CHEMICAL SAFETY REPORT

Sections 9 & 10

Legal name of applicant(s):	Edbro Hydraulics Limited I Holland Ltd Precision Products Ltd Riverside Gravure Ltd Rotometrics International Spline Gauges Ltd
Submitted by:	Surface Engineering Association Chromium Trioxide Authorisation Consortium
Substance:	Chromium Trioxide EC: 215-607-8 CAS: 1333-82-0
Use title:	Use of chromium trioxide for the hard (functional / engineering) chromium electroplating of engineering components with the purpose of creating a coating to meet specific performance characteristics.
Use number:	1

Table of Contents

9 Exposure Assessment (and related risk characterisation)

10. Risk characterisation related to combined Exposure

Tables

Abbreviations

BAT	Best Available Techniques
BMGV	Biological Monitoring Guidance Value
CSR	Chemical Safety Report
DF	Dilution Factor
DNEL	Derived No Effect Level
DWF	Dry Weather Flow
ETP	Effluent Treatment Plant
LEV	Local Exhaust Ventilation
PPE	Personal Protective Equipment
RMM	Risk Management Measures
TWA	Time-weighted Average
WCS	Worker Contributing Scenario
WEL	Workplace Exposure Limit
WWTW	Wastewater Treatment Works

9. EXPOSURE ASSESSMENT (and related risk characterisation)

9.1 Introduction

This exposure assessment is part of the applications for authorisation for the continued use of chromium trioxide (CAS 1333-82- 0, EC: 215-607-8) in specific hard (functional / engineering) chromium plating applications where a set of performance requirements must be met. The companies involved in this application all carry out hard chromium electroplating operations in-house (alongside their component manufacturing operations) This report has been compiled by the Surface Engineering Association Chromium Trioxide Authorisation Consortium (SEACTAC) on behalf of and in conjunction with the applicants. According to Article 62 (4) (d) of the REACH Regulation, CSR in AfA should cover the risks to human health and / or the environment arising from the intrinsic properties specified in Annex XIV, therefore this CSR focuses on carcinogenicity and mutagenicity endpoints.

In particular, the risk assessment performed by SEACTAC took into account the information and the dose-response relationship provided by the risk assessment committee (RAC) in the document "Application for Authorization: Establishing a reference dose response relationship for carcinogenicity of hexavalent chromium "(RAC / 27/2013/06 Rev. 1 Final)[1].

In this document, RAC confirmed that it is not possible to determine a "derived no-effect level" for the carcinogenic properties of chromium trioxide and therefore Chromium Trioxide should be considered as non-threshold substance for the purposes of Article 60 (3) (a) of the REACH Regulation, as a result, according to Article 60 (4) of the REACH Regulation, demonstrating adequate control is not possible and the SEA route is applicable.

This assessment is focused mainly on the Annex XIV properties (Carcinogenic (category 1A) Mutagenic (category 1B)) but an assessment of environmental exposure and consequent assessment of man via the environment has also been carried out to establish any potential exposure levels to the general population.

9.1.1. Overview of uses and Exposure Scenarios

Tonnage information:

The total tonnage used by all the members of this application is between 16 to 20 tonnes per annum. The members are micro, small and medium sized business for the purpose of REACH authorisation applications and full details of company sizes are included with this application for authorisation. All of the members are located in the UK and are members of the Surface Engineering Association

The following table lists all the exposure scenarios (ES) assessed in this CSR.

Table 1 Overview of Contributing Scenarios

Contributing scenario	ERC / PROC	Name of the contributing scenario	Size of the exposed population
ES 1:			
ECS1		Use at an Industrial Site - Use of chromium trioxide for the	All Local Size of exposed

		electroplating of engineering components with the purpose of creating a coating to provide specific performance characteristics	population is for all sites combined
WCS 1	PROC 1	Receipt & storage of chromium trioxide	6
WCS 2	PROC 4	Loading / unloading jigs	18
WCS 3	PROC 13	Operating the electroplating line	18
WCS 4	PROC 8b	Sampling the electroplating solution	6
WCS 5	PROC 8b	Making additions of chromium trioxide	6
WCS 6		Maintenance activities	6
WCS 7	PROC 28	Wastewater / effluent treatment	6

Please not that the majority of these tasks will be undertaken by the same workers.

Further details on each activity are as follows:

WCS 1- Receipt, transfer and storage of Chromium Trioxide

The chromium trioxide to be used in the chromium plating tank arrives in the company in hermetically sealed steel drums of 25 kg or 50kg each, and the chromium trioxide has the appearance of dark red flakes. Upon receipt, checks are carried out to ensure the goods are in accordance with the purchase order but the drums are not opened. Upon successful completion of the checks, the drums are moved by a worker to a dedicated area in the raw material storage area. Access to this area is controlled and only approved employees are allowed access.

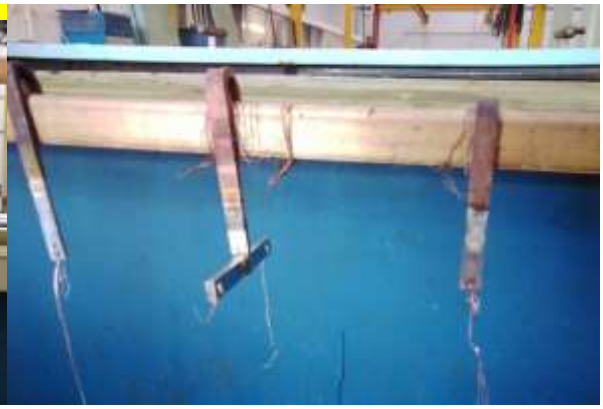
Typical raw material store

WCS 2 - Loading/unloading of jigs

Before being transferred to the electroplating process line, the components are loaded onto specially designed jigs or attached by copper wire to specially designed frames. The components then pass through the electroplating process.

On completion of the electroplating process, the jigs / frames are then unloaded and the components are ready for quality control checks.

Typical Plating Jig with component



Typical Plating Jigs

WCS3 – Operation of electroplating process line

If the process plant is manual, the electroplater will follow the entire electroplating process of the components, loading the jigs into the process tanks according to the process schedule and specification.

If the process plant is automatic, there is very little direct involvement of the workers.

Essentially they just check the correct operation of the plant using the control monitor and performing occasional visual checks on the tanks (tank level monitoring, pumps, pipes).

WCS4 – Sampling the electroplating solution

To monitor the quality of the process, periodic checks are carried out in either external laboratories or the companies own laboratory to check that the electroplating solution is within the specified operating parameters.

WCS5 – Making additions of chromium trioxide

When the result of samples analysis shows a need for additions to the electroplating solution, suitably trained and qualified employees will make additions of chromium trioxide to the electroplating solution to ensure that the optimal concentration of chromium trioxide is maintained.

WCS6 - Maintenance

In accordance with the operating procedures of the site periodic maintenance activities are carried out on the electroplating process line and wastewater treatment plant.

WCS7 – Wastewater and effluent treatment

Wastewater from the rinsing stages of the chromium electroplating will either be stored for disposal by registered waste handlers or reduced to the trivalent form of chromium in an effluent treatment plant before discharge to a further water treatment plant via the foul sewer. Companies that discharge wastewater operate under a consent to discharge from their local water company. The effluent treatment plant will produce a sludge, but this will not contain any chromium trioxide as it has been fully reduced during the effluent treatment process.

Waste rinse water containing Chromium Trioxide is typically treated in 2 stages. Stage 1 changes hexavalent chromium (Cr^{+6}) to trivalent chromium (Cr^{+3}). Trivalent chromium freely bonds to hydroxide in Stage 2 of the treatment process. The final result is a precipitate: chromium hydroxide $Cr(OH)_3$.
Hexavalent Chromium Reduction (Stage 1)

The most common treatment method for reducing hexavalent chromium to trivalent chromium is by using chemical reducing agents such as sulphur dioxide (SO_2), sodium bisulphite ($NaHSO_3$) or sodium meta-bisulphite ($Na_2S_2O_5$). This reaction will progress rapidly at a pH of between 2 and 3.
Precipitation of Chromium Hydroxide (Stage Two)
Once the first stage reaction is complete, calcium hydroxide, $Ca(OH)_2$, (lime), must be added to the wastewater to promote precipitation of chromium hydroxide. The precipitate can be easily separated and disposed of. This precipitation takes place at a pH of 8 and above.

For the tasks undertaken in this application the frequency, mix and durations are entirely dependent upon the particular workpieces being processed on any working day.
As the physical size and/or coating thicknesses being applied are infinitely variable and the areas being coated on the workpiece can vary, there are different time periods spent on each of the Contributing Scenarios each day. E.g. WCS2 (Loading/Unloading Jigs) this scenario includes the process of masking any areas not to be coated which can take just a few minutes to a number of hours.
WCS3 (Operating the Process) can vary, dependent upon the coating thickness and number of batches processed in a working day. This could be 5-6 batches within an 8 hour period or 1 piece being processed over 2 or 3 days continuously – where the operator would check the component 1, possibly 2, times in an 8 hour period.
While not 'actually' performing WCS3, the operator will be within the vicinity of the process while carrying out any of the other WCS's detailed.
For this reason, the Applicants take the conservative approach that, it is the overall exposure values recorded in the Personal Air Monitoring reports that are used and that exposure time is assumed as 8 hours i.e. no task specific reductions applied.

9.1.1.1 Risk Management Measures and Operational Controls

There have been regulations in place in the UK regarding the use of chromium trioxide in chromium electroplating operations since 1931. These were amended in 1973 and then revoked by the issue of the Control of Hazardous Substances regulations in 1988. There has also been joint Health & Safety Executive and Surface Engineering Association guidance on best practice in place for many years and these will be revised following the conclusion of the application for authorisation.

Many educational events have taken place, again over many years, such as the 2005 National Health Awareness Day for the UK Chromium Plating Industry and the Disease Reduction Programme focussing on workplace cancers which began in 2008.

The UK has been at the forefront of the control of the potential risks during chromium electroplating from the use of chromium trioxide. The UK's approach of risk management rather than complete risk removal (leading to processes being carried in countries with less stringent or even no real controls) means that chromium trioxide can be used safely in electroplating processes with exposures similar to background levels.

Here is a list of the risk management measures and operational controls that are in operation at the sites that are covered by this particular application.

1 – Workplace & Employee Exposure

2 – Training

3 – Suitable PPE

4 – Mist Suppressants / extraction

5 – Wastewater treatment

6 – Waste disposal

7 – Regular maintenance

8 – Management Systems

9.1.2. Introduction to the assessment

9.1.2.1. Environment

The quantities of chromium trioxide used are between 10 and 20 tonnes per annum (total) across all 6 sites (companies) detailed within this group. There are releases to atmosphere from all of the sites as there is LEV (extraction) in use but there are no releases to watercourses. All chromium trioxide waste is treated on-site by chemical reduction before disposal via sewer to the local WWTW or, disposed for treatment off-site using registered waste contractors. Once the components have been coated, there is no residual chromium trioxide and so, there is no potential for health impacts during use of the finished articles.

Scope and type of assessment:

Where applicable, waste effluent monitoring is carried out by the relevant Water Authority via site sampling of discharge to Foul Sewer transfer to the local WWTW where it is further diluted before onward discharge.

9.1.2.2. Human via environment

All the Applicants utilise LEV (Extraction) to aid in the control of the workplace atmosphere. As a result, there is discharge of chromium trioxide to the atmosphere which is measured by specialist companies. These measurements are used to assess the potential impact on the local population.

The emissions will be in droplet form which will be dispersed by the prevailing wind and will eventually fall to ground influenced by gravity. According to the UK Health Security Agency guidance document – Chromium: toxicological overview[4], the releases of chromium (VI) from any source are expected to be reduced via abiotic and biotic processes to chromium (III) in most situations in the environment, and the impact of the chromium (VI) form is therefore likely to be limited to the area around an exposure source.

This report will assume a potential dispersal area of 1 Kilometre radius from the source (producing site) and use population data from "Data Devil" (population radius tool) and map coordinates (from Streetmap.co.uk) for each source.

9.1.2.3. Workers

Scope and type of assessment:

The worker exposure via inhalation for all WCS are assessed using the results of the regular chromic acid mist tests, personal air sampling and (where possible) biological monitoring of the worker. In most cases, the air sampling is carried out by specialist companies and analysed off site.

Air-monitoring samples were collected by drawing a measured volume of air through prepared filter media in accordance with the requirement of MDHS 52/4[2] and using the WEL's detailed in EH 40/2005:2020[3].

For the chromic acid mist tests, the Sampling Head is positioned 300mm above the solution, the process covers (enclosure) or extraction level surface and for the personal air samples, the sampling head is positioned within the workers breathing zone.

Table 3: Chromium trioxide concentration measured during plating (mist test) – geometric mean from past 5 years (where available)

Company (site)	Sample Type	Airborne level of chromium trioxide (mg/m^3) Geometric Mean value	Total number of data reported for GM calculation
Edbro Hydraulics Ltd	Mist test (MDHS52/4)	[redacted]	116
I Holland Ltd	Mist test (MDHS52/4)	[redacted]	58
Precision Products (UK) Ltd	Mist test (MDHS52/4)	[redacted]	120
Riverside Gravure Ltd	Mist test (MDHS52/4)	[redacted]	68
Rotometrics International Ltd	Mist test (MDHS52/4)	[redacted]	40
Spline Gauges Ltd	Mist test (MDHS52/4)	[redacted]	115

Table 4: Chromium in Workers' Breathing zone (TWA) – "worst case" results

Company (site)	Sample Type	Airborne level of chromium trioxide (µg/m^3 8hr TWA) *highest reported value	TWA values corrected for frequency (µg/m^3 8hr TWA)
Edbro Hydraulics Ltd	Personal Air	[redacted]	No correction
I Holland Ltd	Personal Air	[redacted]	No correction
Precision Products (UK) Ltd	Personal Air	[redacted]	No correction
Riverside Gravure Ltd	Personal Air	[redacted]	No correction
Rotometrics International Ltd	Personal Air	[redacted]	No correction
Spline Gauges Ltd	Personal Air	[redacted]	No correction

Table 5: Biological monitoring (chrome in urine). Results assumed as 100% chromium trioxide.

Company (site)	Sample Type	Chromium in Urine * (highest since 2021)
Edbro Hydraulics Ltd	Biological Monitoring	[redacted]
I Holland Ltd	Biological Monitoring	[redacted]
Precision Products (UK) Ltd	Biological Monitoring	[redacted]
Riverside Gravure Ltd	Biological Monitoring	[redacted]
Rotometrics International Ltd	Biological Monitoring	[redacted]
Spline Gauges Ltd	Biological Monitoring	[redacted]

Notes:

*UK Biological Monitoring Guidance Value (BMGV) is 10µmol/mol (creatinine) with unexposed level being 2.9µmol/mol (creatinine).

**Measurements below the unexposed (general public) level

***measurements below BMGV

Comments on assessment approach related to toxicological hazard:

The assessment approach uses measured data from each of the sites within this group but, the low frequency and low volume of chromium trioxide additions and the relative proximity of the Worker to the plating process tanks during operation; the only viable data to assess exposure is the mist test and personal air sample results.

Some sites also collect biological monitoring data in order to assess exposure via all potential routes i.e., inhalation, ingestion and dermal contact absorption. This measure indicates "total chrome" but cannot distinguish between the valent states and is, therefore, an indicator only of control measure efficacy.

Comments on assessment approach related to physicochemical hazard:

Chromium Trioxide is classified as a Category 1 carcinogen (R45: 'May cause cancer') and, as such, does not have any Derived No Effect Limit (DNEL). Therefore, WEL and BMGV values (where available) are used as benchmarks for controls.

General information on risk management related to toxicological hazard:

The conditions of use detailed within this CSR (sections 9.2.1 to 9.2.7.) specify that all handling of the substance by the Worker should be done while wearing appropriate PPE relative to the task.

General information on risk management related to physicochemical hazard:

The conditions of storage, use & handling of the substance are detailed within this CSR under sections 9.2.1 to 9.2.7 and are utilised as the RMM's.

9.1.2.4. Consumers

There is no exposure to consumers from the use of chromium trioxide in accordance with this application for Authorisation.

There are no releases of chromium trioxide on any of the finished components from any of the group sites therefore the process operations involving chromium trioxide make no contribution to this potential route of human exposure.

9.2. Exposure scenario 1 for workers

9.2.1. Worker contributing scenario 1

This contributing scenario covers potential exposure during receipt of bulk raw materials and transfer to secure storage area.

9.2.1.1. Conditions of use

	Method
Product (article) characteristics	
▪ Sealed container containing dry flake/granule form comprising >99.8% Chromium Trioxide.	
Amount used (or contained in articles), frequency and duration of use/exposure	
▪ 25Kg container. Average 4x per annum. No exposure as sealed container.	

	Method
Technical and organisational conditions and measures	
▪ Keep sealed in original container. Transfer to store location.	
Conditions and measures related to personal protection, hygiene and health evaluation	
▪ Wear chemically resistant gloves, coverall, eye protection in case of accidental spillage.	
Other conditions affecting workers exposure	
▪ n/a	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
▪ use mechanical aids for movement and lifting where possible.	

9.2.2. Worker contributing scenario 2

This contributing scenario covers the potential exposure to chromic acid during the loading and unloading of components to/from Jigs or wires in preparation for the plating process/final inspection.

9.2.2.1. Conditions of use

	Method
Product (article) characteristics	
▪ Components contaminated with chromic acid (25% chromium trioxide) trapped in features.	
Amount used (or contained in articles), frequency and duration of use/exposure	
▪ Very small amount (unquantified)	
Technical and organisational conditions and measures	
▪ Rinsing jigs & components is the final stage in the plating process.	
Conditions and measures related to personal protection, hygiene and health evaluation	
▪ Wear chemically resistant gloves, coverall, eye protection in combination with specific employee training.	
Other conditions affecting workers exposure	
▪ Use of hand tools for jigging/unjigging	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
▪ Specific training when working with chromium trioxide.	

9.2.3. Worker contributing scenario 3

This contributing scenario covers the potential exposure to chromic acid during the plating operation either via surface contamination or airborne mist.

9.2.3.1. Conditions of use

	Method
Product (article) characteristics	
▪ Chromic acid containing approximately 25% chromium trioxide.	
Amount used (or contained in articles), frequency and duration of use/exposure	
▪ Automated or enclosed plating lines restrict worker access to operational tanks and LEV (Extraction) results in reduced potential airborne mist exposure.	

	Method
Technical and organisational conditions and measures	
▪ Physical barriers on automated lines. ▪ Extraction / local exhaust ventilation	
Conditions and measures related to personal protection, hygiene and health evaluation	
▪ Wear chemically resistant gloves, coverall, eye protection in combination with specific employee training.	
Other conditions affecting workers exposure	
▪ n/a	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
▪ Specific training when working with chromium trioxide.	

9.2.4. Worker contributing scenario 4

This contributing scenario covers the potential exposure to chromic acid while taking samples for analysis which is normally done by Suppliers' own Service Chemist or Third-party specialist.

9.2.4.1. Conditions of use

	Method
Product (article) characteristics	
▪ Chromic acid (25% chromium trioxide)	
Amount used (or contained in articles), frequency and duration of use/exposure	
▪ 100ml per tank typically once per month.	
Technical and organisational conditions and measures	
▪ Seal sample jar and thoroughly rinse before removing from the plating line.	
Conditions and measures related to personal protection, hygiene and health evaluation	
▪ Wear chemically resistant gloves, coverall, eye protection in combination with specific employee training.	
Other conditions affecting workers exposure	
▪ n/a	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
▪ avoid repetitive handling (decanting) to keep exposure to a minimum. ▪ Specific training when working with chromium trioxide.	

9.2.5. Worker contributing scenario 5.

This contributing scenario covers the potential exposure to chromium trioxide during the addition of chromium trioxide flakes to the plating solution.

9.2.5.1. Conditions of use

	Method
Product (article) characteristics	
▪ Dry flake/granule form containing >99.8% Chromium Trioxide or pre-mixed aqueous solution containing >50% Chromium Trioxide	
Amount used (or contained in articles), frequency and duration of use/exposure	
▪ 55Kg per week average	

	Method
▪ Short term exposure (typically once per 4 weeks, 20 minutes total)	
Technical and organisational conditions and measures	
▪ Keep sealed in original container, in specified area when not in use	
Conditions and measures related to personal protection, hygiene and health evaluation	
▪ Wear chemically resistant gloves, coverall, eye protection and particulate filter mask in combination with specific employee training.	
Other conditions affecting workers exposure	
▪ n/a	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
▪ avoid repetitive handling (decanting) to keep dust exposure to a minimum. ▪ Wash empty container and re-seal prior to disposal according to local regulations. ▪ Specific training when working with chromium trioxide.	

9.2.6. Worker contributing scenario 6.

This contributing scenario covers the potential exposure to chromic acid (chromium trioxide) during maintenance of equipment on the plating line.

9.2.6.1. Conditions of use

	Method
Product (article) characteristics	
▪ Chromic acid (25% chromium trioxide)	
Amount used (or contained in articles), frequency and duration of use/exposure	
▪ Occasional exposure subject to requirements	
Technical and organisational conditions and measures	
▪ Plating process must be stopped before any maintenance commences. ▪ All parts/surfaces (including surrounding) to be rinsed with low pressure water.	
Conditions and measures related to personal protection, hygiene and health evaluation	
▪ Wear chemically resistant gloves, coverall, eye protection in combination with specific employee training. Appropriate RPE if required.	
Other conditions affecting workers exposure	
▪ Confined spaces	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
▪ Parts replaced should be cleaned prior to disposal. ▪ Specific training when working with chromium trioxide.	

9.2.7. Worker contributing scenario 7.

This contributing scenario covers the potential exposure to chromic acid flowing to the Effluent Treatment Plant (ETP) during the treatment of wastewater (contaminated) from the rinsing process (tank/spray).

9.2.7.1. Conditions of use

	Method
Product (article) characteristics	
▪ Chromic acid (up to 25% chromium trioxide).	
Amount used (or contained in articles), frequency and duration of use/exposure	
▪ ~14Kg per year, diluted by 3,543,000 litres water. Flows through to ETP.	
Technical and organisational conditions and measures	
▪ Reduced to trivalent chromium by adding sodium metabisulphite in effluent treatment plant.	
Conditions and measures related to personal protection, hygiene and health evaluation	
▪ Wear chemically resistant gloves, coverall, eye protection in combination with specific employee training.	
Other conditions affecting workers exposure	
▪ n/a	
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply	
▪ avoid repetitive handling (decanting) to keep exposure to a minimum. ▪ Specific training when working with chromium trioxide.	

9.3 Combined exposure for all WCS

It is assumed that there is potential for exposure to chromium trioxide from all 7 worker contributing scenarios.

Chromium trioxide is bio-accumulative and exposure potential is via inhalation, ingestion and/or dermal absorption. Results from the regulated monitoring methods of mist testing and personal air sampling all show that the RMM's are effective in maintaining exposures to levels below the WEL for chromium trioxide from both the process generated and TWA measures.

Where biological monitoring is conducted, these results also demonstrate that the RMM's are effective and that most of the results are significantly below the BMGV of 10µmol/mol (creatinine) and with a number of these being below the "un-exposed" level of 2.9µmol/mol (creatinine).

10. RISK CHARACTERISATION RELATED TO COMBINED EXPOSURE

10.1. Human health (related to combined, shift-long exposure)

10.1.1. Workers

Table 6: Combined exposure and risk characterisation

Contributing scenario	Route of exposure	8h TWA exposure values, corrected for PPE and frequency	WEL (EH40/2005 - 4th Edition 2020) (8-hr TWA reference period)	Excess risk factor (from CSR)
*WCS 1-7	Inhalation	<18.8µg/m^{3**}	0.025mg/m^3 (25µg/m^3)	0.014

* WCSs that may be performed by the same worker/s within one shift

** **Detailed in Table 4**

10.1.2. Consumers

Exposure and risk characterisation

There is no exposure to consumers from the use of chromium trioxide in accordance with this application for Authorisation. There is no chromium trioxide present in the electroplated components.

10.2. Environment (combined for all emission sources)

There are minimal emissions to air as some of the Group Companies use LEV on their chromium trioxide plating tanks. The extracted air passes through scrubbers / abatement before being exhausted to the environment.

There are no emissions to ground as all Group Companies facilities are effectively maintained and bunded.

There are no emissions to Surface Water.

All waste solutions from the process are reduced to the Trivalent state (CrIII) within the on-site ETP or collected by licensed waste treatment contractors to be reduced to CrIII before disposal to landfill.

Liquid discharged to foul sewer and transmitted to the local WWTW is sampled and typical analysis results show chromium (total) to be in the range of 0.03mg/l to 0.66mg/l. This is well below the BAT standard of 1.0mg/l chromium (total).

As these discharges are via foul sewer to WWTW, where it is further diluted prior to discharge to surface water from the WWTW, the 'final' concentration of chromium discharged to surface water is further reduced.

As an example, one of the applicants holds consent to discharge 15m^3/day which flows to the local WWTW that has a DWF of 91,500m^3/day. This is typical of the members of the consortium who hold consents to discharge

Therefore the minimum DF is 91,500/15 = 6100:1 or 0.66/6100 = 1.082x10^{-4} mg/l.

This means that if we assume the discharge to sewer is CrVI, rather than chromium (total), then the DF of $1.082x10^{-4}$ is a factor of 1000 times lower than the BAT standard of 0.1mg/l during DWF.

11. REFERENCES

1. Application for Authorisation: Establishing a reference dose response relationship for the carcinogenicity of hexavalent chromium. Published by the Risk Assessment Committee of the European Chemicals Agency – RAC/27/2013/06 Rev. Final
2. MDHS 52/4 – Hexavalent chromium in chromium plating mists. Published by the Health & Safety Executive 11/2014
3. EH40/2005 – Workplace Exposure Limits (Fourth edition). Published by The Stationery Office ISBN 978 0 7176 6733 8
4. Chromium: toxicological overview. Published by the UK Health Security Agency