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Why implement pollution prevention and waste minimization in the metal finishing industry?

Metal finishing substances, wastes, and releases, are potentially hazardous to human health and the environment when improperly managed. This is especially true for the coating and electroplating processes.

Concerns over environmental health and safety, waste treatment costs, regulatory compliance requirements, potential liability and water and energy consumption are a few of the reasons to investigate newer, less-polluting metal finishing technologies. The following discussions present more specifics on some of these issues.

## Environmental and Health Impacts

Many metal finishing processes generate toxic or hazardous pollutants that can result in direct exposure to employees or to air, land and water. Discharging untreated or partially treated electroplating wastes into sewers can cause sewage treatment equipment to fail and allow untreated sewaged to reach surface waters. Significant energy and water consumption associated with metal finishing impart environmental impacts as well.

**Surface Preparation and Parts Cleaning:** Solvent-based cleaners contain volatile organic compounds (VOC), and hazardous air pollutants (HAP) which are regulated because of their adverse health and environmental impacts. Dust from blasting and mechanical cleaning operations causes respiratory impacts.

**Plating:** Heavy metals and cyanide are particularly hazardous materials and wastes common in metal plating.

- Chromium and hard chrome plating provide excellent corrosion resistant properties, but chromate is a known human carcinogen and hexavalent chromium is a potent lung carcinogen.
- Lead compounds are generated from lead anodes as well as lead alloys used for plating. The soft tissues that take up lead and can incur damage are the liver, kidneys, brain, and muscle. Children are much more sensitive to lead exposure than adults.
- Cadmium can cause kidney and lung failure and can potentially cause cancer.
- Other common plating metals include nickel, zinc, silver, and copper, each with their own set of environmental and health hazards.
- Cyanide, used in plating baths, is a very fast-acting poison that prevents oxygen use by cells. Dissolution of cyanide into complex forms is also highly toxic to aquatic life.

**Anodizing, Etching and Chemical Conversion:** Depending on the chemicals used in these processes, reactives, metal-bearing acids, chromium-and phosphate-bearing compounds are regulated hazardous substances. As noted above, hexavalent chromium from chromic anodizing is a potent lung carcinogen.

**Coatings:** Solvent-based paints and liquid coatings, as well as the solvent thinners and cleaners, and the residual sludges and still bottoms, contain hazardous VOCs and HAPs.

**Other:** Solid waste generation, and electricity and water consumption are costly and have their own set of environmental impacts. Finding recyclers for pallets, packaging and other plastics, recovered metals, office and other grades of paper, cardboard, and glass, reduces volumes sent to landfills, and saves energy over production of new products with virgin material. Implementing reuse opportunities, such as suppliers that refurbish toner cartridges, pallets, packaging, chemical containers, etc., also reduce solid waste and life cycle impacts of these goods and materials.

Energy generated via fossil fuels results in greenhouse gas emissions and smog. Excess water consumption reduces water for natural habitat, drinking water, and other important uses.

## Compliance Benefits

Wastes and releases from metal finishing operations are subject to a number of federal and/or state regulations and

are coming under increasing burden of expense, liability, permitting and reporting requirements. Decreases in use of regulated raw materials reduces permitting and reporting requirements for wastes, emissions, and effluents, as well as reduce occupational safety and health compliance efforts.

The following table indicates which regulations and standards apply to various metal finishing wastes.

| Regulations & Standards | Discussion |
|---|---|
| Clean Water Act (CWA) and National Discharge Pollutant Elimination System (NDPES) | Spent solutions and wastewater must meet local, state, or federal discharge limits or limits set by the local publicly owned treatment works. The federal discharge regulations for electroplating indicate a single day maximum and a 4-day average. The federal discharge regulations for metal finishing indicate a single day maximum and a 30-day average. Semiannual or more frequent compliance sampling and reporting may be required. Recently, strict effluent limitations have been established under the CWA for discharges of chromic acid anodizing solution containing hexavalent chromium. |
| Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) | OSHA and NIOSH set occupational safety and health guidelines for chemical hazards and summarizes information on permissible exposure limits (PEL), chemical and physical properties, and health hazards. Most of the aforementioned hazardous substances and wastes fall under OSHA and NIOSH (and/or additional state) guidelines. In the near future, OSHA is expected to reduce the PEL for hexavalent chromium from 5 µg/m3 down to 0.5 µg/m3. In addition to plating chemicals, paints, and solvents, OSHA also regulates occupational exposure to dust, including dust generated by blasting and surface finishing. |
| Resource Conservation and Recovery Act (RCRA) | RCRA regulates the treatment, storage, disposal, and recycling of hazardous materials and wastes, as well as solid waste. RCRA wastes include sludges and still bottoms containing heavy metals or other hazardous compounds, spent solvents, spent plating and process solutions, reactives, solvent-bearing paint wastes, solvent-laden rags, and other metal finishing wastes.<br><br>RCRA also promotes metals recovery from wastewater treatment sludge and requires regulatory impact analysis for 180-day accumulation wastewater treatment sludges.<br><br>Applicable EPA Hazardous Wastes and RCRA codes include:<br>D006 Cadmium<br>D007 Chromium<br>D008 Lead<br>D011 Silver<br>D002 Spent alkaline and acidic cleaning solutions<br>D003 Reactives<br>F001 Spent halogenated solvents<br>F003 - F005 Spent nonhalogenated solvents<br>F006 Wastewater treatment sludge from certain electroplating operations<br>F007 - F012 Waste specific to cyanide plating |
| Clean Air Act (CAA) and National Emission Standards for Hazardous Air Pollutants (NESHAP) | The CAA regulates air emissions of 189 toxic chemicals called hazardous air pollutants (HAP). To control emissions of these chemicals, EPA issued NESHAP for particular industries, including the electroplating industry. NESHAP contains standards that cover emissions limits, work practices, initial performance testing, ongoing compliance monitoring, recordkeeping, and reporting. For the original list of HAPs, go to http://www.epa.gov/ttn/atw/188polls.html. |
| Emergency Planning & Community Right-To-Know Act (EPCRA) | EPCRA was promulgated to help local communities protect public health, safety, and the environment from chemical hazards. Under Section 313, the Toxic Release Inventory (TRI) requires annual reporting of toxic chemical releases and other waste management activities, by many companies that and manufacture, process or "otherwise use" any of the 582 individual chemicals in quantities above TRI thresholds. Most TRI quantities for plating companies fall under 10,000 to 25,000 pounds for an entire facility's activities for a calendar year. However, the new 2001 threshold for lead & lead compounds has been reduced to 100 pounds per calendar year. For a list of TRI chemicals and hazard information, see http://www.epa.gov/tri/chemical/index.htm#chemlist. |

## Cost Savings

Often, businesses only account for waste disposal costs rather than considering all of the associated costs with using toxic raw materials and polluting, energy or water-consuming processes, and inefficient technologies. Total cost accounting ensures that certain management, engineering, and overhead costs are tagged to cost considerations for environmental operations.

Examples of potential cost and savings opportunities associated with improving environmental performance can include:

**Raw Materials Reduction in Quantity or Toxicity**
Storage and inventory
Spill prevention
Secondary containment
Container labels

**Water Use Reduction**
Water use
Sewer and discharge fees
Wastewater treatment
Sludge handling and disposal

**Solid and Hazardous Waste Reduction**
Waste collection and containers
Labels and labeling
Onsite management
Recycling and reuse opportunities (and avoided purchasing of new materials)
Disposal and transportation

**Air Pollution Reduction**
Inspection and monitoring
Ventilation
Pollution control equipment
Sampling, monitoring, and testing
Discharge and permit fees

**Management and Overhead Costs to Consider**
Permit preparation and maintenance
Regulatory impact analysis
Hazard analysis and communication
Product/vendor research
Emergency planning
Spill response procedures and equipment
Right-to-know, emergency, and other safety and health training for staff
Sampling and testing
Inspections and audits
Information and tracking systems
Regulatory reporting
Legal and insurance fees
Penalties and fines for non-compliance

## Public Relations and Marketing

Employing the best environmental practices and products is important for maintaining a good image with the public and stakeholders, as well as attracting new customers and maintaining competitiveness.

Last Updated: 05/27/2008

The Topic Hub™ is a product of the Pollution Prevention Resource Exchange (P2RX™)

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