This sheet provides advice to employers and workers in companies carrying out chromium plating.

Hexavalent chromium in electroplating:

Monitoring for exposure

Introduction

Monitoring for chromium VI using air sampling is required by the Control of Substances Hazardous to Health Regulations (COSHH), which is carried over from the former Chromium Plating Regulations.

Air sampling for chromic acid may not always be suitable because:

- Outdated sampling techniques may be used;
- The procedure can be time consuming and costly:
- Sampling may be inaccurate, particularly when carried out by poorly trained persons;
- Sampling procedures not adhered to (eg adding surfactant immediately before carrying out the test) resulting in the sampling not being representative of normal conditions;
- The use of a dummy cathode may not be properly representative of the real emissions likely to be encountered above a bath.
- Inappropriate methods used (eg. using Draeger tubes which have a detection level which is 20x the Workplace Exposure Limit (WEL[3]));
- The tests may not be carried out every 14 days as required, or infrequently, or at all.

Alternative methods of exposure monitoring are available which can be chosen in place of, or complementary to, ongoing air sampling.

This sheet explains what exposure monitoring means in practice and the options available to the electroplating industry to enable compliance with the law.

What processes are covered by this guidance?

All electrolytic chromium processes except trivalent chromium including:

- hard chrome plating;
- decorative chrome plating (bright and black chrome);
- anodising (though this is not a plating process); and
- some passivation processes.

Chromic acid and chromate solutions are often used in passivation processes, but in most cases passivation is not carried out as an electrolytic process. Where this is the case, it will not attract the specific requirements of Schedule 5 (i.e. for 14 day monitoring) of the COSHH Regulations, although all other requirements for exposure monitoring will still apply.

What the Law says

The COSHH assessment should identify that exposure monitoring is necessary for hexavalent chromium processes. Whilst historically this has been air monitoring for inhalation risks, it has been shown that skin contamination and consequent indirect ingestion also contributes to overall body uptake.

Therefore, Biological Monitoring (BM) is also a readily practical manner in which employers can fulfil the requirement for monitoring (COSHH Regulation 10).

Monitoring is a specific legal requirement (COSHH Schedule 5) every 14 days to confirm that employees are not being exposed to hexavalent chromium in relevant electrolytic processes. HSE have previously agreed with the electroplating industry that there are suitable alternative monitoring techniques which can be used in place of the specific 14 day requirement. This alternative is outlined below.

For more information on COSHH see the Approved Code of Practice and guidance.

Workplace exposure limit (WEL)

Hexavalent chromium compounds have a WEL[3] of 0.05 mg/m3 (8 hour time weighted average (TWA)), measured as chromium. To comply with the requirements of COSHH exposure to these substances should be reduced to as low a level as reasonably practicable below the WEL.

If suitable control measures are properly applied, used and maintained they should be capable of keeping the mist in air substantially below the WEL.

What is exposure monitoring?

Monitoring for hexavalent chromium, for the purposes of Regulation 10 of COSHH, requires the use of valid and suitable occupational hygiene techniques to establish to what extent employees are exposed. For airborne contaminants this measurement will normally involve sampling of the breathing zone of operators using personal sampling equipment but may, where appropriate, involve the periodic or continuous sampling of the atmosphere (above the tank) of the workplace.

This will also include periodic biological testing (eg urine testing) to ascertain if workplace exposures are also occurring through skin absorption and ingestion as well as via inhalation.

Exposure monitoring may initially be required to estimate employees' exposure to hexavalent chromium during the course of their work, for the purposes of risk assessment. Monitoring can also involve ongoing tests of the operating environment to ensure that existing controls are operating effectively and that employees are adequately protected.

There are different ways the required monitoring can be achieved. These are discussed below.

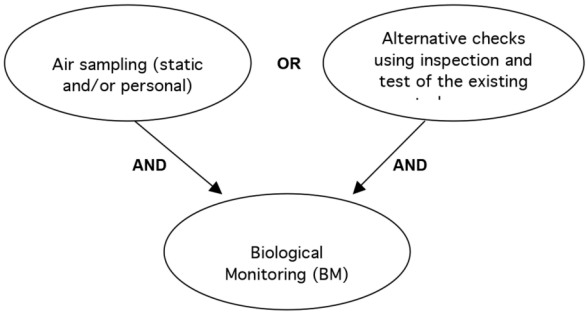
When is monitoring required?

Monitoring is required when any of the following circumstances apply:

- when failure or deterioration of control could create a serious risk to health (either because of toxicity or the extent of exposure, or both);
- when necessary to ensure that the WEL is not exceeded
- when necessary to ensure that any lower in-house working standards are not exceeded;
- as an additional check on the effectiveness of controls provided under regulation 7 and Schedule 5 of COSHH (always in the case of chromium every 14 days)
- where any significant changes occur in the process which could result in adequate control no longer being maintained

For ***non-electrolytic*** processes monitoring is not required every 14 days. The periods between sampling should be considered and determined in the COSHH assessment and reviewed as necessary.

What type of monitoring is required?



Air sampling for chromic acid mist

Initial air sampling should be carried out under worst-case conditions (highest current, longest plating time etc.) to establish the benchmark control measures. The benchmark criteria, including the surface tension, freeboard distance (measured between the level of electrolyte and the top of the tank) and average capture velocity (taken at the slot opening in the lip extraction) will need to be measured and recorded.

A sufficient number of air samples should be taken to establish a reliable benchmark of exposure under worst case conditions. If the amount of mist emitted from the tank is below the WEL it is likely that adequate inhalation control is being achieved at the time of the sampling. Sampling has shown inhalation exposures at the tank sides are approximately one tenth of the measurements taken above the bath.

If the control measures are maintained at the same or a better level than when initially established the employer can be reasonably confident that emissions from the bath are being adequately controlled. The fortnightly air sampling should confirm this.

Important note: If the plating process has not been run for more than 14 days, the appropriate air sampling and LEV checks must be carried out as soon as it is brought back into use.

Sampling must only be undertaken by competent persons. A half day training session on the air sampling technique would normally be required for in-house staff.

The latest sampling and analytical procedure for chromic acid mist is contained in MDHS 52/3; Hexavalent chromium in chromium plating mists. This should be used for all personal sampling (as well as static sampling).You should confirm with the laboratory the necessary sensitivity of your proposed monitoring.

Each workplace air sampling position should be clearly identified and the operational parameters present recorded for each air sample taken. Any result higher than the identified benchmark level should be further investigated and remedial action taken. Where spray suppressants are used you should check if appropriate additions have been made and maintained.

Where static sampling results are representative of identifiable employees' exposure a record must be made and kept available for at least 40 years. Otherwise records must be kept for at least 5 years.

All records should be kept to show long-term trends and the efficiency of any control measures. Monitoring records for each air sampling position must be retained for at least five years.

For more information on monitoring strategies see HSE Guidance Note HSG173 Monitoring strategies for toxic substances.

An alternative approach to air monitoring

An alternative monitoring approach was developed with industry using measuring variables such as the face velocity of the extract ventilation, freeboard, and the surfactant levels which are controlling exposure. This approach to exposure monitoring is considered to comply with the requirements of Regulation 10(2) and Schedule 5 of COSHH.

Benchmark data must be taken to validate this alternative method. You should:

- Undertake initial air sampling under worse case conditions:
  - highest current density,
  - longest plating time
  - greatest chromic acid concentrate
  - greatest electrolyte displacement (least freeboard)
- Determine and measure critical control parameters including
  - measurement of freeboard
  - extract ventilation performance (using anemometers etc)
  - surface tension (for surfactant concentration – eg PFOS) using tensiometers

This will determine the optimum control measures required for the levels to be substantially below the WEL, and as low as is reasonably practicable. Further sampling and measurement of the critical parameters will be necessary if changes occur. Provided that these measures and concentration are maintained at the same level (or under) than when initially established, there is reasonably confidence that emissions from the bath are being adequately controlled.

Biological Monitoring (BM)

Skin absorption and/or ingestion are also significant exposure routes into the body (see Health and Safety Laboratory Research Report RR963 Exposure to hexavalent chromium, nickel and cadmium compounds in the electroplating industry). This affects both platers and other persons working with chromium (eg chemists, jiggers and maintenance personnel).

All persons who have potentially significant exposure to chromium should undergo BM.

BM is in addition to the requirements for either air sampling or the alternative approach to monitoring detailed above.

Undertaking BM

Urine samples should be collected at the end of a work shift and analysed for total chromium.

The Biological Monitoring Guidance Value (BMGV) for hexavalent chromium is 10µmol/mol creatinine. This is an occupational hygiene-based guidance value and it does not provide any evidence of ill health. It does show if there has been recent exposure to hexavalent chromium. Levels found in the general population are generally below 3µmol/mol creatinine.

If BM results show elevated levels of chromium (especially above the BMGV) an investigation of exposure and the control measures already in place should commence.

BM does not show the route of exposure (i.e. inhalation, ingestion or absorption through the skin) only that exposure has occurred. In most cases control measure failures are readily identified and corrective action can be taken.

Subsequent further BM should be arranged to ensure that exposure has been reduced by the corrective action.

The frequency of urine samples for workers exposed to hexavalent chromium should typically be once per year. Care should be taken to ensure that any BM sampling is representative of the worker's typical workload.

For new starters working with chromium an initial BM sample should be taken. The BM test results may show previous exposure of individuals to metallic chromium from processes such as grinding, fettling and welding. This initial sample should be taken in the first two months, and again at six months. Elevated levels should be investigated. Once levels are comparable with other workers yearly BM samples should be taken.

To ensure that results are interpreted correctly and appropriate remedial action is taken you should ensure that suitable explanatory information is provided by the laboratory or occupational health service provider administering the scheme.

For more information on setting up a biological monitoring scheme see HSE guidance note HSG167 Biological monitoring in the workplace.

Records

Employers should keep a suitable record or summary of any exposure monitoring carried out under COSHH. Monitoring records can be kept in any format as long as they are readily retrievable, easy to understand and compatible with the health records required by regulation 11 of COSHH.

Monitoring records should provide sufficient information to determine:

- when, where and under what conditions monitoring took place;
- what monitoring procedures were used, and how long they took;
- whose exposure was monitored; and
- what the results were.

Monitoring records should be made available to:

- employees and their representatives;
- enforcing inspectors; and
- Medical Inspectors or appointed doctors.

Records should be kept for at least 40 years if they record the personal exposure of identifiable employees (eg personal air sampling or BM) or they are representative of personal exposures. They should be kept for at least 5 years in all other cases.

Further Information and references

1 **Health and Safety Laboratory Research Report RR963**
Exposure to hexavalent chromium, nickel and cadmium compounds in the electroplating industry

2 **Approved Code of Practice L5**
COSHH Approved Code of Practice 6th Edition

3 **HSE guidance note EH40/98**
Workplace exposure limits

4 **HSE Guidance Notes HSG173**
Monitoring strategies for toxic substances and HSG167 Biological monitoring in the workplace

5 **HSE guidance note HSG137**
Health risk management - A practical guide for managers in small and medium sized enterprises

6 **HSE leaflet**
Chromium and You - Working with chromium - Are you at risk?

7 **MDHS 52/3**
Hexavalent chromium in chromium plating mists 1998

8 **MDHS 14/4**
General methods for sampling and gravimetric analysis of respirable and inhalable dust 2014

9 **Joint SEA/HSE guidance sheet**
Prevention of Exposure to Hexavalent Chromium and Control of Chromic Acid Mist

10 **Joint SEA/HSE guidance sheet**
Prevention and Control of Skin Exposure Risks from Chromic Acid in the Electroplating industry

11 **Joint SEA/HSE guidance sheet**
Nickel and Nickel Alloy Plating Operations: Controlling the Risk of Skin Exposure

12 **Joint SEA/HSE guidance sheet**
Nickel and Nickel Alloy Plating Operations: Controlling the Risk of Inhaling Mist Containing Nickel

SEA SURFACE ENGINEERING ASSOCIATION

Federation House 10 Vyse Street Birmingham West Midlands B18 6LT

T: +44 (0)121 237 1123 F: +44 (0)121 237 1124 E: info@sea.org.uk W: www.sea.org.uk

twitter follow us @uk_SEA facebook LinkedIn Surface Engineering Association