefit of the **PerfluorAd®** process at Nuremberg Airport is a low consumption of PerfluorAd® and a low consumption of activated carbon which did not require replacement during the first 6 months of operation despite an initial concentration of >700 µg/l total PFAS and an ongoing average concentration of > 350 µg/l.



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Worldwide.



Locations

Essen, Deutschland
Nailsea (Bristol), Vereinigtes Königreich
Gustavsberg (Stockholm), Schweden
Boston, Vereinigte Staaten von Amerika
Rotterdam, Niederlande – Groundwater Technology
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Sustainable Impact
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