

Proper Phosphorous Removal for Wastewater in Anodizing Processes

As a nutrient, phosphorus is part of nature's growth cycle. As with everything, however, too much of something can have a negative impact. When phosphorus is found in excessive amounts in waterways, algae and bacteria can grow in abundance, which can have the following detrimental effects on the environment:

- Algae blooms that deplete oxygen to the point that higher lifeforms, such as fish, cannot survive.
- Sunlight is prevented from reaching the waterway floor, which kills off plant life in the area.
- Cyanotoxins from bacteria growth spurred by excessive phosphorus can turn the water toxic and unsuitable for human consumption.



It falls to manufacturers and applicators to ensure that their wastewater effluent does not harm the environment they discharge to. In the finishing and coating industry, this can often be an issue for the facility. The purpose of this paper is to explain the need for phosphorus removal with a focus on laden wastewater and show a real-life example of how this was accomplished in wastewater generated from an anodizing process.

How Applicators Generate Phosphorus Discharge

The anodizing process is an electrochemical process that converts the surface of the metal part to an anodic oxide finish that is durable, corrosion-resistant, and decorative. While ideally suited for aluminum, other non-ferrous metals such as titanium or magnesium can also be anodized. Anodizing increases the wear and corrosion resistance while providing a finish that can be decorative or ideal for additional process steps such as painting or gluing. Anodized parts can be found in aerospace, automobile, and marine applications, to name a few.

Anodizing follows a set of steps to ensure the parts meet the quality desired after completion of the process. The steps are:

- **Cleaning:** removes soil and prepares the parts for anodizing and post-treatment. Removes protective oils, polishing compounds, surface oxides, greases, fingerprints, dust, chips, and other solids. It can be an alkaline cleaner, acid cleaner, or solvent.
- **Pretreatment through etching or brightening etching** can be done with alkaline or acid products. It produces a uniform finish that is matte or satin. The bright dip is a nitric/phosphoric acid blend. It produces a mirror finish.
- **Deoxidation/DE smutting:** removes smut left by etching or cleaning. Deoxidizers will remove smut, but DE smutters will not deoxidize.
- **Anodization:** the electrochemical oxidation of the metal to produce a stable oxide on the part's surface. Parts are placed in an electrolyte solution and act as the anode. An electric current is passed between the "anode" and a cathode through the electrolytic solution, thus anodizing the part.
- **Post-treatment:** coloring, dyeing, sealing. Electrolytic coloring deposits metal into the oxide layer to color. Dyeing is a soak process that allows the dye to be absorbed into the pores. Sealing converts the oxide layer to boehmite and is more resistant to atmospheric attack.

Multiple rinsing tanks follow each step of the anodizing process to ensure no contamination from one process tank to the next. Any rinse that follows a step with phosphate contributes to the phosphate loading in wastewater. Typical

anodizing wastewater streams can have up to 4000 mg/L of total phosphorus. When looking at phosphate in wastewater, there are several kinds: dissolved, inorganic, organically bound, organic, orthophosphates, and condensed phosphate (such as pyro-, meta-, and other polyphosphates).

Steps to Reduce Total Phosphorus

Total phosphorus (TP) is usually seen on discharge permits and encapsulates all forms of phosphorus in the waste stream. While bacteria are a viable option for removing phosphorus from wastewater, anodizing manufacturers and applicators rarely have the space for these systems on their shop floor or the personnel to run them. Thus, physical/chemical means are the best way to remove phosphorus from wastewater. Physical/chemical wastewater treatment is when physical means of removing contaminants — such as filtration — are combined with chemical means, such as hydroxide precipitation, to ensure the wastewater is sufficiently clean for discharge. This process can be broken down into three steps:

- **Coagulation:** the clumping of very fine particles into larger particles called floc, caused by using chemicals. The chemicals neutralize the electrical charges of the fine particles, allowing them to come closer to form larger clumps. (Industrial Waste Treatment, Volume 1, 3rd edition)
- **Flocculation:** gathering fine particles after coagulation to form larger particles by gentle mixing. This clumping together makes it easier to separate the solids formed in the water by settling, skimming, draining, or filtration. (Industrial Waste Treatment, Volume 1, 3rd edition)
- **Liquid/Solid Separation (Dewatering):** to remove or separate a portion of the water present from the solid, with or without chemical conditioning, to handle or dispose of the solids. (Operation of Wastewater Treatment Plants, Volume 2, 7th edition)

For phosphorus removal to occur in this physical/chemical treatment process, the phosphorus particles must become destabilized and coagulated for removal. In this study, some of the most common coagulants used for phosphorus removal are compared on a side-by-side basis to help show which products may work best in an anodizing facility. Calcium chloride, poly aluminum chloride, lanthanum chloride, AquaPure Cal 50 Plus and AquaPure Cal 76 are each bench tested at the exact dosing and same pH. The AquaPure products from Hubbard-Hall are specialty coagulants designed for phosphorus removal; check out our case study to see the test results.

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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