

PFAS

Slashing the costs to a “forever” problem
In groundwater and landfill leachate

ECOTHOR™

HIGHLIGHTS:

- Known as “forever chemicals”, PFAS are pollutants which persistent in the environment, leading to increase rates of cancer along with many other health problems.
- PFAS has been found in wastewater, groundwater and landfill leachate.
- The adsorption media (granular activated carbon or ion exchange resin) costs for treating contaminated groundwater can be anywhere from \$25 to \$250 per m³ of water.
- ECOTHOR-AOP™, using its award-winning electrotechnology platform, can dramatically reduce the OPEX through electro-oxidation (worst case: <\$7/m³).



What are PFAS?

Per- and polyfluoroalkyl substances (PFAS) are a large group of environmentally-persistent, highly stable man-made chemicals which have been used in household goods and industrial products for their hydrophobic, oleophobic, lubrication, or non-flammable properties – fire-fighting foams, anti-stick coating on cookware, water-repellant clothing, etc.



Why are they harmful?

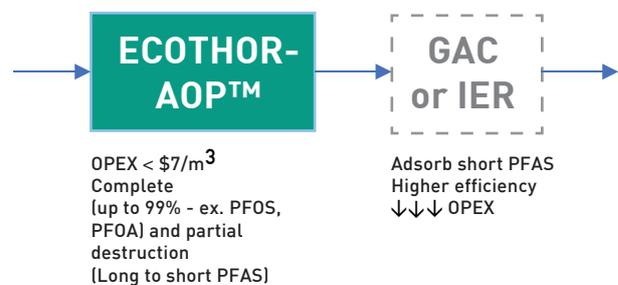
There is evidence that continued exposure above specific levels to certain PFAS may lead to adverse health effects. Very low doses in drinking water have been linked to an increased risk of cancer, reproductive and immune system harm, liver and thyroid disease, and other health problems.

The Challenge

1. Carbon-Fluorine bonds are very hard to break
2. PFAS can be adsorbed by granular activated carbon (GAC) or ion exchange resin (IER) but long chains block adsorption sites, reducing capacity and increasing costs (consumables + disposal or regeneration).
 - GAC - \$200-\$250/m³ of water
 - IER - \$100-\$125/m³ of water

The Solution

Initial treatment with ECOTHOR-AOP™, with complete and partial oxidation of PFAS compounds. The remaining traces of short-chain PFAS molecules are adsorbed at a much higher efficiency by a filtering media (GAC or IER).



ECOTHOR-AOP™ is a patented, cost-effective, and environmentally-sound process for the treatment and removal of recalcitrant compounds. Electro-oxidation is an electrokinetic treatment process whereby an electric current is applied across two electrodes to produce oxidants. This allows for the destruction of numerous types of toxic, recalcitrant organic substances via multiple oxidizing mechanisms. The E2metrix electro-oxidation technology does not use hazardous chemicals and does not produce any solid or liquid waste. Catalytic materials and electrodes are selected depending on the treatment application. E2metrix's technology is protected by an extensive patent portfolio.



Examples of PFAS-contaminated water processed

EXAMPLE 1		Raw sample (ppb)	Treated sample (ppb)	Removal	EXAMPLE 2		Raw sample (ppb)	Treated sample (ppb)	Removal
PFAS compound					PFAS compound				
Perfluorobutanoic acid	PFBA	3.00	0.60	80.00%	Perfluoropentanoic acid	PFPeA	0.46	0.37	19.57%
Perfluoropentanoic acid	PFPeA	1.70	1.50	11.76%	Perfluorohexanoic acid	PFHxA	0.80	0.48	40.00%
Perfluorohexanoic acid	PFHxA	3.00	2.50	16.67%	Perfluorooctanoic acid	PFOA	0.33	0.034	89.70%
Perfluorooctanoic acid	PFOA	0.95	0.10*	>89.47%*	Perfluorobutane sulfonic acid	PFBS	0.2*	0.054	73.00%
Perfluoropentane sulfonic acid	PFPeS	1.70	1.10	35.29%	Perfluoropentane sulfonic acid	PFPeS	0.40	0.080	80.00%
Perfluorohexane sulfonic acid	PFHxS	20.00	14.00	30.00%	Perfluorohexane sulfonic acid	PFHxS	6.6	0.66	90.00%
Perfluoroheptane sulfonic acid	PFHpS	1.60	0.12	92.50%	Perfluoroheptane sulfonic acid	PFHpS	0.59	0.024	95.93%
Perfluorooctane sulfonic acid	PFOS	110.00	1.80	98.36%	Perfluorooctane sulfonic acid	PFOS	50	0.69	98.62%
6:2 Fluorotelomer sulfonic acid	6:2-FTS	3.40	1.40	58.82%	6:2 Fluorotelomer sulfonic acid	6:2-FTS	1.5	0.30	80.00%



E2metrix is a Sherbrooke, Quebec-based water and wastewater treatment systems company, with a focus on **ECOTHOR™**, a “plug & play”, proprietary electrochemical process for treating process water along with industrial and municipal wastewater, either at a greenfield or an existing site. The modular **ECOTHOR™** reactor can be operated alone or in a bank of multiple reactors to treat wastewater discharge flows from as low as a few m³ to thousands of m³ per day to target removal of contaminants including, ammonia nitrogen, phosphorus, suspended solids, metals (ex. Zn, Cu, Ni, As, Se, Mn, Fe, etc.), C10-C50 hydrocarbons, cyanides/thiocyanates, fats/oils & greases, pathogens/bacteria, emerging contaminant (including hormones, pharmaceuticals, PFAS), fluorides, and others.

Low Cost of Ownership	Multiple Contaminant Removal
Fully Automated with Remote Operation	Compact – Small Footprint & Modular
On/Off Capabilities	No moving parts

