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Hexavalent Chromium Headaches

Dear Advice & Counsel,

We perform decorative chromium electroplating on a variety of automotive parts. One of our clients has claimed that these parts will be banned under the European ELV Directive. I believe you have written some articles on the subject, but I am totally confused. Is my customer right?

Signed,
Hexavalent Headache

Dear Advice & Counsel,

I have read that OSHA has proposed a chromium PEL of 1 μg/m.^{3} Does this apply only to hexavalent chromium plating operations? My company performs zinc and trivalent chromium plating, does that mean I'm in the clear?

Signed,
Free and Clear

Dear Headache,

The European ELV Directive applies to hexavalent chromium within the coatings applied to automotive parts. Examples are chromates, paint primers, phosphates, and chromic acid sealed anodized aluminum.

Electroplated chromium (decorative and hard) is a metal and, therefore, is in the zero-valent state (as are all metals). The European ELV Directive **does not** ban any chromium in the zero-valent state. If your client is still confused, you/she can always run a leach test and confirm the absence of hexavalent chromium (see my previous article on the subject—*P&SF*, December 2004, page 20).

Dear Free and Clear,

You may not be as free as you might think. The following is testimony I presented to OSHA in February of this year:

"I have been asked by the organizations I represent (NAMF and AESF) to present OSHA with a realistic picture of the impact of the proposed hexavalent chromium PEL upon operations other than chromium electroplating, which will be covered by others.

"I have attempted to list such operations. While the list is possibly incomplete, it includes:

- Chromic Acid Anodizing
- Chromate Conversion Coatings (Cad, Zinc, Aluminum, Magnesium)
- Passivation
- Anodizing Seals (Sodium Dichromate and Dilute Chromate)
- Chromated Aluminum Deoxidizers
- Chrome Stripping (Electrolytic)
- Anodizing Dyes (Rare, but in existence)
- Phosphating (Chromic Acid Seal)
- Abrasive Blasting (Stripping Chromated Coatings such as Cad)
- Grinding (Stainless Steel and Chrome Plating)
- Color Dipping of Copper Alloys
- Thermal Spraying
- Laboratory operations
- Electroless Nickel Post Treatment
- Painting with Chromated Primers and Topcoats
- Dewaxing (Chrome plating and Anodizing, poorly rinsed parts)
- Welding of Stainless and High Strength Steels (Overhaul and Repair)
- Anodizing of magnesium
- Etching of ABS using chromic acid
- Passivation of copper, brass, bronze, tin, silver in dichromate based solutions
- Wastewater treatment of hexavalent chromium bearing rinses
- Additions of chromic acid or other Cr^{+6} bearing salts to process baths
- Maintenance & repair of tanks, scrubbers and vessels containing Cr^{+6}
- Chromic acid activating dip prior to decorative chromium plating
- Chromic acid passivation dip after trivalent chromium plating
- All rinses bearing Cr^{+6} that are air agitated
- Maintenance of anodes in chromium plating (stripping, cleaning, changing)

"While it is not feasible to cover all of these operations in my allotted time, I'd like to discuss a few of these, as an example.

"There are about 3,000 job shop electroplating companies in the U.S., and at least that many captive facilities. Approximately 17 percent of these facilities perform zinc and or zinc alloy electroplating for an estimated population of about 1,020 companies.

"A zinc or zinc alloy plater typically also has a chromating operation following the electroplating process. The chromating operation consists of one or more tanks containing solutions that range in hexavalent chromium content from zero to several ounces per gallon.

"The most common plating equipment employed is a rotating barrel. As the rotating barrel leaves the chromating tank, process solution gushes from the perforated barrel back to the tank. Based upon preliminary laboratory data, the splashing from this transfer produces enough mist to approach and exceed the proposed PEL of 1 μg/m^3.

"The zinc plating and chromating process do not produce enough emissions to warrant emission controls based upon present OSHA PELs and, therefore, these processes are typically not ventilated.

What Compliance Will Require

"The addition of ventilation equipment will require a plater to:

1. Shut down the process line, thereby losing production for several days.
2. Remove existing chromating tanks.
3. Re-arrange the tanks to allow for the installation of exhaust hoods.
4. Install a ventilation/scrubbing system on the exhaust hoods.

"The above may also require extensive construction work on the building to create the space necessary for the additional equipment.

Compliance Will Be Costly

"We estimate that the cost of the above will be approximately $200,000 for a typical plating line, not including the value of the lost productivity. Multiple plating lines will cost proportionally more with some savings in the scrubber, which can be increased in size at less than proportional cost to accommodate the additional load.

"Since most zinc plating facilities have at least two plating lines, a bottom end estimate of compliance cost would be $400,000 per facility. For 1,020 facilities nationwide, that would come to an investment of $400,000,000.

"There are alternative non-hexavalent chromates available for some, but not all hexavalent based chromate coatings. However, these finishes may not meet specifications that the plater must meet, and they typically require the installation of heating equipment (and the exhaust system/scrubber). In many cases these alternatives will cost about the same amount to employ.

"Chromates are also employed over cadmium plating, silver plating, copper plating, tin plating, brass plating, bronze plating, and on aluminum and magnesium parts. In many cases, these chromating processes are also unventilated under the present PEL and will require modification under the proposed revision.

"Each aqueous process that employs hexavalent chromium mentioned above typically also has a series of rinse tanks. These rinse tanks typically outnumber processing tanks by 2–3 to one. A rinse tank may utilize stagnant water or it may use running water. In either case, the water needs to agitated to blend the processing chemical with the water and effect good rinsing. By far, the most common method of agitation is low pressure air. As the air bubbles agitate the rinse, they burst and produce a measurable amount of mist that typically contains water and a trace of the process tank contents. Except for hot water rinses, under present OSHA regulations, rinses containing hexavalent chromium are almost always not ventilated. While the industry does not have data at this time, we believe that the majority of rinse tanks containing hexavalent chromium from operations such as plating, phosphating, anodizing, chromate conversion coating, passivation of stainless steel, and etching of plate-able plastics will require either the installation of ventilation or replacement of air agitation with alternate methods.

"A typical job shop may have five process lines, each utilizing 3–5 rinse tanks bearing hexavalent chromium for a total of 15–25 tanks. Installation of ventilation would involve the addition of fume hoods, ductwork, and a scrubber. The cost to the average job shop would be in excess of $250,000, not including any tank replacement/moving. Operation and maintenance would cost about $50,000/year.

"Replacing the air agitation with an eductor system costs approximately $2,000/tank for a total of $30,000–$50,000. However, eductors are not effective at eliminating emissions in barrel plating operations where splashing produces additional emissions, so wholesale changes to eductors would not be effective and ventilation systems will be required for some operations. Eductor operation and maintenance would cost $10–20,000/year.

"Estimating that 4,000 job shop and captive facilities nationwide would need to modify their chromium bearing rinse tanks by some combination of ventilation and eductor systems, and assuming each facility has 15–25 rinses requiring modification yields and estimate of about $500,000,000.

"The metal finishing industry has made great strides to replace hexavalent chromium plating processes with trivalent processes in an attempt to avoid the ecological problems associated with hexavalent chromium. However, in many cases, the trivalent chromium deposit often does not yield the same level of appearance and corrosion protection as the hexavalent process.

"To compensate for the corrosion protection deficiency, a soak bearing hexavalent chromium is often employed after trivalent chromium plating. This soak contains several ounces per gallon of chromic acid and is typically air agitated and at room temperature. Under present OSHA regulations, the soak is typically not ventilated. Under the proposed regulations, it is likely that these soaks will require the addition of ventilation or substitution of eductor systems.

"There are approximately 200 facilities employing trivalent chromium plating in the U.S. The cost of adding eductor systems or ventilation to their processes is estimated at $200,000–$500,000.

"More important, the proposed regulations would create a negative incentive for switching from the hexavalent process to the trivalent process.

"A job shop that operates many multiples of the above processes will need to spend many hundreds of thousands of dollars for compliance and lost business. The industry is presently competing against $500/year labor and much less stringent worker exposure and environmental controls in China.

"No other country has hexavalent PELs as low as these that have been proposed by OSHA, nor is any country even close to the proposed PEL. Most of the U.S. trading partners, such as China, Mexico, Canada (Ontario) and several EU countries, such as France and Germany, have limits at 50 $\mu g/m^3$.

"The time OSHA allows for compliance after it finalizes this PEL is far too short to allow for design, planning and construction of modified processing lines. At least three years should be allowed.

"If finalized as proposed, this regulation will serve to accelerate the closure of metal finishing facilities and the loss of manufacturing jobs in the U.S." *P&SF*