Reducing PFAS from Metal Plating and Finishing Operations

What is PFAS?

For the purpose of this fact sheet, PFAS includes per- and polyfluoroalkyl substances as well as other fluorinated substances. They are a group of man-made chemicals known for fire resistance and oil, stain, grease, and water repellency. The strong carbon-fluorine bonds prevent PFAS from breaking down and contribute to their persistence in the environment. The most effective way to reduce the prevalence of PFAS in the environment is to reduce the use of products containing PFAS.

PFAS Uses in Metal Plating and Finishing

PFAS used in multiple types of metal finishing operations and processes ultimately end up in wastewater discharges to the wastewater treatment plants. Wastewater limits for PFAS are not currently in place but will likely be in the parts per trillion (ppt). A Michigan report noted that 15% of metal finishers were discharging to waste water treatment plants at concentrations greater than their screening criteria of 12 ppt perfluoorooctane sulfonic acid (PFOS). Many metal finishers use PFAS-containing products for their surfactant properties of fume suppression and wetting agents. Additionally, some PFAS may be found in chemical conversion coatings, such as teflon.

Within the US metal finishing industry, hexavalent chrome plating represents the most significant source of PFAS to the environment. Historically, perfluorooctane sulfonate (PFOS) was commonly used in the metal plating and finishing industry. Although PFOS was phased out of use in the early 2000s, its primary replacement in the metal finishing industry has been 6:2-fluorotelomersulfonic acid (FTS), which degrades to other PFAS, including perfluorohexanoic acid (PFHxA), into the environment (MPCA, 2022).

Opportunities to Reduce PFAS in Wastewater Discharges

Legacy Sources - Historic use of PFOS-containing fume suppressants can be a legacy source of PFOS discharges from lingering contamination of the process equipment and piping. In Michigan, metal plating tank cleaning and equipment replacement were necessary to reduce PFOS concentrations in the effluent from these facilities (MI EGLE, 2020). Waste generated from the cleanout of tanks or other process equipment will contain PFAS and should be managed and disposed of in accordance with state and local regulations.

Trivalent Chromium vs Hexavalent Chromium Plating - Trivalent chromium (Cr(III)) plating processes, used in decorative chrome plating, generally does not use PFAS containing chemical fume suppressants or wetting agents. Preliminary evaluations by the EPA indicate that some hexavalent chromium (Cr(VI)) plating operations, for which fume suppressants are necessary, may have the option to switch to trivalent chromium (U.S. EPA, 2023). Therefore, it is advised to use Cr(III) wherever technically feasible. However, for hard chrome plating, it is not possible to switch to Cr(III), as the level of hardness, corrosion and wear-resistance provided is insufficient for the performance conditions of hard chrome-plated parts.

Nonfluorinated Wetting Agents and Fume Suppressants

Nonfluorinated or non-PFAS wetting agents and fume suppressants are potentially viable for etching plastics in preparation for electroplating. Fluorinated surfactants are often used to etch and enable electrical conductivity of the underlying plastic. Nonfluorinated surfactants are viable as safer and more biodegradable alternatives.

Acid permanganate solutions, nitric acid, and trichloroacetic acid mixtures have been tested as alternative immersion techniques. Additional safety and technological controls may be required when using these alternatives, as there are risks of fire (permanganate solutions), nitrous gas formation (nitric acid), and organohalogen formation (trichloroacetic acid) (MPCA, 2022, ECHA, 2021).

Alternative Fume Control Options

Some metal finishing facilities have adopted mechanical controls for suppressing metal plating emissions. These may be an alternative to PFAS containing fume suppressant surfactants for hard chrome plating operations (MCPA, 2022). Controls include tank covers with mist eliminators, specially designed hoods or enclosures over the plating tank, floating plastic spheres on the bath surface, chevron-blade mist eliminators, and air filtration systems like packed-bed scrubbers, which physically capture and remove the mist generated during the plating process (U.S. EPA, 1998).

Please note that because of the complexity in metal finishing processes, there is no one-way to accomplish a closed system. Different technological and safety controls would be required for each combination of possible metal finishing processes (e.g. plating, anodizing, etching, cleaning, etc.) (Blepp et al., 2017).

Talk to Your Chemical Suppliers

Inquire about PFAS-free products that may be suitable for your industrial process needs. The current PFAS fume suppressant definition in 40 CFR 63.341 says that a PFOS based fume suppressant contains 1 percent or greater PFOS by weight. Therefore, a PFOS-free fume suppressant could contain 0.01 parts PFOS, while the screening criteria in the Michigan study was 834,000,000 times lower.

Pretreatment and Facility Maintenance

Another option for facilities that use PFAS-based surfactants is to remove PFAS from the effluent wastewater using granulated activated carbon (GAC) technology. Additionally, regular inspection and maintenance of your facility can help reduce PFAS discharges from leaks, cracks, and corrosion of equipment from facility flooring.