ENVIROGEN TECHNOLOGIES

A Lifecycle Performance Company

Case Study

PFAS and VOC Removal from Groundwater

Challenge

Envirogen was contacted to address removal of volatile organic compounds (VOCs) and metals from impacted groundwater at a contaminated site. Upon issuance of the discharge permit for the treatment system, state regulators unexpectedly included a numerical limit for total perfluoroalkyl and polyfluoroalkyl substances (PFAS) of 70 ng/L, and limits for several individual PFAS compounds (see Table 1).

Table 1 | Individual PFAS Discharge Limits

Parameter	Limit
Perfluoro-octanesulfonate	70
Perfluoroheptanoic acid	15
Perfluorohexanoic acid	19
Perfluorononanoic acid	10
Perfluorooctanoic acid	40

*All results in nanograms per liter (ng/L)

Solution

After evaluating the complex mixture of contaminants, Envirogen proposed a treatment system that consisted of chemical oxidation, iron co-precipitation, filtration, granular activated carbon (GAC) and ion exchange (IX) resin. The first 3 stages were designed to address the VOC's and metals, while the GAC and IX were initially employed to act as polishing steps for those contaminants, but also happened to be the best available technologies for PFAS removal.

Results

Envirogen installed and started up the treatment system as it was designed, and continually evaluated several different GAC media from different sources and with different iodine numbers, to obtain the solution with the highest removal efficiency for PFAS. By closely monitoring the PFAS concentration at the GAC inlet, midpoint and outlet, Envirogen staff were able to use predictive modeling to proactively replace the GAC before its adsorptive capacity was depleted, thereby reducing PFAS concentrations to permit compliant concentrations at the GAC outlet. This load reduction allowed the IX resin to act as the final polishing step for PFAS given its higher propensity for removing this group of compounds.

Additional learnings during the operation of the system included:

- Understanding and managing the different breakthrough rates for the various PFAS compounds.
- Proper sampling procedures and techniques that contributed to the collection of reliable influent and effluent data for a true determination of system efficacy.
- The need for quick laboratory turn-around times to get timely data for calculating PFAS load and predicting/coordinating GAC changeout events.

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Upon establishment of the proper changeout frequency, full compliance was accomplished across the range of PFAS compounds in the water.

Savings in carbon usage were achieved by moving the unspent lag carbon to the less critical lead position to allow complete exhaustion.

Actual site data, depicted in Table 2, shows the efficacy of the Envirogen system.

Table 2 | Site Influent and Effluent Data

PFAS Species	Average concentration in influent (ng/l)	Max concentration in influent (ng/l)	Average Effluent Concentration (ng/l)
Perfluoro-octanesulfonate	64	130	0.21
Perfluorobutanesulfonate	6	18	0.14
Perfluorodecanoic acid	65	180	0.56
Perfluorododecanoic acid	3	33	0.17
Perfluoroheptanoic acid	232	510	6.34
Perfluorohexanesulfonate	13	41	0.19
Perfluorohexanoic acid	563	1100	37.7
Perfluorononanoic acid	60	140	0.46
Perfluorooctanoic acid	404	850	5.17
Perfluoroundecanoic acid	4	13	0.19
Total PFAS	1344	2923	48.7