Green Suppliers Network

Clean Lines:

Strategies for Reducing Your Environmental Footprint

Metal Finishing Operations

A Green Suppliers Network review can help you:

- **Significantly reduce costs.** Applying "clean" techniques to a metal finishing line will reduce your water and energy bills and help you cut down on hazardous waste disposal costs.
- **Ease regulatory burden and liability.** By decreasing your use of regulated raw materials, you might be able to reduce your permitting and reporting of wastes, emissions, and effluents, which can save your company time and reduce occupational safety and health compliance efforts.
- **Increase competitiveness through efficiency and attract new customers.** By reducing your environmental footprint, you will help meet your customers' corporate environmental goals and potentially generate new business.
- **Improve product quality.** Well-controlled metal finishing processes require less part reworking and improve plating finish due to the reduction of plating bath impurities.

About the Green Suppliers Network

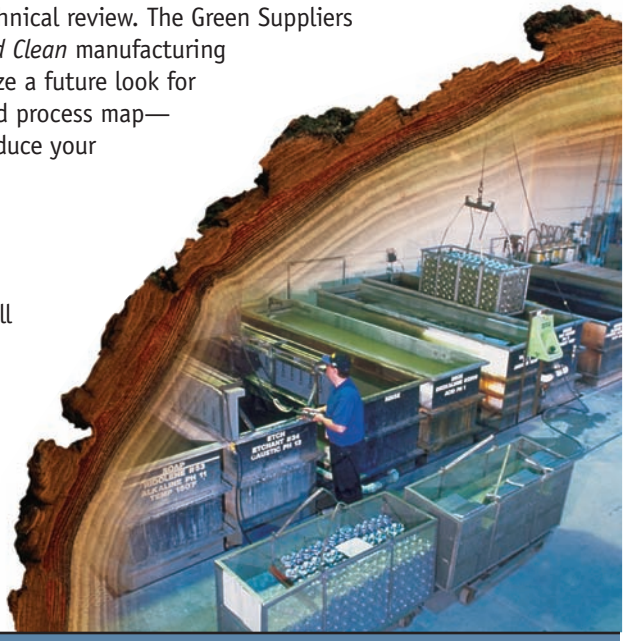
Working in collaboration with the U.S. Department of Commerce's Manufacturing Extension Partnership (MEP), the U.S. Environmental Protection Agency (EPA) established the Green Suppliers Network to help small and medium-sized manufacturers stay competitive and profitable while reducing impacts on the environment.

As a partner with the Green Suppliers Network, you receive a customized, onsite technical review of your materials and processes that couples lean manufacturing techniques with sound environmental management strategies—the *Lean and Clean Advantage*. You might choose to review your metal finishing operations. Metal finishers employ a variety of operations, such as chemical conversion coating, electroplating, electro-less plating, chemical milling, and printed circuit board manufacturing. They also routinely perform several related subprocesses, including surface preparation, machining, and equipment cleaning.

The solvents and cleaners applied to metal parts and solutions used in plating tanks generate significant amounts of waste. Metal-ion-bearing solutions often contain chromium, zinc, nickel, and other metals. Cleaners often appear in process wastewater, while solvents containing hazardous air pollutants (HAPs) and volatile organic compounds (VOCs) can be emitted into the air, released in wastewater, or disposed of in solid form. Other process wastes include metal-bearing filter press sludge. Although these pollutants trigger both cost and regulatory requirements, they can be addressed successfully through sound pollution prevention and manufacturing best practices, such as those provided by a Green Suppliers Network review.

STEPS TO A CLEAN METAL FINISHING PROCESS

The following are just a few of the many strategies to consider while participating in a Green Suppliers Network technical review. The Green Suppliers Network provides experts in *Lean and Clean* manufacturing techniques who will help you visualize a future look for your operations, such as the enclosed process map—one that will save you money and reduce your environmental footprint.



Optimize Rinse Tanks

During your Green Suppliers Network review, *Lean and Clean* practitioners will likely identify your rinsing tanks as an opportunity for increased efficiency. Rinsing improves the quality of the surface finishing process and prevents contamination of subsequent process baths. Rinse tank design and rinsing configuration greatly influence water usage.

EPA United States Environmental Protection Agency

MEP • MANUFACTURING EXTENSION PARTNERSHIP

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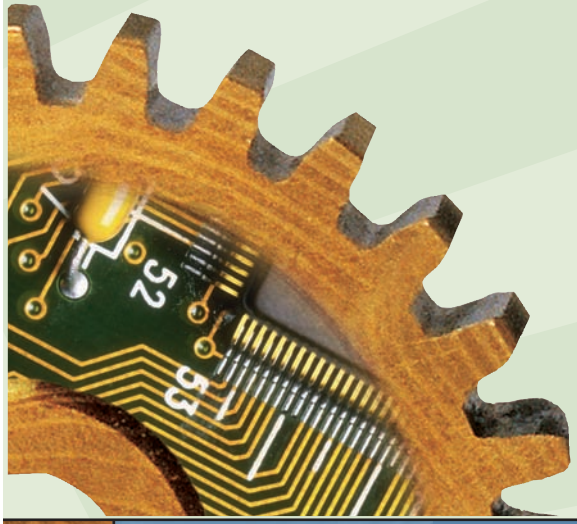
The key objectives of optimal rinse tank design are to quickly remove drag-out solution from the part and to disperse the drag-out throughout the rinse tank. Drag-out is the chemical bath solution retained through surface tension on the part being treated. The use of single overflow rinse tanks following each process tank is the most inefficient use of rinse water. Multiple rinse tanks connected in a series require less water to achieve the same rinsing quality, reducing your water use and associated costs. The following techniques can optimize your rinse tanks:

- **Counter current cascade rinsing** is a method of reusing water from one rinsing operation to another, less critical rinsing operation before being discharged to treatment. Some rinse waters acquire chemical properties, such as low pH, that make them desirable for reuse in other rinse systems. For example, water from an acid treatment rinse may be reused in an alkaline treatment rinse. In this case, the rinse water both removes and neutralizes drag-out from the work piece.
- **Drag-out rinsing** is done in stagnant rinse tank, initially filled with fresh water, positioned immediately after the process tank. Work pieces are rinsed in drag-out tanks directly after exiting the process bath. The drag-out rinse collects most of the drag-out from the process tank, thus preventing it from entering the subsequent flowing rinses. Gradually, the concentration of process chemicals in the drag-out tank rises. Electrolytic recovery is commonly used to remove dissolved metals from drag-out tanks.
- **Spray rinsing** uses considerably less water than immersion rinsing. During spray rinsing, the parts are held over a catch tank and are sprayed with water. Water then drips from the part into the catch tank and is then either recycled to the next stage or discharged to treatment. Spray rinsing can enhance draining over a process bath by diluting and lowering the viscosity of the process fluid film clinging to the product. Using spray rinsing can control rinse-water flow.



Reduce Water Use

Facilities can reduce water use by closely monitoring rinse water requirements. Rinse water use is optimized by using the minimum amount of water necessary to keep the rinse quality consistent. Your Green Suppliers Network review team can examine your water use to make sure you are taking the necessary steps to minimize usage and reduce associated costs. Techniques to reduce rinse water use include using:

- **Flow restrictors** to prevent the flow in a water-supply pipe from exceeding a predetermined flow rate. These restrictors are commonly installed on a rinse tank's water inlet. As a stand-alone device, a flow restrictor provides a constant water flow and is therefore best suited for continuous rinsing.
- **Conductivity controllers,** which use conductivity probes to measure the total dissolved solids of water in a rinse tank to regulate the flow of fresh rinse water into the rinse system.
- **Rinse timers,** which are electronic devices that control a solenoid valve. The timer can be activated either manually by the operator or automatically by the action of racks or hoists. Automatic rinse timers are generally preferred for intermittent rinses because they eliminate operator error. Rinse timers installed in conjunction with flow restrictors can provide precise control when the incoming water pressure may rise and fall.

Reduce Drag-out

Process lines can be modified to reduce drag-out of bath chemicals. For example, air knives and drip tanks reduce the pollutant loading and volume of rinse water requiring treatment, reducing the usage rate for your process bath chemicals, wastewater generated, and associated costs. The following equipment and techniques can reduce drag-out:

- **Air knives** are high-pressure air blowers installed over a process tank or drip shield that remove drag-out by blowing liquid off the surface of work pieces and racks into a catch tank. Liquid from the catch tank is pumped back to the process tank. Air knives are most effective with flat parts and cannot be used to dry surfaces that stain due to oxidation.
- **Drip shields** are inclined sheets installed between process tanks and rinse tanks to drain and recover process fluid that drips from racks and barrels back into process tanks rather than dripping into rinse tanks or onto the floor.
- **Drip tanks** are installed immediately after the process tank. Work pieces exiting a process bath are held over a drip tank to collect process fluid. When enough fluid is collected in the drip tank, the fluid flows back to the process tank.

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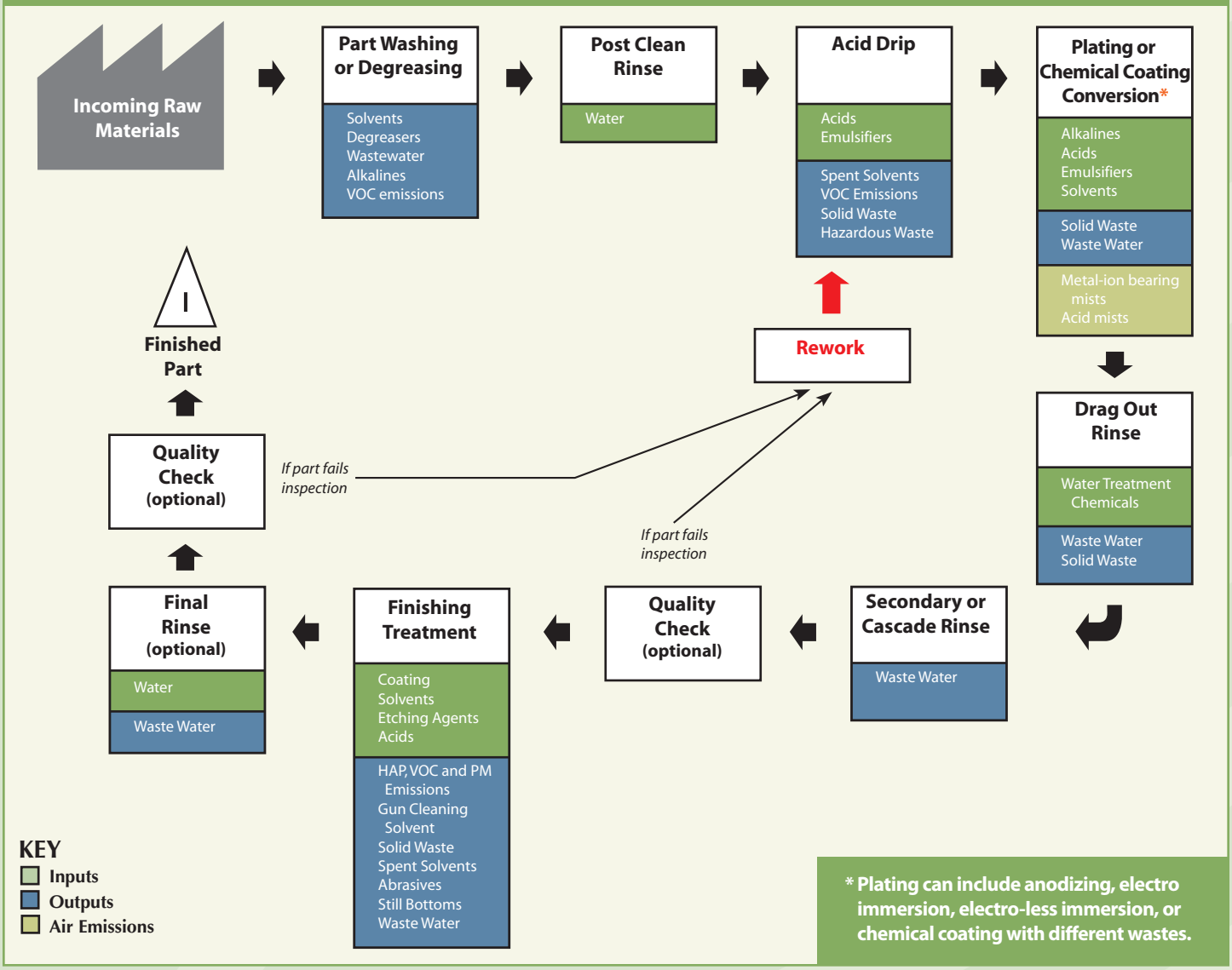
- **Long dwell (or drip) times** can be automatically programmed to optimal periods. Long dwell times over the process tank reduce the volume of drag-out reaching the rinsing system. On manual lines, racks can be hung on bars over process baths to allow fluid to drip. Barrels can be rotated over the process bath to enhance drainage. Increases in drip time might be unsuitable for surfaces that can be oxidized or stained by exposure to air.
- **Process bath temperature increases** can reduce drag-out because temperature and viscosity are inversely related. Operating a bath at the optimal temperature will maximize process bath viscosity in relation to energy consumption.
- **Concentration reduction** in process baths to reduce the mass of chemicals in a given volume of drag-out. Also, viscosity and concentration are directly related; therefore, lower process bath concentration will result in lower process bath viscosity and less drag-out volume.
- **Wetting agents or surfactant additions** to process baths can reduce viscosity and surface tension, thereby significantly reducing drag-out.

Sample Metal Finishing Process Map Customized for Green Suppliers Network Partner:



"By helping us to set and **ACHIEVE** these targets, the Green Suppliers Network is helping our company to increase productivity and customer satisfaction while, at the same time, **REDUCING WASTES** and environmental impact. It's very gratifying to prove that companies like ours can become greener and **INCREASE PROFITABILITY** at the same time!"

-Tim Backus, President, Har-Conn

Extend Useful Life of Process Baths

Process baths become contaminated with impurities that affect their performance. Regeneration and maintenance techniques help keep baths in good operating condition, thereby extending the useful life of process solutions and reducing the cost of the inputs and associated cleaning and disposal costs. These techniques include:

- **Activated carbon adsorption,** which removes organic contaminants from electroplating baths. The process solution flows through a filter where the carbon adsorbs organic impurities that result from the breakdown of bath constituents. Carbon treatment is most commonly applied to nickel, copper, zinc, and cadmium electroplating baths but also can be used to remove organic contaminants from paint curtains.
- **Carbonate "freezing,"** which removes excessive carbonate buildup by forming carbonate salt crystals at a low temperature that are then removed. Electroplating baths formulated with sodium cyanide most commonly use this operation. Carbonates build up in the process bath by the breakdown of cyanide (especially at high temperatures) and the adsorption of carbon dioxide from the air. An excessive carbonate concentration reduces the product quality of many metal finishing operations. The crystallized carbonate can be removed by decanting the fluid into another tank or by filtration.

If customer product **SPECIFICATIONS** and performance **REQUIREMENTS** are keeping your facility from implementing changes to your metal finishing **PROCESS LINES**, the Green Suppliers Network can help. By working with Corporate Champions—your customers—the Network can **EASE** barriers and **FACILITATE** process improvements specific to your situation.

METAL FINISHING QUICK LINKS

Metal Finishing Hub at the Waste Reduction Resource Center

http://wrrc.p2pays.org/indsectinfo.asp?INDSECT=10#Websites

A list of links to the best Lean and Clean resources for metal finishers.

National Metal Finishing Resource Center

www.nmfrc.org

An up-to-date resource including access to benchmarking data and background on the Metal Products and Machinery Effluent Guidelines.

National Metal Finishing Strategic Goals Program

www.strategicgoals.org

A voluntary program between facilities and government agencies to encourage companies to go beyond environmental compliance.

SectorStar—Environmental Strategies, Tools, and Resources

www.sectorstar.com/sector/MetalFinishing/index.cfm

An environmental performance resource that helps businesses find targeted information on environmental innovations.

Best Practices for Metal Finishing Line Operators - Workshop Training

www.p2pays.org/ref/02/01144.pdf

A presentation that addresses process efficiency, bath monitoring, drag-out control, and optimizing rinsing operations.

Environmental Training Workshop for Metal Finishers

www.p2pays.org/ref/02/01146.pdf

A presentation that addresses process control, process bath recycling technologies, and rinse water recycling.

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