# Metal Finishing and the Environment: Is the Surface Finishing Industry Really "Bad" Or Just Misunderstood & Maligned?

By Mark A. Hanson, CAE

The plating/metal finishing industry plays an important support role to nearly all major manufacturing endeavors. The industry has suffered from bad PR (public relations), however—even though modern plating and surface finishing practices have eliminated most of the potential for pollution from finishing operations. Some recent studies have shown that wellmanaged plating shops contribute less to pollution than the average homeowner.

vidence of surface finishing is found in every facet of life. Shiny chromium decorates faucets and automobiles; galvanized nails are used to build homes; gold and silver are used for electrical contacts in computers and telephones; brass is used on doorknobs, lamps and other household items. Surface finishing prolongs the useful life of these items, keeps them out of a landfill, and eliminates the need for additional raw materials and energy to create replacements. The function of the metal finisher (plater) is not to create pollution, but to prevent it. The plating industry is a good example of a "recycling industry." The finished parts last a long time, and if the part should tarnish, scratch or wear, it can be stripped and re-plated.

As long as metal is used in our society, there will be a need for the surface finishing

industry. Surface finishing companies

Suggestion: This overview article may be copied and passed on to those who are unfamiliar with the benefits of the industry, as well as the restrictions placed on it. do use heavy metals and toxic chemicals, and they should be regulated. Poorly run operations can adversely affect the environment. Current government regulations and enforcement, however, make this the exception, not the rule.

## Value of the Industry

Modern electroplating and surface finishing shops use common metals to deposit a metallic coating on an object immersed in a plating solution. When immersed, a suitable low-voltage electric current flows through the part, causing the metallic coating to be attracted to the object to be plated. Some of the most common electroplated coatings and their functions are:

- Brass—Plated mostly for decorative purposes on such items as house-hold lamps, furniture, accessories and builders hardware, either as a bright or satin finish, or oxidized to obtain various antique effects.
- Cadmium—A silver-white deposit used to minimize galvanic corrosion on parts or assemblies consisting of similar metals, such as brass or steel, and for its corrosion protection properties in certain harsh environments.
- Chromium—The bright, shiny mirror-like finish well-known on everything from automobiles to bicycles, plumbing fixtures and appliances. This versatile

finish provides

contosion
protection
and good
wear-life, as
well as
beauty.
Hard Chromium—A blue-

gray deposit used to provide wear resistance on such parts as pistons, cylinders, aircraft engine parts, cutting tools, dies, oil tool parts and valves.

- Copper —A reddish deposit used for plating through-holes on circuit boards in the electronic industry, and on steel wire for making highstrength electric cable.
- Gold—A precious yellow deposit used primarily for decorative plating on such items as jewelry, pens and optical items. It is used extensively by the electronics and allied industries for semi-conductors, electrical contacts and printed circuit applications.
- Nickel—A silver-white deposit used generally on industrial products for corrosion protection and in the chemical and food processing industries to prevent iron contamination.
- Silver—Used for tableware and hollowware, because of its resistance to foods, and for jewelry. It is also used in electrical and electronic industries, because of its outstanding electrical conductivity properties.
- Tin—A white deposit that is useful for resistance to corrosion and tarnish. It's solderable and soft. Because tin is non-toxic, it is used as a coating on steel sheet for making "tin cans" and on foodhandling equipment.
- Zinc—A bluish-white deposit used as an inexpensive decorative and sacrificial protectant against atmospheric corrosion of iron and steel parts; used on nuts, bolts, wire goods, fasteners, stampings and sheet metal parts.

Notice the number of common items that are electroplated with "toxic" heavy metals—jewelry, plumbing fixtures, automobiles, nuts and bolts. Does that mean it is not safe to touch a doorknob or a faucet because of exposure to "toxic" substances? Of course not. It means that a brass doorknob or chromium faucet will look good and last a long time.

The key point to keep in mind is: "Corrosion resistance means it will not rust quickly or easily." Automobiles, tricycles, jewelry, furniture, appliances, etc., will not be headed for a landfill after a very short life. The industry saves raw materials and energy. The ore needed to create new parts will be left in the earth. This reduces open pit mining and depletion of the world's natural resources. The energy to forge, machine and heattreat new parts, to replace those that have become unsuitable from rusting, will not be required. Less nuclear and coal generation of power is needed by industry to remake parts repeatedly.

Just as wood needs to be finished so it will not rot, a piece of metal needs to be properly finished (anodized, plated, painted, powder-coated, etc.) so it will not rust. Finishing results in a *huge* reduction in the need for raw natural ore, landfill space, and electrical energy.

Surface finishing shops can be a source of environmental pollution, even though their function is to minimize pollution in the first place. The potential adverse impacts to water, land and air, however, are well-known throughout the industry. The metal finishing industry is well aware of the need to protect the environment.

#### The Water Issue

A typical basic electroplating sequence is: Cleaner—> (rinse)—> acid dip—> (rinse)—> electroplate—> (rinse).

For example, a rack of faucets would be immersed in a cleaning solution tank to remove impurities, then rinsed with water. The faucets then move to the process tanks, and are rinsed after each step. Small percentages of the cleaning solutions, acids, and electroplating chemicals will be carried into the rinse waters, which are collected in holding tanks.

The rinse waters cannot be discharged directly to an ocean, river or



#### Analysis of Household Commodities (Concentration in micrograms per kilogram)

	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Mouthwash	212	1375	1130	800	1.34	46015	1921
Toothpaste	1975	5323	12373	13744	22.90	153403	8132
Bath Soap	1017	14902	5830	7860	351.27	245228	656
Shaving Cream	176	2845	1102	262	172.92	28805	1784
Dish Detergent	732	3590	5317	332	3.04	86967	912
Drain Opener	392	4255	668	122	0.48	510715	127
Powder Laundry	1391	11610	13050	1637	14.07	603013	4943
Soap							

holding pond, because they contain small quantities of "toxic heavy metals" and alkaline cleaning solutions, and they must be handled properly. The federal government, therefore, established the Clean Water Act to make sure industries meet wastewater pretreatment standards.

Most modern metal finishing companies perform pretreatment (treatment) of their wastewaters. Water containing trace amounts of metal and chemicals, for example, is sent to a holding tank. Within this tank, chemicals are added to precipitate (to cause to separate and create a solid, which will drop out of the solution) the metals. The metal sludge is then extracted from the bottom of the tank, sent through a filter press or sludge dryer (both used to remove water from the metal sludge) and held for removal. The remaining cleaned water from the top of the tank flows to discharge to the sanitation district.

As long as the company meets designated metal discharge requirements established by the government, there is no problem. The industry is allowed to discharge only a preestablished number of parts per million of cadmium, chromium, nickel, zinc, cyanide, etc. These discharge limits are very strict. Companies are *required* by law to meet these standards, or face fines and prosecution, and even closure. Wellmanaged companies support uniform enforcement of the Federal Clean

Water Act, and support reasonable regulations designed to achieve protection of the waterways. Compliant companies also condemn those who would purposely evade the water standards.

Many companies are also evaluating approaches to waste generation by searching for alternative processes and procedures, in an attempt to minimize disposal needs. Some alternative processes include:

- Converting from solvent-based cleaning solutions to aqueousbased cleaners, to prevent chemicals from co-mingling with wastewater.
- (2) Increasing drag-out time within the plating process (allowing parts to drip longer over the process tanks to recover plating solutions before rinsing).
- (3) Installing recycling equipment to separate metals from the water, and reusing the water and metal within the process. This reduces the amount of water used, and diminishes the contaminants that would require treatment.

What happens to industrial wastewater (or, for that matter, your own household wastewater) after discharge? Most governments have local sanitation districts. The sanitation departments look after garbage and wastewater. Many industrialized areas have publicly owned treatment works (POTWs), administered by the sanitation districts, to clean the water (contaminated with industrial waste and sewage) before sending it to natural waterways. The sanitation district performs a similar wastewater pretreatment process that was performed by the industrial discharger upstream. It is because these treatment plants do not want to receive a "loading" of copper, lead, chrome, cyanide, etc., that they vigorously enforce the federal pretreatment requirements.

It is a common belief that industrial sources are solely responsible for metals in wastewaters. A 1979 study prepared by Gurnham & Associates for the Metropolitan Sanitation District of Greater Chicago, reveals some intriguing information. It states: "From the foregoing analysis on industrial loading, it is clear that sources other than industry account for the largest portion of metals arriving at our treatment plants. Therefore, control of industrial sources alone will not solve the metals problem."

The Gurnham & Associates report yields some insight on sources not yet investigated. It reveals a wide variation in concentrations. The Calumet Tributary area is highly industrialized, yet lowest in metal concentrations, except for lead and zinc. Hanover Park (a bedroom suburban community), and Egan (serving a largely residential, light industrial and commerical area) are the highest in copper and mercury, and about the same in cadmium, chromium and nickel as more industrial areas.

Where are these metals coming from? The Gurnham Report says "a significant finding is that the water supply is found to be a major source of several metals in domestic sewage. Water supply is responsible for approximately half of the total metals in domestic sewage, ranging from 20– 95 percent of individual metals."

The finding that foodstuffs are large contributors of metals in domestic sewage is also significant. Nearly all the cadmium in Hanover Park, and about half the cadmium, copper and zinc in Oakdale's domestic sewage, are contributed by foodstuffs. It is not surprising to learn that metals are in circulation throughout the food chain, but this kind of quantification is important in our understanding of the source and control of metals in sewage and sludge.

The information provided by the Gurnham study presents a good deal of data on the metals content of various non-food household products. The table on metals from household



commodities shows the mean (average) concentrations for metals in the study.

Metals are natural and common. To arbitrarily use the words "toxic heavy metal" would only relate to extremely concentrated dosages. There are "heavy metals" in our bodies, as well as in the food and products we use. Numerous metals, as a matter of fact, are required in our everyday diets copper, chromium, iron, zinc and nickel, to name a few.

#### The Real Threat to Water

There are possible threats to the water supply, if extremely concentrated loadings of wastewater-bearing metals are discharged without proper treatment. All known sources are under the scrutiny of pretreatment programs. Sources that are unknown (e.g., the jeweler performing gold/ silver plating in a garage and dumping cyanide down the toilet) are a more pressing problem. Most large industrial sources are under tremendous scrutiny and can show a history of wastewater compliance. Large industrial sources also discharge to a POTW for secondary treatment. True environmentalists should appreciate the pretreatment program, and the work of the sanitation districts in this country. Other areas of the world have no pretreatment programs, no secondary treatment programs, and environmental officials can often be bribed, even if their governments have set industrial standards.

#### Solid Waste Issues

Sludge (solids extracted from the wastewater) from metal finishing operations is primarily contaminated with the metals that are being plated. The sludge is dewatered by the use of

a filter press, sludge dryer, or evaporator, and placed in a container. Most platers have the sludge profiled to check for metals content. The majority of sludge is accepted by metal recovery firms, and the rest is sent to a state or federal certified landfill. Just as copper, nickel, chromium, lead, etc., come from the earth, they are returned to the earth, recycled or reused.

The industry is trying to reduce the amount of solid waste generated, not because it is considered dangerous, but because it is costly to haul and place in a landfill. Reusing the metal within the process is the first option. Sending the waste material to a metal recycler is the second option. Landfill is the most expensive and least desirable alternative.

# A Clean Environment & Healthy Industry

There are many regulations that platers must comply with, including the Clean Air Act, and new safety and health standards for the workplace. Each new standard requires additional investment by companies.

The surface finishing industry has an excellent track record of working with federal and state regulatory officials to find better ways to protect the environment, without threatening the vitality of existing businesses. An example of this is the AESF/NAMF/ MFSA Joint Government Relations Program, which is providing vital information about the industry to lawmakers and regulatory officials. It will continue to require a joint effort from industry and federal, state and local governments to ensure that the industry can meet the goals of environmental protection, while continuing to provide a vital service. We have been using metal in our society since the Bronze Age (5000 B.C. to 1000 B.C.), the period between the Stone Age and Iron Age. I believe we will continue to use metal for a while longer. As long as we do, we will need some platers around to keep this metal from rusting. o

### About the Author

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