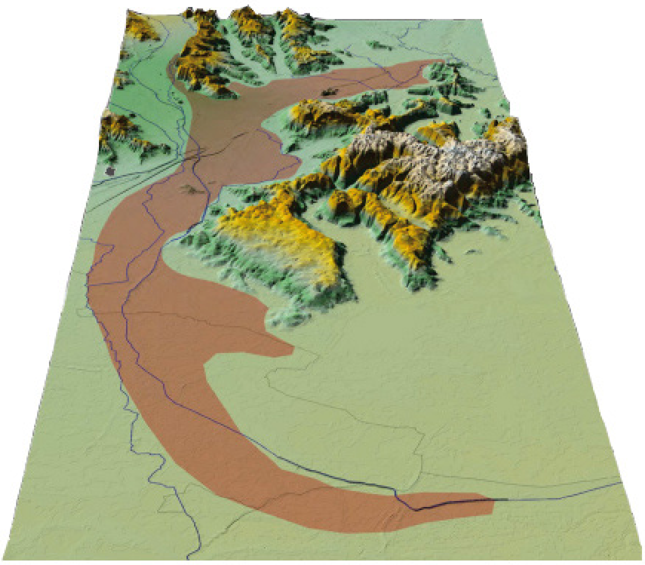
Use of strong anion exchange resin for the removal of PFAS from contaminated drinking water

The term "PerFluoroAlkylated Substances" or PFAS, indicates a broad group of anthropogenic compounds comprising a perfluoroalkyl backbone and a terminal functional group.
Because of their unique properties such as hydro and oleophobicity, chemical, thermal and biological stability and extremely low surface tension, PFAS have found widespread use in the last decades. Due to their outstanding stability, PFAS have been globally found in the environment and biota. Persistency and bioaccumulation of PFAS are strongly related to the length of the fluorinated moiety.
In 2013 abnormally high levels of PFAS were detected in waters sampled in an area covering approximately 150 square kilometers in the Veneto region, Italy (Figure 1). Adsorption of PFAS on granular activated carbon (GAC) was adopted as an emergency measure in many drinking water treatment facilities to meet the performance limits set by the Italian Ministry of Health for drinking water (30 ng·L-1 for PFOS, 500 ng·L-1 for PFOA, 500 ng·L-1 for PFBA, 500 ng·L-1 for PFBS and 500 ng·L-1 for the sum of all other PFAS). Efficiency of GAC filters dramatically drops as the length of the fluorinated chain become shorter. Further GAC is not easily regenerable.
In order to overcome limitations of GAC, strong anion exchange resins (Purolite® A600E, A520E and A532E) were tested in three pilot plants. The role of the hydrophobic sorbate-sorbed interactions on selectivity and exchange capacity of resins proved to be of primary importance in comparison with other parameters such as resin matrix. It is plausible that the removal is due to a mechanism involving both ion exchange of single molecules and retention of molecular aggregates (micelles and hemi-micelles). Further, exchange resins were regenerated in-situ using various solvent and solvent-free saline solutions.
In conclusion strong anion exchange resins are a viable alternative to GAC for removal of PFAS in drinking water decontamination (Table 1).



Resin	$\mu g \cdot g^{-1}$ of PFBA	$\mu g \cdot g^{-1}$ of PFOA	$\mu g \cdot g^{-1}$ of PFBS	$\mu g \cdot g^{-1}$ of PFOS
A600E	0.6	28.5	2.8	2.2
A520E	1.5	37.2	4.3	3.7
A532E	3.3	45.1	5.9	4.7
Activated carbon "C"	4.3	39.6	8.1	4.1
Activated carbon "S"	2.3	31.6	7.1	3.9
Acitvated carbon "J"	3.8	17.3	6.8	2.4

Table 1 - Exchange capacity of anion resins Purolite® A600E, A520E, A532E and granular activated carbon "C", "S" and "J" for PFOA, PFBA, PFOS and PFBS derived from exchange and sorption curves of continuous experiments.

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Main research topics:

- Design, synthesis and reactivity of fluorinated compounds for advanced applications
- Design and operation of drinking, process and wastewater treatment plants