Metal Finishing

PROFILE The metal finishing sector[4] encompasses a variety of surface finishing and electroplating operations that coat an object with one or more layers of metal to improve its resistance to wear and corrosion, alter its appearance, control friction, or impart new physical properties or dimensions. Applications range from common hardware items and automotive parts to sophisticated communications equipment and aerospace technologies.

Most metal finishing shops are small, independently owned facilities that perform on a contract basis. Nearly 90% of the roughly 3,000 U.S. metal finishing establishments in existence in 2003 had fewer than 50 employees.[5] Other metal finishing operations are part of larger manufacturing facilities.

Sector At-a-Glance

Number of Facilities:	2,946[1]
Value of Shipments:	$5.8 billion[2]
Number of Employees:	58,962[3]

TRENDS The 2001 economic recession and the accompanying decline in manufacturing activity hurt the U.S. metal finishing sector. The globalization of manufacturing that has occurred since that time has kept the sector from recovering to the levels of output and employment it experienced in the 1990s.

- Since 2000, the number of metal finishing establishments in the U.S. has fallen by 11% to around 3,000. Over the same time period, the number of employees in the metal finishing sector declined by 21% to just under 59,000.[6]
- After declining for two years, the value of shipments by U.S. metal finishing firms increased to $5.8 billion in 2003, an increase of nearly 6% from 2002.[7]

KEY ENVIRONMENTAL OPPORTUNITIES For the metal finishing sector, the greatest opportunities for environmental improvement are in managing and minimizing toxics and waste, reducing air emissions, and conserving water.

Managing and Minimizing Toxics

Metal finishing facilities use a variety of chemicals and report on the release and management of many of those materials through EPA's Toxics Release Inventory (TRI).

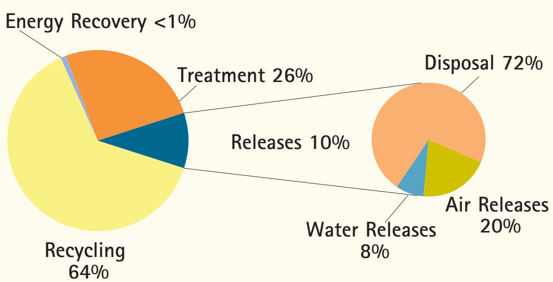
In 2003, 632 facilities in the metal finishing sector reported 95 million pounds of chemicals released (including disposal) or otherwise managed through treatment, energy recovery, or recycling. Of this quantity, 90% was managed, while the remaining 10% was disposed or released to the environment, as shown in the *TRI Waste Management* pie chart. Of those chemicals disposed or released to the environment, 72% were disposed and 28% were released into air or water.

As shown in the *Total TRI Disposal or Other Releases* line graph, the annual normalized quantity of chemicals disposed or released to the environment by the metal finishing sector decreased by 20% between 1994 and 2003, despite an increase in 2002. Over the same 10-year period, the sector's normalized releases to air and water declined by 58%, with one-quarter of this decline occurring between 2000 and 2003. Total pounds of chemicals disposed or released by the sector in 2003 were dominated by metals, with zinc, chromium, and nickel accounting for 59% of the total. Nitrate compounds and nitric acid accounted for another 16%.[8]

Data from TRI allow comparisons of the total quantities of a sector's reported chemical releases across years, as presented below. However, this comparison does not take into account the relative toxicity of each chemical. Chemicals vary greatly in toxicity, meaning they differ in how harmful they can be to human health. To account for differences in toxicities, each chemical can be weighted by a relative toxicity weight using EPA's Risk-Screening Environmental Indicators (RSEI) model.

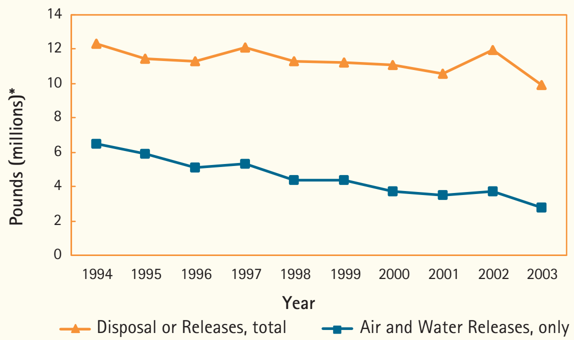
The *TRI Air and Water Releases* line graph presents trends for the sector's air and water releases in both reported pounds and toxicity-weighted results. When weighted for toxicity, the metal finishing sector's normalized air and water releases decreased by 47% from 1994 to 2003.

TRI Waste Management by the Metal Finishing Sector



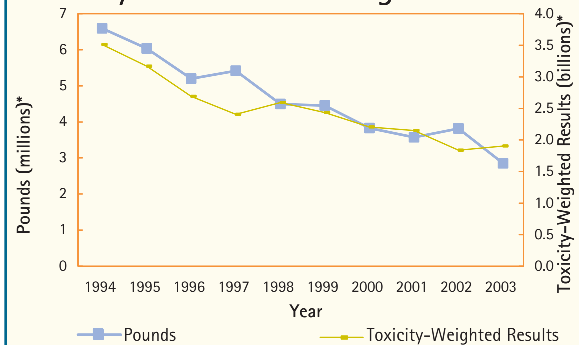
Source: U.S. EPA, 2003.

Total TRI Disposal or Other Releases by the Metal Finishing Sector

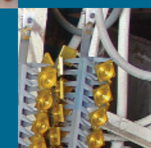


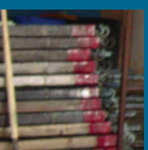
* Normalized by annual value of shipments.
Sources: U.S. EPA, U.S. Census Bureau.

TRI Air and Water Releases by the Metal Finishing Sector



* Normalized by annual value of shipments.
Sources: U.S. EPA, U.S. Census Bureau.





The table below presents a list of the chemicals released that accounted for 90% of the sector's total toxicity-weighted releases to air and water in 2003. More than 99% of the sector's toxicity-weighted results were attributable to air releases, while discharges to water accounted for less than 1%. Therefore, reducing air emissions of these chemicals represents the greatest opportunity for the sector to make progress in reducing the toxicity of its releases.

Top TRI Chemicals Based on Toxicity-Weighted Results

AIR RELEASES (99%)	WATER RELEASES (<1%)
Nickel	Lead
Chromium	Copper
	Chromium

Source: U.S. EPA

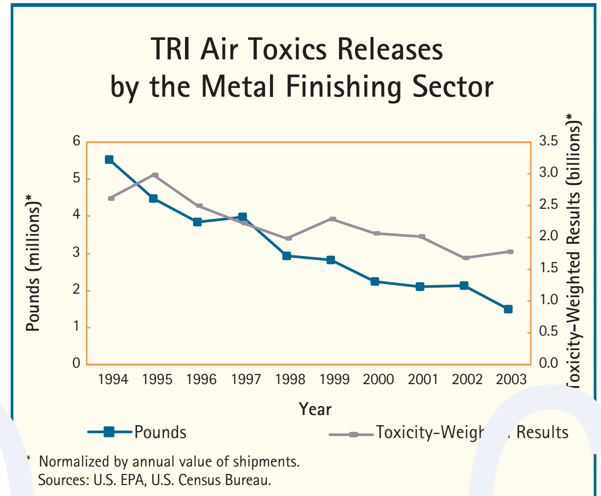
Both air and water toxicity-weighted results were dominated by metals. From 2000 to 2003, the sector's normalized nickel releases to air increased by 9%, while normalized chromium releases to air have been generally declining, with a 28% decrease over this time period.

EPA's RSEI model conservatively assumes that chemicals are released in the form associated with the highest toxicity weight. With respect to chromium releases to air and water, therefore, the model assumes that 100% of these emissions are hexavalent chromium (the most toxic form, with significantly higher oral and inhalation toxicity weights than trivalent chromium). However, the hexavalent form of chromium may not constitute a majority of total chromium releases by this sector. Thus, RSEI analyses may overestimate the relative harmfulness of chromium.[9]

Reducing Air Emissions The metal finishing sector releases a variety of air toxics. While emissions of air toxics during the manufacturing process are largely captured in the TRI air releases discussed above, this section takes a closer look at this chemical category.

Air toxics, also called hazardous air pollutants, are a subset of the TRI chemicals presented above. The Clean Air Act designates 188 chemicals (182 of which are included in TRI) that can cause serious health and environmental effects as air toxics.

In 2003, 259 facilities in the sector reported air toxics releases of 1.4 million pounds. As shown in the *TRI Air Toxics Releases* line graph, normalized air toxics releases decreased by 73% from 1994 to 2003, with almost one-quarter of this decline occurring between 2000 and 2003.[10] Toxicity-weighted results for air toxics releases decreased by 32% over the 10-year period.[11]



Managing and Minimizing Waste The metal finishing sector generates hazardous waste and is working to increase the recovery of metals from wastewater sludge.

Hazardous Waste EPA hazardous waste data on large quantity generators, as reported in the *National Biennial RCRA Hazardous Waste Report*, indicate that the metal finishing sector accounted for 2% of the hazardous waste generated nationally in 2003.

In 2003, 703 metal finishing facilities reported 582,000 tons of hazardous waste generated. However, facility data on the physical and chemical characteristics of the reported waste indicate that 331,000 tons of the reported amount were wastewater rather than hazardous waste.[12] When focusing on the sector's hazardous waste, most was reported as generated from plating and phosphating processes. The management methods most utilized by this sector for hazardous waste were cyanide destruction and other chemical precipitation.

When reporting hazardous wastes to EPA, quantities can be reported as a single waste code (e.g., lead) or as a commingled waste composed of multiple types of wastes. Quantities of a specific waste within the commingled waste are not reported. The metal finishing sector reported 59% of its wastes as individual waste codes. The waste of greatest interest to this sector is the metals-bearing sludge remaining after wastewater treatment processes. Of the individually reported wastes, 49,800 tons of this sludge was generated in 2003. Additional quantities of this waste also were reported as part of commingled wastes.[13]

Metals Recovery Through Sludge Recycling During the metal finishing process, some portion of the materials used in production is not totally captured on the finished product and can exit the process in wastewater and waste. EPA effluent guidelines require metal finishers to treat their wastewater to remove or reduce pollutants prior to discharge to either a wastewater treatment plant or a public waterway. To comply, metal finishers add chemicals to the wastewater to remove metals and other constituents. Most metals then settle and are dewatered to form sludge. This sludge, known as F006 in the RCRA classification system, is regulated as a hazardous waste.

EPA and the industry are working together to increase recovery of metals from metals-bearing sludge. Permitted hazardous waste recycling facilities can use techniques such as ion exchange canisters to recover economically valuable metals from the wastewater treatment sludges generated by the metal finishing sector. Metal recovery reduces land disturbance, resource depletion, energy consumption, and other environmental impacts that result from the mining and processing of virgin metal ore. In 2003, nearly 7,000 tons of the plating sludges reported by the sector using the single waste code F006 were reclaimed or recovered, leaving approximately 40,000 tons that were managed through other means such as land disposal. Note that the neither the amount nor fate of the F006 sludge reported as part of commingled wastes could be determined.[14] EPA is currently exploring options to remove regulatory barriers to additional metals recovery from this sludge.

Improving Water Quality Electroplating involves the use of large volumes of water in plating baths, with the subsequent generation of wastewater. The industry has long promoted the use of best management practices in the pretreatment of wastewater prior to discharge. EPA's recently issued Pretreatment Streamlining Rule has provided additional flexibility for metal finishers to work cooperatively with their wastewater treatment plants to enhance onsite facility cleanup of wastewater effluent.[15] In addition, the industry and EPA's Office of Research and Development have a longstanding partnership to promote the use of more effective pretreatment technologies by metal finishing job shops. As illustrated in the following case study, onsite pretreatment of metal finishing wastewater not only results in cleaner effluent leaving the plant but also promotes water conservation by enabling water reuse in the electroplating process.

Case Study: Efficient Wastewater Management at America's Best Quality Coatings Corporation

America's Best Quality Coatings Corporation (ABQC) plant in Milwaukee, WI, is one of the largest metal finishing facilities in North America. The company recently installed a state-of-the-art wastewater treatment system capable of treating 500 gallons of effluent per minute and monitoring the resulting treatment efficiency on a real-time basis. In addition to efficient wastewater management, ABQC has reduced its water discharges by 20% in the past year by updating the cooling system in its plating baths so that, rather than flowing continuously, the water flow now shuts off when the desired temperature is reached.[16]