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White Paper
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Understanding and Addressing PFAS in Metal Finishing

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Per- and polyfluoroalkyl substances (PFAS) have become one of the most pressing environmental challenges facing the metal finishing industry.

With more than 15,000 known compounds under the PFAS umbrella, their persistence and potential health impacts have led to increased regulatory scrutiny of metal finishing operations.

Additionally, in the coming years, both state and federal regulators may introduce more guidelines and rules that could impact how metal finishing operations are tested for PFAS in their wastewater treatment systems.

Recent announcements from the U.S. Environmental Protection Agency (EPA) indicate that PFAS reduction remains a top national priority, with the metal finishing industry identified explicitly as a focus area. This paper provides an overview of the regulatory landscape, the history of PFAS use in metal finishing, the results of recent analytical studies, and practical pathways forward for finishers seeking to mitigate PFAS in their operations.

The Evolving PFAS Landscape

PFAS are a class of synthetic fluorinated compounds that resist heat, oil, and water—properties that have made them widely used in industrial and consumer applications for decades. Unfortunately, their stability also means they do not readily degrade in the environment, earning the nickname ‘forever chemicals.’

While the rate of discovery has slowed somewhat, new PFAS compounds continue to be identified and classified. Among the thousands of known variants are PFOS, PFOA, GenX, and others—many of which are now recognized as toxic or carcinogenic.

Under EPA Administrator Lee Zeldin, two of the agency’s five strategic pillars—ensuring clean air, land, and water for every American, and improving cross-agency partnerships—directly impact PFAS regulation.

Administrator Zeldin announced in early 2025 that the Trump administration would limit the amount of PFAS that producers of the toxic substances can discharge into the water, and, more importantly, specifically targeted the metal finishing industry.

The EPA's announcement says the agency will “Develop effluent limitations guidelines (ELGs) for PFAS manufacturers and metal finishers and evaluate other ELGs necessary for reducing PFAS discharges.”

And many metal finishing operations will recall that the EPA sent a questionnaire to over 2,000 facilities in early 2024 to collect data for the agency’s planned revision of the metal finishing and electroplating guidelines.

PFAS and Metal Finishing: A Historical Perspective

Metal finishing has a long history of association with PFAS compounds, dating back to the 1950s. PFAS were introduced into chrome plating as mist suppressants to protect workers from exposure to hexavalent chromium.

The Rochester Institute of Technology states that PFAS contain highly electronegative fluorine atoms that form strong bonds with carbon, resulting in weak intermolecular forces and low friction. It is this characteristic that made the chemicals attractive as mist suppressants, as it made PFAS highly “wettable,” a property that enables them to be used for lowering surface tension.

Metal finishers used these mist suppressants, especially when plating parts with hexavalent chromium. The electric charge in the plating process induced electrolysis, where water molecules split into hydrogen and oxygen, resulting in bubbles of gas that would rise and burst on the surface of the chromium solution. That action created a fine mist that dispersed liquid chromic acid into the air.

By the 1970s and 1980s, the EPA itself mandated the use of PFAS-based mist suppressants for worker safety, setting the stage for today’s environmental challenges. Years later, when the EPA and other agencies began introducing restrictions on PFAS in metal finishing operations, many shops and facilities found themselves in a situation where they had used PFAS-based mist suppressants, as well as the challenge of removing PFAS from their processes and wastewater treatment systems.

Investigating PFAS in Metal Finishing Wastewater

In 2024, Hubbard-Hall initiated a nationwide study in partnership with FREDsense to better understand the presence and removal of PFAS in metal finishing wastewater. FRED is the acronym for Field-Ready Environmental Detector, and FREDsense is commercializing the first portable monitoring solution for PFAS testing, allowing end-users to detect PFAS directly on-site without needing to send samples to a lab.

The project sampled effluent from chrome plating and anodizing shops across the U.S.—from small batch processors to large continuous flow facilities. At each facility, a water sample was collected to measure the level of contamination. The staff then purified and extracted the PFAS from the water sample using the capture kit, which allows the user to add a material that contains a fluorescent dye that glows when detecting PFAS. The collected sample is then placed into a measurement device called a fluorometer, and quantitative and accurate data analysis is derived in under three hours using a fluorescent reader that is part of the kit.

The study found 11 compounds that consistently appeared across all the shops tested:

Compound	***Typical Use in Finishing Operations***
6:2 FTS	Mist suppression
PFBS	Surfactant and Defoamer
PFHPA	Mist suppressant
PFHPS	Wetting agent, mist suppressant
PFXAS	Wetting agent, mist suppressant
PFHXS	Surfactant, defoamer
PFOA	Mist suppressant
PFOS	Wetting agent, mist suppressant
PFBA	Mist suppressant
PFPEA	Emulsifying agent
PFPES	Lubricant

Evaluating Treatment Technologies

The study then examined various removal techniques for treating wastewater currently in use, such as traditional hydroxide precipitation, microfiltration, carbon filtration, and even shops that are using evaporation followed by distillation to recover their water for reuse.

Treatment Method	***PFAS Removal Efficiency***	***Observations***
Hydroxide Precipitation	0%	No measurable PFAS removal
Microfiltration	is Minimal,	Insufficient for compliance
Carbon Filtration	78%	Effective, economically viable
Evaporation and Distillation	87%	Highest removal rate, but costly

From the data, a unique question emerged: if a shop is not currently using evaporation or carbon filtration and wants to implement one of these processes, what would be the most economical way for them to do so?

When considering evaporation, there is a significant capital expense associated with building and installing the equipment. The shop will have air quality testing standards that must be met, as well as regular maintenance of the evaporator. Overall, the evaporation process incurs a larger capital expense upfront than carbon filtration.

In the study, we examined what metal finishers can do to help remove PFAS from their effluent in an economically viable way; the answer was carbon filtration. A facility will still be left with spent carbon that is PFAS-loaded and will still incur maintenance costs because it will have to regenerate its bed or dispose of the bed and replace it with new carbon. However, overall, in terms of what is known about how these systems work, it remains the most economically viable option for shops that want to advance with a method to remove, on average, 78% of the PFAS from their waste streams.

The Path Forward: Research and Innovation

Hubbard-Hall is preparing to launch a long-term pilot study to evaluate carbon filtration under real-world operating conditions. The goal is to measure carbon longevity, maintenance requirements, and overall operational economics. Future research will focus on the destruction of captured PFAS compounds through advanced oxidation, electrochemical oxidation, ultrasonic degradation, ball milling, and thrombotic agglomeration.

The recommendations for metal finishers would be:

- Evaluate current waste streams to identify sources of PFAS.
- Conduct baseline PFAS testing through certified laboratories.
- Assess whether current treatment systems can integrate carbon filtration.
- Collaborate with industry partners on pilot programs and data sharing initiatives.
- Plan for long-term mitigation and regulatory compliance.

<u>Conclusion</u>

PFAS regulation represents a pivotal moment for the metal finishing industry. What began decades ago as a safety innovation has evolved into one of the most complex environmental challenges of our generation.

Through proactive testing, technological investment, and collaboration, the industry can meaningfully reduce PFAS contamination while protecting both public health and business sustainability.

Our People. Your Problem Solvers.

For more information on this process,

please call us at 203.756.5521 or email: techservice@hubbardhall.com

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