DIRECT ASSISTANCE PROGRAM

CASE STUDY

NYSP2I Performs Water and Chemical Use Assessment of Plating Operations

Tompkins Metal Finishing (Tompkins) is a metal finishing company located in Batavia, New York. With over 60 years in the industry, Tompkins is one of the largest industrial metal plating companies in the Western NY area. Tompkins uses a myriad of metal finishing operations—including anodizing, zinc coating, electroless nickel plating (EN), electropolishing, chromating, and passivation—to manufacture products that serve industries from aerospace and defense to automotive and transportation, and even medical equipment manufacturers.

CHALLENGE

Metal finishing is one of the most water-intensive manufacturing activities that exists today. Because so many plating and finishing process are electrolytic, they require solution baths to achieve the conduction that attracts and binds finishing materials to the base metal substrate. For high volume and large metal parts, these baths create enormous demand for water. Across six different plating lines, Tompkins consumed 18 million gallons of water in 2016—enough to fill nearly 30 Olympic-sized swimming pools.

The costs of such consumption are immense. While Tompkins spent approximately $116,000 on fresh water resources alone, both the economic and environmental costs of treating and discharging that water after it was used was equally staggering. Heavy metals sent to wastewater treatment in high concentration are of particular concern, because of the direct economic cost of that treatment and the associated environmental impact created in its eventual release.

To address these concerns, Tompkins sought to implement opportunities to reduce process water consumption, reuse and recycle process water that is consumed, and mitigate the severity of chemical contamination of process water. Combined, these potential benefits hold great promise to reduce both the direct costs of treatment and disposition, as well as the indirect costs of liabilities and environmental damage that stem from the company's operations.

SOLUTION

After working extensively to assess and characterize Tompkins' existing operations, New York State Pollution Prevention Institute (NYSP2I) solutions focused on two key elements. First, systems engineers investigated different methodologies for reducing the volume of input water consumed in metal finishing processes. These methodologies centered on the use-efficiency of different processes, as well as opportunities to reuse and recycle process water after its initial use to offset the requirement for fresh water inputs. Based on the characterization of Tompkins operations, final solution recommendations focused on three particular concerns:

- Water systems are designed and set up for single-use only, preventing reuse
- Flow rates are set higher than necessary to achieve required solution balances
- Rate of removal from process bath is too high, or hang time between removal and rinse too short

NYSP2I engineers collaborated with Tompkins to identify best practices for drag out operations, the process by which metal parts are removed from the process (plating) bath and moved into a water-based rinse bath. NYSP2I determined that by adjusting processes to use rack-plating techniques, the volume of process chemicals will reduce the solution dragout by approximately 50% compared to barrel plating techniques. In addition, optimizing the hang period during which removed parts are held above the process

CHALLENGE

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SOLUTION

- Systems engineers investigated different methodologies for reducing the volume of input water consumed in metal finishing processes
- NYSP2I engineers collaborated with Tompkins to identify best practices for drag out operations
- NYSP2I identified water flow reductions as a system methodology that could help reduce the accumulation of chemical contamination that forces frequent water cycling
- NYSP2I leveraged expertise in chemical and process engineering to explore and identify new technologies, operational activities, and process steps

RESULTS

- NYSP2I's work identified the potential to save 1.2 million gallons of water per year, a nearly 7% annual savings in consumption, and significant reduction in costs, over Tompkins' current levels
- NYSP2I calculated that by reclaiming acidic and caustic materials and neutralizing associated wastes, Tompkins could reduce its hazardous waste generation by nearly 30 metric tons each year
- NYSP2I also estimated that together, these measures could save Tompkins over $40,000 in operating costs annually, achieving payback on capital investments in less than four years

TMF Tompkins Metal Finishing, Inc

bath to allow natural drainage could similarly reduce the amount of transferred process chemistry. Using automated equipment to rotate parts during the hang period could also allow chemicals ordinarily trapped inside complex parts to drain out, further reducing chemical transfer. This reduction would minimize rinse bath contamination, meaning rinse bath water would require less frequent replacement.

Figure 2: Dragout diagram

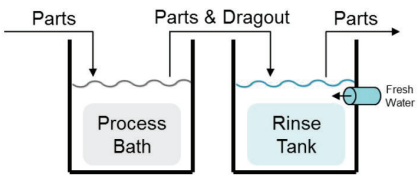
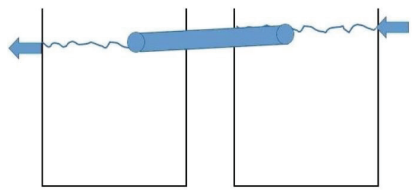


Figure 3: Counterflow Rinse



In addition, NYSP2I identified water flow reductions as a system methodology that could help reduce the accumulation of chemical contamination that forces frequent water cycling. In counter-flow rinsing, multiple rinse tanks are used, with small amounts of fresh water continuously pumped into the lattermost rinse tank in order to cause deliberate overflow into the preceding tank. This continuous flow of freshwater continues back to the first rinse tank, allowing it to reach a steady state ratio of process chemical contamination. By continuously diluting contamination with a continuous low-volume flow, the buildup of process chemicals that necessitates complete rinse bath replacement is avoided, reducing overall water consumption significantly compared to a single-pass rinse method.

Second, NYSP2I leveraged expertise in chemical and process engineering to explore and identify new technologies, operational activities, and process steps through which Tompkins might be able to reduce the amount of chemicals used in (and thus hazardous waste generated by) its processes. These investigations focused on zinc, nickel, and sulfuric acid waste materials—some of Tompkins' highest-volume wastes, and arguably some of the most potentially detrimental to environmental health.

Solutions included introducing diffusion dialysis techniques for anodizing process tanks. Diffusion dialysis uses an ion-exchange membrane to separate and capture heavy metal ions from the process bath, allowing the wastewater to be treated as non-hazardous waste that is therefore not subject to stringent and costly treatment and disposal regulations. In addition, NYSP2I identified sorption methodologies to filter and recover acids that could save both acid and caustic materials used in treatment processes. Beyond these, NYSP2I suggested acid neutralization chemistry processes that would allow Tompkins to reduce the costs and liabilities of disposing corrosive hazardous wastes (defined under EPA Waste Code D002).

RESULTS

NYSP2I was able to identify specific methodologies and equipment technologies that offered significant potential for benefits at Tompkins. By addressing water consumption through optimized dragout and rinse processes, NYSP2I's work identified the potential to save 1.2 million gallons of water per year, a nearly 7% annual savings in consumption, and significant reduction in costs, over Tompkins' current levels. NYSP2I calculated that by reclaiming acidic and caustic materials and neutralizing associated wastes, the company could reduce its hazardous waste generation by nearly 30 metric tons each year. The avoided environmental degradation enabled through these reductions is justification in itself, but NYSP2I also estimated that together, these measures could save Tompkins over $40,000 in operating costs annually, achieving payback on capital investments in less than four years.

NYSP2I PARTNERS

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New York Manufacturing Extension Partnership

Funding provided by the Environmental Protection Fund as administered by the New York State Department of Environmental Conservation.

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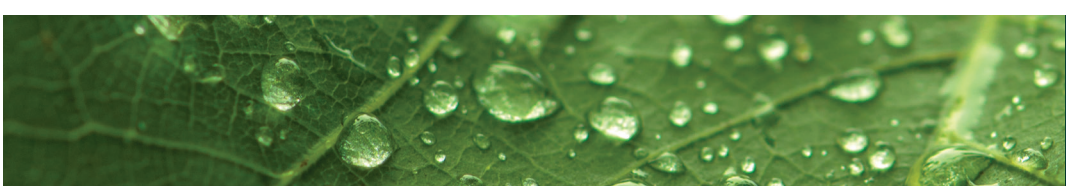

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