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Target Audience:
All HSE Inspectors

OPERATIONAL WORK 2005/06 –DISEASE REDUCTION PROGRAMME: REDUCING THE RISK OF ILL-HEALTH FROM HEXAVALENT CHROMIUM COMPOUNDS IN THE ELECTROPLATING INDUSTRY

This SIM provides information on a national project to reduce the risk of asthma, dermatitis and cancer from contact with hexavalent chromium compounds used in electroplating facilities. A National Chromium Health Awareness Day was held on 7th April 2005 to launch four new guidance documents, which have been agreed with the industry. FOD Inspectors who are likely to visit finishing companies where these substances are used will need to be aware of the Project and new guidelines.

The SIM updates and replaces SIM03/2003/06 “The use of hexavalent chromium in electroplating”.

INTRODUCTION

1 Hexavalent chromium compounds are widely used throughout industry, including electrolytic plating or oxidation (anodising) of metal articles using an electrolyte containing chromic acid or other chromium compound. Similar solutions are also used in other surface treatment processes, eg passivation which gives corrosion protection to metals that are dipped into a hexavalent chromium solution.

2 Chromium plating consists of two distinct processes - ‘decorative-plating’ and ‘hard-chrome’ plating. In each process the general principles, equipment and concentrations of chromic acid used are similar. However, in hard-chrome plating a much thicker coating is deposit (over a period of hours) to obtain the desired engineering properties eg wear resistance.

3 Typically, decorative-chrome plating applies a thickness in the order of 0.5micron onto a nickel base and components being plated will spend only a short time, eg <10 mins, in the plating solution. There are two forms of decorative chrome plating: the ‘black’ form, where the chrome is deposited as chromic oxide (used typically on some car wheel bolts, motorcycle and, mobile phone components); and the considerably more common ‘bright’ form (for cutlery, kitchen and bathroom furnishings, automotive products, etc). Decorative coatings can be further categorized by the degree of protection required related to the severity of the conditions to which it is subjected (defined in standard BS EN 1403:1988 “Corrosion protection of metals”). For example, indoor furniture trim may be coated to ‘Service Condition’ 1 or 2 whereas exterior vehicle trim would require service level 4. Some vehicle manufacturers are demanding even higher standards as they look to extend corrosion warranties. Corrosion resistance is particularly important because, at present, whilst trivalent chromium chemistry can plate to service levels 3 and 4 only hexavalent chemistry can currently meet the higher motor industry standards. This has significant implications when considering substitution by trivalent

chemistry. Similarly, only hexavalent chromium can produce the thick coating required for 'hard chrome' plating.

4 Traditionally, hexavalent chromium Cr(VI) has been used in both the decorative and hard-chrome processes. According to industry statistics (2001) about 1200 tonnes of Cr(VI) are supplied to approximately 300 UK plating companies of which 65% is used in electroplating, 25% in passivation processes and 10% in anodising.

HEALTH EFFECTS

5 Chromium plating first became a commercial process in about 1928. The adverse effects on health were such that by 1931 the first Chromium Plating Regulations had been introduced. The health effects associated with exposure to chromium and its inorganic compounds vary according to valency state and water-solubility, though Cr(VI) compounds are of most concern (chromium metal is inert and trivalent chromium is low hazard). Chromic acid is a common hexavalent form used in chromium plating baths. It is a particularly hazardous substance. Breathing in an aerosol of chromic acid increases the risk of developing lung cancer and on the basis of a recent evaluation, it is now considered possible that chromic acid exposure via the skin or by ingestion could also carry an increased risk of cancer. Consequently, in 2005 it is intended to change chromic acid's classification from "May cause cancer by inhalation" [code R49] to "May cause cancer" [code R45]. In all these cases, any exposure has the potential to increase the risk of developing cancer, but the greater and more common the exposure, the greater the risk. Accordingly, employers must establish safe working practices to minimize **any** risk of contact. All areas where exposure may occur need to be tackled – from storage through to disposal.

6 Chromic acid poses other serious hazards that these safe-working practices will help to prevent. Depending on the nature of the exposure, it can cause skin burns, allergic contact dermatitis and asthma (perforation of the nasal septum and ulcers in the nose have long been ill effects associated with persons employed at chromium plating baths). Furthermore, chromic acid has the potential to cause severe poisoning following skin contact, inhalation exposure or ingestion. More information on the health effects can be found in Guidance Note GN EH2 **Chromium and its inorganic compounds: health hazards and precautionary measures** and [INDG346 Chromium and You](#).

HEALTH AND SAFETY STANDARDS IN CHROME PLATING

7 Results from two surveys carried out in FOD in the 1990s highlighted poor standards in sections of the chromium plating industry. Significant deficiencies were found, particularly in the frequency of atmospheric monitoring at Cr(VI) plating baths, levels of health surveillance, standards of welfare facilities and adequacy of training, instruction and supervision of employees. It was not surprising, therefore, that both surveys found clear evidence of ill health from exposure to hexavalent chromium compounds, especially amongst those employed as platers and jiggers. A further study in London plating shops in 2004/5 visited 29 electroplaters in London. Action was taken in all but a handful of premises and 15 Improvement Notices were served. Those carrying out chromium plating were particularly poor at complying with legal requirements. Many claimed they were not in position to change to trivalent chemistry but it was clear they were falling well short of the standards required for operating a Cr(VI) process, particularly regarding controlling exposure, monitoring exposure and health surveillance.

NEW GUIDANCE AGREED WITH INDUSTRY

8 As a result of these findings, the Manufacturing Sector have collaborated with the industry's trade associations and agreed four definitive guidance documents ([see below](#)) that set out the standards that should be met. These documents are free to download from the HSE's Surface Engineering webpages or from SEA's website. They expand upon Engineering Information Sheets 3 and 5, which provide general guidance on monitoring and health surveillance for the whole of the electroplating industry. The documents clarify best practice and include requirements that will require significant changes for some operators. For example:

- Where surfactants are used to control exposure to chromic acid mist, surface tension meters (tensiometers) must be used at specified periods (initially every 4 hours of operation) to ensure that surface tension is kept below the level specified by the supplier.
- Air sampling above the plating bath should be carried out above the bath every 14 days using the method outlined in MDHS 52/3. The sampling flow rate should be checked before and after testing using a flow meter that is accurate to at least +/- 5%.
- LEV extraction rates and freeboard levels must be maintained. Checks should initially be carried out daily but can be extended to weekly intervals if consistent results are obtained.
- Measurements and additions should be recorded in a logbook that is kept available for inspection.
- Areas that may be contaminated by chromic acid must be designated, warning signs posted, and non-essential personnel must be excluded.

9 The surface finishing industry has previously taken action to effect improvements. The SEA (see [SIM 3/2001/16](#)), for example, published the FOD survey results in its members' newsletter and set up a working group to review the implementation by member companies of the principles in the Metal Finishing Association's (MFA) publication *Safer chromium finishing* (SF 655). The MFA published further guidance in *Chromium: Code of Approved Practice* (SF 655) which recommended that, where possible, in bright decorative-chrome plating Cr(VI) should be substituted by the less hazardous trivalent variety.

SUBSTITUTION USING TRIVALENT CHEMISTRY

10 Although the scope for alternative substances or processes in hard-chrome and 'dark' decorative-chrome surface treatments is limited, there have been a number of attempts to promote substitution of Cr(VI) in 'bright' decorative-chrome plating by the less hazardous trivalent form, Cr(III). Early attempts were not successful, mainly because Cr(III) deposited a different colour to Cr(VI) which was unacceptable for replacement fittings. Today, many of the barriers to substitution have been overcome and, in some cases of 'bright' decorative-chrome plating it is now reasonably practicable to substitute Cr(VI) by Cr(III). Unfortunately, trivalent chemistry cannot currently produce coatings that give corrosion protection above service conditions 3 and 4 (see para 3) but work is currently being undertaken to try and achieve this.

11 In the last few years, there has been increasing regulatory pressures on the use of Cr(VI) by industry. For example, European Directives on End of Life Vehicles (ELVD) and Waste Electrical and Electronic Equipment (WEED) restrict its presence in these products (but this does not preclude chromium metal that is deposited by a Cr(VI) process). As a result, a number of vehicle manufacturers have already removed specifications for hexavalent passivates and chromate pigments.

12 Despite pressure from both HSE and representatives of the industry, many decorative platers have still not made the change. The requirements that are being placed upon Cr(VI) users are such that, those who can substitute probably will. This means that, while Inspectors should enquire why substitution has not taken place, they can concentrate on enforcing the law with respect to control measures, monitoring, health surveillance and so on.

HEALTH INITIATIVES

13 In the UK, the Department of Health has set cancer as one of its four health targets with the aim to reduce cancer deaths in the under 75s by at least a fifth by 2010. This priority was supported by HSE in its Securing Health Together (SHT) programme which has now been incorporated in the FIT3 programme. FIT3 targets also include asthma and skin disease, which makes Cr(VI) used in an industry with poor controls an obvious target to pursue.

14 The Manufacturing Sector and Surface Finishing industry have committed to a concerted effort to reduce the potential for ill-health from the use of Cr(VI). Over 150 Cr(VI) users, industry representatives and HSE staff attended the National Chromium Health Awareness Day at the National Motorcycle Museum in April 2005. They heard speakers outline the issues and the implications of Cr(VI) reclassification and the new Guidance documents were launched.

PROJECT AIMS

15 This project aims to reinforce the messages given to the industry at the National HAD and reduce the risk of cancer, respiratory illness and skin problems. This supports the FIT3 strategic programme, specifically the Disease Reduction element.

OBJECTIVES

16 The main objectives of the project are:

- The Sector will continue to make central interventions with the industry trade bodies that represent chemical manufacturers, suppliers and end users to ensure that the new guidance reaches its target audience.
- Where it is reasonably practicable alternative substances or processes should be used.
- Achieving agreed standards of control, monitoring and health surveillance in plating facilities, as set out in the four new guidance documents will be used as surrogate measures of reduced risk of ill health.

ACTION BY INSPECTORS

17 FOD Inspectors are not being asked to carry out special visits to support this project, as the time has not been allocated in the work plan. But it is essential that Inspectors visiting facilities using hexavalent chromium are aware of the new guidance that has been issued and the standards that users should be meeting to achieve compliance with COSHH.

18 Some chromium plating processes may be subject to the requirements of the Control of Major Accident Hazard (COMAH) Regulations 1999 and, therefore, inspection by HSE's Hazardous Installations Directorate (HID) rather than Field Operations Division (FOD). This number may increase significantly when chromic acid is reclassified (in October 2005) from 'toxic' to 'very toxic'. This is because it only requires 5 tonnes of very toxic substance on site (which includes the total contents of solutions containing greater than 7% of the very toxic substance) to reach the COMAH threshold. The implications are already being discussed with interested parties and further details will be published this year.

19 [Enforcement Management Model \(EMM\)](#) Where it is not reasonably practicable to substitute Cr(VI) in electroplating, ie with Cr(III) or change of process, the Benchmark should be considered as **nil/negligible** likelihood of **serious health effect**. This can be achieved by meeting the standards in GN EH2(rev) **Chromium and its inorganic compounds: health hazards and precautionary measures** and the four new guidance documents. Where the appropriate control measures are not in place and inhalation and dermal exposures are not being adequately controlled, the Actual risk to operators and maintenance staff is a **remote** chance of a **serious health effect** and the Risk Gap **substantial**.

FURTHER READING

20 The following publications contain useful information and can be found on the [Surface Engineering webpages](#) or in Subject Filing:

HSE PUBLICATIONS

EIS 3(rev): **Monitoring requirements in the electroplating industry;**

EIS 4(rev): **Workplace welfare in the electroplating industry;**

EIS 5(rev): **Health surveillance requirements in the electroplating industry;**

EIS 6(rev): **Electrical systems in the electroplating industry;**

[SIM 3/2001/16](#): **Surface Finishing Association Code of Best Practice for the Surface Finishing Industry 2001;**

GN EH 2(rev): **Chromium and its inorganic compounds: health hazards and precautionary measures;**

INDG 346: **Chromium and you;**

MDHS 52/3(rev): **Hexavalent chromium in chromium plating mists;**

HSG 110: **Seven steps to successful substitution of hazardous substances;**

L5(4th edition): **Control of Substances Hazardous to Health Regulations 2002 ACOP and guidance;**

OTHER PUBLICATIONS

[Prevention and control of exposure to chromic acid](#)

[Prevention of exposure and control of chromic acid mist](#)

[Monitoring for electrolytic hexavalent chromium processes](#)

[Health surveillance for hexavalent chromium compounds](#)

Surface Engineering Association (SEA) Technical Guidance: **Trivalent Chromium Plating for a safer workplace & environment (SF 655)**;

[Surface Engineering Association \(SEA\) Code of best practice for the surface finishing industry \(SF 655\)](#);

Metal Finishing Association (MFA) **Safer chromium finishing (SF 655)**;

Metal Finishing Association (MFA) **Chromium Code of Approved Practice: The safe use of chromium compounds in electrolytic plating processes (SF 655)**

CANCELLATION OF INSTRUCTIONS

SIM 03/2003/06 - **cancel** and **destroy**.

FURTHER INFORMATION

21 Further information can be obtained from the project manager, Andrew Lake, Manufacturing Sector (01342 334243).