REGENESIS AND PLUMESTOP COLLOIDAL ACTIVATED CARBON SYSTEM TAKES ON PFAS

Regenesis (San Clemente, Calif.) is a global leader in the research, development, and commercialization of technology-based solutions for the environment. The company specializes in scientifically proven product and services-based solutions for groundwater and soil remediation at contaminated sites. Customers are environmental consulting, engineering, and construction firms worldwide.

Maureen Dooley, Vice President – Industrial Sector at Regenesis, *has over 30 years of experience in the environmental industry and specializes in developing in situ remediation solutions for industrial clients confronted with legacy contamination, including PFAS.*

EBJ: Tell us about the evolution of PlumeStop and Regenesis' collaboration with C&E partners. Is this a continuous learning process?

Maureen Dooley: The evolution of PlumeStop began with a multi-year R&D effort to identify and test materials that could halt the movement of contaminants without impacting the natural groundwater flow. This process led to the developing of a novel colloidal activated carbon (CAC) material, aka, PlumeStop, demonstrating the rapid and complete removal of various organic groundwater contaminants in the laboratory.

PlumeStop's patented CAC formula contains organic polymers that keep blood-cell-sized carbon particles in suspension without clumping. This key material innovation of PlumeStop allows it to move through the much larger soil/rock pores while uniformly painting the subsurface materials with highly reactive carbon. Without this innovation, the carbon particles aggregate and cannot be injected into a treatment zone without creating significant gaps in the treatment that render it ineffective.

As groundwater contaminants move through a PlumeStop-treated zone, they are slowed to where they essentially become bound in place while the water moves through now free of contaminants. PlumeStop treatments, in essence, are massive in-ground carbon filtration systems covering 100 acres per pound of carbon applied. In many cases, and especially with PFAS, the rate of contaminants flowing into the treatment zone is low enough that a single treatment can become a permanent solution to remove the PFAS exposure risk.

Once the material formulation of PlumeStop was developed, we collaborated with our consulting/engineering partners to identify pilot projects for in-field testing. After observing outstanding performance from these field-scale pilot tests, PlumeStop was introduced in the market in 2014 and has since led to unprecedented groundwater remediation success with an easy-to-implement, sustainable, and cost-effective approach.

Every PlumeStop project presents an opportunity to learn and optimize our treatment approach. However, we have treated over 700 contaminated sites with this technology over the past decade and have a solid handle on applying PlumeStop to treat PFAS and other organic contaminant plumes in groundwater.

EBJ: Is PlumeStop part of a treatment train or a standalone treatment? Tell us about the different applications.

Dooley: In situ remedies for PFAS employing PlumeStop are flexibly applied to each site and engineered based on the site-specific contaminant blends, hydrological conditions, and aquifer matrix factors. We developed a unique, highly advanced, proprietary modeling program (PlumeForce) that incorporates these variables to determine the amount of PlumeStop required for injection to achieve the site-specific cleanup goals.

Our design specialists work with consultants on the best way to apply the treatments. These in situ applications may involve one or a combination of the following:

- Placement of a PlumeStop barrier at the leading edge of a contaminant plume.
- PlumeStop injections into the plume body.
- Stabilization/sequestration of PFAS source areas (e.g., fire training pits) using a new, concentrated CAC formula, SourceStop.

These in situ treatments do not require coupling with other ex-situ, pump-and-treat methods but rather serve to replace them.

For chlorinated solvents and other non-PFAS organic contaminants in groundwater, PlumeStop is usually co-injected with other amendments that facilitate their destruction via a range of biogeochemical destruction pathways.

EBJ: The name implies that PlumeStop is a containment technology rather than a destruction technology. Does PFAS treatment tend to fall into those two categories? Is there a big difference between containment technologies?

Containment is the only feasible remedy currently available for treating PFAS in groundwater. The energy required to break the strong carbon-fluorine bonds that form PFAS makes destructive technologies costly and impractical for treating large multi-billion-gallon groundwater plumes.

Dooley: PlumeStop in situ treatments and virtually all other ex-situ, pump-and-treat systems used for treating PFAS-impacted groundwater are containment approaches to remove the exposure risk. Containment is the only feasible remedy currently available for treating PFAS in groundwater. The energy required to break the strong carbon-fluorine bonds that form PFAS makes destructive technologies costly and impractical for treating large multi-billion-gallon groundwater plumes, usually containing only trace amounts (i.e., parts per trillion) of PFAS. While numerous technologies are being developed to destroy PFAS, most aim to treat concentrated waste streams like stockpiled AFFF (aqueous film-forming foams) or landfill leachate.

While both in situ and ex-situ approaches rely on containment, there is a crucial difference in how PFAS plumes are contained. The ex-situ approach is a hydraulic containment method that focuses on stopping groundwater movement to contain the plume. Conversely, the in situ approach allows the water to pass through while retaining the PFAS in the CAC-treated zone.

Passively capturing a tiny amount of PFAS requires almost no energy compared to the energy input needed to hydraulically contain the massive volume of water in a typical PFAS contaminant plume, requiring decades of continuous pumping with no guarantee of reaching regulatory standards. Thus, containment approaches are vastly different regarding cost-effectiveness and sustainability. Additionally, only the in situ containment approach avoids generating PFAS waste products and ensures communities do not become exposed to additional PFAS risk during the handling, transport, and disposal of these wastes.

EBJ: Outside of traditional remediation sites with contaminated soil and groundwater, what applications is Regenesis focused on?

According to one estimate, over 57,000 sites with PFAS contamination may exist in the United States alone, with the PFAS contaminant plumes originating from these sites receiving little attention to date regarding active measures to mitigate them. PFAS contamination in groundwater, affecting the drinking water resources of 200 million Americans and many more worldwide, is a massive problem, and eliminating the exposure risk to downstream communities due to contamination at these sites requires our full attention. ☐

REGENESIS: PFAS SIGNATURE PROJECTS

The following projects are a subset drawn from 42 sites treated by Regenesis globally.

- **Pilot Projects at Two UK Airports Demonstrate Successful In-Situ PFAS Remediation.** Two airport sites in the United Kingdom need to treat PFAS in groundwater, originating from AFFF releases. Successful pilot study results allowed for regulatory permission for full-scale PlumeStop PRB installations on both sites.
- **Martha's Vineyard Airport Successfully Treated Using PlumeStop to Eliminate PFAS Risk.** Pilot test barrier installed to prevent offsite migration of a PFAS plume. PlumeStop has successfully eliminated PFAS mass flux immediately downgradient of the barrier and significantly reduced PFAS concentrations further away as monitoring continues.
- **PFAS and CVOC Remediation Paves the Way for Mixed-Use Tower.** A PlumeStop barrier was put in place to prevent contaminant migration, including PFAS and chlorinated solvents, beyond the site boundary. The successful remedial effort earned the site a Certificate of Completion through New York State's Brownfield Cleanup Program facilitating the development.
- **PlumeStop Successfully Remediates PFAS at Alaska Airport.** PlumeStop was applied to treat PFAS resulting from AFFF releases at an airport facility in Alaska. Application has reduced the five targeted PFAS below detection limits and applicable cleanup levels in a challenging hydrogeologic environment over a two-year sampling period.
- **PlumeStop Eliminates PFAS for Six Years.** The first in situ treatment of PFAS was completed at a site in Canada in 2016, which has reduced PFAS concentrations below detection limits for over seven years thus far.
- **PFAS Eliminated for 3.5 Years and Counting.** PlumeStop was applied at a former Army airfield in Michigan. The in situ barrier has eliminated PFAS for over 3.5 years to date.
- **New York Brownfield Site Treated for PFAS Achieves Closure.** PlumeStop barrier was installed to eliminate offsite migration of a PFAS plume. The effective in situ treatment earned closure through the New York State Brownfield Cleanup Program.
- **PFAS Removed from Aquifer at Hazardous Site Where AFFF Was Used.** PlumeStop was applied to the site of a large industrial fire that occurred in the 1980s in Pennsylvania where groundwater was impacted by residual AFFF. Treatment achieved 99.9% PFAS reduction in less than one month as monitoring continues.
- **PFAS Contaminants Reduced to Non-Detect.** PFAS were effectively reduced to non-detectable levels following injection of PlumeStop at a bulk storage facility in the Middle East. These levels have been maintained through 12 months of monitoring completed thus far.