International Material Restrictions and Metal Finishing

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This presentation summarizes the mounting international legislative and voluntary initiatives to restrict the use of such materials as hexavalent chromium, cadmium, lead and nickel, both in manufacturing and final products. U.S. metal finishers who are unaware, or unprepared to respond to these restrictions may lose market share in critical industries, such as automotive, electronics, and aerospace. This paper reviews the key materials restriction drivers, including the European Union's End-of-Life Directive (ELD), Waste Electrical and Electronic Equipment Directive, Restriction of Hazardous Substances Directive, as well as some OEM requirements, highlighting their relevance to metal finishers. It then discusses measures that metal finishers are taking to prepare for and anticipate the changes, and summarizes initiatives by the Toxics Use Reduction Institute to work with the metal finishing supply chain toward that end.

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1. Introduction

This document summarizes recent legislative and market-based material restriction initiatives that affect the metal finishing industry in Massachusetts. Stringent international legislative efforts, particularly in Europe, coupled with customer-driven requirements, restrict or ban the use of certain toxic materials in manufacturing and in the final products. As a result, metal finishers supplying to such sectors as automotive, aerospace, electronics and jewelry will be required to significantly reduce or completely eliminate the use of lead, cadmium, mercury and hexavalent chromium in most applications. Massachusetts metal finishers unaware or unprepared to address materials restrictions will increasingly be at a competitive disadvantage, and risk losing market share in these and possibly other industry sectors. However, companies that are prepared to offer quality products that comply with international restrictions and customer material requirements will be in a strategic competitive position.

The objective of this paper is to summarize key material restrictions, discuss how they may affect the metal finishing sector in Massachusetts, and highlight some of the ways companies can prepare for and adapt to the new requirements. This paper is one part of the Toxics Use Reduction Institute's Metal Finishing Supply Chain Initiative to assist metal finishers by providing information about material restrictions and available alternatives.

2. Metal Finishing Background

The scope of metal finishing includes chrome plating, aluminum anodizing and other metal treating applications, such as cadmium and nickel. There are two types of businesses engaged in metal finishing:

a) independent metal finishers commonly called "job shops" or "independent metal finishers", and
b) "captive" metal finishers who conduct metal finishing processes as part of a larger manufacturing operations.

Chromium plating and anodizing operations include decorative chromium electroplating of metals and plastics, hard (functional) chromium electroplating of metals, chromic acid anodizing and trivalent chromium plating. According to the 2000 Chemicals Economics Handbook (734.1001 N) an estimated 2,800 decorative plating facilities, 1,540 hard plating facilities and 680 chromic acid anodizing shops operate in the United States. There are roughly 113 SIC code 3471 metal finishing firms located in Massachusetts.

The metal finishing industry supplies plated parts to a host of different industries, including:

- Miscellaneous Metal Parts
- Computers/Electronics/Communication
- Household Appliances
- Jewelry
- Industrial machinery
- Motor vehicles (e.g., shock absorber rods, struts, engine valves, piston ring, and brake pistons)
- Military equipment.

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2.1 – Metal Finishing Companies in Massachusetts

The 113 SIC Code 3471 firms in Massachusetts do not make up the total number of firms in the Commonwealth that perform metal finishing operations. Many firms in the state perform various other metal finishing operations as a minor part of their overall operations. Exact numbers of firms performing specific plating operations is difficult to ascertain, and there are few data available outlining the specific types of finishes employed by metal finishers in Massachusetts. The National Association of Metal Finishers, a trade association that caters mainly to the owners of metal finishing job shop operations, does include some data on its website for 15 firms in the Commonwealth (see Table 1 below).

Table 1. List of some metal finishers in Massachusetts

Company	Town	Finishes
Advance Plating Corporation	Worcester	Hard Cr; Chromium
F. M. Callahan & Son, Inc.	Malden	Pb
General Metal Finishing Co., Inc.	Attleboro	SnPb
Hopwood Globe Metal Finishing Corp.	Malden	SnPb
Independent Plating Company	Worcester	Hard Cr
Light Metal Platers, Inc.	Waltham	SnPb; Chromium
National Metal Finishing Corp.	Springfield	Chromium
New Method Plating Company, Inc.	Worcester	Cd; Chromium
P & L Electroplating Co., Inc.	Canton	SnPb
Plating for Electronics, Inc.	Waltham	Cd; Pb; SnPb
Purecoat North, L.L.C.	Belmont	Cd; Chromium; Hard Cr; SnPb
TDF Metal Finishing Co., Inc.	Lynn	Cd
Walton & Lonsbury, Inc.	Attleboro	Hard Cr
Westfield Electroplating Co.	Westfield	Cd; Chromium; Hard Cr; SnPb
Whitman Company, Inc.	Whitman	Hard Cr

Source: National Association of Metal Finishers, www.namf.org

3. Materials Restrictions Drivers

There has been a growing movement, particularly in Europe, to control the end-of-life disposal of vehicles and of electrical equipment and electronics. Many of these products contain hazardous materials such as hexavalent chromium, cadmium, lead, and mercury that can impact the environment and human health. As a result, there are now important legislative and market-based initiatives that are driving material restrictions in the industry. This section discusses those drivers and the likely impact they will have on metal finishers.

3.1 – European Union Directives

The most important legislative drivers of material restrictions come from the Europe Union. These include the Waste Electrical and Electronic Equipment (WEEE), Restrictions on Hazardous Substances (RoHS) and the End-of-Life Vehicle (ELV) directives.

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3.1.1 – Waste Electronic and Electrical Equipment (WEEE) and Restrictions on Hazardous Substances (RoHS)

On February 19, 2003, the European Parliament formally adopted the Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) and the Restrictions on Hazardous Substances (RoHS) Directives (2002/95/EC). EU Member States are now obliged to implement the regulations by August 13, 2004. The provisions of these directives go into effect on July 1, 2006. After the effective date, any electronic products sold in Europe must be compliant with the directive. The legislation is significant for U.S. companies because Europe is the largest export market for the U.S. electronics and electrical equipment industry sector, representing $36 billion (or 16%) of total sales in 2002.[1]

The WEEE Directive is a producer responsibility regulation with three major objectives: (1) to prevent or reduce the volume of electronic waste resulting from disposal of such products as computers, cell phones, toys and radios; (2) to expand recovery and recycling of waste electronic equipment; and (3) to minimize the environmental risks associated with the recycling, treatment and disposal of the equipment. The WEEE Directive itself will likely have very little direct impact on metal finishers.

More significant for metal finishers is the RoHS directive, the complement to the WEEE directive, which bans most uses of hexavalent chromium, lead, mercury, cadmium and certain brominated flame retardants in electrical and electronic equipment starting on July 1, 2006. The RoHS directive could affect metal finishers, for example, who plate parts such as printed circuit boards, fasteners and equipment housing for use by electronics and electrical equipment manufacturers in products sold in Europe.

There are certain exemptions to the RoHS material restrictions, listed in the RoHS Annex, that relate to metal finishing operations:

- Lead as alloying element in steel containing up to 0.35% lead by weight, aluminum containing up to 0.4% lead by weight and as a copper alloy containing up to 4% lead by weight.
- Lead in high melting temperature type solders (e.g., tin-lead solder alloys containing more than 85% lead); lead in solders for servers, storage and storage array systems (exemption granted until 2010); lead in solders for network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunication; lead in electronic ceramic parts (e.g., piezoelectronic devices).
- Cadmium plating except for applications banned under Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations.
- Hexavalent chromium for anti-corrosion of the carbon steel cooling system in absorption refrigerators.

However, Article 5.1 c) of the Annex emphasizes the right of the Commission to review these exemptions every four years and consider "deletion of materials and components of electrical and electronic equipment from the Annex if their elimination or substitution via design changes becomes technically and scientifically feasible." Therefore, it is possible that the RoHS will become *more* restrictive over time.

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3.1.2 – European Union End-of-Life Vehicle (ELV) Directive

Similar to the WEEE and the RoHS directives, is the EU End-of-Life Vehicles (ELV) directive (2000/53/EC), passed by the EU in 2000. It aims to ensure that vehicles below 3.5 tons total permissible weight are designed and manufactured in a way that reduces the use and release of hazardous substances in the environment, and promotes reuse, recycling and recovery. It covers newly manufactured vehicles and end-of-life vehicles, including their components and materials, as well as spare and replacement parts. The ELV Directive bans the use of the following chemicals in vehicles and components of vehicles put on the market after 1 July 2003: **lead, mercury, cadmium, and hexavalent chromium**. (The restrictions and exemptions of hexavalent chromium are discussed in more detail below).

As with the RoHS, there are several important exemptions, listed in the ELV directive Annex II. In June, 2002, amendments to Annex II eliminated several of the original exemptions, and established expiry dates for others.[2] The following list presents the ELV exemptions and the expiry date of those exemptions (if applicable):

1) Lead as an alloying element in:
   - steel (up to 0.35% lead by weight),
   - aluminum for machining purposes (up to 2% lead by weight), [July 1, 2005]
   - aluminum for machining purposes (up to 1% lead by weight), [July 1, 2008]
   - copper alloy containing up to 4% lead by weight
   - lead/bronze bearing-shells and bushes
2) Lead and lead compounds in components
   - Batteries
   - Vibration dampers
   - Wheel balance weights [July 1, 2005]
   - Vulcanizing agent for high pressure or fuel hoses [July 1, 2005]
   - Stabilizer in protective paints [July 1, 2005]
   - Carbon brushes for electric motors [July 1, 2005]
   - Solder in electronic circuit boards and other applications
   - Copper in brake linings (with 0.5% lead by weight) [July 1, 2004]
   - Valve seats [July 1, 2006]
   - Electrical components containing lead in a glass or ceramic
   - Glass in bulbs and glaze of spark plugs [January 1, 2005]
   - Pyrotechnic initiators [July 1, 2007]
3) Hexavalent chromium
   - Corrosion preventative coating on numerous key vehicle components (maximum 2 g per vehicle) [July 1, 2007]
   - Absorption refrigerators in motorcaravans
4) Mercury
   - Discharge lamps and instrument panel displays

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5) Cadmium

- Thick film pastes [July 1, 2006]
- Batteries for electrical vehicles [December 31, 2005]

Because lead, cadmium, mercury and hexavalent chromium are found naturally in the environment, they are often present in trace amounts as contaminants in many alloys and other substances, even though they were not deliberately added. Therefore, even after the exemptions expire, the ELV directive allows a maximum concentration value up to 0.1% by weight of lead, mercury and hexavalant chromium, and up to 0.01% by weight of cadmium, provided these substances were not "intentionally introduced."*

As with the RoHS directive, the ELV directive Annex II also includes provisions to evaluate the exemptions and amend them accordingly, based on the availability of new substitutes. Therefore, it is possible that the current exemptions listed above could be also eliminated if their use is determined to be avoidable.

3.1.3 – EU Directive on restrictions on the marketing and use of certain dangerous substances and preparations[3]

Another important EU directive is Council Directive 76/769/EEC, passed July 1976, and amended 24 times since then. This directive lists the categories of dangerous chemicals (e.g., heavy metals, carcinogens, mutagens, etc.) and their restriction or ban in specific applications. Important provisions of this directive for metal finishers include:

1. **Cadmium –** The directive prohibits the use of cadmium for plating equipment in the food production, agriculture, household goods, furniture, sanitary waste, etc. (Article 24, Section 3.2). Exempted from this restriction are aerospace, mining, offshore and nuclear sectors whose applications require high safety devices (Article 24, Section 3.3).

2. **Nickel and Nickel Compounds** – Prolonged contact with nickel and nickel compounds can cause sensitization of the skin, and can lead to allergic reactions. In 1994, the EU therefore voted to limit the use of nickel in objects that can come into prolonged contact with the skin. In particular, nickel and its compounds cannot be used in:

    a. post assemblies intended insertion into ears or other pierced parts of the human body, earrings, necklaces, bracelets, chains, anklets, finger rings;
    b. wrist-watch cases, watch straps, and tighteners; and
    c. rivet buttons, zippers, fasteners and metal marks

    unless such assemblies are homogenous and the concentration of nickel is less than 0.05% total mass.

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* From the Annex II amendments, "*intentionally introduced*" means "deliberately utilized in the formulation of a material or component where its continued presence is desired in the final product to provide a specific characteristic, appearance or quality."

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3.2 – U.S. Legislative Initiatives

California Proposition 65 – Overwhelmingly approved by California voters in 1986, Prop 65 (as it commonly referred to) requires the California governor to publish a list of chemicals that are known to cause cancer, birth defects or other reproductive harm. There are currently 550 chemicals on the list, which must be updated annually. The purpose of Prop 65 is to protect public drinking water sources and allow the public to make informed decisions about the products they buy and use.

Prop 65 applies to any company with 10 or more employees that operates in California **or sells** products in California. It prohibits companies from knowingly discharging listed chemicals to drinking water sources. But more importantly for metal finishers in New England, it requires a "clear and reasonable" warning that the product or process uses a listed chemical. The appropriate warning method depends on the type of human exposure expected – such as consumer product, environmental or occupational. But at a minimum, the warning must (1) clearly make known that the chemical involved is known to cause cancer, birth defects or other reproductive harm, and (2) be given in such a way that the warning reaches the person before exposure.[4] The unique requirements of Prop 65, its severe penalties and its broad reach make it one of the most important and effective labeling laws in existence.[5]

Prop 65 listed chemicals that are of concern to metal finishers include:

- hexavalent chromium
- nickel and certain nickel compounds
- lead and lead compounds
- mercury and mercury compounds
- cadmium and cadmium compounds

Since the parts that metal finishers plate are generally not sold directly to consumers, and since they do not operate in California, it is unlikely that New England metal finishers will be subject to the Prop 65 labeling requirements. However, Prop 65 creates a powerful incentive for large companies to eliminate listed chemicals in their products, so increasingly original equipment manufacturers (OEMs) are prohibiting their suppliers from using Prop 65 chemicals. Therefore, metal finishers who can provide plated parts without the use of restricted chemicals could have a competitive advantage as a preferred supplier to companies selling products in California.[6]

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3.3 Market Drivers

3.3.1 – Original Equipment Manufacturers (OEMs) requirements

"Suppliers must view material content as a competitive issue – if you can't supply products without restricted materials, then your competitor will."

- Ray Lizotte, Texas Instruments

As with the California Proposition 65 requirements, the European Union directives create important incentives for large OEMs to reduce or eliminate certain materials from the products they sell. For example, under the WEEE, RoHS and ELV directives, OEMs are entirely responsible for the end-of-life management of electronic products and vehicles they sell in Europe. Large companies are therefore designing products that are easier to collect, reuse, dismantle and recycle. As a result, many OEMs, particularly in the automotive and electronics sectors, have developed their own lists of restricted materials. In most cases, OEM requirements are more stringent and cover more chemicals than legislative restrictions, in order to anticipate future limits and to ensure cost advantages during the end-of-life management of products. Metal finishers who are prepared to offer products without restricted materials will be well positioned competitively.

3.3.1.1 – Automotive Sector

Under the End of Life Vehicle directive, automotive manufacturers are faced with the challenge of certifying that their products do not contain prohibited hazardous substances, in addition to providing appropriate information to treatment facilities regarding the dismantling, reuse and recycling of their vehicles. In order to address the logistical and technical challenges of collecting material use information on hundreds of thousands of parts from thousands of companies throughout the supply chain, the major automotive companies cooperatively developed the International Material Data System (IMDS), a joint system for supplier materials declarations. OEMs and tier 1 automotive suppliers impose competitive "penalties" on suppliers who fail to input the data to the IMDS, and give preferred status to suppliers who provide products without restricted materials.

A sample material declaration from General Motors lists all substances used in materials and components of automobiles, which are currently prohibited or limited by existing legislation or self-imposed regulations.[7] For example, suppliers are required to disclose any amount of hexavalent chromium used above 0.01 $\mu g/cm^2$ as chrome pigments or surface coating. Cadmium is prohibited in quantities above 75 ppm in surface protection, and lead is prohibited above 100 ppm, though suppliers are still required to declare any amount of cadmium and lead in their parts and components.

3.3.1.2 – Electronics and Electrical Equipment (EEE) Sector – Similar requirements and initiatives have emerged in the electronics sector, driven largely by the European Union directives for Wastes from Electric and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS). The EEE industry collects information about the products and subparts they purchase from suppliers. Material composition information allows companies to satisfy regulatory requirements, develop improvements in product design and respond to inquiries from customers and stakeholders. The Electronics Industry Alliance (EIA) has developed the Joint Industry Guide, a material composition declaration guide designed to streamline and standardize data transfer across the supply chain.

Similarly, Dell, HP, IBM, and Nokia formed the High Density Packaging User Group (HDPUG) to jointly address the issues of material composition and supplier compliance. The main goal of the

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HDPUG is to identify and quantify the use of restricted substances and cases of non-compliance. As a first step the group tested some products for lead, cadmium, chromium, nickel, copper and other restricted materials. (For more information see www.hdpug.org).

Toshiba America Electronic Components, Inc. recently announced that it is implementing new manufacturing procedures using new materials that support the current industry movement to lead-free manufacturing. TAEC reports it has developed a plan to transition a portion of its manufacturing to lead-free by the end of 2003.[8] This step was driven in part because of the European Community directives for Wastes from Electric and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS), which will regulate the use of lead and other hazardous substances by July 1, 2006. Although there is no similar requirement in the U.S. at this time, the European directives will have a widespread impact on the global marketplace, requiring lead-free assemblies, and Toshiba decided to be proactive. This automatically means that suppliers who are able to provide lead-free parts and components will be in a better market position in this case.

3.3.2 – Eco-Labeling

In response to increasing demands by consumers for environmentally responsible products and services, many companies are seeking to qualify their products for one or more eco-labels – third-party certifications that verify a product meets certain specific material and manufacturing criteria. Eco-labeling provides information to consumers about the impact of a product throughout its life cycle, from manufacturing to use to disposal. It also provides information for handlers about the potential for reuse and recycling of a product. The first major eco-label was the Blue Angel eco-label, established in Germany in 1977. Since then, dozens of major eco-labels have been established globally. Among the most important eco-labels are TCO (Sweden), EU Flower (European Union), Nordic Swan (Nordic countries), Ecomark (Japan), Green Seal (USA).[9]

Among the attributes for eco-labeling are corporate environmental management, product design (including toxic substances used in the product, design for longevity and design for recycling), product manufacturing, packaging, energy savings and end-of-life management. In order to become certified, most eco-labels prohibit or severely restrict the use of hazardous substances such as lead, mercury, cadmium, hexavalent chromium, and brominated flame retardants during manufacture or incorporation into final products. Eco-labels are becoming increasingly popular. For example, 50% of computer monitors on the world market are TCO-certified.[10]

4. Hexavalent Chromium

Perhaps the most important ELV provision affecting metal finishers is the ban on hexavalent chromium on automobiles. Hexavalent chromium has been widely used for years by the plating industry in two common applications. The first is as a chromate conversion coating – also known as a passivation layer – for zinc and zinc-alloy electroplated parts. In this application, the zinc or zinc alloy serves as a sacrificial corrosion layer to protect the metal substrate (usually steel) underneath it. Hexavalent chromium is then added to protect the zinc layer to provide added corrosion protection, as well as other important end-use benefits, including color, torque control and abrasion resistance. In this application, hexavalent chromium is intentionally left on the parts, and it is this form of hexavalent chromium plating that is banned by the ELV directive.

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The second application is chrome electroplating, as used on such products as toasters, irons, truck bumpers, tableware and sink faucets. In this application, the layer left on the part is metallic chrome, which has a zero valence. This use of hexavalent chromium is ***not*** affected by the ELV directive, even though the plating process involves many of the same hazardous chemicals. The ELV directive is concerned with how chemicals affect after-life vehicle management, rather than chemical use during production.

The ELV directive allows a maximum limit of 2 grams of hexavalent chromium per vehicle, and may only be used for corrosion protection – all other uses of hexavalent conversion coating layers are prohibited. The 2 gram allowance was originally set to expire on January 1, 2003, however, amendments to the ELV Annex II extended the exemption to July 1, 2007. After that date, hexavalent chromium may not be intentionally introduced, and must not be present in concentrations exceeding 0.1% by weight.

The mass of hexavalent chromium on electroplated zinc parts is estimated to be 12 mg/dm^2, of which 70% is hexavalant chromium. This translates to approximately 2 grams per 73 ft^2 of vehicle.[11] Nevertheless, the reality of calculating the actual content of hexavalent chromium in a vehicle is extremely difficult. Therefore, most automotive manufacturers have chosen to ban its use altogether, in advance of the actual ELV deadline, simply to ensure they are in compliance with the directive.

4.1 - Alternative Conversion Coatings

The ideal hexavalent chromium substitute conversion coating would provide identical properties, such as comparable corrosion protection, torque and tension control, and consistent color. It would also have the unique "self-healing" property of hexavalent chromium. When scratched, soluble hexavalent chromium in the passivation layer will diffuse out to repassivate the exposed area.[12] While several acceptable alternatives exist, no one substitute can offer all of these properties, and none is self-healing.

4.1.1 Trivalent Chromium

Clear and blue trivalent chromium passivation coatings have been used successfully for years. Trivalent chromium is far less toxic than hexavalent chromium, and appears to be the most viable near-term conversion coating substitute for hexavalent chromium. Of all the possible alternatives, trivalent chromium most closely resembles the desirable characteristics of hexavalent chromium. In fact, trivalent chromium achieves superior corrosion resistance over zinc alloy than hexavalent chromium over zinc.[13]

However, thickness build is difficult to control on zinc plated parts and colors obtained with trivalent chromium are different than with hexavalent chromium. But given the challenges and urgency associated with converting to alternative conversion coatings, most end-users are becoming more forgiving of color shade variations.

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The main drawback of trivalent chromium is that it is still a chromium-based technology and many industry experts predict that all forms of chromium will eventually be phased out. Therefore, the long term fate of trivalent chromium is uncertain. Nevertheless, trivalent chromium appears, for the near term at least, to be the most commercially acceptable alternative to hexavalent chromium without excessive additional cost.

4.1.2 – Non-Chromium Alternatives

There are many possible non-chromium substitutes for conversion coatings. However, they all have their limitations when used individually, so none seems likely to be employed independently. Instead, these alternatives are likely to be adopted as a combination of alternatives in a multi-step process.

4.1.2.1 – Organic Films

There are many varieties of organic films. The organic film generally serves as a pretreatment for a topcoat, and acts to prevent oxygen migration that causes corrosion and poor adhesion. Organic coating films are generally between 50 and 300 nanometers thick and can by applied either by spray or immersion, usually without any process modifications. Because organic film coatings do not contain heavy metals, they are safer for worker health and safety, as well as being easier and cheaper to treat. However, coating thickness, uniformity and color are concerns.[14]

4.1.2.2 – Inorganic Films

Many color passivation coatings are possible with inorganic salts and oxides of aluminum, titanium, molybdenum, tungsten, cobalt, cesium and zirconium. But they usually perform poorly on salt spray tests.[15]

Combinations of the alternatives above are very promising, however, there may be capital expense involved.

4.2 – The Future of Hexavalent Chromium

Hexavalent chromium continues to be an important and widely used chemical by industry. In addition to automotive applications, hexavalent chromium is used in many other industry sectors for a variety of applications including leather tanning; pigments in paints, dyes, inks and plastics; wood preserving and in electronics as an anti-corrosion treatment. Given its widespread use and utility, there will always be a strong voice in support of its continued use.

Nevertheless, the human health dangers of hexavalent chromium are well known and widely accepted, and there is increasing pressure to eliminate its use altogether. Hexavalent chromium is a known human carcinogen, and is extremely corrosive to human tissue. Prolonged inhalation exposure can damage mucous membranes of the nasal passages and respiratory tract. If the ELV directives are any indication of the future of hexavalent chromium, it is quite possible that its use will be phased out completely in all applications.

5. Toxics Use Reduction Institute (TURI) Metal Finishing Supply Chain Initiative

The TURI Metal Finishing Supply Chain Initiative is a response to growing environmental challenges facing the plating industry. The goal of this initiative is to help Massachusetts metal finishers stay

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abreast of national and international government and customer chemical restriction policies, learn how those policies affect them, and how they can respond to the challenges. The initiative involves research on alternatives to hexavalent chromium and other restricted chemicals, technical update reports on research findings, and meetings to draw metal platers together to discuss new alternatives technology and performance updates, and business strategies for addressing and preparing for materials restrictions. Check the TURI website for Metal Finishing Supply Chain Initiative updates at www.turi.org

6. Summary

International restrictions on the use of chemicals such as lead, mercury, cadmium, and hexavalent chromium have far-reaching consequences for the surface finishing industry. The European Restrictions on Hazardous Substances (RoHS) Directive bans the use of these metals in most electronic devices sold in Europe by July 1, 2006. But the most impacting restriction on metal finishers is the European End-of-Life Vehicle (ELV) Directive, which bans hexavalant chromium on all automobiles sold in Europe by July 1, 2007. The use of hexavalent chromium affected by this restriction is as a post-treatment conversion coating, most commonly on zinc and zinc alloy plating in the automotive industry. In anticipation of this deadline, many automobile manufacturers are already requiring their suppliers to use non-hexavalent chromium finishes. Eliminating this use of hexavalent chromium presents a considerable challenge for metal platers because corrosion-resistant coatings based on hexavalent chromium are technically well established, cost-effective and simple to apply.

Trivalent chromium is the most cost-effective and viable short-term alternative to hexavalent chromium. However, many industry experts agree that all chromate-based conversion coatings will be phased out eventually. Therefore, much effort is being invested throughout the metal finishing industry to find viable non-chromate conversion coatings. Non-chromate conversion coatings based on salts of titanium, zirconium and molybdenum provide reasonable corrosion protection. However, these inorganic coatings generally cannot match the performance of hexavalent chromium coatings, although they definitely serve a purpose in applications where only mild corrosion protection is necessary. In general, any conversion coating alternative to hexavalent chromium will require that special attention be paid to mechanical handling of parts, since no alternative can provide the self-healing characteristic of hexavalent chromium.

The Toxics Use Reduction Institute is working with Massachusetts metal finishers to help them understand materials restrictions and find technical solutions to the challenges they face in finding viable, safer alternatives to restricted materials.

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