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THE PROBLEM WITH PFAS WASTE INCINERATION

By **Maureen Dooley**

In April 2022, the U.S. Department of Defense (DOD) released a memo placing a moratorium on the incineration of materials containing PFAS (per- and polyfluoroalkyl substances). According to the memo, the 2022 National Defense Authorization Act (NDAA) requires the ban until the DOD issues guidance implementing the U.S. Environmental Protection Agency's (EPA's) interim guidance on the destruction and disposal of PFAS.

And, what does the EPA's current interim guidance say about incinerating PFAS-containing waste? It is best summarized this way: "More research is needed."

The DOD's incineration ban highlights the critical problem that PFAS-impacted facilities must grapple with when managing waste streams as: *"No commercially available disposal or incineration methods have proven effective at preventing the 'forever chemicals' from being recycled back into the environment."*

Upon injection, PlumeStop attaches to aquifer materials, forming permeable reactive barriers that allow groundwater flow, but prevent movement of PFAS and other contaminants from impacting downstream receptors.

While landfilling PFAS-laden wastes may cause the chemicals to leach into groundwater, thermally treating them in commercial incinerators risks redistributing contaminants through the air, hitting downwind communities the hardest. Consequently, many facilities are stockpiling waste materials, hoping for future clarification of the issue.

Generating PFAS waste may have been unavoidable in some cases, potentially even required as part of mandated firefighting training exercises or insurance-mandated testing of Class B firefighting systems discharging aqueous film-forming foams (AFFF).

However, as the need for addressing PFAS contamination in soil and groundwater continues to increase, generating PFAS waste can, and should be, avoided where possible. Facility managers dealing with these impacts can avoid the environmental recycling of PFAS by implementing remedies that contain them in situ.

These remedies employ a patented form of colloidal activated carbon (CAC) that attaches to aquifer materials and removes PFAS from groundwater immediately and over the long term. By treating contaminants below-ground to eliminate exposure risk, the in situ approach effectively bypasses the PFAS waste management dilemma.

The field-proven CAC treatment method was first applied at a site in Canada more than six years ago. It avoids the potential for creating new or exacerbating existing problems, in contrast to thermally treating the PFAS wastes, which can do both.

Commercial hazardous waste incinerators (HWIs) are used to burn a range of chemical wastes. Some of these include other halogenated hydrocarbons such as chlorinated solvents like trichloroethene (TCE), polychlorinated biphenyls (PCBs), or chlorofluorocarbons (CFCs).

Three critical parameters govern the destruction of contaminants by incineration: heat, contact time, and turbulence or mixing efficiency. While these parameters are known for waste products that HWIs traditionally accept, the same cannot be said for PFAS.

What is known is the carbon-fluorine (C-F) bonds comprising PFAS are significantly stronger than the carbon-chlorine bonds of other halogenated substances. Consequently, it takes significantly greater energy to break the C-F bonds, requiring higher temperatures and extended reaction times.

The increased energy and resultant higher costs to thermally destroy PFAS might be palatable if their complete destruction was guaranteed, but it is not. On the contrary, the process creates new PFAS that may, or may not, be detectable.

In its 2019 Technical Brief *"Per– and Polyfluoroalkyl Substances (PFAS): Incineration to Manage PFAS Waste Streams"*, the EPA explains how improper temperature/residence time/mixing conditions may lead to incomplete destruc-

tion and form smaller PFAS. These are referred to as products of incomplete combustion (PICs). These PFAS-related PICs may not have been researched and thus could be a potential chemical (sic) of concern.

Currently, the EPA has little emissions data from PFAS sources to work with. It is working to develop measurement methodologies and gather information to conclude whether potential PICs are adequately controlled. After sufficient research has been completed to address the related knowledge and data gaps, EPA can make a more informed recommendation on disposal of PFAS compounds and PFAS-containing substances using incineration.

PFAS INCINERATION STUDIES FUEL FURTHER DOUBTS

In April 2020, Bennington College published soil and groundwater testing results near a hazardous waste incinerator in Cohoes, New York. Results showed elevated PFAS levels in soil and water near a public housing complex adjacent to the incinerator. The New York Department of Environmental Conservation followed up with its own study, claiming no clear link between the incinerator's operations and PFAS.

But questions remain regarding the facility's general waste burning practices, which according to the New York Department of Environmental Correction, placed the facility on formal notice of six violations arising from its improper management of dust from air pollution control equipment and its repeated failure to control off-site fugitive dust resulting from operations. Human error and neglect are often ignored elements in the practice of disposal methods deemed "safe", as are the potential unintended consequences.

Another study discussed in a PFAS incineration "State of the Science Review" in 2020, found higher PFAS concentrations downwind of two Chinese sewage sludge incinerator (SSI) facilities. The review also notes the fundamental challenge in understanding whether complete PFAS destruction has occurred.

And then there are the PICs. The mystery surrounding the potential PICs

PlumeStop colloidal activated carbon is applied using a hydraulic percussion drill rig to remediate PFAS in-situ.

formed while burning PFAS was highlighted during a recent mass balance study, considered the first of its kind, at a wastewater treatment plant SSI in Manchester, New Hampshire.

The study, which included emissions stack testing, revealed that only 51% of the PFAS mass was destroyed via incineration. Municipal SSIs operate at lower temperatures than hazardous waste combustors (HWCs), and higher temperatures lead to more PFAS destruction. However, the most perplexing and concerning finding was that 44,000 times higher fluorine levels were emitted from the stack than could be explained. The study awaits publication in a peer-reviewed science journal.

Many unresolved questions remain concerning the incineration of PFAS wastes:

- What PFAS species are present in an incoming waste stream (beyond what laboratories can currently detect)?
- What temperatures, residence times, and mixing are required to destroy PFAS (both identified and unidentified) completely?
- What are the potential PICs these facilities might generate?
- How are the PICs to be measured and analyzed?
- What are the environmental fates of the PICs?
- What are the health and environmental effects related to these PICs?
- Will the facilities operate according to the requirements once determined?
- Who will be affected?

Although several DOD-funded studies on the thermal destruction of PFAS wastes are in progress, the questions and concerns over the burning of PFAS solid wastes will not be resolved quickly. Also, as this type of incineration must be energy intensive to be effective, the economic feasibility of the approach is in question.

The environmental cleanup of PFAS-contaminated sites will continue to increase to meet regulatory guidelines, existing and forthcoming. Unfortunately, many groundwater recovery (i.e., pump-and-treat) systems will be employed, generating more PFAS waste products with no proven effective or safe disposal methods. Besides incineration, landfilling PFAS solid wastes also risks reintroducing the toxic chemicals into the environment.

CAC METHOD AVOIDS GENERATING PFAS WASTE

Colloidal activated carbon (CAC) has been successfully applied at PFAS-contaminated sites worldwide. The patented CAC technology, from REGENESIS, filters PFAS from groundwater to remove human and environmental exposure risks. Treating contaminants in place eliminates the generation of PFAS waste products. Besides avoiding generating and disposing of wastes whose ultimate fate cannot be assured, the use of the CAC technology to contain PFAS in place also avoids many of the financial and environmental costs of installing, operating and maintaining these pump-and-treat systems.

Injection of PlumeStop® CAC avoids these costs. CAC PFAS treatments are designed to immobilize PFAS for decades following a single application. They are backed by the PlumeShield® performance warranty program for qualifying sites. ■

References available upon request.

Maureen Dooley is with REGENESIS.
Email: mdooley@regenesis.com