Clean Harbors

Low to High Concentration PFAS Treatment and Disposal

December 8, 2023

Overview of PFAS Treatment Approach

- Defining difference between high and low concentration PFAS treatment
- Limitations of current analytical methods
- Selective identification and non-selective removal of PFAS
- Where PFAS chemistry is going and why is that important
- SCID* removal process
- Approaches for high concentration PFAS treatment with co-contaminants
- Comparing selection of media to selection of chromatography columns
- Disposal options for PFAS

Comparing High Concentration to Low Concentration PFAS Treatment Applications

- Drinking water PFAS treatment mainly concentrations in low to mid ppt range and high volume MGD
- High concentration PFAS treatment applications can be considered mid ppb range to 20 ppm range and volumes are considerably lower average treatment range of 100 gpm-500 gpm range
- Discharge criteria is similar
- High concentration treatment also has considerably more pre-treatment required often in multi-stage treatment trains
- Analytical between media beds are more frequent for high concentration treatment
- Treatment medias and approaches vary greatly depending upon co-contaminants for high concentration applications

Examples of Concentrations and Discharge Requirements

Date	Location	Flow-Rate	PFAS Influent Concentration	Project Type	Discharge Type	Discharge Criteria
2017-2018	MI	100 gpm	500ppb-1ppm	Industrial WW	POTW	<12ppt
2018-present	Midwest	200-400 gpm	500 ppb-1ppm	AFFF release	POTW	ND <2 ppt
2018	Northeast	3 gpm	1ppm-2ppm	Pilot Test	POTW	ND <2 ppt
2018	NJ	40 gpm	low ppb	Remediation Dewatering	POTW	<70 ppt
2018	MI	50 gpm	low ppb	Groundwater Treatment	POTW	<12 ppt
2019-present	CA	15 gpm	10-12 ppm	AFFF Remediation	POTW	<20 ppt
2019-present	MI	100 gpm	1-3 ppm	Industrial WW	POTW	<11 ppt
2019-Present	Northeast	10 gpm	1-2 ppm	Industrial WW	POTW	ND<2ppt
2019-2020	MI	200 gpm	low ppb	Construction Dewatering	Surface Water	<12 ppt
2019	WI	150 gpm	high ppb	Boisolids Dewatering	POTW	<70 ppt
2020	WI	15-20 gpm	1ppm w/ high As	Dewatering	Tanker Haul	ND<2ppt
2019	WI	200 gpm	low ppb	Construction Dewatering	Surface Water	< 12 ppt
2019	WI	200 gpm	1-2 ppm	Construction Dewatering	POTW	<12 ppt
2021	LA	22gpm	high ppb	Industrial WW	Client WWTP	<70 ppt
2018-Present	MI	40 gpm	low ppb	Industrial Remediation	POTW	<12 ppt
2020	CA	5 gpm	1-2 ppm	AFFF Remediation	Tanker Haul	ND<2ppt
2019-Present	MI	20 gpm	low ppb	Groundwater Treatment	POTW	<12ppt
2020-Present	MI	100gpm	10 ppm	Industrial WW	POTW	<12 ppt

References for Projects Provided Upon Request and in Coordination with Clean Harbors due to Client Confidentiality*

A Conservative Approach to PFAS Water Treatment is the Best Defense Throughout the Lifecycle of a PFAS Project

- Identification- Obtain a comprehensive analysis of the incoming water to evaluate competitive analytes for adsorption and ion exchange
- Agreement on Project Objectives- Confirm with all parties what expectations are for discharged water. What constitutes ND, what analyte list and methods are to be used
- Pilot Study- If time allows this is the best means for determining breakthrough rates. If time does not allow for this an option is to start with a very robust treatment train that can be adjusted
- Selecting Approach and Equipment- Comparing costs and benefits to find the right fit for the application throughout the complete lifecycle of the project not just mobilization and initial equipment costs
- Final Deposition of Spent Media and Associated Solids- Landfill, incineration or (reactivation)

SCID* Approach to PFAS Water Treatment

- Separate- Separate contaminants from the water by mechanical filtration, adsorption and ion exchange
- Concentrate- The contaminants are concentrated from large volumes of water onto relatively small quantities of media
- Isolate- The contaminants are isolated onto the media
- Destroy/Dispose- Adsorptive and ion exchange media is either sent to our closed loop landfills or sent to our MACT compliant hazardous incinerators.
- Current position for Clean Harbors on PFAS disposal is to consider projects individually
- This approach limits the potential for liberation or transformation of PFAS during the treatment process