CHEMICAL SAFETY REPORT

Public

May 2026

Legal name of applicant:	Rimex Metals (UK) Ltd.
Substance:	Chromium trioxide CAS number: 1333-82-0; EC number: 215-607-8 (Annex XIV entry number: 16)
Uses title:	Use of chromium trioxide as an oxidising and hardening agent in the manufacture of coloured stainless steel
Uses number:	1

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List of Abbreviations

ACH	Air Changes per Hour
AfA	Application for Authorization
AFP	Anti Finger Print
APF	Assigned Protection Factor
ART	Advanced REACH Tool
CSA	Chemical Safety Assessment
CSR	Chemical Safety Report
ECS	Environmental Contributing Scenario
E.O.L.	End of Line
ERC	Environmental Release Category
ES	Exposure Scenario
EUSES	European Union System for the Evaluation of Substances
LEV	Local Exhaust Ventilation
LOAEL	Lowest Observed Adverse Effect Level
LOD	Limit of Detection
LOQ	Limit of Quantification
Min	Minutes
NOAEL	No Observed Adverse Effect Level
NTP	National Toxicology Program
OEL	Occupational Exposure Limit
PEC	Predicted Environmental Concentration
PPE	Personal Protective Equipment
PROC	Process Category
RAC	Committee of Risk Assessment
REACH	Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)
RMM	Risk Management Measure
RPE	Respiratory Protective Equipment
SEG	Similar Exposure Group
SpERC	Specific Environmental Release Category
TWA	Time Weighted Average
WCS	Worker Contributing Scenario

Part A

1. SUMMARY OF RISK MANAGEMENT MEASURES

The risk management measures implemented for the use applied for are documented in detail in the exposure scenario in Chapter 9 of this CSR.

2. DECLARATION THAT RISK MANAGEMENT MEASURES ARE IMPLEMENTED

We declare that the risk management measures described in the exposure scenario in Chapter 9 are implemented at the site of use of chromium (VI) trioxide.

3. DECLARATION THAT RISK MANAGEMENT MEASURES ARE COMMUNICATED

As a downstream user of chromium (VI) trioxide the applicant does not put on the market the substance and therefore no risk management measures are to be communicated.

Part B

This review report uses the dose-response relationship established by the ECHA Committee on Risk Assessment (RAC) (see below). In this case, Chapters 1-8 of the CSR do not need to be provided as described in the ECHA document ‘How to apply for authorisation’ (ECHA, 2021). Relevant physico-chemical and environmental fate data used for modelling are taken from the literature as documented in section 9.1.1.4.

9. EXPOSURE ASSESSMENT (AND RELATED RISK CHARACTERISATION)

9.1 Introduction

9.1.1 Introduction to the assessment

9.1.1.1 Relationship to previous application

This review report is for Use 1: "Use of chromium trioxide as an oxidising and hardening agent in the manufacture of coloured stainless steel". It was prepared on behalf of Rimex Metals (UK) Ltd. and is based on site-specific knowledge provided by Rimex Metals (UK) Ltd. for its site in Enfield/UK..

This CSR refers to the initial EU application ID: 0056-01 / EU Authorisation number: REACH/17/12/0, which has been grandfathered from EU REACH to UK REACH (UK Authorisation number: 02UKREACH/17/12/0).

9.1.1.2 Classification of the substance

Chromium trioxide has been included in Annex XIV of Regulation (EC) No 1907/2006 (EU REACH) due to its carcinogenic and mutagenic properties as it is classified as carcinogenic (Cat. 1A) and mutagenic (Cat. 1B). According to Article 62 (4)(d) of this Regulation, the chemical safety report (CSR) supporting an Application for Authorisation (AfA) needs to cover only those risks arising from the intrinsic properties specified in Annex XIV. Therefore, only the human health risks related to the classification of the chromate as carcinogenic are addressed in this CSR. As mutagenicity is a mode of action expected to contribute to carcinogenicity mutagenic risk can be considered to be included in the assessment of carcinogenic risk and low risks for mutagenicity are expected for exposures associated with low carcinogenic risks. Therefore, carcinogenicity is regarded as the most critical endpoint for risk assessment and in the following only the carcinogenic risk of chromium trioxide exposure will be considered. This requires investigating the potential exposure of workers as well as exposure of humans via the environment.

9.1.1.3 Exposure-risk relationships (ERRs) for carcinogenic effects used for the assessment

The exposure-risk relationship presented by ECHA (2013) is used for calculating risks associated with the use of chromium trioxide covered by this application. The risk characterisation for workers is solely based on inhalation exposure and the risk for lung cancer, as there is no information on the fraction of inhalable, but non-respirable particles, preventing the differentiated consideration of inhalation and oral exposure of workers. This is also the default procedure proposed by ECHA (2013). The following exposure-risk relationships are used.

Table 1. Exposure-risk relationships for inhalation exposure of workers used for calculating risks due to chromium trioxide exposure (from ECHA, 2013)

TWA Cr(VI) exposure concentration [µg/m^3]*	Excess lung cancer risk in EU workers [x 10^{-3}]
25	100
12.5	50
10	40
5	20
2.5	10
1	4
0.5	2
0.25	1
0.1	0.4
0.01	0.04

TWA: Time-weighted average, expressed in micrograms of Cr(VI) per cubic meter of air

* Based on a 40-year working life (8h/day, 5 days/week).

For the general population, oral exposure (via drinking water and food) and inhalation exposure are considered,

in line with the RAC's recommendations (the RAC did not identify any cancer risks following dermal exposure for workers or the general population). For inhalation exposure, the RAC again identified a link between exposure and risk of lung cancer, while for oral exposure the focus was on an increased risk of small intestine tumours (ECHA, 2013). As considered above for the worker exposure assessment, it is assumed that all particles are respirable for inhalation exposure of the general population.

The following exposure-risk relationships are used to characterise the risks to the general population following exposure (over 70 years) of humans via the environment.

Table 2. Exposure-risk relationships for inhalation exposure of general population used for calculating risks due to chromium trioxide exposure (from ECHA, 2013)

Ambient Cr(VI) exposure concentration [µg/m^3]*	Excess lung cancer risk in the general population [x 10^{-3}]
10	290
5	145
2.5	72
1	29
0.5	14
0.25	7
0.1	2.9
0.01	0.29
0.001	0.029
0.0001	0.0029

* Based on an exposure for 70 years (24h/day, every day).

Table 3. Exposure-risk relationships for oral exposure of general population used for calculating risks due to chromium trioxide exposure of humans via environment (from ECHA, 2013)

Constant average oral daily dose of Cr(VI) [µg/kg bw/day]	Excess small intestine cancer risk in the general population [x 10^{-4}]
10	80
5	40
2.5	20
1	8
0.5	4
0.1	0.8

* Based on an exposure for 70 years (24h/day, every day).

9.1.1.4 Environment

Scope and type of assessment

No environmental assessment is performed because chromium (VI) trioxide is not listed in Annex XIV for endpoints related to concerns for the environment.

9.1.1.5 Exposure of humans via the environment

Scope and type of assessment

Human exposure to Cr(VI) via the environment due to emissions from the site to air and wastewater streams is considered in section 9.1.1. In relation to oral exposure of humans via the environment, it has to be acknowledged that Cr(VI) is rapidly reduced to Cr(III) in many environmental compartments. Exposure to Cr(VI) estimated on the basis of releases of Cr(VI) into environmental compartments may therefore significantly overestimate exposure of humans via the environment. In addition, many of the environmental modelling parameters (and partition coefficients in particular) rely on the log Kow of a given substance. This parameter is irrelevant for inorganic substances such as Cr(VI) and the calculated partition coefficients are not applicable.

In addition, there are only few data which report the presence of Cr(VI) in foodstuff (EFSA, 2014). Mostly, only total chromium was determined. Some scarce studies reported that the fraction of Cr(VI) of total chromium is generally below 10 % (range 1.31-12.9 %). Additionally, some investigations even indicate that there is no Cr(VI)

in foodstuff of plant origin at all and that measurement on Cr(VI) are analytical artefacts. This might also be the case in foodstuff of animal origin. Based on these data, the EFSA CONTAM Panel noted '*that there is a lack of data on the presence of Cr(VI) in food, and decided to consider all the reported analytical results in food as Cr(III)*'. The CONTAM Panel concluded that it can be considered '*that all the chromium ingested via food is in the trivalent form, in contrast to drinking water where chromium may easily be present in the hexavalent state*', primarily due to the use of strong oxidants in drinking water purification (EFSA, 2014). These considerations of the CONTAM Panel strengthen the former evaluation of the EU Risk Assessment Report for chromates, which assessed indirect oral exposure of humans via the environment only for exposure via (drinking) water and fish (ECB, 2005). This approach is also followed here.

The assessment is focused on the carcinogenicity of chromium trioxide and compares the exposure estimates with the exposure-risk relationship derived by RAC as described in section 9.1.1.2.

Comments on assessment approach:

This section describes the approach to exposure estimation for humans via the environment resulting from the industrial use of chromium trioxide covered in this CSR. Exposure via ambient air and from oral exposure (through ingestion of drinking water and consumption of fish, see discussion above) were assessed for the local scale. As outlined above, due to the rapid conversion of Cr(VI) to Cr(III) in most environmental situations , no regional assessment has been carried out (ECB, 2005). The approach to not perform a regional assessment for human Cr(VI) exposure via the environment for chromate AfAs uses was also supported in compiled HSE opinions, as described e.g. in the *Opinion on Anodise sealing using potassium dichromate, sodium chromate and/or sodium dichromate in aerospace and defence industry and its supply chains.* (ID AFA040-01). Therein, it is stated that regional exposure of the general population is not considered relevant by HSE[1].

EUSES modelling of human exposure via the environment

The assessment of human Cr(VI) exposure via the environment is based on emission measurements in air and wastewater from the site. Distribution and exposure modelling are carried out with the European Union System for the Evaluation of Substances (EUSES) software (v. 2.1.2).

Release days

For the exposure assessment, 286 release days are considered. While exhaust air is emitted continuously, wastewater is only emitted on 286 days per year (on average 5.5 days per week, see description in section 9.2.3.2). Accordingly, 286 release days are taken into account for the exposure assessment. Since for the inhalation exposure assessment, the modelled air concentration (annual average local 'Predicted environmental concentration' (PEC) in air (total)) is based on the annual average PEC value and therefore the number of release days has no impact for this exposure route.

Sewage treatment plant (STP)

For the assessment we adapted the default distribution of Cr(VI) in the sewage treatment plant (STP) used in EUSES (99.9% in water and 0.1% in sludge) to 50% in water and 50% in sludge. This is based on the description given in the EU Risk Assessment Report (ECB, 2005)that during biological treatment 50% of Cr(VI) are released into the effluent and 50% are absorbed to sewage sludge. The application of sludge on agricultural soil (rate: 5000 kg/ha/year) and grassland (rate: 1000 kg/ha/year) was considered according to the EUSES standard setting.

Oral uptake via drinking water and fish

It has to be noted that the intake of pollutants via drinking water and fish, as modelled in EUSES, is unreasonably conservative and therefore specific reduction factors are applied for risk calculations in the environmental contributing scenario (see section 9.2.3.3). The arguments why the EUSES calculations are overly conservative for these pathways, and derivation of reduction factors are described below:

- Drinking water
  a) Local concentration in drinking water based on the local PEC in surface water ("*annual average local PEC in surface water (dissolved)")*:

[1] https://www.hse.gov.uk/reach/applications-for-authorisation.htm; accessed 9 March 2026

- The approach chosen is likely to "*overestimate the actual indirect exposure as the conversion of Cr (VI) to Cr (III) is expected to occur under the vast majority of environmental conditions* " (ECB, 2005). This reduction is not considered in the exposure values calculated in EUSES.
- EUSES typically specifies a "purification factor" that accounts for removal processes from surface water in deriving the concentration in drinking water, e.g., by evaporation or adsorption to suspended solids. However, the latter is estimated by log Kow and not by specific distribution coefficients. This approach is not feasible for inorganic substances and therefore the estimate does not account for adsorption to suspended particles as a removal process before and during drinking water purification. Although these effects are difficult to quantify, the value of 50% (i.e., reduction by factor 2) for adsorption to sewage sludge as applied in the EU RAR (ECB, 2005) (as described above) can serve as an indicator of the degree of Cr(VI) adsorption to suspended solids in surface water.
- The local PEC in surface water is calculated for the mixing zone, neglecting the fact that for drinking water preparation additional water sources are added and dilution takes place.

b) Local concentration in drinking water based on the "*local PEC in pore water of agricultural soil*":

- The Cr(VI) concentration in groundwater is taken directly from the pore water concentration in the soil, which in turn is modelled from the Cr(VI) concentration in the soil. Cr(VI) reduction in soil is a well-known process and the EU Risk Assessment Report states that "*chromium (VI) is reduced to chromium (III) by organic matter and this process occurs reasonably readily in soils*" and assumes "*chromium present in soil following application is in the form of chromium (III)*" (ECB, 2005). This reduction is not considered in EUSES modelling.
- In addition, EUSES calculates the deposition (the main relevant pathway of groundwater contamination) for a circle around the source with a radius of 1000 m (RIVM, 2004), so that the resulting groundwater concentration only applies to the groundwater below this area.
- EUSES modelling of the concentration in groundwater is based on a simple algorithm that equates the concentration of a substance in groundwater with its concentration in the pore water of the soil (RIVM, 2004). These authors state, that "*this is a worst-case assumption, neglecting transformation and dilution in deeper soil layers*".
- Like for surface water, any additional dilution with other groundwater or surface water for drinking water preparation is not considered.

Overall, the conservatism of EUSES with respect to exposure to drinking water is classified as "worst case" by the software developers (RIVM, 2004).

Against the background of these substance-specific and model-inherent considerations, the estimate for local exposure via drinking water is regarded as unreasonable. The effects of all these issues are not quantifiable, but a general reduction of the local Cr(VI) concentration in drinking water, calculated in EUSES, by a factor of 5 due to the above factors, seems to be appropriate. Still, this is considered to result in a conservative exposure estimate.

- Fish

1) In EUSES, a default consumption of 115 g fish per day is used, which overestimates the realistic human daily intake of fish on a long-term basis. According to the food consumption data for humans in Europe, as accessible in the *PRIMo – Pesticide Residue Intake Model*[2] (v.3.1) of the European Food Safety Authority (EFSA), the maximum of the mean consumption of fish (and fish- and marine-/freshwater-

[2] In the *PRIMo – Pesticide Residue Intake Model* (v.3.1) of the European Food Safety Authority (EFSA) food consumption data for individuals of different age groups in numerous European countries are listed. The model can be accessed via https://www.efsa.europa.eu/en/applications/pesticides/tools (accessed in November 2020).

More detailed information on the model is under the following links:
https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2018.5147 and
https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/sp.efsa.2019.EN-1605

products) is 29.3 g per day[3]. This amount is approximately 4-fold lower (factor 3.9) than the default consumption used in EUSES, most likely due to the fact that it reflects a long-term estimate (i.e., most people do not eat fish every single day).

2) It must be noted, that "*(p)eople do not consume 100% of their food products from the immediate vicinity of a point source. Therefore, the local assessment represents a situation which does not exist in reality*" (ECHA, 2016a).

From argument 1) (almost) a reduction factor of 4 can be assumed and although argument 2) is not scientifically verifiable, it certainly makes up more than a factor of 1.25. Thus, combining these two arguments, a **total reduction factor of 5** can be derived, which is assumed to be sufficiently conservative to also cover, for example, that some countries have not indicated long-term consumption quantities to EFSA (and are thus not represented in the PRIMo Model). Adding further to the conservatism, it must be noted that the value derived from the data in the PRIMo model relate to the consumption of '*fish, fish products and other marine and freshwater food product'* and therefore include food items that are unlikely to be sourced from the immediate vicinity of the site assessed.

Inhalation exposure

The following must be considered for local inhalation risks: The concentration in air and deposition are estimated in EUSES with the Operational Priority Substances (OPS) model that is embedded in EUSES (de Bruin et al., 2010; Toet and de Leeuw, 1992). When EUSES was developed, conservative input values were chosen (e.g., stack height of 10 m, no excess heat of the plume emitted compared to environmental temperature and an ideal point source). For a stack height of 10 m, the maximum concentration is modelled at a distance of 100 m from the source and this distance was set as the default distance for the local PECair in EUSES. The developers of the OPS model at the Dutch RIVM analysed the impact of these conservative default settings on the estimated concentration in air and on the total deposition. For example, they noted that '*[i]ncreasing the stack height from 10 to 50 m lowers the maximum concentration by a factor 40*' and – considering all factors – concluded that '*air concentration and total deposition used for risk assessment purposes are likely to be overestimated due to over-conservative default settings used in the standard scenario in EUSES*' (de Bruin et al., 2010). In the light of these findings, the inhalation risk estimates presented in this report are highly conservative.

Site-specific releases

The measured release data from the site were used for the EUSES assessment. The detailed release data are reported in section 9.2.3.2.

Substance-specific input values

The input values for physico-chemical and environmental fate properties of CrO_3 were taken from section 1.3 and the EU Risk Assessment Report (ECB, 2005).

Table 4. Input data for chromium trioxide in EUSES modelling

Parameter	Value	Comment
Molecular weight	100 g/mol	Refers to CrO_3, Value used in ECB (2005)
Melting point	196 °C	Refers to CrO_3, Value used in ECB (2005)
Boiling point	250 °C	Refers to CrO_3; CrO_3 decomposes at about 250 °C (ECB, 2005)
Vapour pressure	0.001 Pa at 20 °C	n/a: inorganic ionic compound, dummy value entered
Log Kow	0.1	n/a: inorganic ionic compound, dummy value entered
Water solubility	1 667 g/L*	Refers to CrO_3;
Bioconcentration factor fish	1 L/kg	Refers to Cr(VI); Value used in ECB (2005)
Kp *suspended matter*	1 100 L/kg	Refers to Cr(VI); Mean of values in ECB (2005); see text for

[3] The value was provided for Germany (general population) based on the daily intake (reported in the PRIMo model in g/kg bw and day), multiplied by the body weight (reported in kg). The value represents the maximum of the mean values reported for different countries and population groups (e.g., children, adults, general population).

		details
Kp *sediment*	550 L/kg	Refers to Cr(VI); Mean of values in ECB (2005); see text for details
Kp *soil*	26 L/kg	Refers to Cr(VI); Mean of values in ECB (2005); see text for details

* With the note that this is above the maximum of 100 g/L for the advised range in EUSES.

The partition coefficients used for suspended matter, sediment and soil are the means of the two values used in ECB (2005) for Cr(VI) for these compartments. These are:

	Acid conditions (pH ≤ 5)	Alkaline conditions (pH ≥ 6)
Kp *suspended matter*	2 000 L/kg	200 L/kg
Kp *sediment*	1 000 L/kg	100 L/kg
Kp *soil*	50 L/kg	2 L/kg

The mean of the value under acidic and alkaline conditions was used in the present assessment, since (a) it reflects the range of values and (b) the underlying data – especially for Kp *suspended matter* and Kp *sediment* – are not very well founded, preventing a more reliable estimate of these parameters.

Finally, removal during wastewater treatment was adapted according to the EU Risk Assessment Report (ECB, 2005) that assumed 50 % release in the effluent and 50% adsorbed onto sewage sludge for Cr(VI).

Regional and local assessments

Human exposure via the environment from consumption of drinking water, fish and via air (for rationale see above) is modelled only for the local scale. Due to the reasons described above, no regional assessment has been carried out.

9.1.1.6 Workers

Scope and type of assessment

Chromium trioxide has been included in Annex XIV of the EU REACH Regulation for its carcinogenic and mutagenic properties. As regards this toxicological effect, the assessment is limited to the inhalation exposure pathway: indeed, according to RAC “there are no data to indicate that dermal exposure to Cr(VI) compounds presents a cancer risk to humans” (ECHA, 2013). Therefore, the quantitative occupational exposure estimation and risk characterisation for carcinogenic effects focuses on inhalation exposure of workers.

Table 5. Type of risk characterisation required for workers

Route of exposure and type of effects	Endpoint considered and type of risk characterisation	Hazard conclusion DNEL/dose – response relationship
Inhalation: Systemic Long Term	Carcinogenicity Quantitative	RAC dose-response relationship based on excess lifetime lung cancer risk (ECHA, 2013) For workers; based on 40 years of exposure; 8h/day; 5 days/week Exposure to 1 µg/m^3 Cr(VI) relates to an excess risk of 4x10^{-3} *

* The cancer risk characterisation for workers by inhalation is solely based on inhalation exposure and the risk for lung cancer, as no information on the fraction of inhalable, but non-respirable particles is available, which prevents a differentiated consideration of inhalation and oral exposure of workers.

A qualitative risk characterisation with respect to other health effects like the skin sensitising and respiratory sensitising properties of chromium trioxide is outside the scope of this CSR as the substance has been included in Annex XIV to Regulation (EC) No 1907/2006 (EU REACH) solely due to its mutagenic and carcinogenic properties (see section 9.1.1.2). According to EU REACH, Article 62(4)(d), the CSR supporting an AfA needs to cover only those potential risks arising from the intrinsic properties specified in Annex XIV. The applicant duly applies and communicates risk management measures derived by the registrants of the chromate due to other substance properties related to human health concerns, which they communicated via the Safety Data Sheets

(SDS).

Comments on assessment approach:

General approach

The exposure scenario covers only the industrial use of chromium (VI) trioxide as an oxidising and hardening agent in the manufacture of coloured stainless steel. No professional or consumer uses are applied for in this application for authorisation and are therefore not part of this chemical safety report.

Colouring of stainless steel takes place in colouring lines with open tanks containing [redacted] chromium (VI) trioxide. Although local exhaust ventilation systems are in place release of Cr(VI) into workplace air cannot totally be prevented as shown by air monitoring results (see below). Beside this general exposure due to the colouring in open tanks some specific tasks like decanting of a solid, sampling and cleaning of stainless steel components with a hose were identified which also contribute to overall worker exposure. Based on the process characteristics and properties of chromium (VI) trioxide as a non-volatile substance, all potential inhalation exposure will be towards an aerosol/dust containing chromic acid (H_2CrO_4) or chromium (VI) trioxide and all potential dermal exposure will be towards chromic acid which is rapidly generated in aqueous solutions of chromium (VI) trioxide (CrO_3).

As outlined below carcinogenicity is the most critical endpoint for risk assessment. According to the Risk Assessment Committee (RAC) “there are no data to indicate that dermal exposure to Cr(VI) compounds presents a cancer risk to humans” (ECHA, 2013). Therefore, the quantitative exposure estimation and risk characterisation is restricted to inhalation exposure of workers in the context of carcinogenic effects. No quantitative dermal exposure assessment and risk characterisation is performed.

A qualitative risk characterisation with respect to the corrosive and skin sensitising properties of chromium (VI) trioxide is not part of this CSR, as chromium (VI) trioxide has been included into Annex XIV of Regulation (EC) No 1907/2006 (EU REACH) due to its carcinogenic and mutagenic properties. According to EU REACH, Article 62(4)(d), the CSR supporting an AfA needs to cover only those potential risks arising from the intrinsic properties specified in Annex XIV. The applicant duly applies risk management measures derived by the registrant of chromium (VI) trioxide due to other substance properties related to human health concerns and communicated via the SDS.

Reliable and representative measured data are generally favoured in an assessment of occupational exposure to chemicals. For a carcinogen such as chromium (VI) trioxide, this is all the more desirable and considerable efforts were undertaken to obtain such data. Chromium exposure was monitored by Rimex Metals (UK) Ltd. to show compliance with national legislation. In accordance with legal requirements, urine monitoring is carried out as part of the annual occupational examination (for details see Annex 7). However,

- Biological monitoring (assessment of total chromium in urine) does not allow a differentiation between Cr(III) and Cr(VI) (Drexler and Hartwig, 2009) and is therefore unsuitable for the assessment in this report (i.e. a comparison with the exposure-risk relationship (ERR)). In addition, total chromium levels in biomonitoring studies are also highly influenced by several other factors apart from occupational exposure (geographical region, smoking status, intake from food and drinking water etc.), making an interpretation of obtained difficult to impossible in the absence of data on the background exposure.

In accordance with Article 3 of the Commission Implementing Decision C (2017) 3439[4] regular air monitoring (personal and stationary measurements) was performed at Rimex Metals (UK) Ltd. in the past with a limit of quantification (LoQ) adequate to demonstrate compliance with the national occupational exposure limit. The 8-h TWA (Time Weighted Average) for chromium (VI) was 50 µg/m³ in UK until the end of 2019. Since 2020, a limit value of 10 µg/m³ has been in force. A further reduction of the TWA to 5 µg/m³ is also planned for the UK. These values are on the upper end of occupational exposure limits in force in Europe which generally range between 10 - 50 µg/m³, with more recent values at 1 µg/m³ (see Annex 1). Monitoring results from Rimex Metals (UK) Ltd. generated by personal and stationary monitoring in the years from 2016 onwards document that the exposure is well below the 8-h TWA and mainly below 1 µg/m³ (= LoQ).

As outlined above, Cr(VI) concentration in the production hall is mainly influenced by the colouring of stainless steel components in open tanks containing chromium (VI) trioxide, generating an overall contamination of the workplace air with chromium (VI). Therefore, static monitoring is regarded as adequate to monitor workplace

[4] https://ec.europa.eu/docsroom/documents/23662

exposure, especially in the case of operators at Rimex who perform some tasks like sampling, laboratory analysis associated with direct handling of Cr(VI) containing liquids, but also stay most time of the day in the production hall, even if they do not perform a task associated with direct contact to chromium (VI) containing liquids. Additionally, some specific tasks associated with direct handling or Cr(VI) containing liquids are modelled with a higher tier tool (Advanced REACH Tool, ART, see below) to assess the contribution of these tasks to the overall exposure.

As part of the exposure assessments for the first authorisation CSR, stationary measurements were carried out in collaboration with a German laboratory (previously named Eurofins GfA, Münster, Germany; now named Eurofins Umwelt Nord GmbH, Gefahrstoffmessstelle Münster; in the following named Eurofins), which also enabled measurements in the lower nanogram range. To maintain this standard, Rimex Metals (UK) Ltd purchased its own pumps and, in cooperation with Eurofins, continued to carry out annual stationary measurements. The sampling filters were then analysed by Eurofins. Analysis was performed by ion chromatography according to method ISO 16740:2005 (LoQ 0.02 µg/sample; i.e. about 0.1 ng/m^3 considering a sample volume of 180 m^3). Consequently, annual measurements have been available since 2016, with interruptions during the COVID-19 pandemic. To ensure the comparability of the measurements, the sampling points were selected identically throughout the years and positioned so as to cover both areas where no chromium-containing solutions are handled (e.g. packaging unit) and various areas along the production lines where chromium-containing solutions are used (for details see Dashed line: dividing curtain

Figure 1).

In addition to stationary measurements, personal monitoring was carried out. Samples were collected by Rimex Metals (UK) Ltd. using SKC aircheck XR5000 pumps with IOM filter cassettes (Durapore membrane filters). Samples were analysed by an external service provider according to test method M127N. However, particularly in the measurements from earlier years (2016), the limits of quantification (LoQs) were too high, meaning that only readings below the LoQ were obtained. These do not reflect the actual exposure, but rather the limitations of the method. However, analytical methods have been improved over the years, and most recently, with the 2025 measurement, a sufficiently low LoQ (0.01 µg Cr(VI)/sample) was achieved to enable personal measurements in the lower nanogram per cubic metre range. The LoQ varies for individual samples, depending on the volume of air collected (for details see Annex 2). This means that both stationary and personal measurements are available for exposure assessment in this CSR.

Air monitoring approach

As outlined above, air stationary monitoring was performed using stationary sampling to achieve a sufficiently low limit of quantification. All sampling was performed to reflect exposure during specific tasks or exposure at certain places of the production hall. The monitoring can be described in detail as following:

- Stationary air monitoring was performed in the colouring stainless steel production of Rimex Metals (UK) Ltd. in Enfield. Sampling of each monitoring point was performed on two days per year. Monitoring was typically performed from ca. 8:00 to 16:00, i.e. during the day shift of CSS which represents the time of most activities. Monitoring during the night shift was not regarded to be appropriate as during the night shift, if one is even held, there is less activity at the colouring lines. Besides monitoring in the part of the hall where the colouring takes place, additional measurements were made in the part of the production hall where the preparation of the stainless steel for the colouring and the packaging of the coloured stainless steel takes place, i.e. in an area of the production hall where no handling of Cr(VI) containing liquids takes place. In addition, comparative measurements were carried out in the surrounding area.
- The monitoring pumps were located as close to a potential source of worker exposure (e.g. a sampling point, a (black) colouring tank or a laboratory workplace) or the worker as possible. As described above, due to the process organisation of colouring in open tanks and open structure of the hall without separated workplaces with individual air support this design is more or less typical of a “classic” stationary sampling, which aims to measure concentrations in general work areas. Placing pumps at different locations with possible higher exposure concentrations (e.g. with an impact of several sources), was chosen to reflect different concentrations at different work zones, rather than task-specific concentrations (which would typically be measured by personal monitoring). The monitoring pumps were positioned as close as possible to the workers. However, as the workers move around, e.g. the controller of the colouring line moves along the line during the colouring process, measuring close to the workers was impossible. But in some special cases, e.g. monitoring of tank sampling, the position of the monitoring pumps was often within 1 m of the position of the worker when performing the task. Safety considerations limited the possible positions, e.g. since emergency exits had to be kept clear and extension cables (required for the power supply of the monitoring

pumps) were limited to certain areas to ensure the safety of the workplaces. In addition, the sampling devices had to be positioned in a way that did not prevent workers from carrying out the activities in their usual work routine, since this could lead to unrepresentative monitoring results. These settings may in some cases underestimate or overestimate the concentration in the breathing zone of the worker. Nevertheless, the distribution of the pumps all around the production hall provided the possibility to record Cr(VI) air concentrations at all relevant workplaces in the production hall.

- At each of these stationary monitoring points, sampling was performed over 8 hours, which resulted in a sampled volume of about (22.5 m^3/hour x 8 h =) 180 m^3. The guaranteed limit of quantification for Cr(VI) in air for this method was 2.4 ng/m^3. Sampling over such an extended period of time was necessary in order to achieve a limit of quantification in the range of exposure concentrations associated with low risks in the range of 10^{-5}.
- As workers are active in the production hall all day long, but not always just beside the single monitoring points and not always performing special tasks like e.g. sampling, which are associated with a direct handling of Cr(VI) containing liquids, this monitoring design was regarded as most appropriate to measure overall exposure. Besides this general exposure, some exposure hot spots might exist during special tasks only performed at specific times during a workday. Monitoring these hotspots was regarded to be especially helpful to reflect the outcome of the modelling data.
- As Rimex Metals (UK) Ltd. is located in an industrialised area in the northern part of Greater London monitoring of background concentration of Cr(VI) was also performed, since levels of up to about 8 ng Cr(VI)/m^3 may be found as a background concentration in industrial areas, e.g. due to emissions from stainless steel factories (Gladtke et al., 2012; Scott et al., 1997). Therefore, ambient samples were taken upwind and downwind of the production hall to measure the influence of CSS on ambient Cr(VI) concentrations in the vicinity of the production site. The monitoring pumps for the ambient samples were positioned about 25 m upwind and downwind of the production hall to cover emissions from other sources and emissions from the production hall, respectively. Due to practical reasons (end of premises) the pumps could not be placed further away. Wind direction was not measured as part of the monitoring campaign, but was judged visually from wind vanes at sites.

As stated above, workers spend the whole workday in the production hall. Outside activities are only the operation of the filter press and some maintenance activities performed in a small work shop container located outside the production hall.

The monitoring results represent the time weighted average (TWA) for the monitoring day at the place of the production hall where the pump is located. Different locations document differences in exposure concentration at different places of the production hall, probably due to certain emission sources or activities.

Operators involved in CSS at Rimex Metals (UK) Ltd. can be divided in several groups, as shown in Table 10:

As outlined above the different types of workers perform different task which are associated with a possible exposure to Cr(VI). Many of these activities like working in the packaging unit (Task 18), controlling the coulouring process (Task 13), loading and off-loading of stainless steel components (Tasks 14 and 16), controlling the effluent treatment plant (Task 9), or performing maintenance work somewhere in the production hall (Task 11) are only indirectly associated with exposure to Cr(VI) due to its presence in the workplace air, but not due to the direct handling of Cr(VI) containing liquids or solids. As there are many sources which contribute to the overall Cr(VI) concentration in the workplace air stationary monitoring data are the only reliable source for exposure estimates, as no task specific exposure can be modelled for this indirect exposure.

Also for those activities, which are associated with a possible exposure towards Cr(VI) containing solids or liquids but not associated with direct handling of Cr(VI) like cleaning activities (Tasks 4 and 5), no task specific exposure can be modelled and exposure assessment can only be based on monitoring data.

There are some tasks which are associated with possible direct contact to solid chromium (VI) trioxide (Task 1), or to chromic acid (e.g. sampling (Task 6), laboratory analysis (Task 7)). But these tasks are only performed during a short period of the workday. The possible contribution of these defined tasks with handling of Cr(VI) containing solids or liquids to overall exposure can be modelled with higher tier tools (see below). For these activities the outcome of the modelling approach will be discussed in the light of the monitoring results.

When estimating exposure, the results of stationary measurements are taken into account as well as the results of personal monitoring. The relevance and reliability of the data available for the respective activities are discussed, and a decision is made case by case as to which data to use for the respective exposure estimate of the respective WCS.

Some operators spend parts of their workdays at different places in the production hall. If the exposure concentration at the different places differs substantially the overall exposure will be calculated under consideration of the duration and frequency of the activities in the different parts of the production hall. Therefore, the TWA measured or calculated on basis of the monitoring values will be transformed into a long-term TWA under consideration of the duration and the frequency typical for presence in a certain area of the production hall.

Long term TWA = monitoring result x exposure duration [min/shift]/480 min x frequency [d/a]/ 240 d/a

Task definitions as presented in the following section help to further characterise the different tasks performed by the workers and to describe the PPE to be worn during the tasks. For single tasks which could be modelled (task 1, 6, 7, and 12) the critical input parameters for the modelling approach are also defined in the following section and the exposure assessment on basis of monitoring data is discussed in light of the modelling data.

Modelling approach for inhalation exposure

The exposure assessment performed in this CSR based on measured data is supported by exposure modelling for some tasks. As outlined below, there are only some tasks where exposure is defined by a specific activity and which can be modelled due to the limitations of the tool (task 1, 6, 7, and 12).

Occupational inhalative exposure was modelled with ART (Advanced REACH Tool, version 1.5, http://www.advancedreachtool.com) that is considered a higher tier tool in the ECHA Guidance IR & CSA, Ch. R.14 (ECHA, 2016b). It allows more adequately reflecting real conditions of use than lower tier tools such as ECETOC TRA. In addition, chromium (VI) trioxide is dissolved in a liquid during most activities except one (Task 1, Decanting of a solid) related to this use, a situation that is outside the applicability domain of ECETOC TRA (ECETOC, 2012). For all tasks modelled with ART, the following principal approach was chosen:

- Exposure was modelled as “near field exposure” within ART, i.e. the worker is assumed to be less than 1 m from the emission source for the entire exposure duration assumed.
- The upper limit of the inter-quartile confidence interval of the 75th percentile is used as the exposure estimate. This approach follows the recommendations of the developers of the tool. This value better accounts for uncertainty and variability in the underlying data than e.g. the 90th percentile. However, both measures often result in similar values.
- Exposure was modelled in ART as a task-based concentration (assuming exposure duration = 480 min) that was then converted outside the tool to time-weighted average (TWA) on the day of exposure considering the exposure duration for the specific task:
    - TWA = task-based concentration x exposure duration [min/shift]/480 min
    - This algorithm is identical to the one applied in ART, if the TWA is modelled rather than the task-based concentration).

The exposure resulting from single tasks will be discussed in light of the overall exposure resulting from Cr (VI) in workplace air.

Definition of tasks

Colouring of stainless steel at Rimex Metals (UK) Ltd. takes place in in colouring lines with open tanks. Exposure control is via local exhaust ventilation especially of the tanks containing chromium (VI) trioxide. Due to the low volatility of chromium (VI) trioxide or chromic acid Cr(VI) exposure may occur due to the generation of aerosols during the colouring process. Further, chromium (VI) trioxide in the aqueous phase shows no potential for dust exposure. The only risk for dust exposure is during tank make up when solid chromium (VI) trioxide is decanted and the workplace contaminated with solid chromium (VI) trioxide and the drums containing the chromium (VI) trioxide flakes are cleaned with a hose.

The entire process of colouring stainless steel can best be described by PROC 15 according to ECHA Guidance (ECHA, 2015):

“Treatment of articles by dipping and pouring. Treatment of articles by dipping, pouring, immersing, soaking, washing out or washing in substances; Includes handling of treated objects (e.g. from/to treatment basin, after drying, plating).”

The following specific tasks were identified as being potentially associated with exposure (**Table 6**). These tasks are described in more details below.

Table 6. Task definition

Task	Description
Task 1 (T1)	Decanting of a solid (PROC 8b)
Task 2 (T2)	Dissolution of solid CrO_3 in tanks (PROC 8b)
Task 3 (3)	Re-filling of baths – liquids (PROC 8b)
Task 4 (T4)	Cleaning of solid CrO_3 with a hose (PROC 28)
Task 5 (T5)	Cleaning of equipment (PROC 28)
Task 6 (T6)	Tank sampling (PROC 9)
Task 7 (T7)	Laboratory analyses (PROC 15)
Task 8 (T8)	Addition of mist suppressant (PROC 8b)
Task 9 (T9)	Operating effluent treatment plant (PROC 4)
Task 10 (T10)	Tank fill up (PROC 4)
Task 11 (T11)	Maintenance (PROC 28)
Task 12 (T12)	Waste handling (filter press) (PROC 8b)
Task 13 (T13)	Operating colouring line – controler (PROC 13)
Task 14 (T14)	Operating colouring line – loading (PROC 13)
Task 15 (T15)	Operating colouring line – rinsing (PROC 13)
Task 16 (T16)	Operating colouring line – off loading (PROC 13)
Task 17 (T17)	Operating colouring line – colour control (PROC 13)
Task 18 (T18)	Activities in packaging area (no PROC assigned)

Like the overall process the activities associated with the operation of the colouring line (Tasks 13-17) are considered to be covered by PROC 13 definition from ECHA (2015) due to the immersion of the stainless steel in open tanks. Maintenance activities including cleaning were described by PROC 28. PROC 15 was assigned to laboratory activities performed by a chemist in the laboratory of the production site. Sampling activities are best described by PROC 9 and tank fill up as well as operation of the effluent treatment plant are covered by PROC 4, as no direct handling of a Cr(VI) containing solution takes place, but opportunity for exposure arises. PROC 8b was assigned to all remaining tasks as these activities are performed at dedicated facilities.

The PROCs given in **Table 6** are only a surrogate and are not used for the exposure assessment presented below, since this is especially based on air monitoring, supported by single modelling results using ART. Both air monitoring and ART modelling are independent of PROCs (see above for details on the approach to exposure estimation).

As described above the individual tasks are performed by different workers and certain tasks can be assigned to certain groups of workers. The individual tasks are described in more detail in the following sections. There it will also be outlined for which tasks exposure can be modelled and for which tasks modelling does not seem to be appropriate, because e.g. the task is performed semi-manually and the worker exposure is only indirectly via overall Cr(VI) concentration in the workplace air but not due to the directly handling of Cr(VI) containing solids or liquids. Where appropriate, the general modelling input for ART (e.g. activity classes, containment levels assumed) are also provided in the following section. Full ART reports are attached in Annex 5. More specific input parameters (e.g. Cr(VI) concentration, exposure duration and frequency) are described below in the section on “critical input parameters”.

Depending on the activities and the possible exposure to solutions with different Cr(VI) concentrations different gloves are used:

Triple dipped nitrile gloves (0.48 mm) are used for handling concentrated Cr(VI)/sulphuric acid liquids or pure chromium (VI) trioxide (Task 1, 2, 3, 4, 5 (not for all maintenance activities, but only for those associated with handling of the concentrated liquid)). When handling pure chromium (Task 1, 2, 3, 4, 5), a disposable nitrile glove (see below) is also worn under the triple dipped nitrile glove:

- SKYTEC XENON PLUS Triple dipped Nitrile 0.48 mm, EN374-1:2016 Type A-J,K,L,O,P,T EN388 :2016 +A1 :2008 4,4,3,C

During work in the loading and packaging area (Task 14, 16, and 18) rubberized gloves are used for the handling of the stainless steel components to protect from mechanical injury of the hands. The following gloves are used:

- ATG Maxicut Ultra dotted. Abrasion 4, Blade 4, Tear 4, Puncture 2, Cut C. 1.10 mm. Approved to EN388:2016+A1:2018 - 4.4.4.2C, Protective gloves against mechanical risks.

Nitrile gloves (ATG powerform S6 nitrile disposable. 0.14 mm) are worn

- during activites in the loading area associated with possible contact of diluted Cr(VI) liquids (e.g. rinsing or colour control),
- during laboratory work and operation of the effluent treatment plant (Task 7 and 9)
- during all other remaining tasks not requiring triple dipped nitrile gloves (0.48 mm)

During activities associated with possible exposure to chromium (VI) trioxide dust (Task 1, 2, and 4) respiratory protection equipment is worn. This is also worn during Task 3 although this activity is not associated with a possible exposure to Cr(VI) containing dust. But due to the workflow (Task 3 is performed in the meantime of Task 2, i.e. sulphuric acid is added to the tanks during dissolution of chromium (VI) trioxide) the operators keep the RPE.

- RPE: 3M Versaflo TR600 series powered air respirator with full hood. Filter type A2B2E2K 1Hg P (battery powered filtering device; assigned protection factor (APF) 40; see HSG53[5].
- Accordingly, for the calculations in this CSR, in line with the recommendations of HSG53, an APF twice as high (40 vs. 20) is assumed as in the CSR of the first authorisation application.

Additional PPEs like goggles or face shields are not addressed in detail here, as they have no impact on inhalation exposure modelling. But, of course they are used during the handling of (corrosive) liquids (for details see summary of risk-management measures and operational conditions).

Delivery and transport of chromium (VI) oxide. Chromium (VI) oxide is purchased as flakes in clip-top steel drums (usually 25 kg drums, occasionally 50 kg drums). The drums are transported to the chemical storage using a forklift and no exposure of workers to chromium (VI) takes place during this process. Also during transport of the closed steel drums to the coloring lines for tank make up (see below) no exposure of workers takes place. These activities are therefore not regarded in the exposure assessment.

T1: Decanting of a solid

Due to the loss of chromium trioxide during the colouring of the stainless steel regular refilling of the colouring, black colouring and hardener tank is necessary. The frequency and the amount of refilling is determined by the usage of chromium (VI) trioxide which is dependent on the frequency of colouring, the size and the surface structure of the components. Chromium (VI) content of the tanks is analysed weekly and depending on the results of the analysis the frequency and amount of chromium (VI) trioxide to be refilled is set. In general, this task takes place weekly and is performed by two operators. For refilling solid chromium (VI) trioxide flakes delivered in clip-top steel drums (typically 25 kg; 50 kg drums are only used in the rare case of new tank make up) is used. As a principal risk management measure to reduce dust exposure chromium trioxide flakes are used instead of powdered material. The drums are opened by one operator. Then the drums have to be lift up to the basket (about 0.5 m above the floor) and are carefully decanted into a titanium mesh basket. Decanting of each drum takes no longer than 1 min. As outlined above the total amount of drums needed per refilling depends on the colouring activities, usage of [redacted] for the total of the 3 colouring lines can be assumed as an upper estimate of the average weekly activity, i.e. decanting duration about 16 minutes at maximum, frequency 1/week. This activity takes place in the loading area of the colouring lines. This task is performed by trained operators wearing chemical resistant overalls (Dupont Tychem 6000F hooded chemical suit), gloves (triple dipped nitrile, 0.48 mm combined with disposable nitrile glove 0.14 mm), powered air respirator with full hood (filter type A2B2E2K 1Hg P) and rubber boots in the morning, before the other shift-operators arrive. Within ART, this situation was modelled as ‘Movement and agitation of powders, granules or pelletised material’ and ‘Handling that reduces contact between

[5] https://www.hse.gov.uk/pubns/priced/hsg53.pdf (fourth edition, published 2013; accessed 8 December 2025)

product and adjacent air.'

T2: Dissolution of solid CrO_3 in tanks

After filling the basket with chromium (VI) trioxide the basket is lift up and directed to the dedicated tanks and immersed using the pendant controller. Dissolution of chromium (VI) trioxide is supported by air agitation and pumping of the tanks. During this activity the operators move around close to the colouring lines, but only in the area which is protected against the tanks with a Plexiglas shield. The breathing zone is at least about 3 m away from the basket with the chromium (VI) trioxide flakes and the dissolution of the flakes is performed semiautomatically. Like task 1 this task 2 is performed by trained operators wearing chemical resistant overalls (Dupont Tychem 6000F hooded chemical suit), gloves (triple dipped nitrile, 0.48 mm combined with disposable nitrile glove 0.14 mm), powered air respirator with full hood (filter type A2B2E2K 1Hg P) and rubber boots. Modelling of this situation within ART e.g. as activity class 'falling powders' is not regarded as appropriate as the operators are not performing this task manually. Therefore, exposure assessment of this task is based on monitoring data only. Dissolution of chromium (VI) trioxide can take up to 20 min for all three colouring lines. The activities are performed in the morning, before the other shift-operators arrive.

T3: Re-filling of baths-liquids

Tank make up consists of addition of solid chromium (VI) trioxide (see task 1 and 2) and addition of concentrated sulphuric acid to the colouring and black colouring tank where necessary. I.e. in total a maximum of 5 tanks have to be filled per tank make-up session. Plastic drums with concentrated sulphuric acid (96%) are located close to the tanks where the sulphuric acid has to be filled in. Then a hand pump is used to pump the sulphuric acid into the respective tank of the colouring line. To prevent splashes of the very acidic tank liquid the outlet of the hand pump is immerged into the liquid. The two trained operators performing this task are close to the tanks (< 1m) during this activity, but behind the Plexiglas shield. The duration of this activity is up to 15 minutes, depending on the number of tanks to be filled. Like for task 1 and 2 during this task 3 operators are wearing chemical resistant overalls (Dupont Tychem 6000F hooded chemical suit), gloves (triple dipped nitrile, 0.48 mm combined with disposable nitrile glove 0.14 mm), powered air respirator with full hood (filter type A2B2E2K 1Hg P) and rubber boots. The activities are performed in the morning, before the other shift-operators arrive. Like for task 2 this task 3 cannot appropriately be modelled within ART as the operators handle sulphuric acid but not a chromium containing liquid. Therefore, exposure assessment of this task is based on monitoring data.

T4: Cleaning of solid CrO_3 with a hose

During the filling of chromium (VI) trioxide into the mesh baskets some powder and flakes fall through the small meshes on the floor of the loading zone. This area is cleaned with a hose, i.e. the chromium (VI) trioxide is dissolved in the wash water and transferred to the waste water collector by water carriage. Additionally, the drums containing the chromium (VI) trioxide flakes are cleaned with a hose and then transferred to the normal waste. Therefore, about 20-25 drums are opened just beside the sump and cleaned with a hose till the wash water is clear and colourless. The waste water is directly transferred into the sump. This activity takes place about fortnightly, and lasts about 30 minutes. The operator performing this task is wearing a chemical resistant overalls (Dupont Tychem 6000F hooded chemical suit), gloves (triple dipped nitrile, 0.48 mm combined with disposable nitrile glove 0.14 mm), and powered air respirator with full hood (filter type A2B2E2K 1Hg P), and rubber boots. Again, this task cannot be modelled within ART as the operators handle water but not a chromium containing liquid. Therefore, exposure assessment of this task is based on monitoring data.

T5: Cleaning of equipment

As explained above, transfer of sulphuric acid to the tanks of the colouring line is performed with a hand pump which is submerged into the tank liquid. After finishing this activity the pump is removed from the tank, the open end transferred into a bucket to avoid contamination of the working area with droplets of the acidic and Cr(VI) containing liquid and carried to the effluent treatment plant. There the pump is cleaned carefully with a water hose. During this activity the operator stands in front of the effluent treatment plant which is equipped with a water barrier. The washing takes place behind the barrier so that the wash water automatically is transferred to the waste water sump. Additionally, the glass pipettes used for the sampling (see below) are cleaned with a water hose in the area of the effluent treatment plant, similar to the way the hand pump is cleaned. This activity cannot adequately be modelled with ART. Therefore, exposure assessment is based on monitoring data. This activity takes place about fortnightly and lasts about 30 minutes. PPE during cleaning of pipettes are overall, gloves (nitrile glove 0.14 mm), and and powered air respirator with full hood (filter type A2B2E2K 1Hg P; i.e. same PPE as for task 6, see below). PPE worn during cleaning of hand pump are chemical resistant overalls (Dupont Tychem

6000F hooded chemical suit), gloves (triple dipped nitrile, 0.48 mm combined with disposable nitrile glove 0.14 mm), and powered air respirator with full hood (filter type A2B2E2K 1Hg P) (i.e. same PPE as for task 3, see above).

T6: Tank sampling

Samples of the liquids of the (black) colouring and hardener tank are taken weekly for laboratory analysis. Liquid samples are taken using glass pipettes of about 1 m length. The pipette is submerged in the tank liquid. After filling the pipette the liquid is transferred to a 250 ml glas flask. For some tanks the sampling is performed from the place between colouring line 1 and 2 and for some tanks from the place behind the Plexiglas shield, depending on the space available at each tank. Within ART, this task is modelled as a "transfer of liquid products – falling liquids". Operators are wearing chemically resistant overalls (Chemical splash coverall EN13034-6), gloves (triple dipped nitrile, 0.48 mm), and powered air respirator with full hood (filter type A2B2E2K 1Hg P). Between each sampling step the pipette is carried to the effluent treatment plant where it is carefully cleaned by flushing with water. This cleaning activity is described in task 4.

T7: Laboratory analysis

Samples taken from the (black) colouring and hardener tank are processed in the laboratory. The probes are rapidly diluted (1:1000) before further analysis. Within ART, this task was modelled as a 'transfer of liquid products – falling liquids'. Further, 'handling that reduces contact between product and adjacent air' and 'submerged loading' were selected in ART, since relatively small amounts of liquid are carefully transferred into bottles with a small opening. Handling of concentrated solutions for dilution takes about 15 minutes per week including measurement of surface tension of the solution of the hardening tank. Other analytical investigations are performed with the diluted probes. Localised controls (fume hood) were assumed in ART modelling for production lab analyses. PPE are overall (Chemical splash coverall EN13034-6), safety glasses and nitrile gloves (0.14 mm).

Besides the laboratory activities directly associated with the handling of concentrated Cr(VI) liquids the chemist performs several other activities in the laboratory, where also his desk stands. This means that the chemist is exposed to the laboratory atmosphere, even in case he does not directly handle any Cr(VI) containing liquids. This will be reflected in the exposure assessment for this task.

T8: Addition of mist suppressant

As there are no LEVs installed above the hardener tanks mist suppressants are added to the tanks to prevent mist generation during cathodic hardening (formation of bubbles due to hydrogen generation during hardening which move to the surface and burst on the surface). Frequency of addition of mist suppressant is dependent on the outcome of the analysis of the surface tension of the tank solution and on the Cr concentration measured closely above the tank (about 20 cm above the surface using a personal pump fixed at the edge of the tank). The mist suppressant (250 mL) is carefully filled from a jar into the tank. The mist suppressant is automatically mixed with the solution during colouring. This task cannot be modelled within ART, as the liquid decanted is not containing Cr(VI). Therefore, exposure assessment is based on monitoring data. PPE to protect from the acidic liquid in the tank are overall (Chemical splash coverall EN13034-6), safety glasses and nitrile gloves (0.14 mm).

T9: Operating effluent treatment plant

During colouring of stainless steel substantial amounts of waste water are generated, e.g. due to washing and rinsing activities. All the waste water is collected in a sump and transferred to the effluent treatment plant located close to the sump. In the effluent treatment plant the waste water is reduced by the addition of sodium metabisulphite ($Na_2S_2O_5$). Generated chromium (III) is precipitated using an aquatic solution of $Ca(OH)_2$ (lime). One operator is responsible to keep the effluent treatment plant running. Main activities are controlling the liquid flows, the addition of reducing and precipitating agents, controlling the automated process, and taking samples of the waste water. The operator supervising the effluent treatment plant is engaged in this part of the plant about 40-50% of his workday, without directly handling Cr(VI) containing liquids. This activity cannot be modelled within ART, exposure is estimated on basis of the monitoring data. PPE are overall (Chemical splash coverall EN13034-6), safety glasses and nitrile gloves (0.14 mm).

T10: Tank fill up - operational activity close to the colouring lines

Before shift operators start working the tanks of the colouring line are filled up every morning. To this end, water is transferred from the rinse tanks to the (black) colouring and hardener tank. This activity is performed semi-automatically by pumps which have to be turned on and off. Additionally, the operator equalises the temperature

of the solutions in the (black) colouring and hardener tank, a process supported by air agitation or a pump. This process takes about 45 minutes every morning. During this process there is no contact with the Cr(VI) containing liquids, but the operator supervising this process is exposed to the general workplace atmosphere of the colouring lines. This activity is part of the operational activities close to the colouring lines. This activity cannot be modelled within ART, exposure is estimated on basis of the monitoring data only. PPE are overall (Chemical splash coverall EN13034-6), safety glasses and nitrile gloves (0.14 mm).

T11: Maintenance

Several maintenance activities have to be fulfilled to keep the process running. The maintenance operator is active in all areas of the production hall, including activities in the packaging area as well as in the area with the colouring lines or the effluent treatment plant. Maintenance activities are usually not associated with a direct contact with Cr(VI) containing liquids. Maintenance of the tanks with the chromium (VI) trioxide is infrequent (once in a year or once in five years) and no direct exposure due to such activities has to be considered for the calculation of the daily exposure. Exposure during maintenance is via contaminated air in the workplace. This activity cannot be modelled within ART, exposure is estimated on basis of the monitoring data only. PPE are at least overall (Chemical splash coverall EN13034-6), safety glasses and nitrile gloves (0.14 mm). If the situation requires it, the PPE would be adapted to the potential exposure situation.

T12: Waste handling (filter press)

Sludge generated in the effluent treatment plant by precipitating Cr(III) is transferred by pumps to a filter press to be separated from the waste water. The latter one is transferred to the municipal sewage drain. The sludge has to be removed from the filter press about two times per day. Filter presses are marketed as fully automatic systems and are supposed to run without intervention by the workers. Generally, the filter cake is removed from the press by gravity without any intervention by workers. In practice, however, workers have to scrape off some of the filter cake with a tool from time to time. The cake is still very wet ([redacted], otherwise gravity would not work) and exposure modelling within ART was therefore performed as “Paste, slurry or clearly (soaked) wet powder – Handling of contaminated solid objects or paste” that are not contaminated with powdered material. The filter cake is collected in skips and sent for special waste treatment (due to its nickel but not due to its Cr content). PPE are overall (Chemical splash coverall EN13034-6 and Paper overall - Chemsplash AV max Cat III type 4B, 5B & 6B), safety glasses and nitrile gloves (0.14 mm).

T13: Operating colouring line - controller

The colouring lines are run by several operators. Per colouring line one operator is responsible for the colouring process. He handles the pendant control by which the immersion time of the objects in the individual tanks is controlled. But sometimes he also supports the operators who are responsible for the loading and off-loading of the jigs. Usually, the controller is not in direct contact with Cr(VI) containing liquids. Exposure is via general workplace air. This activity cannot be modelled within ART, exposure is estimated on basis of the monitoring data only. PPE are work wear long sleeve polo top and ballistic trousers, gloves (ATG powerform S6 nitrile disposable. 0.14 mm).

T14: Operating colouring line - loading

During the loading of the jigs no handling of Cr(VI) containing objects takes place. Exposure is via general workplace air. This activity cannot be modelled within ART, exposure is estimated on basis of the monitoring data only. PPE are work wear long sleeve polo top and ballistic trousers, gloves (ATG Maxicut Ultra dotted. Abrasion 4, Blade 4, Tear 4, Puncture 2, Cut C. 1.10 mm).

T15: Operating colouring line - rinsing

Before off-loading the stainless steel components or before colour control the stainless steel components are carefully rinsed with water using a hose. This activity cannot be modelled within ART, exposure is estimated on basis of the monitoring data only. PPE are work wear long sleeve polo top and ballistic trousers and gloves (ATG powerform S6 nitrile disposable. 0.14 mm).

T16: Operating colouring line – off-loading

After rinsing the finished stainless steel objects they are off-loaded manually from the jigs and transported to the drying rack just behind the colouring line. Exposure is via general workplace air. This activity cannot be modelled within ART, exposure is estimated on basis of the monitoring data only. PPE are work wear long sleeve polo top

and ballistic trousers and gloves (ATG Maxicut Ultra dotted. Abrasion 4, Blade 4, Tear 4, Puncture 2, Cut C. 1.10 mm).

T17: Operating colouring line – colour control

After colouring and before hardening colour of the objects has to be controlled infrequently. Therefore the stainless steel components are moved to the loading area after leaving the rinse tank after the colouring step. [redacted] Exposure is via general workplace air. This activity cannot be modelled within ART, exposure is estimated on basis of the monitoring data only. PPE are work wear long sleeve polo top and ballistic trousers and gloves (ATG powerform S6 nitrile disposable. 0.14 mm).

T18: Activities in packaging area

Besides the activities near the colouring lines several worker are concerned with the preparation of the stainless steel components for the colouring process and with the packaging of the stainless steel components for the subsequent transport. These operators are not in contact with any chromium (VI) containing liquids or objects. But, as the production hall contains both areas, packaging and colouring without separated control of workplace atmosphere the workers of the packaging unit may also be exposed to chromium (VI) in the workplace air. This activity cannot be modelled within ART, exposure is estimated on basis of the monitoring data only. PPE are work wear long sleeve polo top and ballistic trousers and gloves (ATG Maxicut Ultra dotted. Abrasion 4, Blade 4, Tear 4, Puncture 2, Cut C. 1.10 mm).

Critical input parameters

This section describes the critical input parameters for the tasks to be modelled by ART. The critical input parameter values are based on the observations made and the information collected during the site visit. Note that maximum values and realistic estimates are reported in the table below. The realistic estimate is based on the estimate of the operators/plant manager who are familiar with the process. The following approach was selected for the input values (except where indicated otherwise):

- maximum values for the chromium (VI) trioxide concentration (and Cr(VI) concentration calculated from it)
- realistic estimate for the exposure duration
- realistic estimate for the task frequency
- realistic estimate for most of the other input parameters (e.g. room volume) and air changes were used; in the absence of measured data a ‘median’ value of 3 air changes per hour (ACH) were assumed as a typical value for the use to be covered by this CSR. During the workday the production hall gates are widely opened which facilitates air changes. In addition, the air changes per hour only have a limited effect on the near-field task-based concentration in large workrooms. For a room volume of 1000 m^3, for example, the concentration modelled in ART with 0.3 ACH is only 1.4-times higher than the one modelled with 10 ACH for dusts/mists (i.e. low volatile liquids as is relevant here) during a 8-hour task (Fransman et al., 2010).

Table 7. Critical input parameters (bold print indicates values used in modelling)

	Unit	Range	Realistic estimate	Max.	Source/comment
Task 1 Decanting of a solid					
CrO_3	kg	[redacted]	[redacted]	[redacted]	Site visit, number of 25 kg drums to be handled per week varies between [redacted] drums being an average value for the number of drums to be handled per week
Cr(VI)	kg	[redacted]	[redacted]	[redacted]	Calculated from CrO_3 amount handled
Duration	min	[redacted]	[redacted]	[redacted]	Site visit; values reflect duration of decanting solid (max. 1 min per drum)
Frequency	d/a	48-72	48	**72**	Site visit; Typically tank make up takes place once a week, but not all CrO3 containing tanks need to made up every week; only during periods of very high activity more than weekly tank make ups are necessary; in a conservative manner a frequency of 72 days per year are assumed to account for high production periods
Room volume	m^3	9000		9000	Site visit; volume of production hall; assumed in ART 3000 m^3 as highest volume available
Transfer rate	kg/min		**25 kg/min**		Site visit; duration for one 25 kg drum: about 1 min
Task 6 Tank sampling					
CrO_3 concentration	g/L	[redacted]		[redacted]	Site visit; concentration colouring and hardener tank: [redacted] g/L; concentration black colouring tank: [redacted] g/L; highest concentration was selected as worst case assumption
Density of solution	g/L	[redacted]		[redacted]	Site visit; densitiy of black colouring, colouring and hardener tank; lowest density was selected as worst case assumption
Cr(VI) concentration	%			[redacted]	Calculated from the above, worst case assumption
Room volume	m^3	4000-9000	**4000**	9000	See task 1
Duration	min	15-30	**15**	30	Site visit; average value
Frequency	d/a	48			Site visit; sampling and cleaning of glas pipettes takes place once per week
Transfer rate	L/min	0.25	**0.25**	0.25	Site visit; 250 ml was transferred in less than 1 min; ART input **0.1-1 L/min** (for "filling of bottles") selected, covers situation of applicant
Task 7 Laboratory analysis					
CrO_3 concentration	g/L	[redacted]	[redacted]	[redacted]	Site visit; concentration colouring and hardener tank: [redacted] g/L; concentration black colouring tank: [redacted] g/L; highest concentration was selected as worst case assumption
Density of solution	g/L	[redacted]	[redacted]	[redacted]	Site visit; densitiy of black colouring, colouring and hardener tank; lowest density was selected as worst case assumption
Cr(VI) concentration	%		[redacted]	[redacted]	Calculated from the above, worst case assumption
Room volume	m^3	55	**55**		Site visit: ART input 30 m^3 was selected which covers situation of applicant (actual room size about 55 m^3); ART input 'mechanical ventilation giving at least 1ACH' covers situation of applicant
Duration	min	15-30	**15**	30	Site visit; average value for the handling of the concentrated liquid

	Unit	Range	Realistic estimate	Max.	Source/comment
Frequency	d/a	48			Site visit; dilution and handling of concentrated liquid takes place once per week
Transfer rate	L/min	< 0.1	< 0.1	< 0.1	Site visit; 1 ml was transferred in less than 1 min; ART input <0.1 L/min (for "filling of bottles") selected, covers situation of applicant
Task 12 Waste handling (filter press)					
CrO_3 concentration	g/L	[redacted]		[redacted]	Maximum amount, assuming that no reduction and no dilution took place
Density of solution	g/L	[redacted]		[redacted]	Maximum amount, assuming that no reduction and no dilution took place
Cr(VI) concentration	%			[redacted]	See task 6; this concentration was also applied to filter cake, which represents a very conservative assumption; values in waste water before transfer to filter cake are mostly <0.1 %; no refinement necessary as model output is independent from this parameter
Duration	min			**60**	On average 1 hour per day; this duration refers to actual manual intervention of the worker at filter presses.
Frequency	d/a			**240**	
Room volume	m^3			**outdoors**	

Exposure assessment for all other tasks will be solely based on monitoring data.

9.1.1.7 Consumers

Exposure assessment is not applicable as there are no consumer-related uses for the substance.

9.2 Use 1: Use at industrial site - Use of chromium trioxide as an oxidising and hardening agent in the manufacture of coloured stainless steel.

9.2.1 Introduction

9.2.1.1 Relationship to previous application

As outlined above, this CSR refers to the initial EU Application ID: 0056-01 (EU Authorisation number: REACH/17/12/0), which has been grandfathered from EU REACH to UK REACH (UK Authorisation number: 02UKREACH/17/12/0).

The European Commission issued several obligations with the initial authorisation. Table 8 compares the initial and the current applications in a concise way, while the individual exposure scenarios describe the measures already implemented.

Table 8. Obligations in EC Implementing decision

Initial application 0056-1	Current application
The AH shall conduct regular occupational exposure measurements which i) take place at least annually ii) are based on relevant standard methodologies or protocols iii) ensure a sufficiently low detection limit iv) comprise both static and personal inhalation exposure sampling v) are representative of the range of tasks with possible exposure to chromium (VI) and the total number of workers that are potentially exposed	i) annual monitoring campaigns were carried out with the exception of 2020 (Corona pandemic) ii) appropriate methods were applied: stationary monitoring: sampling according to method IFA 6665, analysis according to ISO 16740:2005; personal monitoring according to BS ISO 16740:2005 (Durapore PVDF filter) iii) detection limit for stationary monitoring: 0.02 µg/sample (about 0.1 ng/m3); detection limit for personal monitoring: 0.1 µg (about 100 ng/m3; see Annex 2) iv) stationary monitoring values cover the complete production hall including the packaging unit and the filter press outside; personal monitoring values cover all Cr(VI) related tasks like operations along the colouring lines, and the handling of Cr(VI) containing solutions (for details see Annex 2)
The AH shall regularly, and at least annually, measure emissions of chromium (VI) to ambient air	Annual measurements performed (for details see Annex 3)
The AH shall use the information gathered in the occupational and air emission measurements to regularly review the effectiveness of the risk management measures and operational conditions and to take action, as appropriate, to reduce exposure of workers and emissions to the ambient air.	Monitoring results were carefully analysed and permanent activities to improve the risk management measures as well as the operational conditions were implemented. Main operational improvements was the redistribution of tasks so that as few workers as possible came into contact with the CrVI-containing solutions (for details see **Table 10**).
	Even though it was not required in the permit, the wastewater is closely monitored with regard to its Cr(VI) content.

AH: authorisation holder

Technical improvements

The following table summarises the improvements introduced during the past years. Significant improvements include the installation of a dividing curtain to better protect the hall area where only packaging takes place, as well as the installation of new roof fans, which have significantly increased air exchange in the hall. The extraction processes are continuously maintained and, if necessary, defective parts are replaced in order to achieve the most efficient extraction possible. Back in 2018, tank mixing using air was replaced by a so-called 'eductor mixing system'[6] in order to achieve mixing with the lowest possible emissions. In the same year, pumps were purchased by Rimex so that the stationary measurements used for the AfA could be continued without interruption. The analyses were carried out by the same laboratory (Eurofins) as for the AfA measurements. Most recently, four air purification units were installed in the production hall in June 2025. These units draw in air and pass it through chemical. electrostatic and Hepa filters expelling clean air. The 4 units are positioned in the production hall so their air drawing in radius completely covers the colouring lines. These units process 2500 m^3 of air 24 hours a day 7 days a week.

Table 9. Improvements over the years

Year	Technical improvement	Operational conditions
2016		1) Introduction of long sleeved workwear
2017	1) Line guarding installation using metal and perspex panels - provides protection against accidental splashes also shields Cr(VI) emissions from operators 2) Installation of dividing curtain 3) New roof fans installed over line 1 + 2 - air changes per hour increased to 22 from 3	
2018	1) Extraction on colour line 1 and 2 2) Eductor mixing system on Lines 1 ~~+ 2~~ replacing air agitation 3) JUNG high volume air monitor procured	1) Introduction of Derma shield skin protectant 2) Began using Nitrile surgical type disposable gloves under the cut resistant gloves
2020	1) Line 2 lip extraction replaced	
2023	1) Lip extraction on Line 3 replaced 2) Motor replaced on extraction system for Line 1 and line 2	
2025	1) Installation of 4 air purification units	

9.2.1.2 Overview of use and exposure scenarios

9.2.1.2.1 Deviations from the exposure scenarios and contributing scenarios in the original submission

This review report essentially describes the same work and individual activities (tasks) as the original CSR. However, due to organisational optimisations, there were slight shifts in the individual tasks between the worker groups. In the original CSR, workers were divided into so-called 'types of workers' according to their tasks and activity profiles. The wording has changed in the review report so that it no longer refers to 'types of workers' but to 'similar exposure groups' (SEGs). The following table compares 'types of workers' and 'similar exposure groups' with their respective assigned tasks. For better comparability, the tasks in this review report have been numbered in the same way as in the original CSR.

[6] Pressurized liquid is pumped into the eductor. As the liquid exits at high velocity, it draws surrounding solution through the eductor's flow-through chamber. This additional liquid flow mixes with the pumped solution and multiplies its volume.
Eductors are designed for in-tank mixing of liquids using a liquid as the motive fluid. Mixing is accomplished first within the eductor as the motive liquid entrains the tank contents into the suction openings, and thoroughly mixes within the unit before being discharged. The discharge flow, or plume, provides further mixing and agitation within the tank. For each litre of motive liquid, 5 litres are discharged in an 11° plume.

- The ‘type of workers’ ‘colouring line’ was split into two SEGs: colouring line operator and end of line operator due to the significantly different tasks performed by both groups. The colouring line operator sometimes performs the tasks of an end of line operator, but the end of line operator is only ever involved in loading and unloading the carriers before and after colouring the stainless steel, never in tasks along the colouring line.
- The previously separate types of workers of the supervisor and plant manager were now considered together with the foreman as one SEG, as these employees have no direct contact with chromium (VI) containing solutions. The plant manager no longer performs Cr(VI) related activities while the plant chemist is on holiday. Actually, the plant chemist and technician share these types of activity.
- The groups of the chemist, packaging unit workers and maintenance workers still exist, the wording of the groups changed minimally. Most importantly, the maintenance workers are part of the company’s maintenance team and only perform maintenance activities, no more activities related to the handling of Cr(VI) containing solutions. Tasks, related to the handling of Cr(VI) containing solutions, that were previously performed by maintenance workers (Tasks 10, 11, 12) are now performed by the plant chemist and technician. The latter also partially control the colouring process (Task 13).

Table 10. Comparison of ‘types of workers’ (previous CSR) and ‘similar exposure groups’ (this review report)

Previous CSR		**Current Review Report**	
Type of workers	**Tasks performed by the specific type of workers**	**Similar exposure groups**	**Tasks performed by a specific similar exposure group**
Colouring line	**Task 13** – controller **Task 14** – loading **Task 15** – rinsing **Task 16** – off-loading **Task 17** – colour control	Colouring line operator	**Task 13** – controller **Task 14** – loading **Task 15** – rinsing **Task 16** – off-loading **Task 17** – colour control
		End of line operator	**Task 14** – loading **Task 16** – off-loading
Chemist	**Task 7** – Laboratory analysis **Task 8** – Addition of mist suppressant **Task 9** – Operating effluent treatment plant The following activities were shared with a maintenance worker **Task 1** – Decanting of a solid **Task 2** – Dissolution of solid chromium (VI) trioxide in tanks **Task 3** – Refilling of bath-liquids **Task 4** – Cleaning of solid chromium (VI) trioxide with a hose **Task 5** – Cleaning of equipment **Task 6** – Tank sampling	Colouring plant chemist and technician	**Task 1** – Decanting of a solid **Task 2** – Dissolution of solid chromium (VI) trioxide in tanks **Task 3** – Refilling of bath-liquids **Task 4** – Cleaning of solid chromium (VI) trioxide with a hose **Task 5** – Cleaning of equipment **Task 6** – Tank sampling **Task 7** – Laboratory analysis **Task 8** – Addition of mist suppressant **Task 9** – Operating effluent treatment plant **Task 10** – Tank fill up – operational activity close to the colouring lines **Task 11** – Maintenance **Task 12** – Waste handling (filter press) **Task 13** – controller
Packaging unit	**Task 18** – Activities in	Packaging unit operator	**Task 18** – Activities in

Previous CSR		Current Review Report	
Type of workers	**Tasks performed by the specific type of workers**	**Similar exposure groups**	**Tasks performed by a specific similar exposure group**
	packaging area		packaging area
Maintenance	**Task 10** – Tank fill up – operational activity close to the colouring lines **Task 11** – Maintenance **Task 12** – Waste handling (filter press) Additional activities for trained maintenance workers **Task 1** – Decanting of a solid **Task 2** – Dissolution of solid chromium (VI) trioxide in tanks **Task 3** – Refilling of bath-liquids **Task 4** – Cleaning of solid chromium (VI) trioxide with a hose **Task 5** – Cleaning of equipment **Task 6** – Tank sampling	Maintenance manager and maintenance worker	**Task 11** – Maintenance
Supervisor	No task assignable	Colouring plant manager, foreman, supervisor	No specific Cr(VI) related task
Plant manager	Indirect exposure, and exposure due to Tasks 1, 2, 3, 4, 5, 6, 7, 8, 9 during part of the year (deputy of chemist during holidays)		

Fundamentally, nothing has changed in the process in comparison to the previous CSR. However, a few organisational changes have been made to minimise the number of people who come into contact with solutions containing Cr(VI), see table above. As before, there are only a few tasks that involve direct handling of Cr(VI) or solutions containing Cr(VI). In most cases, exposure in the production hall due to emissions from Cr(VI)-containing baths must be taken into account. This is done by means of appropriate measurements (stationary and personal).

9.2.1.2.2 Scope of use

Sector of use:
SU 15, Manufacture of fabricated metal products except machinery and equipment

Table 11. Overview of exposure scenario and their contributing scenarios

Identifiers	Titles of exposure scenario and the related contributing scenarios	Environmental release category (ERC)/ Process category (PROC)
ES1 - IW1	Use at industrial site - manufacture of coloured stainless	

Identifiers	Titles of exposure scenario and the related contributing scenarios	Environmental release category (ERC)/ Process category (PROC)
	steel.	
Environmental contributing scenario		
ECS 1	Use of chromium trioxide as an oxidising and hardening agent in the manufacture of coloured stainless steel.	ERC 5
Worker contributing scenarios		
WCS 1	Colouring line operator	PROC 13,
WCS 2	End of line operator	PROC 13
WCS 3	Colouring plant chemist and technician	PROC 4, PROC 8b, PROC 9, PROC 13, PROC 15 PROC 28
WCS 4	Packaging unit operator*	Not applicable
WCS 5	Maintenance manager and maintenance worker	PROC 28
WCS 6	Supervisor/Foreman	Not applicable
WCS 7	Colouring plant manager	Not applicable

During the colouring process Cr(VI) is reduced to Cr(III), both during the (black) colouring and hardening step, i.e. there is no Cr(VI) present at the final product, the coloured stainless steel. Using the standard 'BS EN 15205: 2006 Determination of hexavalent chromium in corrosion protection layers. Qualitative analysis', tests have been undertaken on a range of products with varying surface finishes: Green Mirror, Red Canvas, Blue Mirror, Gold Vortex, Bronze BA. All samples passed the qualifying criteria of having <0.1 µg/cm^2, therefore all samples were deemed to be free from Cr(VI). Exposure from the handling of the final product therefore does not need to be considered in this report.

9.2.2 Detailed information on use

9.2.2.1 Process description

Chromium trioxide (CrO_3) is used as an oxidising and hardening agent in the manufacture of coloured stainless steel.

Colouring of stainless steel (CSS) takes place through immersion in a solution of chromic acid and sulphuric acid (H_2SO_4) at elevated temperatures ([redacted]). Chromic acid is immediately generated in aqueous solutions after addition of chromium (VI) trioxide (CrO_3), which is a strong oxidiser in the presence of sulphuric acid. Chromium (VI) trioxide forms a thin film of chromium (III) oxide (Cr_2O_3) on the surface of the stainless steel, i.e. the passive chromium oxide layer which gives stainless steel its corrosion resistance is thickened through the colouring process. Colouring takes place through thin film interference that occurs when light waves pass through the transparent passive layer. The immersion time of the stainless steel in the chromium trioxide containing acid solution determines the thickness of the colourless surface film, the light wave interference and the intense reflected colour effect. Different colours from gold, bronze, purple, blue, red, green and even black can be produced. [redacted] To make the soft and porous chromium (III) oxide layer (thickness below 1 µm) more durable an additional hardening step is necessary. Hardening takes place through cathodic treatment in a chromium trioxide containing acidic solution at ambient temperature.

Chromium trioxide has two roles in the colouring process: [redacted] Due to the cathodic reduction chromium (VI) is reduced to chromium (III) throughout the hardening process.

Colouring of stainless steel takes place in three colouring lines which are installed in parallel in the production hall of the applicant. Each colouring line is built up of several open tanks (e.g. for alkaline degreasing, colouring,

hardening, rinsing).

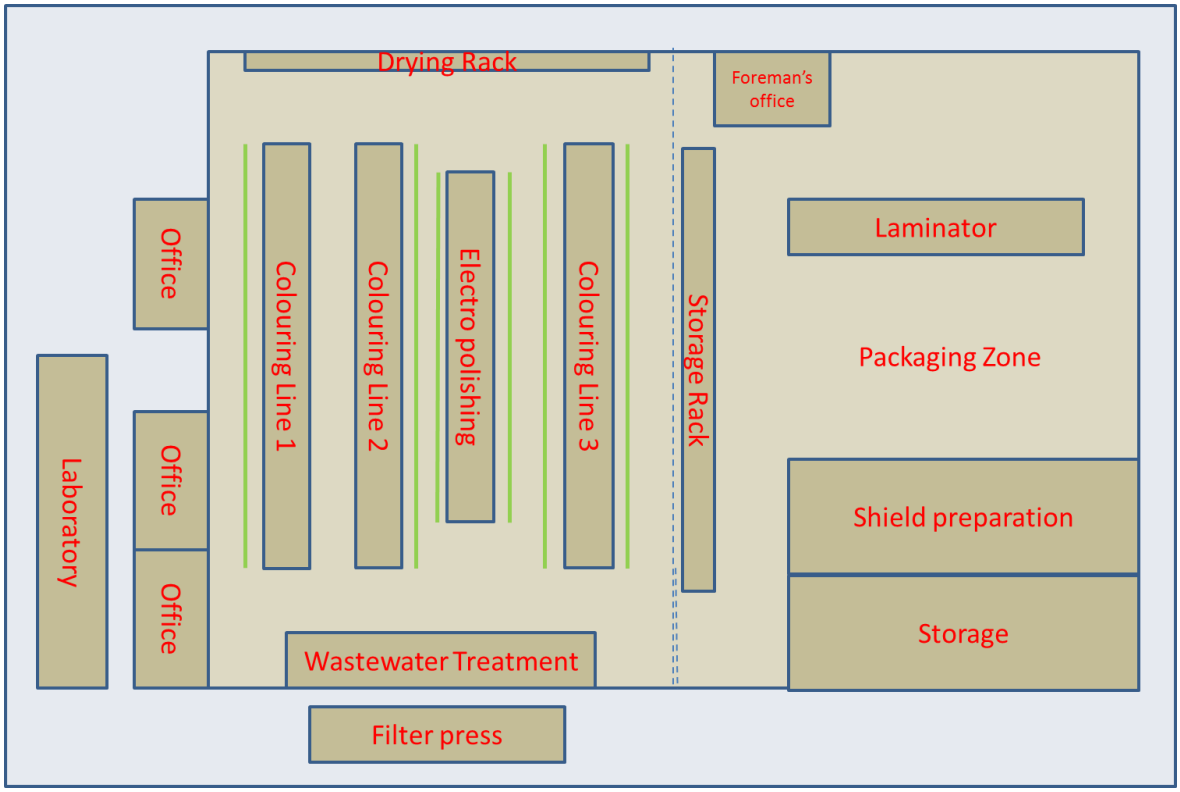
Stainless steel components are manually fixed on jigs located in front of the colouring line and then moved semi-automatically via a pendant controller along a transport bar to the single open tanks, immersed and after final washing removed back to the loading area. There, the stainless steel components are rinsed with water after finalisation of the colouring and moved on drying racks before they are transported to the packaging area where they are wrapped for transport.

Presence of chromium trioxide is technically relevant for the colouring or black colouring and the hardening. Due to the immersion of stainless steel components into heated chromium (VI) solutions in open tanks chromium (VI) emission to the workplace air is possible. To control production hall ventilation roof fans are in place. Additionally, some of the colouring tanks and the black colouring tanks are equipped with lip extractions to reduce chromium (VI) concentration in the production hall. Emission of spray or mist to the workplace atmosphere from the hardener tanks which are run without lip extraction or other local exhaust ventilation is reduced by addition of PFOS-free mist suppressing chemicals. Workers are spatially separated from the tanks by Plexiglas shields to prevent exposure to splashes as well as to aerosols and mist generated during immersion of stainless steel or cathodic hardening.

The process of CSS colouring at Rimex Metals (UK) Ltd. can be described in detail as following:

There are three colouring lines installed in parallel in the production hall of Rimex Metals (UK) Ltd. (see scheme in Dashed line: dividing curtain

Figure 1). Lines 1 and 2 are close together with a distance of about 2 m. Between line 2 and 3 the electropolishing line is located. [redacted]. No chromium (VI) is necessary for this activity. Colouring line 3 is located behind the electropolishing line and the distance to colouring line 2 is about 10 m. Colouring lines are shielded with Plexiglas to protect workers against splashes, especially from the acidic and alkaline liquids in the tanks. These Plexiglas shields are installed at the sites where the workers of the colouring lines usually are active during steering of the colouring process, i.e. on both sides of colouring line 3 and on one side of colouring lines 1 and 2 (for details see scheme). In the middle of colouring line 1 and 2 no Plexiglas shields are installed as this area is only entered by workers for very specific tasks of short duration like sampling or maintenance. Presence of Plexiglas shields would hinder these activities.



Dashed line: dividing curtain

Figure 1: Scheme of the production hall, green lines show where Plexiglas shields are installed

The colouring lines consist of different open washing, colouring and hardening tanks where the stainless steel components are immersed. The colouring lines are basically set up as follows (see Figure 2):

- Alkaline degreasing tank ([redacted])
- [redacted] rinse tank
- Colouring tank ([redacted])
- Rinse tank
- Black colouring tank ([redacted]
- Hardener tank ([redacted])
- 2-3 additional [redacted] rinse tanks

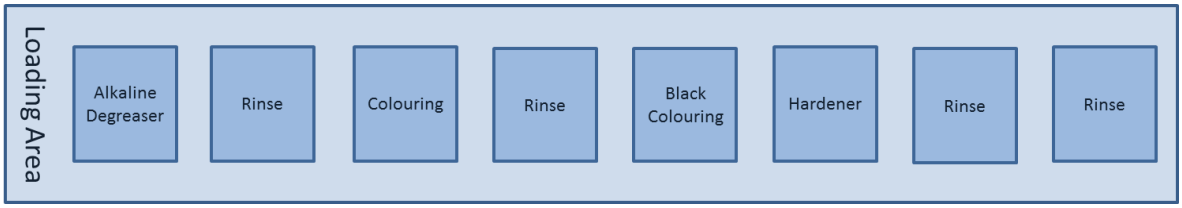


Figure 2: Generic scheme of colouring line

Figure 3: Confidential scheme of colouring lines

Black colouring tanks are only present in the colouring lines 1 and 3, but not in colouring line 2. Presence of chromium (VI) oxide is required in the colouring tank ([redacted] g/L chromic acid), the hardener tank ([redacted] g/L chromic acid) as well as in the black colouring tank ([redacted] g/L chromic acid). The colouring, hardener and black colouring tank also contain high concentrations of sulphuric acid ([redacted] g/L, [redacted] g/L and [redacted] g/L, respectively). Stainless steel components are manually fixed on jigs by operators standing in front of the alkaline decrease tank. The stainless steel components are then moved semi-

automatically along a transport bar to the single tanks. These transport bars are operated by trained shift workers, who walk along the colouring line, watch and control the process via a pendant controller. Depending on the colour to be yielded the stainless steel components are immersed into alkaline degrease, the rinse tank, the colouring tank or black colouring tank, another rinse tank, the hardener tank and to the final rinse tanks. By variation of the immersion time in the (black) colouring tank the final colour of the stainless steel can be determined. Overall colouring process for a single component can take up to [redacted], depending on the intended colour. If necessary, the stainless steel components are washed with a water hose after the colouring step and partially cleaned by wipes to control the colour with a hand reader. Depending on the result of this colour proof additional immersion time in the (black) colouring tank or direct immersion in the hardening tank will follow. [redacted] This process step is installed between colouring lines 2 and 3. After finalisation of the colouring the stainless steel components are washed with a water hose and then moved to drying racks which are located at the back site of the colouring lines. After drying they are moved to the packaging unit at the other end of the production hall, where they are packed for further shipment.

The packaging unit is located in the other half of the production hall which is separated from the colouring division by an open storage rack located about 2 m besides colouring line 3. Additionally, in September 2016 a dividing curtain was installed next to the storage rack on the side facing colouring line 3 (see Figure 19 in Annex 4). This plastic curtain minimises the exchange of air between the two parts of the production hall and helps the roof fans to become more efficient at extracting moist air from the process lines.

The colouring lines are set up with open tanks which are partially equipped with lip extractions. Lip extractions are installed on

- Line 1 black colouring tank (but not on colouring tank),
- Line 2 colouring tank,
- Line 3 black colouring and colouring tank.

There is no lip extraction on line 1 colouring tank due to the use of a pump to mix the liquid around rather than air agitation (best available technique to be installed in future at the other tanks too). Overall, workplace atmosphere is controlled by roof fans.

9.2.2.2 Teams and employees involved

During CSS handling of solid chromium (VI) trioxide and aqueous solutions of chromium (VI) oxide containing chromic acid is necessary which may be associated with exposure to chromium (VI). A number of activities with possible Cr(VI) exposure were identified. These activities are performed by different workers responsible for different work processes. We have identified similar exposure groups (SEGs) of workers and the SEGs are described in separate worker contributing scenarios (WCS). Each contributing scenario covers the relevant individual tasks performed by the respective group of workers. Further the individual tasks involving Cr(VI) exposure and the corresponding operating conditions (OCs) and risk management measures (RMMs) are described. The Cr(VI) exposure from these activities is quantified by (personal) air measurements or by modelling. In this way, Cr(VI) inhalation exposures from all relevant tasks performed by a SEG during its daily work are considered and combined for risk assessment.

The following SEGs/WCSs have been identified:

Table 12. Workers engaged in CSS production of the applicant

Worker contributing scenarios	Total number of workers per WCS	Exposed? Y/N	Tasks performed by WCS
WCS 1: Colouring line operator	3	Y	Tasks 13, 14, 15, 16, 17
WCS 2: End of line operator	5	Y (indirect)	Tasks 14, 16
WCS 3: Colouring plant chemist and technician	2	Y	Tasks 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
WCS 4: Packaging unit operator*	5	Y (indirect)	Task 18
WCS 5: Maintenance manager and	4	Y (indirect)	No specific Cr(VI) related task

maintenance worker			
WCS 6: Colouring supervisor/foreman	2	Y (indirect)	No specific Cr(VI) related task
WCS 7: Colouring plant manager	1	Y (indirect)	No specific Cr(VI) related task
Total	**22**		

* including activities like fork lift driving, mirror polishing, etching, coating and packing; Y (indirect): exposure via Cr(VI) present in air of production hall, but these workers have no direct contact to Cr(VI) containing material/solids/liquids

The following activities/tasks are carried out by the operators (see table above for the assignment to the individual WCSs). For each task identified as potentially being associated with some exposure a process category was assigned. These PROCs primarily serve for orientation but are not key in the exposure assessment performed here, since the monitoring data used in the exposure assessment as well as ART (Advanced Reach Tool) modelling performed in addition are completely independent of PROCs. A detailed description of the tasks performed by workers, the rationale for PROC assignment as well as details on the approach to exposure estimation is given in section 9.1.1.5.

- Manual decanting of solid chromium (VI) trioxide into mesh basket during tank make up (**Task 1, Decanting of a solid**, PROC 8b)
- Dissolution of chromium (VI) trioxide filled into the mesh baskets in the colouring, black colouring and hardening tank using a pendant controller (**Task 2, Dissolution of solid CrO_3 in tanks**, PROC 8b)
- Filling of concentrated sulfuric acid from a plastic drum into tanks using a hand pump (**Task 3, Re-filling of bath-liquids**, PROC 8b)
- Cleaning of solid chromium (VI) trioxide with a hose after tank make up including cleaning of the work area and cleaning of the drums (**Task 4, Cleaning of solid CrO_3 with a hose**, PROC 28)
- Cleaning of equipment like sampling pipettes or hand pumps submerged into Cr(VI) containing liquids after end of activity (**Task 5, Cleaning of equipment**, PROC 28)
- Sampling of Cr(VI) containing liquids for laboratory analysis (**Task 6, Tank sampling**, PROC 9)
- Analysis of Cr(VI) containing liquids for process control and control of effluent treatment plant (**Task 7, Laboratory analysis**, PROC 15)
- To minimise mist generation above the hardener tank (where formation of bubbles due to hydrogen generation during hardening takes place which move to the surface and burst on the surface) liquid is added to the hardener tank (**Task 8, Addition of mist suppressant**, PROC 8b)
- Cr(VI) containing waste water is treated on site to reduce Cr(VI) to Cr(III) (**Task 9, Operating effluent treatment plant**, PROC 4)
- Delivery, storage and transport of chromium (VI) oxide in clip-top steel drums with a forklift (no exposure as drums are closed)
- Tank fill-up of the colouring, black colouring and hardening tank every morning by semi-automatically pumping water from the rinse tank to the aforementioned tanks **(Task 10 , Tank fill up - operational activity close to the colouring lines**, PROC 4)
- Maintenance activities in the production hall including activities in the section with the colouring lines and the packaging unit (**Task 11, Maintenance**, PROC 28)
- Emptying of filter Press (**Task 12, Waste handling (filter press)**, PROC 8b)
- Activities along the colouring lines to keep the colouring process ongoing
    - **Task 13, Operating colouring line – controller**, PROC 13
    - **Task 14, Operating colouring line - loading**, PROC 13
    - **Task 15, Operating colouring line - rinsing**, PROC 13
    - **Task 16, Operating colouring line – off-loading**, PROC 13
    - **Task 17, Operating colouring line – colour control**, PROC 13
- Packaging of CSS (**Task 18, Activities in packaging area**)

Irregular tasks like emptying process tanks which may take place only once in a few years are not modelled as they are not frequent enough to contribute to daily TWA.

9.2.3 Environmental contributing scenario 1

As chromium trioxide is not listed in EU REACH Annex XIV due to environmental effects, no environmental exposure assessment is performed here. However, human exposure via the environment is assessed and the local releases assumed in this context are shown in the following table (see section 9.2.3.2 for a justification of these values).

9.2.3.1 Conditions of use

Table 13. Conditions of use – environmental contributing scenario 1

Product (article) characteristics
▪ Solid CT (flakes or powder), pure substance or mixture (up to 100%); **max. 52% Cr(VI)**
Amount used, frequency and duration of use (or from service life)
▪ Daily use at site: up to [redacted] (range 1-10) kg/day [as Cr(VI)] ▪ Annual use at a site: up to [redacted] (range 1000 – 10,000) kg/year [as Cr(VI)] ▪ Batch process ▪ 286 days/year (see section 9.2.3.2)
Technical and organisational conditions and measures
All products: ▪ **Technical measures** o Air - Chemical treatment baths are equipped with LEV - No waste air treatment o Wastewater - Wastewater occurs from bath solutions, water from drag-out tanks, rinsing water, cleaning water, liquid from secondary containment pits, and liquid hazardous waste from the laboratory - Cr(VI)-containing wastewater is gathered and treated on-site in a reduction facility, where Cr(VI) in wastewater is reduced to Cr(III) by addition of a reduction agent (sodium metabisulphite ($Na_2S_2O_5$)), followed by precipitation with lime - Reduced wastewater is sent to an external sewage treatment plant (STP) o Soil - The indoor and outdoor surfaces where chemicals are handled are sealed and if chemicals and solid waste containing Cr(VI) are stored outside then it is only in closed containers - Tanks are surrounded by secondary containment pits, and liquids collected in the pit are sent to the wastewater collection tank ▪ **Organisational conditions and measures** o Air - Cr(VI) air emission measurements are regularly performed at identified exhaust stack(s) where the process emissions are released o Wastewater - Reduction of Cr(VI) in wastewater is controlled regularly by Cr(VI) measurements - Batches of reduced wastewater are discharged only after confirmation of Cr(VI) reduction to a concentration below the permitting limit (in accordance with the local regulatory requirements)
Conditions and measures related to sewage treatment plant
▪ Biological (municipal) STP: Standard STP (removal rate: 50% to sludge assumed, see description in section 9.1.1.4) ▪ Sludge application to agricultural soil: in most cases not; however, as it is not ascertained in all cases, for a conservative assessment sludge application is assumed ▪ Discharge rate STP: 232 656 m^3/day (see section 9.2.3.2) ▪ Dilution factor for receiving water body: 1.03 (see section 9.2.3.2)
Conditions and measures related to treatment of waste (including article waste)

All products: ▪ Filter cake from the wastewater reduction plant only contains Cr(III) (since, even if the reduction were incomplete, residual Cr(VI) is readily soluble in water and would be found in the water phase) and is forwarded to an external waste management company (licensed contractor) for disposal as waste. ▪ Other solid hazardous waste contaminated with Cr(VI) such as contaminated wipes, and PPE (e.g., gloves), contaminated equipment or empty chemical containers (canisters, bags, drums) are usually also disposed as hazardous waste. This hazardous solid waste is stored in closed drums and containers and forwarded to an external waste management company (licenced contractor) for disposal as hazardous waste.
Other conditions affecting environmental exposure
All products: ▪ Process temperature of the treatment baths ([redacted]°C)
Additional good practice advice. Obligations according to Article 37(4) of EU REACH do not apply
▪ None

Colouring lines are organised in a way that all waste water (process water, rinse water) is collected by a drainage system which leads the waste water to a bunded waste water sump (reservoir with open surface beyond the floor), located at the end of the colouring lines. The waste water is then transferred to the bunded effluent treatment plant close to the sump. In the effluent treatment plant the waste water is chemically treated with sodium metabisulphite (Na2S2O5) to reduce chromium (VI) to chromium (III). Chromium (III) is subsequently precipitated using an aquatic solution of $Ca(OH)_2$ (lime). The suspension with the precipitated chromium (III) is then directed to a filter press where the sludge is removed and transferred to a waste deposit. (The sludge has to be treated as hazardous waste due to its nickel content but not due to its chromium content, as it only contains Cr(III)). The remaining waste water with chromium (VI) concentrations usually below the limit of quantification (3 µg/L) is led into the municipal sewage drain from where it enters the municipal sewage treatment plant.

9.2.3.2 Releases

Releases to air

Emissions to air are calculated from measurements performed on stack emissions at the site. Air emissions from all relevant stacks are monitored at the site once per year. Monitoring of total chromium is performed in accordance with EN 14385 by a laboratory accredited according to ISO 17025, UKAS and the certification scheme of the UK Environment Agency (MCERTS). Samples were analysed by ICP-MS. As it is not possible to quantify the Cr(VI) content in the total chromium measurement, we conservatively assume that the measured concentrations are equivalent to Cr(VI). The annual air emissions from the three treatment lines for the years 2019-2024 are presented in the following table. Please note that all measurements from 2020 and the measurement at line 1 from 2022 were not taken into account for calculating the arithmetic mean (AM) emission over the years 2019-2024. For 2020, the measured Cr(VI) concentrations were inexplicably high, and they are considered as outliers, which becomes obvious in comparison to the measurements from the other years (between factor 8 and factor 23 higher than the AM over the years 2019-2024). One explanation for these unusual high values might be that the tank solution level was over the maximum board gauge mark, which led to solution being taken into the lip extraction. In 2022, bath agitation was operated by mistake on line 1 during the emission measurement, which is usually not running and is not representative of the operational conditions at this line. The individual measurements for the individual treatment lines are provided in Annex 3 to this CSR.

Table 14. Annual Cr(VI) air emissions

Year	Emission [kg/year]			
	Line 1	Line 2	Line 3	Sum
2019	[redacted]	[redacted]	[redacted]	[redacted]
2020	[redacted]	[redacted]	[redacted]	[redacted]
2021	[redacted]	[redacted]	[redacted]	[redacted]
2022	[redacted]	[redacted]	[redacted]	[redacted]
2023	[redacted]	[redacted]	[redacted]	[redacted]

2024	[redacted]	[redacted]	[redacted]	[redacted]
Arithmetic mean (2019-2024, excluding outliers)				

All values rounded to three significant figures, but unrounded values were taken for calculation.

* Considered as outlier, see explanation above.

The AM Cr(VI) emission for the years 2019-2024 (excluding outliers) is [redacted] kg/year. Dividing this release by the AM use amount of Cr(VI) over the years 2019-2024 [redacted] kg/year) results in a release fraction to air of 4.78 x 10^{-03}.

The exposure-risk relationship derived by ECHA (2013) for inhalation exposure of the general population identifies a concentration of 0.0345 ng/m^3 to be associated with a risk of 10^{-6}. While such a concentration may theoretically be measured with current sampling and analytical methods (i.e. based on blind values of instruments), experience with real samples suggest that the true limit of detection for Cr(VI) in ambient air samples is considerably higher, e.g. 0.45 ng/m^3 (Gladtke et al., 2012). As a consequence of these considerations, ambient air monitoring around the sites was not performed.

However, in the context of the workplace monitoring activities outside samples were taken on the plant premises approximately 25 m from the production hall (on average one sample downwind and one upwind, i.e. two samples per year). Sampling and analytical procedures were identical to the ones for the stationary occupational monitoring. The results for the years 2018, 2019, 2021, 2022, 2023, and 2024 are summarised in Annex 2. The AM for all downwind and upwind measurements is 3.14 ± 3.44 ng Cr(VI)/m^3 and the median is 1 ng (Cr(VI)/m^3 with a minimum of < LoQ and a maximum of 9.25 ng Cr(VI)/m^3. The values are therefore at least a factor of 1000 below the measured emission values for total chromium. These stationary monitoring values would thus correspond to a local PEC of 3.14 ng Cr(VI)/m^3.

EUSES modelling using the release fraction derived above resulted in a local PEC air of 10 ng Cr/m^3. This is considered to be an overestimate for the following reasons:

- The estimate is based on total chromium emissions to air. As outlined in section 9.2.2, the technical function of chromium trioxide in the use applied for involves reduction of Cr(VI) to Cr(III). It can therefore be expected that chromium emissions to air will also contain some Cr(III). However, no quantitative differentiation can be made since the measurement of stack emissions only determined total chromium levels.
- The monitoring data in the vicinity of the production hall demonstrate that Cr(VI) concentrations are actually lower. They point to a threefold lower local PEC air for Cr(VI).

Overall, the local PEC air of 10 ng Cr/m^3 is about fourfold higher than the local PEC air calculated by EUSES in the CSR of the original application (2.28 ng Cr/m^3). The difference may be due to the fact that only measurement data from one year was available for the original CSR, whereas much more representative data for the years 2018 to 2024 was used for the review report. However, the higher value for air emissions may also be due to improved air extraction in the production hall.

Releases to water

The releases to water are based on monitoring data in the effluent of the plant that is sent to the external sewage treatment plant (STP). Effluents from the site are regularly monitored for total chromium as well as Cr(VI) by an external laboratory accredited according to ISO 17025 and UKAS. Weekly mixed composite samples of the plant effluent are taken and analysed for Cr(VI) by discrete colorimetric analysis. The limit of detection (LoD) of the method is 3 µg/L. Approximately 50 measurements are available per year. The statistical analysis of the results is presented in the following table.

Table 15. Cr(VI) concentrations in wastewater (prior to STP)

Year	N (Number of samples)	N < LoD	% < LoD	AM Cr(VI) concen-tration [mg/L]	Median Cr(VI) concen-tration [mg/L]	P90 Cr(VI) concen-tration [mg/L]	Effluent discharge rate [m^3/year]	Emission based on AM Cr(VI) concentration [kg/year]
2019	50	30	60%	[redacted]	[redacted]	[redacted]	1410	[redacted]
2020	41	24	59%	[redacted]	[redacted]	[redacted]	1592	[redacted]
2021	54	44	81%	[redacted]	[redacted]	[redacted]	1357	[redacted]
2022	50	37	74%	[redacted]	[redacted]	[redacted]	984	[redacted]
2023	51	29	57%	[redacted]	[redacted]	[redacted]	758	[redacted]
2024	51	30	59%	[redacted]	[redacted]	[redacted]	651	[redacted]
AM 2019-2024	50	32	65%	[redacted]	[redacted]	[redacted]	1083	[redacted]

AM: Arithmetic mean; P90: 90th percentile

* All values below the LoD were included in the calculation with ½ of the LoD (1.5 µg/L).

These data show that half of the measurements (50 %) are below the limit of detection of 3 µg/L. The AM concentration is [redacted] µg Cr(VI)/L. The AM effluent discharge rate over the years 2019-2024 is 1083 m^3/year. Wastewater is discharged on average 5.5 days/week (discharge on Saturdays only every second week), based on which 286 release days per year are calculated. The discharge rate is recorded on every release day.

The annual AM Cr(VI) concentration in wastewater is multiplied by the annual effluent discharge rate, which results in an AM for water emissions over the years of 2019-2024 of [redacted] g/year (AM of annual emissions). Dividing this release by the AM use amount of Cr(VI) over the years 2019-2024 [redacted] kg/year) results in a release fraction to water of 2.35×10^{-06}.

This calculated release fraction is conservative, since – due to the high number of non-detects – the AM Cr(VI) concentration is dependent on the LoD of the analytical method. A lower LoD and a similar fraction of data points below the LoD would result in a substantially lower AM concentration.

STP discharge rate and river flow rate

The wastewater from the site is sent to an external STP (Deephams sewage work, run by Thames Water Ltd.). The STP discharge rate was reported by the UK Environment Agency as the permitting authority of the municipal STP.

STP discharge rate: 232 656 m^3/d

From the external STP the wastewater is released to the river [redacted], at the release point [redacted], as specified by the UK Environment Agency as the permitting authority of the municipal STP. The river flow rates at this release point are recorded and published by the Department for Environment Food and Rural Affairs[7]

River flow rate: 6 651 m^3/d (AM of daily min flow over the measurement period from 1956-2025, n=4 846 measurements[8])

The resulting dilution factor is 1.03, i.e. the river is primarily fed by discharges from the STP.

It should be noted that this method of calculating the dilution factor is very conservative. The [redacted], which is mainly fed by wastewater from the STP, flows into the Lee River shortly after the gauging station [redacted]. Measurements taken at the gauging station Lee Bridge for the Lee River show a much higher flow rate for the Lee

[7] River flow rate of [redacted]; [redacted] ; last accessed in September 2025.

[8] Only measurements with the characteristics ‚Complete' for completeness and 'Good' for quality were considered for calculating the AM of daily min. flows.

River (6651 m^3/d at [redacted] vs. 267840 m^3/d at Lee Bridge). If the flow rate of the Lee River were used as a basis, this would result in an about twofold higher dilution factor of 2.2. Overall, however, the risk of humans via the environment is primarily determined by the inhalation route (see below), so that a discussion of which flow rate would be most suitable is rather theoretical and does not significantly influence the overall risk.

Releases to soil

No direct substance release occurs from the use covered by this CSR. However, the sludge from the STP to which the plant discharges is exported offsite for land spreading[9]. Therefore, application of sewage sludge to agricultural soil was considered for EUSES modelling.

Table 16. Local releases to the environment

Release route	Release fraction	Release [kg/year] [a]	Explanation/Justification
Air	4.78 x 10^{-3}	[redacted]	Measured release (site-specific data)
Water	2.35 x 10^{-6}	[redacted]	Measured release (site-specific data)
Soil	0	0	No release to soil

[a] For values <LOQ a value corresponding to LOQ/2 was used, as described in ECHA´s Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.16: Environmental exposure assessment (ECHA, 2016a). For wastewater emissions this is very likely an overestimation since the upstream redox process leads to the almost complete conversion of Cr(VI) into Cr(III).

9.2.3.3 Exposure and risks for the environment and man via the environment

As chromium trioxide is not listed in EU REACH Annex XIV due to environmental effects, effects of the substance on the environment are not considered here.

Exposure of humans via the environment was assessed using release data and EUSES modelling (as described in section 9.0.2.2). The modelled exposure concentration in air and doses for oral exposure are shown in the following table.

Table 17. Modelled exposure for humans via the environment on a local scale (based on emissions from the site)

Inhalation	
Local Cr(VI) PEC in air [µg/m^3]	1.04 x 10^{-02}
Oral (drinking water and fish)	
Drinking water * [µg Cr(VI)/kg x d]	5.36 x 10^{-05}
Fish * [µg Cr(VI)/kg x d]	9.02 x 10^{-08}
Oral exposure (water and fish) [µg Cr(VI)/kg x d]	5.37 x 10^{-05}

All values rounded to three significant figures for presentation, but unrounded values were used for calculation of sums.
* Considering a reduction factor of 5, as described in section 9.1.1.4.

The local PEC in air is 1.04 x 10^{-02} µg/m^3 and the oral doses are 5.36 x 10^{-05} in drinking water and 9.02 x 10^{-08} in fish. A comparison of these modelled exposure estimates with the exposure-risk relationships (ERR) derived by ECHA (2013) for the general population (see Section 9.1.1.2) results in the risk estimates shown in the following table.

[9] See [redacted]; last accessed August 2025

Table 18. Excess cancer risk estimates for humans via the environment (general population, local assessment)

Pathway	**Risk**
Inhalation	3.02×10^{-04}
Drinking water	4.29×10^{-08}
Fish	7.22×10^{-11}
Aggregated for all pathways	3.02×10^{-04}
Contribution drinking water	*0.01 %*
Contribution inhalation	*99.99 %*

All values rounded to three significant figures for presentation, but unrounded values were used for calculation of sums.

The combined risk from all pathways is 3.02×10^{-04}, which is dominated by the risk from inhalation exposure (99.99%). The underlying exposure estimate has already been discussed above, outlining that the exposure and risk estimates relate to the immediate vicinity of the site. In this context, it must be stressed again, that the Cr(VI) concentration considered by ECHA to be associated with a risk of 10^{-6} in the general population (0.0345 ng/m^3) cannot be analytically verified, with 'real world' samples yielding true limits of detection for Cr(VI) in ambient air samples of 0.45 ng/m^3 (Gladtke et al., 2012).

9.2.4Overview of air monitoring results

During the monitoring campaigns in the years 2018-2025 with the exception of the year 2020 a total of 129 measurements were performed. The following section provides an overview of the results documented in detail in Annex 2. The results are summarised in Table 19**Fehler! Verweisquelle konnte nicht gefunden werden.**. The table also shows Cr(VI) concentrations based on an evaluation of the German MEGA database for comparison. The underlying data were measured by stationary sampling at German workplaces between 2000 and 2009[10]. These values were used here for comparison, since they were obtained with a uniform method, represent a large number of samples and sites monitored and clearly differentiate stationary sampling results from those obtained with personal sampling.

Table 19. Summary of air monitoring results (2018-2025)

Type of sample	**N**	**Cr(VI) measurements <LoQ**	**Air monitoring results: Cr(VI) [ng/m³]**		
			AM	**Media n**	**90 P**
Ambient (upwind and downwind)	19	16% (LoQ 0.1 ng/m³)	3.27*	2.00*	9.08
All values (including waste handling outdoors but without ambient air measurements)	129	0% (LoQ 0.1 ng/m³)	304.21	80.00	729.60
All values indoors	122	0% (LoQ 0.1 ng/m³)	320.70	90.00	833.20
All values indoors except packaging unit	103	0% (LoQ 0.1 ng/m³)	377.24	115.00	1209.20
All values indoors except packaging unit and except measurements ‘between colouring lines’	85	0% (LoQ 0.1 ng/m³)	241.12	90.00	521.60
All values indoors except packaging unit and except measurements ‘between colouring lines’ plus filter press	92	0% (LoQ 0.1 ng/m³)	224.06	82	447.70
Packaging unit	19	0% (LoQ 0.1 ng/m³)	14.18	10.00	27.68
Values for comparison					
MEGA (DE, 2000-2009)**	1837	65% (LoQ 100 ng/m³)	2933	<LoQ	3656

All values rounded to two significant figures for presentation, but unrounded values used for calculation of exposure.
AM: arithmetic mean; 90 P: 90th percentile; N: Number of measurements; N/A: not applicable because n < 10
* Values below the limit of quantification (LoQ: 0.1 ng/m³) were taken here as one half the LoQ (0.05 ng/m³).
** Values given as CrO_3 concentrations in the source were multiplied by a factor of 0.52 (based on molecular weights), resulting in the Cr(VI) concentrations given in the table.

All ambient air measurements were below 10 ng/m³, in 14 out of 19 cases, even below 5 ng/m³, irrespective if measured upwind or downwind. In the packaging unit mean Cr(VI) concentrations of about 14.18 ng/m³ were measured, which are definitely above the LoQ of 0.1 ng/m³. Clearly higher mean values of about 377.24 or 115 ng/m³ (AM or GM, respectively) were measured at all other indoor places in the part of the hall where the colouring lines are located. These data are in good agreement with the previous CSR, but are approximately twice as high as in 2015, but well below the current UK OEL of 10 µg/m³ (see Annex 1). The value for the 90th percentile is approximately three times higher than the 2015 figure and is influenced by individual elevated readings.

9.2.5 Worker contributing scenario 1: Colouring line operators

Operators of the colouring line perform different tasks:

- Task 13, Operating colouring line – controler
- Task 14, Operating colouring line – loading
- Task 15, Operating colouring line – rinsing
- Task 16, Operating colouring line – off-loading
- Task 17, Operating colouring line – colour control

Usually, there is one controller who is responsible for the colouring and controls the whole process. The controller (Task 13; see Figure 13) spends most time of the day by moving along the colouring line, operating the pendant controller. But the controller also supports the other workers of the colouring line who perform the loading, rinsing, off-loading and the colour control, if necessary. The operators who perform the tasks 14, 15, 16, and 17 (loading, rinsing (see Figure 14), off-loading (see Figure 15), and colour control, respectively) are mainly active in the loading zone area. But, depending on the actual activity they stand more or less close to the loading zone. E.g. during the preparation of the stainless steel components for the loading they are about 2 m away, but the rinsing takes place directly in the loading zone. There are also times during which the operators of the colouring lines move to the packaging unit and support the workers of the packaging unit, if necessary, but not the other way round.

9.2.5.1 Conditions of use

T13, 14, 15, 16, 17: Operating colouring line – several activities

	Method
Product (article) characteristics	
• Concentration of substance in mixture: [redacted] *no handling of Cr(VI) containing liquids during loading, off-loading or controlling;*	Monitoring data
• Product type: Powders dissolved in a liquid or incorporated in a liquid matrix	Monitoring data
• Viscosity: Liquids with low viscosity (like water)	Monitoring data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: up to 480 min	Monitoring data
• Frequency of use/task: = 240 days per year	Monitoring data
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m³ *Maximal room size available in ART; size of production hall about 3-fold higher*	Monitoring data
• Ventilation rate of general ventilation system: ≥ 10 ACH	Monitoring data
• Localised controls: No	Monitoring data
Conditions and measures related to personal protection, hygiene and health evaluation	
• At least overall (adaption due to situation)	Monitoring data
• Latex gloves or rubberised gloves in combination with specific activity training (adaption due to situation; latex gloves e.g. for rinsing and colour control, rubberised gloves for loading)	Monitoring data
• Goggles (only for rinsing)	Monitoring data
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m) *Worst case assumption*	Monitoring data
• Containment of the process: Open process	Monitoring data

9.2.5.2 Exposure assessment

The different tasks of the workers of the colouring lines cannot be modelled by ART, as they do not handle directly any Cr(VI) containing liquids or solids. The exposure is to the overall workplace atmosphere. Therefore, exposure assessment is based on monitoring data.

Monitoring values obtained from stationary pumps located close to the colouring lines are documented in the following table.

Table 20. Monitoring result: Stationary monitoring around colouring lines (Tasks 13, 14, 15, 16, 17)

	2018	2019	2021	2022	2023	2024	2024	2025	2025
	ng Cr(VI)/m³								
Line 3, Loading area	72.4	317	13.1	22	37	26	220	570	110
Line 2, Loading area	180	436	261	66	141	93	1437	220	1430
Line 1, Loading area	221	1496	95	80	384	1294	1636	1720	700
Line 3, Colouring Tank	5.6	76	31	86	30	107	101	80	60
Line 3, Hardening Tank	74.1	344	18	73	115	22	195	80	80
Line 3, Black RinseTank	15.7	208	69	26	79	23	283	130	90
Line 2, Hardening Tank	106	-	84	174	51	65	667	310	170
Line 2, Colouring Tank**	180 425	503	672	372	666	390	1875	3460	930
Line 1, Black Colouring Tank**	104	369	474	325	263	1279	848	3590	2060

Statistical analysis	Regarding all values	All values except those performed 'between the colouring lines' (**)
number of measurements (n)	81	63
AM	446.80	283.03
SD	690.27	428.53
Median	174.00	101.00
90th Percentile	1430.00	693.40
MAX	3590.00	1720.00
MIN	5.6	5.60

As can be seen in Table 20 highest Cr(VI) concentrations were measured in the loading areas and in the area between colouring line 1 and 2, where the pumps were located close to the tanks and not separated from the tanks by Plexiglas shields. It has to be recognized that the operators of the colouring line usually do not stay in this area between the lines. Presence in this area is only needed for tank sampling (task 6), addition of mist suppressant (task 8) or maintenance (task 11), tasks not performed by the operators of the colouring line. Additionally, the measurements document that the Plexiglas shields efficiently protect against exposure from the tanks: The hardener and the colouring tank of line 2 contain both the same concentration of chromium (VI) trioxide or chromic acid. But, the measurements differ clearly, depending on the place of location of the pump.

In addition to the stationary measurements, nine personal measurements are available for the period from 2018 to 2025 (for details, see Table 43). Similar to the stationary measurements, the personal measurements vary widely, ranging from < LoQ (n=7) to 856.53 ng/m³ (n=1). Possibly, these wide variations depend on the intensity of the activities along the colouring lines. Overall, however, the volume of personal data is too small to identify clear correlations or trends. It is not yet possible to determine with certainty whether the installation of the air purifying units in the summer of 2025 is the cause of the low exposure levels measured in the autumn 2025. The exposure assessment for the colouring line operators is therefore based on the basis of the stationary monitoring values.

As can be seen in Table 20 mean exposure concentrations measured close to the colouring lines differ substantially if the measurements 'between the colouring lines' are included or not. As the operators of the colouring lines usually do not stay in this part of the production hall the 90th percentile of the mean values as presented in Table 20 without considering the values measured 'between colouring lines' are taken for the risk assessment of operators of the colouring lines. This procedure is regarded as appropriate to account for different exposure concentrations due to different work load as well as differences between the colouring lines. Based on the fact that colouring line operators also spend part of their work day in the packaging unit, where the Cr(VI) concentration is substantially lower than close to the colouring line, it seems to be appropriate to calculate the risk on basis of the 90th percentile instead of maximum values. No differentiation is performed between operators mainly working as controllers or between operators of the different colouring lines, because operators change between the colouring lines.

Risk estimate for operators of the colouring line is based on the 90th percentile of the monitoring values collected close to the colouring lines (**693.40 ng/m^3**) excluding the measurements between the lines.

9.2.5.3 Comparison of outcome with initial application

The exposure assessment in the initial application for authorisation was also based on the stationary measurements taken in the colouring plang. The measurement points were identical to the stationary measurement points used in this CSR. However, at that time, only measurements from two consecutive days in 2015 were available. The 90th percentile of all measurements (excluding those between Colouring Lines 1 and 2) was 387 ng/m³. For this review report, a significantly higher number of measurements are available (14 vs. 63), spanning the years 2018 to 2025.

There are, in some cases, significant differences between the measured values for the individual years, which probably reflect the varying levels of activity depending on the order situation. In addition, the stationary measurements are supported by the available personal measurements. The latter also show significant variations over the years, ranging from < LOQ to over 800 ng/m³. Overall, the data set is consistent and mutually supportive. Since the last technical measure to reduce the concentration of Cr(VI) in the air – the installation of air purifying units in the summer of 2025 – there are not yet enough measurement data available to conclusively demonstrate their effectiveness. However, with one exception, the stationary measurements from autumn 2025 are all lower than those from spring 2025.

9.2.6 Worker contributing scenario 2: End of line operator (Task 18)

End of line operators perform two tasks:

- Task 14, Operating colouring line – loading
- Task 16, Operating colouring line – off-loading

9.2.6.1 Conditions of use

The conditions of use are described in section 9.2.5.1.

9.2.6.2 Exposure assessment

The results of the stationary monitoring performed between 2018 and 2025 are summarised in the table below.

Table 21. Monitoring result: Stationary monitoring colouring line (Tasks 14, 16)

	2018	**2019**	**2021**	**2022**	**2023**	**2024**	**2024**	**2025**	**2025**
	ng Cr(VI)/m³								
Line 3, Loading area	72.4	317	13.1	22	37	26	220	570	110
Line 2, Loading area	180	436	261	66	141	93	1437	220	1430
Line 1, Loading area	221	1496	95	80	384	1294	1636	1720	700
Statistical analysis	Regarding all values								
number of measurements (n)	27								
AM	491.76								
SD	578.30								
Median	220								
90th Percentile	1454.70								
MAX	1720								
MIN	13.10								

A total of 27 stationary measurements are available for the loading area. The measured values are in the range of 13 to 1720 ng/m³. Even though there is no contact with chromium-containing liquids in this area, significantly elevated concentrations of Cr(VI) are frequently measured here, as it is not possible to completely seal off this area from the area containing the Cr(VI)-containing baths. An observation that corresponds to the personal data (for details see **Table 42**). For the period 2018–2025, a total of 10 personal measurements are available, ranging from < LoQ to 937.50 ng/m³, whereas all other readings were below 200 ng/m³. Of the total of 10 measurements, 3 were above the LoQ. To avoid disrupting the workflow and the handling of the large metal sheets, the pumps are positioned relatively close to the colouring line during stationary measurements. The workers, on the other hand, are constantly moving between the colouring line and the rack on the wall opposite the loading area of the production line. For this reason, personal measurements are considered to be a more accurate reflection of actual exposure than stationary measurements. However, as only 10 personal measurements are available in total, the highest measured value is used for the exposure estimate as a conservative approach. For the risk assessment of workers in the loading area, the exposure level corresponding to the highest value from the personal monitoring is used.

Risk estimate for end of line operators of the colouring line is based on the highest value from the personal monitoring values (**937.50 ng/m³**).

9.2.6.3 Comparison of outcome with initial application

In the CSR for the initial approval, this group was not considered a separate WCS, as there was an overlap with the workers operating the colouring line. They were assessed alongside these in a group.

Following the reorganisation of the responsibilities of the individual WCSs, this group has emerged as an independent group. Data from personal monitoring suggest that using the highest measured value for risk characterisation often certainly represents a significant overestimation of actual exposure. At the same time, data from stationary monitoring support this approach, as they show that elevated chromium concentrations in the air can be measured in individual cases. In this case too, only the forthcoming measurements will reveal the impact of the air purifying units installed in 2025.

9.2.7 Worker contributing scenario 3: Operators of Packaging unit

As outlined above, operators of the packaging unit do not handle any chromium containing liquids (Task 18).

9.2.7.1 Conditions of use

T18: Activities in packaging area

	Method
Product (article) characteristics	
• not applicable, only indirect exposure via workplace air	Monitoring data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: up to 480 min	Monitoring data
• Frequency of use/task: = 240 days per year	Monitoring data
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m³ *Maximal room size available in ART; size of production hall about 3-fold higher*	Monitoring data
• Ventilation rate of general ventilation system: Basic general ventilation, ≥ 10 ACH	Monitoring data
• Localised controls: No	Monitoring data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Overall	Monitoring data
• Rubberised gloves where appropriate	Monitoring data
Other conditions affecting workers exposure	
• not applicable, only indirect exposure via workplace air	Monitoring data

9.2.7.2 Exposure assessment

Operators working in the packaging unit are not in direct contact with any chromium (VI) containing liquids or solids. But, due to the fact that the packaging area is located in the same production hall as the colouring lines and that air supply of both parts of the production hall is not independently from each other the operators of the packaging unit are also exposed towards Cr(VI). The results of the monitoring campaign are shown in the following table:

Table 22. Monitoring result: Packaging area, stationary measurements (Task 18)

Year	Monitoring TWA - end of hall, left (ng/m³)	Monitoring TWA - end of hall, right (ng/m³)
2018	28	24 and 6
2019	16	26
2021	28	18
2022	2	3
2023	6	10
2024	8	10
2024	14	11
2025	10	10
2025	10	30
N (total)	19	
AM [ng/m³]	14.18	
SD [ng/m³]	8.91	
Median [ng/m³]	10.00	
90th Perc. [ng/m³]	27.68	
MAX [ng/m³]	30.00	
MIN [ng/m³]	2	

During the monitoring campaigns Cr(VI) concentrations in the air of the packaging unit were measured. The stationary pumps were located in the middle of the packaging unit (i.e. about the same distance to the colouring line 3 and the end of the hall), one on the right and one on the left side (see Figure 18). As the workers move around in this part of the packaging unit this location was selected to reflect an average exposure in this part of the production hall. Overall exposure in this part of the hall is influenced from the exposure from the part with the colouring lines and the ambient air which is provided from outside. Air exchange with ambient air is improved by the fact that the gate of the production hall is open most time of the day. Over the years, measurements were performed during different month including winter and summer. The situation with the open gate is characteristic for the workplace, as there is permanent transport in an out of stainless steel components which are transported with a forklift.

Stationary monitoring values were in a very narrow range, between 2 and 30 ng/m^3, with a tendency of lower values, below 15 ng/m^3, since 2022. However, as the last stationary measurement from 2025 shows (30 ng/m^3), slightly higher values still can occur occasionally. In addition to the stationary measurements, four personal measurements are available. All personal measurements were below the detection limit, which varied from year to year (for details, see Annex 2). Expressed as LoQ/2, the personalised measurements lie between 5.21 and 54 ng/m^3. The personal measurements correspond very well with the stationary measurements. However, as there are more stationary than personal measurements overall, the 90th percentile of the stationary measurements is used to characterise the exposure of workers in the packaging unit. Packaging unit operators (especially the forklift driver) may shortly enter the area of the colouring lines which is not regarded in this approach. This seems to be justified as the fact that the packaging unit operators (especially the forklift driver) also spend parts of their workday outside of the production hall where lower Cr(VI) concentration (below LoQ of 1.0 ng/m^3 up to 9 ng/m^3) were measured. As they spend more time outside than in the colouring line unit this approach seems to be justified.

As this activity cannot be modelled within ART, exposure is estimated on basis of the monitoring data only.

The 90th percentile of the stationary measurements (**27.68 ng/m^3**) is used for the risk assessment of packaging unit operators.

9.2.7.3 Comparison of outcome with initial application

For the CSR of the application for authorisation, only four stationary measurements from one calendar year were available, of which the highest measured value (36.66 ng/m^3) was used to characterise the exposure of workers in the packaging unit. For the current review report, however, stationary measurements from seven calendar years are available, which were measured at different times of the year. Since 2022, a decrease in the measured exposure concentrations has been observed, mostly below or at 10 ng/m^3. Only a single value from the most recent measurement was elevated in comparison. The most recent personal measurement, which like all previous measurements was below the detection limit but ultimately had a sufficiently sensitive detection limit, also confirms that the exposure of workers does not exceed a concentration of 10 ng/m^3. These data indicated that the dividing curtain is an efficient risk management measurement. However, as further personal measurements with a sufficiently low detection limit are currently still lacking, the value of the 90th percentile of the stationary measurements is used conservatively for the risk characterisation of the workers in the packaging unit.

9.2.8 Worker contributing scenario 4: Colouring plant chemist and technician

The colouring plant chemist and technician are responsible for all activities related with the handling of Cr(VI) containing solutions and the handling of solid chromium trioxide. The tasks are shared equally between the two (see Figures 5-12 and Figures 16 and 17 in Annex 4):

- Task 1 (Decanting of a solid),
- Task 2 (Dissolution of solid chromium (VI) trioxide in tanks),
- Task 3 (Refilling of bath-liquids; see Figure 7 in Annex 4),

Task 4 (Cleaning of solid chromium (VI) trioxide with a hose; see Figure 8

- in Annex 4),
- Task 5 (Cleaning of equipment; see Figure 9 in Annex 4)
- Task 6 (Tank sampling).
- Task 7 (Laboratory analysis)
- Task 8 (Addition of mist suppressant)

- Task 9 (Operating effluent treatment plant)

They are also responsible for the tank fill-up in the morning, the control and operation of the filter press as well as for the support of the maintenance workers:

- Task 10 (Tank fill up – operational activity close to the colouring lines),
- Task 11 (Maintenance),
- Task 12 (Waste handling (filter press)).

Due to the different duties of the chemist and the technician they spend about half of their workday in the production hall in the area close to the colouring lines including waste handling at the filter press (outdoors) and about half of their workday in the laboratory.

During the tasks performed in the production hall they move around the colouring lines including the area between the lines 1 and 2. As there are no Plexiglas shields this provides better access to the tanks, which is advantageous for e.g. tank sampling and addition of mist suppressant.

As outlined in section 9.1.1.5. exposure during most of these Tasks, except Tasks 1, 6, 7 and 12 cannot be adequately modelled and is best described by monitoring data.

Laboratory work comprises a lot of different activities. Direct handling of chromium containing liquids is only one part of the work which lasts only about a few minutes when e.g. the samples taken from the (black) colouring and hardener tank are processed in the laboratory. The probes are rapidly diluted (1:1000) before further analysis and only relatively small amounts of liquid are carefully transferred. Handling of concentrated solutions for dilution takes about 15 minutes per week including measurement of surface tension of the solution of the hardening tank. Other analytical investigations are performed with the diluted probes. Handling and controlling the analytical devices and evaluation of the results lasts much longer than the direct handling of the Cr(VI) containing liquids. For comparative reasons, the exposure during the handling of the concentrated solutions was modelled with ART and is shown in section 9.2.8.2.4.

The colouring plant chemist and technician are very well trained to carry out the tasks carefully and prudently with as little exposure as possible. Furthermore, depending on the activity, they wear the personal protective equipment described above for their own protection..

As described above, most of these activities cannot be modelled with ART. Nevertheless, as far as possible the tasks 1, 6, 7 and 12 were modelled using ART to reflect the monitoring outcome. The results of the modelling approaches are documented in the following sections in light of the monitoring data.

9.2.8.1 Conditions of use

This section contains all conditions of use for the tasks performed by the plant chemist and technician including those for the tasks modelled (Tasks 1, 6, 7 and 12; see below). As the plant chemist and technician support maintenance workers, the conditions of use for maintenance work are also described in this section below.

T1: Manual decanting of chromium (VI) trioxide flakes into a mesh basket

	Method
Substance emission potential	
• Substance product type: Powders, granules or pelletised material	External Tool (ART 1.5)
• Dustiness: Granules, flakes or pellets	External Tool (ART 1.5)
• Moisture content: Dry product (< 5 % moisture content)	External Tool (ART 1.5)
• Powder weight fraction: Pure material	External Tool (ART 1.5)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: [redacted] minutes *Maximum duration/frequency: [redacted] minutes/day; refers to actual manual interventions*	External Tool (ART 1.5)
• Frequency of use/task: = 72 days per year	External Tool (ART 1.5)

	Method
Maximum frequency/duration: 4.8 minutes/day	
Technical and organisational conditions and measures	
• Place of use: Indoors	External Tool (ART 1.5)
• Room size: 3000 m^3	External Tool (ART 1.5)
• Ventilation rate of general ventilation system: ≥ 10 ACH	External Tool (ART 1.5)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Surface contamination/fugitive emission sources: The process is not fully enclosed and the integrity of that enclosure is not regularly monitored, but effective housekeeping practices are in place.	External Tool (ART 1.5)
• Localised controls: No	External Tool (ART 1.5)
• Protective apron	
• Chemical resistant overall	
• Wear chemically resistant gloves (triple dipped nitrile gloves, 0.48 mm) in combination with specific activity training.	
Respiratory Protection: Yes (Respirator with APF of 40) [Effectiveness Inhal: 97.5%]	)
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m)	External Tool (ART 1.5)
• Activity class: Falling powders	External Tool (ART 1.5)
• Situation: Transferring 10 – 100 kg/minute	External Tool (ART 1.5)
• Handling type: Careful transfer involves workers showing attention to potential danger, error or harm and carrying out the activity in a very exact and thorough (or cautious) manner.	External Tool (ART 1.5)
• Drop height: < 0.5 m	External Tool (ART 1.5)
• Containment level: Handling that reduces contact between product and adjacent air	External Tool (ART 1.5)

T2: Dissolution of solid CrO_3 in tanks

	Method
Product (article) characteristics	
• Substance product type: Powders, granules or pelletised material	Monitoring data
• Dustiness: Granules, flakes or pellets	Monitoring data
• Moisture content: Dry product (< 5 % moisture content)	Monitoring data
• Powder weight fraction: Pure material	Monitoring data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: 20 min *Realistic estimate: 20 minutes/day*	Monitoring data
• Frequency of use/task: = 72 days per year	Monitoring data
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m³ *Maximal room size available in ART; size of production hall about 3-fold higher*	Monitoring data
• Ventilation rate of general ventilation system: ≥ 10 ACH	Monitoring data
• Localised controls: No	Monitoring data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Protective apron	Monitoring data

	Method
• Chemical resistant overall	Monitoring data
• Wear chemically resistant gloves (triple dipped nitrile gloves, 0.48 mm) in combination with specific activity training.	Monitoring data
• Respiratory Protection: Yes (Respirator with APF of 40) [Effectiveness Inhal: 97.5%]	Monitoring data
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m) *Worst case assumption*	Monitoring data
• Containment of the process: Open process	Monitoring data

T3: Re-filling of bath-liquids

	Method
Product (article) characteristics	
• Concentration of substance in mixture: no handling of Cr(VI) containing liquid	Monitoring data
• Product type: Powders dissolved in a liquid or incorporated in a liquid matrix	Monitoring data
• Viscosity: Liquids with low viscosity (like water)	Monitoring data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: 15 min *Realistic estimate: 15 minutes/day*	Monitoring data
• Frequency of use/task: = 72 days per year	Monitoring data
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m³ *Maximal room size available in ART; size of production hall about 3-fold higher*	Monitoring data
• Ventilation rate of general ventilation system: ≥ 10 ACH	Monitoring data
• Localised controls: No	Monitoring data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Protective apron	Monitoring data
• Chemical resistant overall	Monitoring data
• Wear chemically resistant gloves (triple dipped nitrile gloves, 0.48 mm) in combination with specific activity training.	Monitoring data
• Respiratory Protection: Yes (Respirator with APF of 40) [Effectiveness Inhal: 97.5%]	Monitoring data
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m) *Worst case assumption*	Monitoring data
• Containment of the process: Open process	Monitoring data

T4: Cleaning of solid CrO_3 with a hose

	Method
Product (article) characteristics	
• Substance product type: Powders, granules or pelletised material	Monitoring data
• Dustiness: Granules, flakes or pellets	Monitoring data
• Moisture content: Dry product (< 5 % moisture content)	Monitoring data
• Powder weight fraction: Pure material	Monitoring data

	Method
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: 30 min *Maximum value: 30 minutes/day*	Monitoring data
• Frequency of use/task: = 30 days per year	Monitoring data
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m³ *Maximal room size available in ART; size of production hall about 3-fold higher*	Monitoring data
• Ventilation rate of general ventilation system: ≥ 10 ACH	Monitoring data
• Localised controls: No	Monitoring data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Protective apron	Monitoring data
• Chemical resistant overall and rubber boots	Monitoring data
• Wear chemically resistant gloves (triple dipped nitrile gloves, 0.48 mm) in combination with specific activity training.	Monitoring data
• Respiratory Protection: Yes (Respirator with APF of 40) [Effectiveness Inhal: 97.5%]	Monitoring data
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m) *Worst case assumption*	Monitoring data
• Containment of the process: Open process	Monitoring data

T5: Cleaning of equipment

	Method
Product (article) characteristics	
• Concentration of substance in mixture: [redacted] *Concentration of Cr(VI) based on CrO_3 concentration of [redacted] g/L in the electrolyte and a density of the electrolyte of [redacted] g/L.*	Monitoring data
• Product type: Powders dissolved in a liquid or incorporated in a liquid matrix	Monitoring data
• Viscosity: Liquids with low viscosity (like water)	Monitoring data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: 30 min	Monitoring data
• Frequency of use/task: = 30 days per year	Monitoring data
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m³ *Maximal room size available in ART; size of production hall about 3-fold higher*	Monitoring data
• Ventilation rate of general ventilation system: ≥ 10 ACH	Monitoring data
• Localised controls: No	Monitoring data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Protective apron	Monitoring data
• Chemical resistant overall (only in combination with T3)	Monitoring data
• Wear chemically resistant gloves (triple dipped nitrile gloves, 0.48 mm) in combination with specific activity training.	Monitoring data
• Respiratory Protection: Yes (Respirator with APF of 40) [Effectiveness Inhal: 97.5%]	Monitoring data
Other conditions affecting workers exposure	

	Method
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m) *Worst case assumption*	Monitoring data
• Containment of the process: Open process	Monitoring data

T6: Tank sampling

	Method
Product (article) characteristics	
• Concentration of substance in mixture: [redacted] *Concentration of Cr(VI) based on CrO_3 concentration of [redacted] g/L in the electrolyte and a density of the electrolyte of [redacted] g/L.*	External Tool (ART 1.5)
• Product type: Powders dissolved in a liquid or incorporated in a liquid matrix	External Tool (ART 1.5)
• Viscosity: Liquids with low viscosity (like water)	External Tool (ART 1.5)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: 15 min *Realistic estimate: 15 minutes/day*	External Tool (ART 1.5)
• Frequency of use/task: = 48 days per year	External Tool (ART 1.5)
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m³	External Tool (ART 1.5)
• Ventilation rate of general ventilation system: ≥ 10 ACH	External Tool (ART 1.5)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Surface contamination/fugitive emission sources: The process is not fully enclosed and the integrity of that enclosure is not regularly monitored, but effective housekeeping practices are in place.	External Tool (ART 1.5)
• Localised controls: No	External Tool (ART 1.5)
• Protective apron	
• Overall	
• Wear chemically resistant gloves (triple dipped nitrile gloves, 0.48 mm) in combination with specific activity training.	
• Respiratory Protection: Yes (Respirator with APF of 40) [Effectiveness Inhal: 97.5%]	
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m)	External Tool (ART 1.5)
• Activity class and subclass: Transfer of liquid products - falling liquid	External Tool (ART 1.5)
• Falling liquid (transfer rate): 0.1 - 1 L/min	External Tool (ART 1.5)
• Containment of the process: Open process	External Tool (ART 1.5)
• Transfer Loading Type : Submerged loading, where the liquid dispenser remains below the fluid level reducing the amount of aerosol formation	External Tool (ART 1.5)

T7: Laboratory analyses of the tank solutions with LEV

	Method
Product (article) characteristics	
• Concentration of substance in mixture: [redacted] *Concentration of Cr(VI) based on CrO_3 concentration of [redacted] g/L in the electrolyte and a density of the electrolyte of [redacted] g/L.*	External Tool (ART 1.5)

	Method
• Product type: Powders dissolved in a liquid or incorporated in a liquid matrix	External Tool (ART 1.5)
• Viscosity: Liquids with low viscosity (like water)	External Tool (ART 1.5)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: 15 minutes *Realistic estimate*	External Tool (ART 1.5)
• Frequency of use/task: = 48 days per year	External Tool (ART 1.5)
Technical and organisational conditions and measures	
• Place of use: Indoors – room size 30 m^3 (assumption for modelling, default value in ART; actual room size about 55 m^3)	External Tool (ART 1.5)
• Ventilation rate of general ventilation system: Mechanical ventilation giving at least 1 ACH	External Tool (ART 1.5)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Surface contamination/fugitive emission sources: The process is not fully enclosed and the integrity of that enclosure is not regularly monitored, but effective housekeeping practices are in place.	External Tool (ART 1.5)
• Localised controls: Other LEV systems (50.00 % reduction)	External Tool (ART 1.5)
• Overall	
• Latex gloves	
• Goggles	
Other conditions affecting workers exposure	
• Primary emission source proximity: The primary emission source is located in the breathing zone of the worker (near field, < 1 m)	External Tool (ART 1.5)
• Activity class and subclass: Transfer of liquid products - falling liquid	External Tool (ART 1.5)
• Falling liquid (transfer rate): 0.1 - 1 L/min	External Tool (ART 1.5)
• Containment of the process: Handling that reduces contact between product and adjacent air	External Tool (ART 1.5)
• Transfer Loading Type : Submerged loading, where the liquid dispenser remains below the fluid level reducing the amount of aerosol formation	External Tool (ART 1.5)

T8: Addition of mist suppressant

	Method
Product (article) characteristics	
• Concentration of substance in mixture: no handling of Cr(VI) containing liquid	Monitoring data
• Product type: Powders dissolved in a liquid or incorporated in a liquid matrix	Monitoring data
• Viscosity: Liquids with low viscosity (like water)	Monitoring data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: 2 min	Monitoring data
• Frequency of use/task: = 48 days per year	Monitoring data
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m^3 *Maximal room size available in ART; size of production hall about 3-fold higher*	Monitoring data
• Ventilation rate of general ventilation system: ≥ 10 ACH	Monitoring data
• Localised controls: No	Monitoring data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Overall	Monitoring data
• Latex gloves in combination with specific activity training.	Monitoring data

	Method
• Goggles	Monitoring data
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m) *Worst case assumption*	Monitoring data
• Containment of the process: Open process	Monitoring data

T9: Operating effluent treatment plant

	Method
Product (article) characteristics	
• Concentration of substance in mixture: [redacted] *Concentration of Cr(VI) based on CrO_3 concentration of [redacted] g/L in the electrolyte and a density of the electrolyte of [redacted] g/L; worst case assumption as solution is rapidly diluted and Cr(VI) reduced to Cr(III); usually, no handling of Cr(VI) containing liquids*	Monitoring data
• Product type: Powders dissolved in a liquid or incorporated in a liquid matrix	Monitoring data
• Viscosity: Liquids with low viscosity (like water)	Monitoring data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: 240 min *Worst case assumption; total activity of the chemist in the production hall lasts about 240 min/d; relevant part is the operation of the effluent treatment plant*	Monitoring data
• Frequency of use/task: = 240 days per year	Monitoring data
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m³ *Maximal room size available in ART; size of production hall about 3-fold higher*	Monitoring data
• Ventilation rate of general ventilation system: ≥ 10 ACH	Monitoring data
• Localised controls: No	Monitoring data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Overall	Monitoring data
• Latex gloves in combination with specific activity training.	Monitoring data
• Goggles	Monitoring data
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m) *Worst case assumption*	Monitoring data
• Containment of the process: Open process	Monitoring data

T10: Tank fill up

	Method
Product (article) characteristics	
• Concentration of substance in mixture: [redacted] *Concentration of Cr(VI) based on CrO_3 concentration of [redacted] g/L in the electrolyte and a density of the electrolyte of [redacted] g/L; worst case assumption no handling of Cr(VI) containing liquids takes place.*	Monitoring data
• Product type: Powders dissolved in a liquid or incorporated in a liquid matrix	Monitoring data
• Viscosity: Liquids with low viscosity (like water)	Monitoring data
Amount used (or contained in articles), frequency and duration of use/exposure	

	Method
• Duration of activity: 45 min	Monitoring data
• Frequency of use/task: = 240 days per year	Monitoring data
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m³ *Maximal room size available in ART; size of production hall about 3-fold higher*	Monitoring data
• Ventilation rate of general ventilation system: ≥ 10 ACH	Monitoring data
• Localised controls: No	Monitoring data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Overall	Monitoring data
• Latex gloves in combination with specific activity training.	Monitoring data
• Goggles	Monitoring data
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m) *Worst case assumption*	Monitoring data
• Containment of the process: Open process	Monitoring data

T11: Maintenance

	Method
Product (article) characteristics	
• Concentration of substance in mixture: [redacted] *Concentration of Cr(VI) based on CrO_3 concentration of [redacted] g/L in the electrolyte and a density of the electrolyte of [redacted] g/L; worst case assumption as many maintenance activities are not related to a direct handling of Cr(VI) containing liquids.*	Monitoring data
• Product type: Powders dissolved in a liquid or incorporated in a liquid matrix	Monitoring data
• Viscosity: Liquids with low viscosity (like water)	Monitoring data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: up to 480 min	Monitoring data
• Frequency of use/task: = 240 days per year	Monitoring data
Technical and organisational conditions and measures	
• Place of use: Indoors - 3000 m³ *Maximal room size available in ART; size of production hall about 3-fold higher*	Monitoring data
• Ventilation rate of general ventilation system: ≥ 10 ACH	Monitoring data
• Localised controls: No	Monitoring data
Conditions and measures related to personal protection, hygiene and health evaluation	
• At least overall (adaption due to situation)	Monitoring data
• At least latex gloves in combination with specific activity training (adaption due to situation)	Monitoring data
• At least goggles (adaption due to situation)	Monitoring data
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m) *Worst case assumption*	Monitoring data
• Containment of the process: Open process	Monitoring data

T12: Manual intervention at the filter press

	Method
Product (article) characteristics	
• Concentration of substance in mixture: [redacted] *Concentration of Cr based on CrO_3 concentration of [redacted] and density of [redacted] g/L; also applied for filter cake; worst case assumption applied for modelling; < 0.1 mg/L as deduced from monitoring data*	External Tool (ART 1.5)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: 60 minutes *Maximum duration/frequency: 60 minutes/day; refers to actual manual interventions*	External Tool (ART 1.5)
• Frequency of use/task: = 240 days per year *Maximum frequency/duration: 60 minutes/day*	External Tool (ART 1.5)
Technical and organisational conditions and measures	
• Place of use: Outdoors	External Tool (ART 1.5)
• Source located close to buildings? yes	External Tool (ART 1.5)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Surface contamination/fugitive emission sources: The process is not fully enclosed and the integrity of that enclosure is not regularly monitored, but effective housekeeping practices are in place.	External Tool (ART 1.5)
• Wear chemically resistant gloves (tested to EN374) in combination with specific activity training.	
• Overall	
Other conditions affecting workers exposure	
• Primary emission source proximity : The primary emission source is located in the breathing zone of the worker (near field, < 1 m)	External Tool (ART 1.5)

9.2.8.2 Exposure assessment

9.2.8.2.1 Task 1 - Decanting of a solid (PROC 8b)

Modelling results

The modelled exposure estimates are shown in the following table.

Table 23. Modelled Exposure for workers: task 1

Frequency (d/a)	Duration [min/shift]	Inhalation exposure [ng/m³]	
		Task-based	TWA (on day of exposure solely due to this task)
72	16	460 (without RPE)	15.33 (without RPE)
72	16	11.5 (with RPE)*	0.38 (with RPE)*

All calculated values (TWA) rounded to two significant figures for presentation; full ART reports are attached in Annex 5; * includes reduction by 97.5 % due to respiratory protection (powered air respirator with full hood. Filter type A2B2E2K 1Hg P).

Under the conditions of use as described above ART models a task-based exposure of 460 ng/m³, i.e. this is the exposure concentration which would result if this activity is performed for the whole workday (480 minutes). Taking into account that the whole process last maximally 16 minutes a TWA for the day of exposure of 15.33 ng/m³ would result. This calculation does not account for the respiratory protection equipment worn by the operators. If this reduction due to RPE of 97.5% is considered a task based exposure of 11.5 ng/m³ and a TWA for the day of exposure of 0.38 ng/m³ results.

Air monitoring results

There are no stationary measurements available covering the tank top up, an activity which is performed in the early morning by the chemist and technician at a time, when no other operators are present in the production hall. The chromium (VI) trioxide flakes to be filled into the tanks are shown in annex 4 (see Figure 4). There is also a picture showing the personal protective equipment (see Figure 5) and the process of decanting (see Figure 6). There are personal air monitoring results, some of them which only were taken during the tank top up (short term measurements) and some of them for which the air was collected during tank up and other activities (long term measurements).

Table 24. Monitored exposure for workers: Task 1 (Manual decanting of chromium (VI) trioxide flakes into a mesh basket for tank top up)

Monitoring values (short term, only covering Task 1) [ng/m^3]	**Monitoring values (long term, including Task 1); [ng/m^3]**
304.88 (<LoQ)	2083.33
2500.00	208.33 (<LoQ)
1000.00	23375.00
44.64 (<LoQ)	

The values show considerable variation, ranging from below the limit of quantification (LoQ) to readings in the µg/m³ range, for both short-term and long-term measurements. The values measured solely during the activity sometimes exceed the modelled values significantly (by up to a factor of 5.4). This variation in values is likely due to individual differences in handling, as well as depending on whether the measurement was taken from the person pouring the flakes or the person assisting them. However, none of these figures take into account the use of face masks and the efficient reduction of the exposure by this PPE. At the same time, however, the data also show that this activity is the one that contributes most significantly to overall exposure, and that the extent of this contribution can vary greatly between individual events.

9.2.8.2.2. Task 12 - Waste Handling (filter press) (PROC 8b)

Modelling results

The modelled exposure estimate for manually scraping off solids from the filter press is shown in the following table.

Table 25. Modelled exposure for workers: task 12

Frequency (d/a)	**Duration [min/shift]**	**Inhalation exposure [ng/m^3]**	
		Task-based	**TWA (on day of exposure)**
240	60	0	0

All calculated values (TWA) rounded to two significant figures for presentation; full ART reports are attached in Annex 5.

Modelling the inhalation exposure during the manual removal of waste slurry from the filter (‘filter cake’) using ART results in a zero exposure, even if unrealistic worst case assumptions on duration and Cr(VI) concentration are used. This finding is due to the fact that the cake to be removed from such filter presses is clearly wet (moisture content about [redacted]) and is best described as “paste, slurry or clearly (soaked) wet powder” within ART. In addition, no contamination of the cake with powder was selected in ART (based on visual inspection at site) and this combination results in a message in the ART software: “There is no potential for exposure through inhalation from this source” (Fransman et al., 2010). This outcome is independent of the concentration of a chemical. The ART report is attached in Annex 5, showing that no inhalation exposure is expected even if worst case assumptions for the other parameters are selected that do not represent real conditions.

Air monitoring results

Treatment of waste water with reducing and precipitating substances creates large amount of sludge which have to be separated from the waste water before transfer of the waste water to the municipal sewage drain. The sludge is removed from the waste water by a filter press. Filter presses are marketed as fully automatic systems and are supposed to run without intervention by the workers. Generally, the filter cake is removed from the press by gravity without any intervention by workers. In practice, however, workers have to scrape off some of the filter

cake with a tool from time to time, especially when the filters are aged. Then the sludge has to be removed from the filter press about two times per day (see Figure 16 and Figure 17 in Annex 4). The cake is still very wet (about [redacted], otherwise gravity would not work) and exposure modelling within ART was therefore performed as "Paste, slurry or clearly (soaked) wet powder – Handling of contaminated solid objects or paste" that are not contaminated with powdered material.

The following table shows the results of the monitoring campaigns.

Table 26. Monitored exposure for workers: Task 12 (results of stationary monitoring)

Year	Inhalation exposure [ng/m^3]
2019	11
2021	34
2023	15
2024	21
2024	4
2025	30
2025	3

Due to the wet nature of the filter cake no inhalation exposure would be expected during this task as it was modelled with ART and supported from the visual inspection. Nevertheless, concentrations above the LoQ were measured on all five days. As the filter press is located outside, directly behind the production hall and as the gate of the hall is usually widely opened cross contamination of the air close to the filter press from the indoor air cannot be ruled out. Therefore, it is assumed that the monitored exposure is rather due to the contamination by the indoor air than due to task 12. This interpretation is supported by the fact that the Cr(VI) content in the 'sludge water' which is cleaned by the filter press is very low, below 0.01 ppm (see Table 15), i.e. far below the concentration for which exposure has to be assessed.

Consistent with the stationary measurements, three of the four short-term personal exposure measurements for work on the filter press are below the LoQ. Only one other personal exposure reading from 2020 reports a short-term exposure of 833 ng/m³ during this activity. Based on the considerations set out above and the observation that this is a single value from 2020, this value is assessed as an outlier.

9.2.8.2.3. Task 6 - Tank sampling (PROC 8b)

Modelling results

The modelled exposure estimate for tank sampling is shown in the following table.

Table 27. Modelled exposure for workers: task 6

Frequency (d/a)	Duration [min/shift]	Inhalation exposure [ng/m^3]	
		Task-based	TWA (on day of exposure)
48	15	3200 (without RPE)	100 (without RPE)
48	15	80 (with RPE) *	2.5 (with RPE) *

All calculated values (TWA) rounded to two significant figures for presentation; full ART reports are attached in Annex 5. * includes reduction by 97.5 % due to respiratory protection (powered air respirator with full hood. Filter type A2B2E2K 1Hg P).

Under the conditions of use as described above ART models a task-based exposure of 3200 ng/m^3, i.e. this is the exposure concentration which would result if this activity is performed for the whole workday (480 minutes). Taking into account that the whole process lasts maximally 15 minutes a TWA for the day of exposure of 100 ng/m^3 would result. This calculation does not account for the respiratory protection equipment worn by the operators. If this reduction due to RPE of 97.5% is considered a task based exposure of 80 ng/m^3 and a TWA for the day of exposure of 2.5 ng/m^3 results. This calculation is based on the maximum Cr(VI) concentration present in any of the tanks from which samples are taken. Further no LEV was selected as LEVs are not present at all tanks from which samples are taken. This is a worst-case assumption, because for some of the tanks Cr(VI)

concentration is less than 50% of the assumed concentration and most of the tanks are equipped with lip extractions. Further, it should be regarded that the air concentration is probably more influenced by the colouring process and the immersion of the stainless steel components into the tank liquids than by the tank sampling as the handling of the liquids (see Figure 10) is very carefully due to the corrosive properties of the acidic liquids.

Air monitoring results

Tank sampling is performed weekly for all colouring, black colouring and hardener tanks. The operators performing the sampling stand either behind the Plexiglas shield and use small lockable windows in the Plexiglas shield for the sampling or they stand in the space between the lines where not Plexiglas shields are installed. The place for taken the samples depends on the space for handling and access to the tanks which is different from different positions. The position selected is the one with the best access to guarantee safe handling of the corrosive liquids. The following table summarises the monitoring results for these tanks:

Table 28. Monitoring result: Colouring line (Tasks 13, 14, 15, 16, 17)

	2018	**2019**	**2021**	**2022**	**2023**	**2024**	**2024**	**2025**	**2015**
	ng Cr(VI)/m³								
Line 3, Colouring Tank	5.6	76	31	86	30	107	101	80	60
Line 3, Hardening Tank	74.1	344	18	73	115	22	195	80	80
Line 3, Black RinseTank	15.7	208	69	26	79	23	283	130	90
Line 2, Hardening Tank	106	-	84	174	51	65	667	310	170
Line 2, Colouring Tank**	180/425	503	672	372	666	390	1875	3460	930
Line 1, Black Colouring Tank**	104	369	474	325	263	1279	848	3590	2060
number of measurements (n)	54								
AM	424.32								
SD	744.05								
Median	122.50								
90th Percentile	905.40								
MAX	3590.00								
MIN	5.6								

** Measurement performed 'between the colouring lines', i.e. between the two colouring lines 1 and 2, where no Plexiglas shield is installed. The chemist and technician are wearing RPE when they perform tank sampling in this area.

The monitoring data differ significantly between the different tanks, although all colouring, black colouring or hardener tanks contain comparable Cr(VI) concentrations. For some of the tanks they are lower and for other tanks they are higher than the concentration predicted on basis of the modelling results for the sampling activity. This indicates that the real exposure is largely independent from the sampling process. It is concluded that the activity at the colouring line is the most important factor influencing the overall Cr(VI) concentration measured close to the tanks.

In addition, five personal measurement results are available for this activity. All five measurements are below the LoQ; due to the varying detection limits of the individual measurements, calculations using LoQ/2 yield concentrations of between approximately 45 and 417 ng/m³, which are therefore significantly lower than the modelling results. If we also take into account that workers wear respiratory protection whilst carrying out this task and that the task takes only a few minutes a day, the overall contribution to total exposure is minimal.

9.2.8.2.4. Task 7 - Laboratory analysis (PROC 15)

Modelling results

The modelled exposure estimates are shown in the following table.

Table 29. Modelled Exposure for workers: task 7

Frequency (d/a)	Duration [min/shift]	Inhalation exposure [ng/m³]	
		Task-based	TWA (on day of exposure solely due to this task)
48	15	1100	34.38

All calculated values (TWA) rounded to two significant figures for presentation; full ART reports are attached in Annex 5

Under the conditions of use as described above ART models a task-based exposure of 1100 ng/m³, i.e. this is the exposure concentration which would result if this activity is performed for the whole workday (480 minutes). Taking into account that the whole process lasts maximally 15 minutes a TWA for the day of exposure of 34.38 ng/m³ would result. But, it has to be considered, that the modelled exposure only regards the handling of the concentrated liquid, but not the handling of the diluted liquid.

Air monitoring results

Monitoring was performed on one day in the laboratory in the years 2018, 2019, 2021, 2023 and on two days in the years 2024 and 2025. The results of the stationary monitoring are shown in the following table

Table 30. Monitored exposure for chemist: laboratory

Year	Monitoring values [ng/m³]	Monitoring values without outlier [ng/m³]
2018	163	
2019	91	91
2021	74	74
2022	27	27
2023	25	25
2024	37	37
2024	11	11
2025	90	90
2025	30	30
N (total)	9	8
AM	60.89	48.13
SD	48.48	31.79
Median	37	33.50
90th Perc.	105.40	90.30
MAX	163	91.00
MIN	11	11

In the year 2018 an exceptionally high monitoring value of 163 ng/m³ has been reported. As this value was higher than any other monitoring value reported since 2015 it is regarded as an outlier and not further considered for the exposure and risk characterisation. Disregarding the 2018 value one can say that the monitoring values vary over one order of magnitude with the highest concentration of 91.00 ng/m³ and the lowest concentration of 5.30 ng/m³. Unfortunately, no details about the activities performed during the monitoring are available. Therefore, it remains unclear, whether a specific activity has contributed to the highest values. All in all, the monitoring results support the outcome of the modelling. As the laboratory is located close to the production hall and as the door is usually open the overall exposure in the laboratory is probably influenced by the Cr(VI) concentration in the production hall and not only due to the handling of Cr(VI) containing liquids. Due to the low number of measurements (<10) the highest value disregarding the outlier characterizes best the exposure situation during laboratory work.

There are two personal monitoring values available for Task 7, both were below the LoQ and the resulting concentration based on LoQ/2 were 90.58 and 98.04 ng/m³, which is in accordance with the modelled value. Additional monitoring data were always collected in conjunction with the sampling activity and are therefore not representative of exposure in the laboratory.

Discussion and conclusions
As discussed above for the tasks 1, 6, 7, and 12 the modelling results only insufficiently describe the real exposure of the plant chemist and technician. Calculations for the single tasks partially underestimate and sometimes overestimate the real exposures as can be seen from a comparison of the task-based modelling results and the task-based measurements. When looking at the long-term personal monitoring data for this WCS, the values range from < LOQ to 23 µg/m³, where values in the µg range are only ever achieved if the sampling time includes the time taken for Task 1 (tank top-up). However, the monitoring does not take into account the protective effect of the face mask. If the three long-term measurements relating to Task 1 are excluded, there remain nine individual long-term measurements for this WCS. It is therefore proposed that the highest of the nine remaining measurements (312.5 ng/m^3) is used as the basis for estimating exposure for this WCS. This is considered sufficiently conservative, given that it also includes measurements taken during Task 6 (tank sampling), during which respiratory protection is also worn. At the same time, however, it prevents a significant overestimation based on the measurements taken in connection with Task 1, which do not take respiratory protection into account in any way.

Risk estimate for the plant chemist and technician is based on the highest personal monitoring value, excluding the values covering Task 1 activities (not adequately represented as the protective effect of the face mask is not considered), which results in a long-term TWA of **312.5 ng/m^3**.

9.2.8.3 Comparison of outcome with initial application

Unlike in the CSR for the 2015 authorisation application, the exposure assessment for the chemist and plant technician has now been carried out on the basis of personal measurement data, which was not available at that time. As outlined above this procedure is considered conservative, given that it also includes measurements taken during Task 6 (tank sampling), during which respiratory protection is also worn.

If the exposure assessment were to be carried out in the same way as in 2015, the total exposure would consist of 50% each from exposure resulting from work in the laboratory and exposure resulting from work in the hall. For exposure in the hall, it would be assumed that this is best characterised by the 90th percentile of the monitoring values obtained indoors in the part of the production hall where the colouring lines are located (1209.20 ng/m^3). However, from today's perspective, taking into account the different division of tasks between the WCS and bearing in mind that, unlike in 2015, respiratory protection is now also worn during Task 6 (tank sampling), this appears to be too conservative. If stationary measurement values were to be used, the 90th percentile of 'All values indoors except packaging unit and except measurements 'between colouring lines' plus filter press' would be more suitable for this WCS (447.70 ng/m^3). This would be sufficiently conservative as the plant chemist and technician have also some duties outside the production hall as well as in the packaging unit and spend also some time in their office next to the actual production hall.

The exposure assessment for the plant chemist and technician would then be based on the 90th percentile of 'All values indoors except packaging unit and except measurements 'between colouring lines' plus filter press' (447.70 ng/m^3; see Table 19) and the maximum monitoring value for the laboratory obtained over the years 2019 – 2025 (91 ng/m^3). Overall exposure would then be calculated as the sum of 0.5 x long-term TWA from both areas as outlined in the table below.

Table 31. Exposure calculation for plant chemist and technician

Frequency (d/a)	Duration [min/shift]	Inhalation exposure [ng/m^3]		
		TWA (laboratory)	TWA (colouring line unit of hall)	Long-term TWA
240	240	91	-	45.5
240	240	-	447.70	223.85
Resulting long term exposure				**269.35**

*highest value measured between 2019-2025 (n=8; without outlier)

The value calculated on the basis of stationary measurements (269.35 ng/m^3) would be slightly lower than the highest individual measurement (312.5 ng/m^3) and thus supports this value.

9.2.9 Worker contributing scenario 5: Maintenance manager and maintenance worker

Maintenance workers are active in different parts of the hall, including maintenance activities in the packaging unit as well as maintenance activities in the part of the hall where the colouring lines are located. There, they may be active in areas with lower concentrations as well as in areas with higher concentrations like the area between the colouring lines. They are also performing activities outside the production hall e.g. at the filter press or in the workshop container. The maintenance team is responsible for all maintenance activities at Rimex, not just in the colouring plant. Frequency and duration of the activities in the colouring hall vary. It can be assumed that the 4 maintenance worker (including the maintenance manager) spend on average 20 days per year in the colouring plant, i.e. each maintenance worker spends 5 days per year there. This corresponds to 2 hours on 20 days per year.

9.2.9.1 Conditions of use

The conditions of use are described in section 9.2.8.1.

9.2.9.2 Exposure assessment

Modelling results

Since maintenance workers do not handle chromium-containing liquids directly, their exposure cannot be modelled by ART.

Air monitoring results

Personal monitoring values are not available for the maintenance workers, as their activity in the colouring plant is spontaneous and therefore could not be coordinated with the monitoring activities.

Therefore, stationary measurements are used to estimate the exposure of maintenance workers. Their exposure can best be described by the 90th percentile of all values measured in the production hall as well as outdoors near the filter press, but excluding ambient air measurements (729.60 ng/m^3; see Table 19). This value characterises the typical exposure concentration on a working day. The calculation for the average daily exposure concentration, taking into account that maintenance operators only work in the colouring plant for an average of 2 hours a day on 20 days a year is shown in the following table. The resulting TWA is 15.20 ng/m^3, which is only slightly above the 90 percentile of the ambient air measurements of 9.08 ng/m^3 (see Table 19).

Table 32. Exposure for workers: task 11

Frequency (d/a)	Duration [min/shift]	Inhalation exposure [ng/m^3]	
		Based on stationary measurements	TWA (on day of exposure)
20	120	729.60	15.20

Risk estimate for maintenance workers is based on the 90th percentile of all monitoring values measured in the production hall as well as outdoors near the filter press (729.60 ng/m^3), and taking into account that they spend only a very small part of their workday on tasks in and around the colouring plant, which results in a long-term TWA of **15.20 ng/m^3**.

9.2.9.3. Comparison of outcome with initial application

A direct comparison with the initial application is not possible, as there was no group of workers in the first assessment who were solely responsible for monitoring. Prior to the organisational restructuring, maintenance operators were responsible for the majority of the tasks that are now carried out by the chemist and plant technician. Back then, too, the exposure was calculated based on the 90th percentile of all monitoring values measured in the production hall as well as outdoors near the filter press. However, as the maintenance workers at the colouring plant were working there on a permanent basis at the time, the value was taken as such and was not adjusted to take into account the duration and frequency of their work. Under the new system, whereby

maintenance workers are now solely responsible for maintenance tasks, their exposure to Cr(VI) is significantly lower than in the first CSR, and is barely above background levels.

9.2.10 Worker contributing scenario 6: Supervisor/Foreman

9.2.10.1 Conditions of use

The shift foreman (supervisor) does not perform any tasks associated with a direct handling of Cr(VI) containing liquids or solids. Therefore, his exposure cannot be modelled by ART. But, he is exposed indirectly through the presence of Cr(VI) in the workplace air.

His office is located in the area of the production hall where the part of the colouring lines ends and where the packaging unit begins (see Dashed line: dividing curtain

Figure 1). Due to his duties and activities as a coordinator of the work in the colouring and packaging unit it is assumed that he spends about half of his workday in the area with the colouring lines and half of his workday in the packaging unit.

9.2.10.2 Exposure assessment

The exposure assessment for the shift foreman (supervisor) is therefore calculated on basis of the 90th percentile of the monitoring values obtained indoors in the part of the production hall where the colouring lines are located except measurements 'between colouring lines' as he is never in that area (521.60 ng/m^3; see Table 19 'all values indoors except packaging unit and except measurements 'between colouring lines'') and the 90th percentile of the stationary measurements from the packaging area (27.68 ng/m^3). Overall exposure is then calculated as the sum of 0.5 x long-term TWA from both areas as outlined in the table below.

Table 33. Exposure calculation for shift foreman (supervisor)

Frequency (d/a)	**Duration [min/shift]**	**Inhalation exposure [ng/m^3]**		
		TWA (packaging unit of hall)	**TWA (colouring line unit of hall)**	**Long-term TWA**
240	240	27.68	-	13.84
240	240	-	521.60	260.80
Resulting long term exposure				**274.64**

There are no personal monitoring values for the supervisor or foreman.

Risk estimate for the supervisor/foreman of the colouring line is based on 90th percentile of the monitoring values obtained indoors in the part of the production hall where the colouring lines are located except measurements 'between colouring lines' and the 90th percentile of the stationary measurements from the packaging area, which results in a long-term TWA of **274.64 ng/m^3**.

9.2.10.3 Comparison of outcome with initial application

In the 2015 assessment, the 90th percentile of all values indoors except packaging units was used for the calculation. This approach appears overly conservative, as it also includes the high measurements between lines 1 and 2 in the evaluation. In reality, however, this is an area where the supervisor does not spend any time. Should it nevertheless be necessary to enter this area, this would only be done with full protective equipment, including a breathing mask. For a more realistic estimate, the measured values between lines 1 and 2 were therefore not taken into account for the current assessment.

This assessment is less conservative than that of 2015, as the current assessment does not take into account the high Cr concentrations between lines 1 and 2. However, it is considered more appropriate as it better reflects actual exposure. The numerical value is very similar, 217.22 vs. 274.64 ng/m^3.

Overall, this assessment is considered representative as it takes into account measurements from 2018 to 2025 and different seasons, whereas the 2015 assessment was based on measurements from only one year.

9.2.11 Worker contributing scenario 7: Plant Manager

9.2.11.1 Conditions of use

The office of the plant manager is located close to the production hall, at the end of the hall, near the effluent treatment plant with one door to the production hall and one door leading outdoors. He usually is not involved in any tasks associated with the handling of Cr(VI) containing solids or liquids.

9.2.11.2 Exposure assessment

During a normal workday the plant manager spends most time of the day in his office or even outside the production hall for meetings with other colleagues. He is only present in the production hall for short periods, including presence in the area with the colouring lines and the packaging unit.

There are two personal monitoring values for the plant manager, both were below the LoQ. One value is from 2017 and one from 2025; due to the different LoQs, calculating LoQ/2 yields values of 53,19 ng/m^3 and 5.23 ng/m^3, respectively. The current measured value from 2025 is used for the exposure assessment. This results in an exposure of 5.23 ng/m^3.

Risk estimate for the plant manager is based on personal monitoring data, resulting in a long-term TWA of **5.23 ng/m^3**.

9.2.11.3 Comparison of outcome with initial application

No personal measurement data was available for the initial application. The exposure was therefore estimated using in-situ measurements. Due to the fact that the times of his presence in the different parts of the hall is varying exposure assessment for the plant manager was calculated using the arithmetic mean value of all indoor monitoring values, for which the current value is 320.70 ng/m^3. To take the arithmetic mean value as basis for the exposure assessment instead of the 90th percentile seemed justified if one takes into account that the door of the office leading outdoors is open very often. Additionally, the monitoring values taken at the effluent treatment plant (actually n=7; 4.00 to 34 ng/m^3; for details see Annex 2), which is close to the office, confirm that the exposure in the office is probably substantially lower than the 90th percentile of all indoor values (actually 833.20 ng/m^3). However, all these estimates appear far too high when compared with individual measurements, which is why risk assessment is currently carried out using individual measurement data.

10. RISK CHARACTERISATION RELATED TO COMBINED EXPOSURE

10.1 Human health

10.1.1 Workers

The exposure estimates derived in sections 9.2.5. to 9.2.11. were compared with the exposure-risk relationship (ERR) derived by ECHA (2013), according to which occupational exposure to 10 ng/m^3 is associated with an excess lung cancer risk of 4 x 10^{-5} (see section 9.0.3). The risks resulting from the application of this ERR to the inhalation exposure estimates presented above is shown in the follwing table.

Table 34. Risk resulting from Cr(VI) exposure during its industrial use as an oxidising and hardening agent in the manufacture of coloured stainless steel

Worker	Tasks performed by operators	Inhalation exposure [ng/m^3]	Risk
WCS 1: Colouring line operators	Tasks 13, 14, 15, 16, 17	693.40	2.77 x 10^{-3}
WCS 2: End of line operators	Tasks 14, 16	937.50	3.75 x 10^{-3}
WCS 3: Packaging unit operator	Task 18	27.68	1.11 x 10^{-4}
WCS 4: Colouring plant chemist and technician	Tasks 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	312.50	1.25 x 10^{-3}
WCS 5: Maintenance manager and maintenance worker	Task 11	15.20	6.08 x 10^{-5}
WCS 6: Supervisor/Foreman	Not applicable, indirect exposure	274.64	1.10 x 10^{-3}
WCS 7: Plant manager	Not applicable, indirect exposure	5.23	2.10 x 10^{-5}

The table below shows, for comparison, the exposure and risk assessments from the first marketing authorisation application. Thanks to personal exposure measurements and fixed-point measurements taken over several years, the data set used for exposure estimation has been significantly improved. At the same time, however, it must be noted that this results in higher exposure concentrations for some WCS, possibly due to measurements that also reflect exposure levels during periods of high line utilisation.

Table 35. Risk resulting from Cr(VI) exposure during its industrial use as an oxidising and hardening agent in the manufacture of coloured stainless steel – Calculations of previous application for authorisation

Worker	Tasks performed by operators	Inhalation exposure [ng/m^3]	Risk
Colouring line operators	Tasks 13, 14, 15, 16, 17	387.04	1.55 x 10^{-3}
Packaging unit operator	Task 18	36.66	1.47 x 10^{-4}
Maintenance	Tasks 1, 2, 3, 4, 5, 6, 10, 11, 12	373.02	1.49 x 10^{-3}
Chemist	Tasks 1, 2, 3, 4, 5, 6, 7, 8, 9	229.14	9.17 x 10^{-4}
Supervisor	Not applicable	217.22	8.69 x 10^{-4}
Plant manager	Indirect exposure, and exposure due to Tasks 1, 2, 3, 4, 5, 6, 7, 8, 9 during part of the year	147.47	5.90 x 10^{-4}

As outlined in section 9.1.1, no risk characterisation is performed for the dermal pathway. But due to the fact that chromium (VI) trioxide is classified as skin corrosive Category 1A, skin sensitising Category 1 and respiratory sensitising Category 1 risk management measures are in place which efficiently protect from skin contact.

Conclusion on risk characterisation

Handling of Cr(VI) is reduced to a minimum and for all tasks involving contact to Cr(VI) effective protective measures are used. Exposure is dominated by low levels of Cr(VI) in indoor workplace air, which is caused by the open batch procedures inherent and inalterable for this specific production process. The calculated risk for life-time exposure of operators to Cr(VI) under the described use conditions is in the range of 2.10×10^{-5} to 3.75×10^{-3}.

10.1.2 Consumer

Exposure assessment and risk characterisation is not applicable as there are no consumer-related uses for the substance addressed in this CSR.

10.2 Environment (combined for all emission sources)

As chromium (VI) trioxide is not listed in EU REACH Annex XIV due to environmental effects, no environmental exposure assessment is performed here.

Man via environment

Exposure of humans via the environment and associated risks are discussed and presented in Section 9.2.3 above (local and regional scale).

10.2.1 All uses (regional scale)

Not relevant as no environmental assessment is performed.

10.2.2 Local exposure due to all wide dispersive uses

Not relevant as no environmental assessment is performed and there are no wide dispersive uses covered in this CSR.

10.2.3 Local exposure due to combined uses at a site

Not relevant as no environmental assessment is performed and there is only one use covered in this CSR.

Annex 1 Extract of GESTIS database International limit values for chemical agents Occupational exposure limits (OELs)

Chromium(VI) oxide

CAS-No.: 1333-82-0

● new ● updated

	Limit value - TWA			Limit value - STEL		
Country	ppm	mg/m³	F/cm³	ppm	mg/m³	F/cm³
Australia		0,05				
Austria						
Canada - Ontario		0,05				
Finland		0,005 (1)				
France		0,05			0,1	
Hungary					0,05	
Latvia		0,01				
New Zealand		0,01 (1)				
Sweden		0,005 (1)			0,015 (1) (2)	
The Netherlands		0,025 (1)			0,05 (1) (2)	
USA - NIOSH		0,0002				
USA - OSHA		0,005				

Chromium(VI) compounds, water-soluble compounds

CAS-No.: 7440-47-3

● new ● updated

	Limit value - TWA			Limit value - STEL		
Country	ppm	mg/m³	F/cm³	ppm	mg/m³	F/cm³
Canada - Québec		0,05				
Israel		0,05				
Japan (JSOH)		0,01 (1)				
South Africa		0,0004 (1) (2)			0,001 (1) (2) (3)	
South Africa Mining		0,05				
United Kingdom		0,025 (1)				
		0,01				

Chromium(VI) compounds, insoluble

Remark: as Cr

new updated

	Limit value - TWA			Limit value - STEL		
Country	ppm	mg/m³	F/cm³	ppm	mg/m³	F/cm³
Australia		0,05				
Canada - Ontario		0,01				
Canada - Québec		0,01				
Ireland		0,01				
Israel		0,01				
New Zealand		0,00002			0,0005 (1)	
Norway		0,001				
South Korea		0,01				

Accessed: 8 December 2025

Annex 2 Workplace air monitoring

Table 36. Monitoring result: Stationary monitoring outside the production hall

Year	Downwind [ng Cr(VI)/m^3]	Upwind [ng Cr(VI)/m^3]
2018	7.75	9.25
2019	2	1
2021	3	9
2021	-	0.05 (= LoQ/2)
2022	1	1
2023	1	0.05 (= LoQ/2)
2024	1	2
2024	1	8
2025	0.05 (= LoQ/2)	10
2025	2	3
number of measurements (n)	9	10
AM]	2.09	4.34
SD	2.29	4.19
Median	1.0	2.50
90th Percentile	3.95	9.33
MAX	7.75	10
MIN	0.05	0.05

Table 37. Monitoring result: Stationary monitoring packaging area (Task 18)

Year	End of hall (packaging), left [ng Cr(VI)/m^3]	End of hall (packaging), right [ng Cr(VI)/m^3]
2018	28	24 and 6
2019	16	26
2021	28	18
2022	2	3
2023	6	10
2024	8	10
2024	14	11
2025	10	10
2025	10	30
number of measurements (n)	19	
AM]	14.18	
SD	8.91	
Median	10.00	
90th Percentile	27.68	
MAX	30.00	
MIN	2	

Table 38. Monitoring result: Stationary monitoring colouring line (Tasks 13, 14, 15, 16, 17)

	2018	**2019**	**2021**	**2022**	**2023**	**2024**	**2024**	**2025**	**2025**
	ng Cr(VI)/m³								
Line 3, Loading area	72.4	317	13.1	22	37	26	220	570	110
Line 2, Loading area	180	436	261	66	141	93	1437	220	1430
Line 1, Loading area	221	1496	95	80	384	1294	1636	1720	700
Line 3, Colouring Tank	5.6	76	31	86	30	107	101	80	60
Line 3, Hardening Tank	74.1	344	18	73	115	22	195	80	80
Line 3, Black RinseTank	15.7	208	69	26	79	23	283	130	90
Line 2, Hardening Tank	106	-	84	174	51	65	667	310	170
Line 2, Colouring Tank**	180 425	503	672	372	666	390	1875	3460	930
Line 1, Black Colouring Tank**	104	369	474	325	263	1279	848	3590	2060

Statistical analysis	Regarding all values	All values except those performed 'between the colouring lines' (**)
number of measurements (n)	81	63
AM	446.80	283.03
SD	690.27	428.53
Median	174.00	101.00
90th Percentile	1430.00	693.40
MAX	3590.00	1720.00
MIN	5.6	5.60

Table 39. Monitoring result: Stationary monitoring filter press (Task 12)

Year	**Inhalation exposure [ng/m³]**
2019	11
2021	34
2023	15
2024	21
2024	4
2025	30
2025	3

Table 40. Monitoring result: Stationary monitoring laboratory (Task 7)

Year	Monitoring values [ng/m^3]	Monitoring values without outlier [ng/m^3]
2018	163	
2019	91	91
2021	74	74
2022	27	27
2023	25	25
2024	37	37
2024	11	11
2025	90	90
2025	30	30
N (total)	9	8
AM	60.89	48.13
SD	48.48	31.79
Median	37	33.50
90th Perc.	105.40	90.30
MAX	163	91.00
MIN	11	11

Table 41. Monitoring result: Personal monitoring

Year	Sample location and Tasks performed	Monitoring values [ng/m^3]*, [a]	Monitoring values [ng/m^3]*, [b]	Remark
2016	Line 3 operator	1041.67 **		(= LoQ/2; LoQ = 2 µg)
2016	Working on and around Line 2 Colouring Line	1041.67		(= LoQ/2; LoQ = 2 µg)
2016	Tank sampling & Running of Effluent treatment plant	1041.67		(= LoQ/2; LoQ = 2 µg)
2016	Working on and around Line 1 Colouring Line	1041.67		(= LoQ/2; LoQ = 2 µg)
2016	Working end on Colouring lines 1 & 2	1041.67		(= LoQ/2; LoQ = 2 µg)
2017	Tank sampling & Operating the Effluent plant	312.5		(LoQ = 0.1 µg)
2017	Line 1 operator loading sheets onto jigs and operating the transporter	52.08		(= LoQ/2; LoQ = 0.1 µg)
2017	Line 2 operator loading sheets onto jigs and operating the transporter	52.08		(= LoQ/2; LoQ = 0.1 µg)
2017	Line 3 operator loading sheets onto jigs and operating the transporter	52.08		(= LoQ/2; LoQ = 0.1 µg)
2017	Electropolishing operator loading sheets onto jigs and operating the transporter	52.08		(= LoQ/2; LoQ = 0.1 µg)
2017	End of line, loading sheets onto jigs	52.08		(= LoQ/2; LoQ = 0.1 µg)
2017	Colouring plant manager	53.19		(= LoQ/2; LoQ = 0.1 µg)
2018	Worn by Operator during tank sampling and sample preparation	208.33		(= LoQ/2; LoQ = 0.1 µg)
2018	Worn by Operator on exterior of Respirator during top up	2083.33		

2018	Worn by Operator on exterior of Respirator during top up	208.33		(= LoQ/2; LoQ = 0.1 µg)
2018	Filter press operation	208.33		(= LoQ/2; LoQ = 0.1 µg)
2018	Forklift operation in Colouring plant	52.08		(= LoQ/2; LoQ = 0.1 µg)
2018	Cleaning around effluent and colouring lines	208.33		(= LoQ/2; LoQ = 0.1 µg)
2018	Worn during titrations of Black tank samples for trivalent chrome	98.04		(= LoQ/2; LoQ = 0.1 µg)
2020	Line operator worn during shift	114.58		
2020	Filter press operation		833.33	
2020	Collecting and diluting tank samples		316.46	(= LoQ/2; LoQ = 0.1 µg)
2020	End of line sheet handling	54.35		(= LoQ/2; LoQ = 0.1 µg)
2020	Effluent plant S1 sampling		416.67	(= LoQ/2; LoQ = 0.1 µg)
2020	Colouring tanks chemical top ups	23375.00		
2020	Electro polishing line operation	177.08		
2020	Titrations of tank samples in Laboratory	90.58		(= LoQ/2; LoQ = 0.1 µg)
2020	Final inspection and sheet coating	54.00		(= LoQ/2; LoQ = 0.1 µg)
2020	Blank sample	52.08		(= LoQ/2; LoQ = 0.1 µg)
2021	Monday morning tank top up		304.88	(= LoQ/2; LoQ = 0.1 µg)
2021	line 1 operator	52.08		(= LoQ/2; LoQ = 0.1 µg)
2021	decontamination of chrome cans		312.50	(= LoQ/2; LoQ = 0.1 µg)
2021	line 2 operator	52.08		(= LoQ/2; LoQ = 0.1 µg)
2021	Line 3 operator	52.85		(= LoQ/2; LoQ = 0.1 µg)
2021	tank sampling + sample prep		416.67	(= LoQ/2; LoQ = 0.1 µg)
2021	mirrorpolishing	60.68		(= LoQ/2; LoQ = 0.1 µg)
2021	worn by crane operator during chemical top up		2500.00	
2021	dropping filter cake		263.16	(= LoQ/2; LoQ = 0.1 µg)
2021	end of the line	67.20		(= LoQ/2; LoQ = 0.1 µg)
2024	Collecting and diluting tank samples +tensiomater (CrVI)		333.33	(= LoQ/2; LoQ = 0.1 µg)
2024	filter press chrome (CrVI)		657.89	(= LoQ/2; LoQ = 0.1 µg)
2024	line 1 operator (CrVI)	856.53		
2024	e-pol operator /end of line chrome VI	52.30		(= LoQ/2; LoQ = 0.1 µg)
2024	morning top up (CrVI)		1000.00	
2024	mirroropolish /front of line (CrVI)	52.97		(= LoQ/2; LoQ = 0.1 µg)
2024	front of line operator (CrVI)	937.5		

2024	paking CrVI	52.85		(= LoQ/2; LoQ = 0.1 µg)
2024	Technician typical Day CrVI	57.74		(= LoQ/2; LoQ = 0.1 µg)
2025	Chemist typical day total + maintenance on pH probe and line 1 pit pump	5.21		(= LoQ/2; LoQ = 0.01 µg)
2025	line 3 operator	5.21		(= LoQ/2; LoQ = 0.01 µg)
2025	front of line	5.56		(= LoQ/2; LoQ = 0.01 µg)
2025	morning tank top up		44.64	(= LoQ/2; LoQ = 0.01 µg)
2025	E-pol operator	20.83		
2025	Tank sampling and dilution		44.64	(= LoQ/2; LoQ = 0.01 µg)
2025	filter press		58.14	(= LoQ/2; LoQ = 0.01 µg)
2025	Technician typical day	5.21		(= LoQ/2; LoQ = 0.01 µg)
2025	colouring plant manager	5.23		(= LoQ/2; LoQ = 0.01 µg)
2025	inspection and packing	5.21		(= LoQ/2; LoQ = 0.01 µg)

a: sampling duration ≥ 120 up to 480 min; b: sampling duration < 95 min
*calculated values, which are < LoQ – expressed as µg Cr(VI) on the filter – may differ due to different sampling volumes
** 2016 values not considered for further evaluation due to the high LoQ

Table 42. Monitoring result: Personal monitoring (2017 -2025; sorted by WCS)

Year	WCS 1: Colouring line operators [ng/m³]	WCS 2: End of line operator [ng/m³]	WCS 3: Operators of Packaging unit [ng/m³]	WCS 4: Colouring plant chemist and technician – long term [ng/m³]	WCS 4: Colouring plant chemist and technician – short term [ng/m³]	WCS 4: Colouring plant chemist and technician [ng/m³]
2017				312.5		
2017	52.08					
2017	52.08					
2017	52.08					
2017		52.08				
2017		52.08				
2017						53.19
2018				208.33		
2018				2083.33		
2018				208.33		
2018				208.33		
2018			52.08			
2018				208.33		
2018				98.04		
2020	114.58					
2020					833.33	
2020					316.46	
2020		54.35				
2020					416.67	
2020				23375.0		
2020		177.08				
2020				90.58		
2020			54.0			
2021					304.88	
2021	52.08					
2021					312.5	
2021	52.08					
2021	52.85					
2021					416.67	
2021						
2021					2500.0	
2021					263.16	
2021		67.2				
2024					333.33	
2024					657.89	
2024	856.53					
2024		52.3				
2024					1000.0	
2024		52.97				
2024		937.5				
2024			52.85			
2024				57.74		

2025				5.21		
2025	5.21					
2025		5.56				
2025					44.64	
2025		20.83				
2025					44.64	
2025					58.14	
2025				5.21		
2025						5.23
2025			5.21			
N (total)	**9**	**10**	**4**	**12 (11)***	**13**	**2**
AM	143.29	147.19	41.03	2238.41 (316.90)	513.00	
SD	268.88	281.37	23.90	6680.35 (593.97)	651.11	
Median	52.08	52.64	52.47	208.33 (208.33)	316.46	
90th Perc.	262.97	253.12	53.66	1906.25 (312.50)	931.58	
MAX	856.53	937.50	54.00	23375.00 (2083.33)	2500.00	
MIN	5.21	5.56	5.21	5.21 (5.21)	44.64	
n>LoQ	**2**	**3**	**0**	**2 (1)**	**3**	**0**

Figures marked in red were results > LoQ; all other monitoring results were < LoQ for which LoQ/2 was used for statistical analysis

*values in brackets calculated by omitting the highest measured value, which was measured during tank top up)

Annex 3 Environmental monitoring – Air emissions

The tables below show the individual measurements of total chromium per treatment line for the years 2019-2024.

2019

	Line 1	**Line 2**	**Line 3**	**Sum**
Cr conc. [mg/m³]	0.034	0.012	0.026	-
Volumetric flow rate [m^3/h]	13105	2501	22156	-
Operational hours [h/year]	8760	8760	8760	-
Emission [kg/year]	3.90	0.263	5.05	9.21

All emission values rounded to three significant figures.

2020

	Line 1	**Line 2**	**Line 3**	**Sum**
Cr conc. [mg/m³]	2	0.58	0.25	-
Volumetric flow rate [m^3/h]	9667	5502	22876	-
Operational hours [h/year]	8760	8760	8760	-
Emission [kg/year]	169	28.0	50.1	247

All emission values rounded to three significant figures.

2021

	Line 1	**Line 2**	**Line 3**	**Sum**
Cr conc. [mg/m³]	0.072	0.27	0.012	-
Volumetric flow rate [m^3/h]	11381	6184	17328	-
Operational hours [h/year]	8760	8760	8760	-
Emission [kg/year]	7.18	14.6	1.82	23.6

All emission values rounded to three significant figures.

2022

	Line 1	**Line 2**	**Line 3**	**Sum**
Cr conc. [mg/m³]	0.55	0.007	0.025	-
Volumetric flow rate [m^3/h]	11532	6284	19864	-
Operational hours [h/year]	8760	8760	8760	-
Emission [kg/year]	55.6	0.385	4.35	60.3

All emission values rounded to three significant figures.

2023

	Line 1	**Line 2**	**Line 3**	**Sum**
Cr conc. [mg/m³]	0.1	0.011	0.0076	-
Volumetric flow rate [m^3/h]	12148	5095	18632	-
Operational hours [h/year]	8760	8760	8760	-
Emission [kg/year]	10.6	0.491	1.24	12.4

All emission values rounded to three significant figures.

2024

	Line 1	**Line 2**	**Line 3**	**Sum**
Cr conc. [mg/m³]	0.048	0.0041	0.01	-
Volumetric flow rate [m^3/h]	18829	18204	30255	-

Operational hours [h/year]	8760	8760	8760	-
Emission [kg/year]	7.92	0.65	2.65	11.2

All emission values rounded to three significant figures.

Annex 4 Photo documentation

This annex includes a photo documentation. The photos document the activities described in the different WCS above. All photos are confidential.

Figure 4: Chromium (VI) trioxide flakes

Figure 5: Personal Protection Equipment worn during task 1, 2, and 3

Figure 6: Task 1 - Decanting of a solid

Figure 7: Task 3 - Re-filling of baths – liquids

Figure 8: Task 4 - Cleaning of solid CrO3 with a hose

Figure 9: Task 5 - Cleaning of equipment (cleaning of sampling glass pipette)

Figure 10: Task 6 - Tank sampling

Figure 11: Task 7 - Laboratory analyses

Figure 12: Task 9 - Operating effluent treatment plant

Figure 13: Task 13 - Operating colouring line – controler

Figure 14: Task 15 - Operating colouring line – rinsing

Figure 15: Task 16 - Operating colouring line – off loading

Figure 16: Task 12 - Waste handling (filter press)

Figure 17: Task 12 - Waste handling (sludge container)

Figure 18: Task 18 - Activities in packaging area

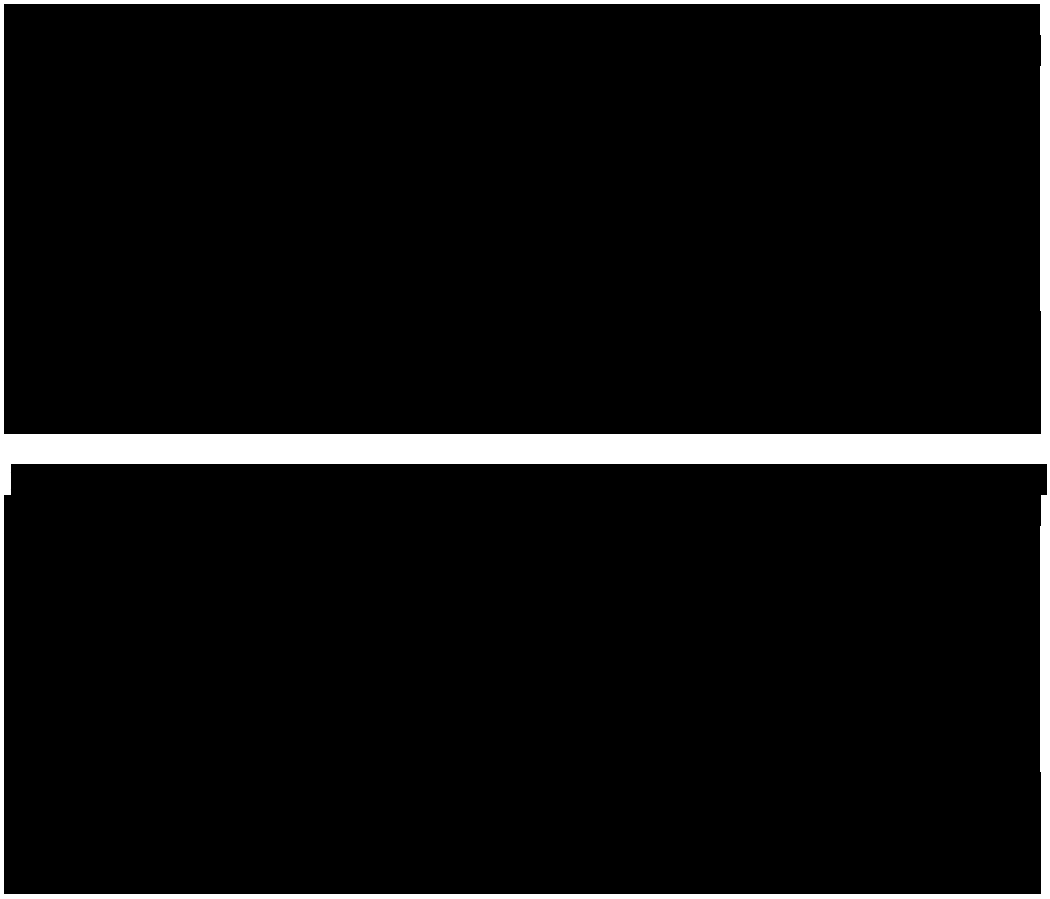


Figure 19: Dividing curtain separating a) the packaging area (upper photo) and b) the area with the colouring lines (lower photo)

Annex 5 ART modelling input and results

Note: "Cr" in the following ART reports refers to Cr(VI), Cr-concentrations or amounts mentioned in this annex are confidential and have been redacted.

ART REPORT – T1: Decanting of a solid (2025)

Decanting of a solid (REDACTED g CrO3; REDACTED g Cr)

Chemical details	
Chemical	Chromium trioxide
CAS No.	1333-82-0
Scenario details	
Number of activities	1
Total duration (mins)	480
Nonexposure period (mins)	0
Metadata	
ART version	1.5

Details for Activity (Decanting of a solid)

Emission sources: Near field ✓ Far field

Duration (mins): 480

Near-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Powders, granules or pelletised material
Dustiness	Granules, flakes or pellets
Moisture content	Dry product (< 5 % moisture content)
Powder weight fraction	Pure material
Activity emission potential	
Activity class	Falling powders
Situation	Transferring 10 – 100 kg/minute
Handling type	Careful transfer involves workers showing attention to potential danger, error or harm and carrying out the activity in a very exact and thorough (or cautious)
Drop height	Drop height < 0.5 m
Containment level	Handling that reduces contact between product and adjacent air. Note: This does not include processes that are fully contained by localised controls (see next
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Indoors
Room size	3000 m³

Risk Management Measures

Localised controls	
Primary	No localized controls (0.00 % reduction)
Secondary	No localized controls (0.00 % reduction)
Dispersion	
Ventilation rate	10 air changes per hour (ACH)

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 75th percentile full-shift exposure is 0.24 mg/m³.

The inter-quartile confidence interval is 0.13 mg/m³ to 0.46 mg/m³.

Notes/Comments/Justifications

RPE: Powered air respirator with full hood (APF 40 according to HSG53; efficiency 97.5%)

460 µg/m3 x 0.025= 11.5 µg/m3 (final task-based estimate)

ART REPORT – T5: Tank Sampling (2025)

Sampling (REDACTED%CrO3; REDACTED%Cr)

Chemical details	
Chemical	Chromium trioxide
CAS No.	1333-82-0
Scenario details	
Number of activities	1
Total duration (mins)	480
Nonexposure period (mins)	0
Metadata	
ART version	1.5
Activity class	Falling liquids
Situation	Transfer of liquid product with flow of 0.1 - 1 l/minute
Containment level	Open process
Loading type	Submerged loading, where the liquid dispenser remains below the fluid level reducing the amount of aerosol formation
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Indoors
Room size	3000 m³

Risk Management Measures

Localised controls	
Primary	No localized controls (0.00 % reduction)
Secondary	No localized controls (0.00 % reduction)
Dispersion	
Ventilation rate	10 air changes per hour (ACH)

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 75th percentile full-shift exposure is 0.0015 mg/m³.

The inter-quartile confidence interval is 0.00071 mg/m³ to 0.0032 mg/m³.

ART REPORT – T7: Laboratory analysis

Laboratory Analysis (REDACTED %CrO3; REDACTED %Cr)

Chemical details	
Chemical	Chromium trioxide
CAS No.	1333-82-0
Scenario details	
Number of activities	1
Total duration (mins)	480
Nonexposure period (mins)	0
Metadata	
ART version	1.5

Details for Activity (Tank Sampling)

Emission sources: Near field ✓ Far field

Duration (mins): 480

Near-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Powders dissolved in a liquid or incorporated in a liquid
Liquid matrix weight fraction	0.11017
Viscosity	Low
Activity emission potential	
Activity class	Falling liquids
Situation	Transfer of liquid product with flow of 0.1 - 1 l/minute
Containment level	Handling that reduces contact between product and adjacent air. Note: This does not include processes that are fully contained by localised controls (see next questions).
Loading type	Submerged loading, where the liquid dispenser remains below the fluid level reducing the amount of aerosol formation
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Indoors
Room size	30 m³

Risk Management Measures

Localised controls	
Primary	Other LEV systems (50.00 % reduction)
Secondary	Other LEV systems (50.00 % reduction)
Dispersion	
Ventilation rate	Mechanical ventilation giving at least 1 ACH

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 75th percentile full-shift exposure is 0.00049 mg/m³.

The inter-quartile confidence interval is 0.00023 mg/m³ to 0.0011 mg/m³.

ART REPORT – T12: Waste handling (filter press)

Sampling (REDACTED %CrO3; REDACTED %Cr)

Chemical details	
Chemical	Chromium trioxide
CAS No.	1333-82-0
Scenario details	
Number of activities	1
Total duration (mins)	480
Nonexposure period (mins)	0
Metadata	
ART version	1.5

Details for Activity (Tank Sampling)

Emission sources: Near field ✓ Far field

Duration (mins): 480

Near-field exposure

Operational Conditions

Substance emission potential	
Substance product type	Paste, slurry or clearly (soaked) wet powder
Contaminated with powder	No
Activity emission potential	
Activity class	Handling of contaminated solid objects or paste
Situation	Handling of substantially and visibly contaminated objects (layers of more than 0.5 kg).
Handling type	Handling that departs from regular work procedures and involves large amounts of energy (e.g. rough handling or throwing of bags)
Surface contamination	
Process fully enclosed?	No
Effective housekeeping practices in place?	Yes
Dispersion	
Work area	Outdoors
Source located close to buildings?	Yes

Risk Management Measures

Localised controls	
Primary	No localized controls (0.00 % reduction)
Secondary	No localized controls (0.00 % reduction)

Predicted exposure levels

ART predicts air concentrations in a worker's personal breathing zone outside of any Respiratory Protection Equipment (RPE). The use of RPE must be considered separately.

Mechanistic model results

The predicted 75th percentile full-shift exposure is 0 mg/m³.

The inter-quartile confidence interval is 0 mg/m³ to 0 mg/m³.

Annex 6 EUSES report

Section/parameter	Actual value	Unit	Stat
STUDY			
STUDY IDENTIFICATION			
Study name	CT		S
Study description	Cr(VI) AfA		S
DEFAULTS			
DEFAULT IDENTIFICATION			
General name	Standard Euses 2.1		D
Description	According to TGDs		D
CHARACTERISTICS OF COMPARTMENTS			
GENERAL			
Density of solid phase	[redacted]	[kg.l-1]	D
Density of water phase	[redacted]	[kg.l-1]	D
Density of air phase	[redacted]	[kg.l-1]	D
Environmental temperature	[redacted]	[oC]	D
Standard temperature for Vp and Sol	[redacted]	[oC]	D
Temperature correction method	Temperature correction for local distribution		D
Constant of Junge equation	[redacted]	[Pa.m]	D
Surface area of aerosol particles	[redacted]	[m2.m-3]	D
Gas constant (8.314)	[redacted]	[Pa.m3.mol-1.K-1]	D
SUSPENDED MATTER			
Volume fraction solids in suspended matter	[redacted]	[m3.m-3]	D
Volume fraction water in suspended matter	[redacted]	[m3.m-3]	D
Weight fraction of organic carbon in suspended matter	[redacted]	[kg.kg-1]	D
Bulk density of suspended matter	[redacted]	[kgwwt.m-3]	O
Conversion factor wet-dry suspened matter	[redacted]	[kgwwt.kgdwt-1]	O
SEDIMENT			
Volume fraction solids in sediment	[redacted]	[m3.m-3]	D
Volume fraction water in sediment	[redacted]	[m3.m-3]	D
Weight fraction of organic carbon in sediment	[redacted]	[kg.kg-1]	D
SOIL			
Volume fraction solids in soil	[redacted]	[m3.m-3]	D
Volume fraction water in soil	[redacted]	[m3.m-3]	D

Volume fraction air in soil	[redacted]	[m3.m-3]	D
Weight fraction of organic carbon in soil	[redacted]	[kg.kg-1]	D
Weight fraction of organic matter in soil	[redacted]	[kg.kg-1]	O
Bulk density of soil	[redacted]	[kgwwt.m-3]	O
Conversion factor wet-dry soil	[redacted]	[kgwwt.kgdwt-1]	O

STP SLUDGE

Fraction of organic carbon in raw sewage sludge	[redacted]	[kg.kg-1]	D
Fraction of organic carbon in settled sewage sludge	[redacted]	[kg.kg-1]	D
Fraction of organic carbon in activated sewage sludge	[redacted]	[kg.kg-1]	D
Fraction of organic carbon in effluent sewage sludge	[redacted]	[kg.kg-1]	D

DEGRADATION AND TRANSFORMATION RATES

Rate constant for abiotic degradation in STP	[redacted]	[d-1]	D
Rate constant for abiotic degradation in bulk sediment	[redacted]	[d-1] (12[oC])	D
Rate constant for anaerobic biodegradation in sediment	[redacted]	[d-1] (12[oC])	D
Fraction of sediment compartment that is aerated	[redacted]	[m3.m-3]	D
Concentration of OH-radicals in atmosphere	[redacted]	[molec.cm-3]	D
Rate constant for abiotic degradation in bulk soil	[redacted]	[d-1] (12[oC])	D

RELEASE ESTIMATION

Fraction of EU production volume for region	[redacted]	[%]	D
Fraction of EU tonnage for region (private use)	[redacted]	[%]	D
Fraction connected to sewer systems	[redacted]	[%]	D

SEWAGE TREATMENT

GENERAL

Number of inhabitants feeding one STP	[redacted]	[eq]	D
Sewage flow	[redacted]	[l.eq-1.d-1]	D
Effluent discharge rate of local STP	[redacted]	[l.d-1]	O
Temperature correction for STP degradation	[redacted]		D
Temperature of air above aeration tank	[redacted]	[oC]	D
Temperature of water in aeration tank	[redacted]	[oC]	D
Height of air column above STP	[redacted]	[m]	D
Number of inhabitants of region	[redacted]	[eq]	D
Number of inhabitants of continental system	[redacted]	[eq]	O
Windspeed in the system	[redacted]	[m.s-1]	D

RAW SEWAGE

Mass of O2 binding material per person per day	[redacted]	[g.eq-1.d-1]	D
Dry weight solids produced per person per day	[redacted]	[kg.eq-1.d-1]	D
Density solids in raw sewage	[redacted]	[kg.l-1]	D
Fraction of organic carbon in raw sewage sludge	[redacted]	[kg.kg-1]	D

PRIMARY SETTLER			
Depth of primary settler	[redacted]	[m]	D
Hydraulic retention time of primary settler	[redacted]	[hr]	D
Density suspended and settled solids in primary settler	[redacted]	[kg.l-1]	D
Fraction of organic carbon in settled sewage sludge	[redacted]	[kg.kg-1]	D
ACTIVATED SLUDGE TANK			
Depth of aeration tank	[redacted]	[m]	D
Density solids of activated sludge	[redacted]	[kg.l-1]	D
Concentration solids of activated sludge	[redacted]	[kg.m-3]	D
Steady state O2 concentration in activated sludge	[redacted]	[kg.m-3]	D
Mode of aeration	[redacted]		D
Aeration rate of bubble aeration	[redacted]	[m3.s-1.eq-1]	D
Fraction of organic carbon in activated sewage sludge	[redacted]	[kg.kg-1]	D
Sludge loading rate	[redacted]	[kg.kg-1.d-1]	D
Hydraulic retention time in aerator (9-box STP)	[redacted]	[hr]	O
Hydraulic retention time in aerator (6-box STP)	[redacted]	[hr]	O
Sludge retention time of aeration tank	[redacted]	[d]	O
SOLIDS-LIQUIDS SEPARATOR			
Depth of solids-liquid separator	[redacted]	[m]	D
Density suspended and settled solids in solids-liquid separator	[redacted]	[kg.l-1]	D
Concentration solids in effluent	[redacted]	[mg.l-1]	D
Hydraulic retention time of solids-liquid separator	[redacted]	[hr]	D
Fraction of organic carbon in effluent sewage sludge	[redacted]	[kg.kg-1]	D
LOCAL DISTRIBUTION			
AIR AND SURFACE WATER			
Concentration in air at source strength 1 [kg.d-1]	[redacted]	[mg.m-3]	D
Standard deposition flux of aerosol-bound compounds	[redacted]	[mg.m-2.d-1]	D
Standard deposition flux of gaseous compounds	[redacted]	[mg.m-2.d-1]	O
Suspended solids concentration in STP effluent water	[redacted]	[mg.l-1]	D
Dilution factor (rivers)	[redacted]	[-]	D
Flow rate of the river	[redacted]	[m3.d-1]	D
Calculate dilution from river flow rate	[redacted]		D
Dilution factor (coastal areas)	[redacted]	[-]	D
SOIL			
Mixing depth of grassland soil	[redacted]	[m]	D
Dry sludge application rate on agricultural soil	[redacted]	[kg.ha-1.yr-1]	D
Dry sludge application rate on grassland	[redacted]	[kg.ha-1.yr-1]	D
Averaging time soil (for terrestrial ecosystem)	[redacted]	[d]	D

Averaging time agricultural soil	[redacted]	[d]	D
Averaging time grassland	[redacted]	[d]	D
PMTC, air side of air-soil interface	[redacted]	[m.s-1]	O
Soil-air PMTC (air-soil interface)	[redacted]	[m.s-1]	D
Soil-water film PMTC (air-soil interface)	[redacted]	[m.s-1]	D
Mixing depth agricultural soil	[redacted]	[m]	D
Fraction of rain water infiltrating soil	[redacted]	[-]	D
Average annual precipitation	[redacted]	[mm.yr-1]	D

REGIONAL AND CONTINENTAL DISTRIBUTION

CONFIGURATION

Fraction of direct regional emissions to seawater	[redacted]	[%]	D
Fraction of direct continental emissions to seawater	[redacted]	[%]	D
Fraction of regional STP effluent to seawater	[redacted]	[%]	D
Fraction of continental STP effluent to seawater	[redacted]	[%]	D
Fraction of flow from continental rivers to regional rivers	[redacted]	[-]	D
Fraction of flow from continental rivers to regional sea	[redacted]	[-]	D
Fraction of flow from continental rivers to continental sea	[redacted]	[-]	O
Number of inhabitants of region	[redacted]	[eq]	D
Number of inhabitants in the EU	[redacted]	[eq]	D
Number of inhabitants of continental system	[redacted]	[eq]	O

AREAS

REGIONAL

Area (land+rivers) of regional system	[redacted]	[km2]	D
Area fraction of freshwater, region (excl. sea)	[redacted]	[-]	D
Area fraction of natural soil, region (excl. sea)	[redacted]	[-]	D
Area fraction of agricultural soil, region (excl. sea)	[redacted]	[-]	D
Area fraction of industrial/urban soil, region (excl. sea)	[redacted]	[-]	D
Length of regional seawater	[redacted]	[km]	D
Width of regional seawater	[redacted]	[km]	D
Area of regional seawater	[redacted]	[km2]	O
Area (land+rivers+sea) of regional system	[redacted]	[km2]	O
Area fraction of freshwater, region (total)	[redacted]	[-]	O
Area fraction of seawater, region (total)	[redacted]	[-]	O
Area fraction of natural soil, region (total)	[redacted]	[-]	O
Area fraction of agricultural soil, region (total)	[redacted]	[-]	O
Area fraction of industrial/urban soil, region (total)	[redacted]	[-]	O

CONTINENTAL

Total area of EU (continent+region, incl. sea)	[redacted]	[km2]	D
Area (land+rivers+sea) of continental system	[redacted]	[km2]	O
Area (land+rivers) of continental system	[redacted]	[km2]	O
Area fraction of freshwater, continent (excl. sea)	[redacted]	[-]	D

Area fraction of natural soil, continent (excl. sea)	[redacted]	[-]	D
Area fraction of agricultural soil, continent (excl. sea)	[redacted]	[-]	D
Area fraction of industrial/urban soil, continent (excl. sea)	[redacted]	[-]	D
Area fraction of freshwater, continent (total)	[redacted]	[-]	O
Area fraction of seawater, continent (total)	[redacted]	[-]	D
Area fraction of natural soil, continent (total)	[redacted]	[-]	O
Area fraction of agricultural soil, continent (total)	[redacted]	[-]	O
Area fraction of industrial/urban soil, continent (total)	[redacted]	[-]	O
MODERATE			
Area of moderate system (incl.continent,region)	[redacted]	[km2]	D
Area of moderate system (excl.continent, region)	[redacted]	[km2]	O
Area fraction of water, moderate system	[redacted]	[-]	D
ARCTIC			
Area of arctic system	[redacted]	[km2]	D
Area fraction of water, arctic system	[redacted]	[-]	D
TROPIC			
Area of tropic system	[redacted]	[km2]	D
Area fraction of water, tropic system	[redacted]	[-]	D
TEMPERATURE			
Environmental temperature, regional scale	[redacted]	[oC]	D
Environmental temperature, continental scale	[redacted]	[oC]	D
Environmental temperature, moderate scale	[redacted]	[oC]	D
Environmental temperature, arctic scale	[redacted]	[oC]	D
Environmental temperature, tropic scale	[redacted]	[oC]	D
Enthalpy of vaporisation	[redacted]	[kJ.mol-1]	D
Enthalpy of solution	[redacted]	[kJ.mol-1]	D
MASS TRANSFER			
Air-film PMTC (air-water interface)	[redacted]	[m.s-1]	O
Water-film PMTC (air-water interface)	[redacted]	[m.s-1]	O
PMTC, air side of air-soil interface	[redacted]	[m.s-1]	O
PMTC, soil side of air-soil interface	[redacted]	[m.s-1]	O
Soil-air PMTC (air-soil interface)	[redacted]	[m.s-1]	D
Soil-water film PMTC (air-soil interface)	[redacted]	[m.s-1]	D
Water-film PMTC (sediment-water interface)	[redacted]	[m.s-1]	D
Pore water PMTC (sediment-water interface)	[redacted]	[m.s-1]	D

AIR

GENERAL

Atmospheric mixing height	[redacted]	[m]	D
Windspeed in the system	[redacted]	[m.s-1]	D
Aerosol deposition velocity	[redacted]	[m.s-1]	D
Aerosol collection efficiency	[redacted]	[-]	D
RAIN			
Average precipitation, regional system	[redacted]	[mm.yr-1]	D
Average precipitation, continental system	[redacted]	[mm.yr-1]	D
Average precipitation, moderate system	[redacted]	[mm.yr-1]	D
Average precipitation, arctic system	[redacted]	[mm.yr-1]	D
Average precipitation, tropic system	[redacted]	[mm.yr-1]	D
RESIDENCE TIMES			
Residence time of air, regional	[redacted]	[d]	O
Residence time of air, continental	[redacted]	[d]	O
Residence time of air, moderate	[redacted]	[d]	O
Residence time of air, arctic	[redacted]	[d]	O
Residence time of air, tropic	[redacted]	[d]	O
WATER			
DEPTH			
Water depth of freshwater, regional system	[redacted]	[m]	D
Water depth of seawater, regional system	[redacted]	[m]	D
Water depth of freshwater, continental system	[redacted]	[m]	D
Water depth of seawater, continental system	[redacted]	[m]	D
Water depth, moderate system	[redacted]	[m]	D
Water depth, arctic system	[redacted]	[m]	D
Water depth, tropic system	[redacted]	[m]	D
SUSPENDED SOLIDS			
Suspended solids conc. freshwater, regional	[redacted]	[mg.l-1]	D
Suspended solids conc. seawater, regional	[redacted]	[mg.l-1]	D
Suspended solids conc. freshwater, continental	[redacted]	[mg.l-1]	D
Suspended solids conc. seawater, continental	[redacted]	[mg.l-1]	D
Suspended solids conc. seawater, moderate	[redacted]	[mg.l-1]	D
Suspended solids conc. seawater, arctic	[redacted]	[mg.l-1]	D
Suspended solids conc. seawater, tropic	[redacted]	[mg.l-1]	D
Concentration solids in effluent, regional	[redacted]	[mg.l-1]	D
Concentration solids in effluent, continental	[redacted]	[mg.l-1]	D
Concentration biota	[redacted]	[mgwwt.l-1]	D
RESIDENCE TIMES			
Residence time of freshwater, regional	[redacted]	[d]	O
Residence time of seawater, regional	[redacted]	[d]	O
Residence time of freshwater, continental	[redacted]	[d]	O

Residence time of seawater, continental	[redacted]	[d]	O
Residence time of water, moderate	[redacted]	[d]	O
Residence time of water, arctic	[redacted]	[d]	O
Residence time of water, tropic	[redacted]	[d]	O
SEDIMENT			
DEPTH			
Sediment mixing depth	[redacted]	[m]	D
SUSPENDED SOLIDS			
(Biogenic) prod. susp. solids in freshwater, reg	[redacted]	[g.m-2.yr-1]	D
(Biogenic) prod. susp. solids in seawater, reg	[redacted]	[g.m-2.yr-1]	D
(Biogenic) prod. susp. solids in freshwater, cont	[redacted]	[g.m-2.yr-1]	D
(Biogenic) prod. susp. solids in seawater, cont	[redacted]	[g.m-2.yr-1]	D
(Biogenic) prod. susp. solids in water, moderate	[redacted]	[g.m-2.yr-1]	D
(Biogenic) prod. susp. solids in water, arctic	[redacted]	[g.m-2.yr-1]	D
(Biogenic) prod. susp. solids in water, tropic	[redacted]	[g.m-2.yr-1]	D
SEDIMENTATION RATES			
Settling velocity of suspended solids	[redacted]	[m.d-1]	D
Net sedimentation rate, freshwater, regional	[redacted]	[mm.yr-1]	O
Net sedimentation rate, seawater, regional	[redacted]	[mm.yr-1]	O
Net sedimentation rate, freshwater, continental	[redacted]	[mm.yr-1]	O
Net sedimentation rate, seawater, continental	[redacted]	[mm.yr-1]	O
Net sedimentation rate, moderate	[redacted]	[mm.yr-1]	O
Net sedimentation rate, arctic	[redacted]	[mm.yr-1]	O
Net sedimentation rate, tropic	[redacted]	[mm.yr-1]	O
SOIL			
GENERAL			
Fraction of rain water infiltrating soil	[redacted]	[-]	D
Fraction of rain water running off soil	[redacted]	[-]	D
DEPTH			
Chemical-dependent soil depth	[redacted]		D
Mixing depth natural soil	[redacted]	[m]	D
Mixing depth agricultural soil	[redacted]	[m]	D
Mixing depth industrial/urban soil	[redacted]	[m]	D
Mixing depth of soil, moderate system	[redacted]	[m]	D
Mixing depth of soil, arctic system	[redacted]	[m]	D
Mixing depth of soil, tropic system	[redacted]	[m]	D
EROSION			
Soil erosion rate, regional system	[redacted]	[mm.yr-1]	D
Soil erosion rate, continental system	[redacted]	[mm.yr-1]	D

Soil erosion rate, moderate system	[redacted]	[mm.yr-1]	D
Soil erosion rate, arctic system	[redacted]	[mm.yr-1]	D
Soil erosion rate, tropic system	[redacted]	[mm.yr-1]	D

CHARACTERISTICS OF HUMANS

Daily intake of drinking water	[redacted]	[l.d-1]	D
Daily intake of fish	[redacted]	[kg.d-1]	D
Daily intake of leaf crops (incl. fruit and cereals)	[redacted]	[kg.d-1]	D
Daily intake of root crops	[redacted]	[kg.d-1]	D
Daily intake of meat	[redacted]	[kg.d-1]	D
Daily intake of dairy products	[redacted]	[kg.d-1]	D
Inhalation rate for humans (consumers, environment)	[redacted]	[m3.hr-1]	D
Inhalation rate for humans (worker exposure)	[redacted]	[m3.hr-1]	D
Bodyweight of the human considered	[redacted]	[kg]	D
Correction factor for duration and frequency of exposure	[redacted]	[-]	D

SUBSTANCE

SUBSTANCE IDENTIFICATION

General name	Chromium trioxide		S
Description			D
CAS-No	1333-82-0		S
EC-notification no.			D
EINECS no.	215-607-8		S

PHYSICO-CHEMICAL PROPERTIES

Molecular weight	[redacted]	[g.mol-1]	S
Melting point	[redacted]	[oC]	S
Boiling point	[redacted]	[oC]	S
Vapour pressure at test temperature	[redacted]	[Pa]	S
Temperature at which vapour pressure was measured	[redacted]	[oC]	S
Vapour pressure at 25 [oC]	[redacted]	[Pa]	O
Octanol-water partition coefficient	[redacted]	[log10]	S
Water solubility at test temperature	[redacted]	[mg.l-1]	S
Temperature at which solubility was measured	[redacted]	[oC]	S
Water solubility at 25 [oC]	[redacted]	[mg.l-1]	O

PARTITION COEFFICIENTS AND BIOCONCENTRATION FACTORS

SOLIDS-WATER

Chemical class for Koc-QSAR	[redacted]		D
Organic carbon-water partition coefficient	[redacted]	[l.kg-1]	O
Solids-water partition coefficient in soil	[redacted]	[l.kg-1]	S

Solids-water partition coefficient in sediment	[redacted]	[l.kg-1]	S
Solids-water partition coefficient suspended matter	[redacted]	[l.kg-1]	S
Solids-water partition coefficient in raw sewage sludge	[redacted]	[l.kg-1]	O
Solids-water partition coefficient in settled sewage sludge	[redacted]	[l.kg-1]	O
Solids-water partition coefficient in activated sewage sludge	[redacted]	[l.kg-1]	O
Solids-water partition coefficient in effluent sewage sludge	[redacted]	[l.kg-1]	O
Soil-water partition coefficient	[redacted]	[m3.m-3]	O
Suspended matter-water partition coefficient	[redacted]	[m3.m-3]	O
Sediment-water partition coefficient	[redacted]	[m3.m-3]	O
AIR-WATER			
Environmental temperature	[redacted]	[oC]	D
Water solubility at environmental temperature	[redacted]	[mg.l-1]	O
Vapour pressure at environmental temperature	[redacted]	[Pa]	O
Sub-cooled liquid vapour pressure	[redacted]	[Pa]	O
Fraction of chemical associated with aerosol particles	[redacted]	[-]	O
Henry's law constant at test temparature	[redacted]	[Pa.m3.mol-1]	D
Temperature at which Henry's law constant was measured	[redacted]	[oC]	D
Henry's law constant at 25 [oC]	[redacted]	[Pa.m3.mol-1]	O
Henry's law constant at enviromental temparature	[redacted]	[Pa.m3.mol-1]	O
Air-water partitioning coefficient	[redacted]	[m3.m-3]	O
BIOCONCENTRATION FACTORS			
PREDATOR EXPOSURE			
Bioconcentration factor for earthworms	[redacted]	[l.kgwwt-1]	O
HUMAN AND PREDATOR EXPOSURE			
Bioconcentration factor for fish	[redacted]	[l.kgwwt-1]	S
QSAR valid for calculation of BCF-Fish	[redacted]		O
Biomagnification factor in fish	[redacted]	[-]	O
Biomagnification factor in predator	[redacted]	[-]	O
HUMAN EXPOSURE			
Partition coefficient between leaves and air	[redacted]	[m3.m-3]	O
Partition coefficient between plant tissue and water	[redacted]	[m3.m-3]	O
Transpiration-stream concentration factor	[redacted]	[-]	O
Bioaccumulation factor for meat	[redacted]	[d.kg-1]	O
Bioaccumulation factor for milk	[redacted]	[d.kg-1]	O
Purification factor for surface water	[redacted]	[-]	O

DEGRADATION AND TRANSFORMATION RATES

CHARACTARIZATION			
Characterization of biodegradability	[redacted]		D
STP			
Degradation calculation method in STP	[redacted]		D
Rate constant for biodegradation in STP	[redacted]	[d-1]	O
Total rate constant for degradation in STP	[redacted]	[d-1]	O
Maximum growth rate of specific microorganisms	[redacted]	[d-1]	D
Half saturation concentration	[redacted]	[g.m-3]	D
WATER/SEDIMENT			
WATER			
Rate constant for hydrolysis in surface water	[redacted]	[d-1] (12[oC])	O
Rate constant for photolysis in surface water	[redacted]	[d-1]	O
Rate constant for biodegradation in surface water	[redacted]	[d-1] (12[oC])	O
Total rate constant for degradation in bulk surface water	[redacted]	[d-1] (12[oC])	O
Rate constant for biodegradation in saltwater	[redacted]	[d-1] (12[oC])	O
Total rate constant for degradation in bulk saltwater	[redacted]	[d-1] (12[oC])	O
SEDIMENT			
Rate constant for biodegradation in aerated sediment	[redacted]	[d-1] (12[oC])	O
Total rate constant for degradation in bulk sediment	[redacted]	[d-1] (12[oC])	O
AIR			
Specific degradation rate constant with OH-radicals	[redacted]	[cm3.molec-1.s-1]	D
Rate constant for degradation in air	[redacted]	[d-1]	O
SOIL			
Rate constant for biodegradation in bulk soil	[redacted]	[d-1] (12[oC])	O
Total rate constant for degradation in bulk soil	[redacted]	[d-1] (12[oC])	O
REMOVAL RATE CONSTANTS SOIL			
Total rate constant for degradation in bulk soil	[redacted]	[d-1] (12[oC])	O
Rate constant for volatilisation from agricultural soil	[redacted]	[d-1]	O
Rate constant for leaching from agricultural soil	[redacted]	[d-1]	O
Total rate constant for removal from agricultural top soil	[redacted]	[d-1]	O
Rate constant for volatilisation from grassland soil	[redacted]	[d-1]	O
Rate constant for leaching from grassland soil	[redacted]	[d-1]	O
Total rate constant for removal from grassland top soil	[redacted]	[d-1]	O
Rate constant for volatilisation from industrial soil	[redacted]	[d-1]	O
Rate constant for leaching from industrial soil	[redacted]	[d-1]	O

Total rate constant for removal from industrial soil	[redacted]	[d-1]	O

RELEASE ESTIMATION

CHARACTERIZATION AND TONNAGE

High Production Volume Chemical	[redacted]		S
Production volume of chemical in EU	[redacted]	[kg.yr-1]	S
Fraction of EU production volume for region	[redacted]	[%]	D
Regional production volume of substance	[redacted]	[kg.yr-1]	O
Continental production volume of substance	[redacted]	[kg.yr-1]	O
Volume of chemical imported to EU	[redacted]	[kg.yr-1]	D
Volume of chemical exported from EU	[redacted]	[kg.yr-1]	D
Tonnage of substance in Europe	[redacted]	[kg.yr-1]	O

USE PATTERNS

PRODUCTION STEPS

EMISSION INPUT DATA [1 "PRODUCTION OF CHROMATE"]

Usage/production title	Production of chromate		S
Industry category	2 Chemical industry: basic chemicals		S
Use category	43 Process regulators		S
Extra details on use category	No extra details necessary		D
Extra details on use category	No extra details necessary		D
Main category production	III Multi-purpose equipment		S
Use specific emission scenario	No		D
Emission scenario	no special scenario selected/available		S
Fraction of tonnage for application	[redacted]	[-]	O
Total of fractions for all production steps	[redacted]	[-]	O
Relevant production volume for usage	[redacted]	[tonnes.yr-1]	O
Regional production volume of substance	[redacted]	[kg.yr-1]	O
Regional production volume for usage	[redacted]	[tonnes.yr-1]	O

OTHER LIFE CYCLE STEPS

EMISSION INPUT DATA [2 "USE OF CHROMATE AS A PROCESS CHEMICAL"]

Usage/production title	Use of chromate as a process chemical		S

USE PATTERN

Industry category	2 Chemical industry: basic chemicals		S
Use category	43 Process regulators		S
Extra details on use category	No extra details necessary		D
Extra details on use category	No extra details necessary		D

INDUSTRIAL USE

Use specific emission scenario	No		D
Emission scenario	no special scenario selected/available		S

TONNAGE

Fraction of tonnage for application	[redacted]	[-]	O
Fraction of chemical in formulation	[redacted]	[-]	D
Tonnage of formulated product	[redacted]	[tonnes.yr-1]	O
Relevant tonnage for application	[redacted]	[kg.yr-1]	O
Regional tonnage of substance	[redacted]	[kg.yr-1]	O
Tonnage of formulated product	[redacted]	[tonnes.yr-1]	O
Regional tonnage of substance (private use step)	[redacted]	[tonnes.yr-1]	O
Continental tonnage of substance (private use step)	[redacted]	[tonnes.yr-1]	O
Total of fractions for all applications	[redacted]	[-]	O

INTERMEDIATE RESULTS

INTERMEDIATE [1 "PRODUCTION OF CHROMATE"]

RELEASE FRACTIONS AND EMISSION DAYS [1 "PRODUCTION OF CHROMATE"]

PRODUCTION

Emission tables	[redacted]		S

RELEASE FRACTIONS

Fraction of tonnage released to air	[redacted]	[-]	S
Fraction of tonnage released to wastewater	[redacted]	[-]	S
Fraction of tonnage released to surface water	[redacted]	[-]	O
Fraction of tonnage released to industrial soil	[redacted]	[-]	S
Fraction of tonnage released to agricultural soil	[redacted]	[-]	O
Emission fractions determined by special scenario	[redacted]		O

EMISSION DAYS

Fraction of the main local source	[redacted]	[-]	S
Number of emission days per year	[redacted]	[-]	S

Release to wastewater only	[redacted]		D
Emission days determined by special scenario	[redacted]		O

INTERMEDIATE [2 "USE OF CHROMATE AS A PROCESS CHEMICAL"]

RELEASE FRACTIONS AND EMISSION DAYS [2 "USE OF CHROMATE AS A PROCESS CHEMICAL"]

INDUSTRIAL USE

Emission tables	[redacted]		S

RELEASE FRACTIONS

Fraction of tonnage released to air	[redacted]	[-]	S
Fraction of tonnage released to wastewater	[redacted]	[-]	S
Fraction of tonnage released to surface water	[redacted]	[-]	O
Fraction of tonnage released to industrial soil	[redacted]	[-]	S
Fraction of tonnage released to agricultural soil	[redacted]	[-]	O
Emission fractions determined by special scenario	[redacted]		O

EMISSION DAYS

Fraction of the main local source	[redacted]	[-]	S
Number of emission days per year	[redacted]	[-]	S
Release to wastewater only	[redacted]		D
Emission days determined by special scenario	[redacted]		O

LOCAL

[1 "PRODUCTION OF CHROMATE"] [PRODUCTION]

Local emission to air during episode	[redacted]	[kg.d-1]	O
Emission to air calculated by special scenario	[redacted]		O
Local emission to wastewater during episode	[redacted]	[kg.d-1]	O
Emission to water calculated by special scenario	[redacted]		O
Show this step in further calculations	[redacted]		O
Intermittent release	[redacted]		D

[2 "USE OF CHROMATE AS A PROCESS CHEMICAL"] [INDUSTRIAL USE]

Local emission to air during episode	[redacted]	[kg.d-1]	O
Emission to air calculated by special scenario	[redacted]		O
Local emission to wastewater during episode	[redacted]	[kg.d-1]	O
Emission to water calculated by special scenario	[redacted]		O
Show this step in further calculations	[redacted]		O
Intermittent release	[redacted]		D

DISTRIBUTION

SEWAGE TREATMENT

[2 "USE OF CHROMATE AS A PROCESS CHEMICAL"] [INDUSTRIAL USE]

INPUT AND CONFIGURATION [2 "USE OF CHROMATE AS A PROCESS CHEMICAL"] [INDUSTRIAL USE]

INPUT

Use or bypass STP (local freshwater assessment)	[redacted]		S
Use or bypass STP (local marine assessment)	[redacted]		S
Local emission to wastewater during episode	[redacted]	[kg.d-1]	O
Concentration in untreated wastewater	[redacted]	[mg.l-1]	O
Local emission entering the STP	[redacted]	[kg.d-1]	O

CONFIGURATION

Type of local STP	[redacted]		D
Number of inhabitants feeding this STP	[redacted]	[eq]	O
Effluent discharge rate of this STP	[redacted]	[m3.d-1]	S
Calculate dilution from river flow rate	[redacted]		S
Flow rate of the river	[redacted]	[m3.d-1]	S
Dilution factor (rivers)	[redacted]	[-]	O
Dilution factor (coastal areas)	[redacted]	[-]	S

OUTPUT [2 "USE OF CHROMATE AS A PROCESS CHEMICAL"] [INDUSTRIAL USE]

Fraction of emission directed to air by STP	[redacted]	[%]	O
Fraction of emission directed to water by STP	[redacted]	[%]	S
Fraction of emission directed to sludge by STP	[redacted]	[%]	S
Fraction of the emission degraded in STP	[redacted]	[%]	O
Total of fractions	[redacted]	[%]	O
Local indirect emission to air from STP during episode	[redacted]	[kg.d-1]	O
Concentration in untreated wastewater	[redacted]	[mg.l-1]	O
Concentration of chemical (total) in the STP-effluent	[redacted]	[mg.l-1]	O
Concentration in effluent exceeds solubility	[redacted]		O
Concentration in dry sewage sludge	[redacted]	[mg.kg-1]	O
PEC for micro-organisms in the STP	[redacted]	[mg.l-1]	O

[2 "USE OF CHROMATE AS A PROCESS CHEMICAL"] [INDUSTRIAL USE]

LOCAL CONCENTRATIONS AND DEPOSITIONS [INDUSTRIAL USE]

AIR

Concentration in air during emission episode	[redacted]	[mg.m-3]	O

Annual average concentration in air, 100 m from point source	[redacted]	[mg.m-3]	O
Total deposition flux during emission episode	[redacted]	[mg.m-2.d-1]	O
Annual average total deposition flux	[redacted]	[mg.m-2.d-1]	O

WATER, SEDIMENT

Concentration in surface water during emission episode (dissolved)	[redacted]	[mg.l-1]	O
Concentration in surface water exceeds solubility	[redacted]		O
Annual average concentration in surface water (dissolved)	[redacted]	[mg.l-1]	O
Concentration in seawater during emission episode (dissolved)	[redacted]	[mg.l-1]	O
Annual average concentration in seawater (dissolved)	[redacted]	[mg.l-1]	O

SOIL, GROUNDWATER

Concentration in agric. soil averaged over 30 days	[redacted]	[mg.kgwwt-1]	O
Concentration in agric. soil averaged over 180 days	[redacted]	[mg.kgwwt-1]	O
Concentration in grassland averaged over 180 days	[redacted]	[mg.kgwwt-1]	O
Fraction of steady-state (agricultural soil)	[redacted]	[-]	O
Fraction of steady-state (grassland soil)	[redacted]	[-]	O

LOCAL PECS [INDUSTRIAL USE]

AIR

Annual average local PEC in air (total)	[redacted]	[mg.m-3]	O

WATER, SEDIMENT

Local PEC in surface water during emission episode (dissolved)	[redacted]	[mg.l-1]	O
Qualitative assessment might be needed (TGD Part II, 5.6)	[redacted]		O
Annual average local PEC in surface water (dissolved)	[redacted]	[mg.l-1]	O
Local PEC in fresh-water sediment during emission episode	[redacted]	[mg.kgwwt-1]	O
Local PEC in seawater during emission episode (dissolved)	[redacted]	[mg.l-1]	O
Qualitative assessment might be needed (TGD Part II, 5.6)	[redacted]		O
Annual average local PEC in seawater (dissolved)	[redacted]	[mg.l-1]	O
Local PEC in marine sediment during emission episode	[redacted]	[mg.kgwwt-1]	O

SOIL, GROUNDWATER

Local PEC in agric. soil (total) averaged over 30 days	[redacted]	[mg.kgwwt-1]	O

Local PEC in agric. soil (total) averaged over 180 days	[redacted]	[mg.kgwwt-1]	O
Local PEC in grassland (total) averaged over 180 days	[redacted]	[mg.kgwwt-1]	O
Local PEC in pore water of agricultural soil	[redacted]	[mg.l-1]	O
Local PEC in pore water of grassland	[redacted]	[mg.l-1]	O
Local PEC in groundwater under agricultural soil	[redacted]	[mg.l-1]	O

EXPOSURE

HUMANS EXPOSED TO OR VIA THE ENVIRONMENT

[2 "USE OF CHROMATE AS A PROCESS CHEMICAL"] [INDUSTRIAL USE]

CONCENTRATIONS IN FISH, PLANTS AND DRINKING WATER [2 "USE OF CHROMATE AS A PROCESS CHEMICAL"] [INDUSTRIAL USE]

Local concentration in wet fish	[redacted]	[mg.kg-1]	O
Local concentration in root tissue of plant	[redacted]	[mg.kg-1]	O
Local concentration in leaves of plant	[redacted]	[mg.kg-1]	O
Local concentration in grass (wet weight)	[redacted]	[mg.kg-1]	O
Fraction of total uptake by crops from pore water	[redacted]	[-]	O
Fraction of total uptake by crops from air	[redacted]	[-]	O
Fraction of total uptake by grass from pore water	[redacted]	[-]	O
Fraction of total uptake by grass from air	[redacted]	[-]	O
Local concentration in drinking water	[redacted]	[mg.l-1]	O
Annual average local PEC in air (total)	[redacted]	[mg.m-3]	O

CONCENTRATIONS IN MEAT AND MILK [2 "USE OF CHROMATE AS A PROCESS CHEMICAL"] [INDUSTRIAL USE]

Local concentration in meat (wet weight)	[redacted]	[mg.kg-1]	O
Local concentration in milk (wet weight)	[redacted]	[mg.kg-1]	O
Fraction of total intake by cattle through grass	[redacted]	[-]	O
Fraction of total intake by cattle through drinking water	[redacted]	[-]	O
Fraction of total intake by cattle through air	[redacted]	[-]	O
Fraction of total intake by cattle through soil	[redacted]	[-]	O

DAILY HUMAN DOSES [2 "USE OF CHROMATE AS A PROCESS CHEMICAL"] [INDUSTRIAL USE]

Daily dose through intake of drinking water	[redacted]	[mg.kg-1.d-1]	O
Fraction of total dose through intake of drinking water	[redacted]	[-]	O
Daily dose through intake of fish	[redacted]	[mg.kg-1.d-1]	O
Fraction of total dose through intake of fish	[redacted]	[-]	O
Daily dose through intake of leaf crops	[redacted]	[mg.kg-1.d-1]	O
Fraction of total dose through intake of leaf crops	[redacted]	[-]	O
Daily dose through intake of root crops	[redacted]	[mg.kg-1.d-1]	O

Fraction of total dose through intake of root crops	[redacted]	[-]	O
Daily dose through intake of meat	[redacted]	[mg.kg-1.d-1]	O
Fraction of total dose through intake of meat	[redacted]	[-]	O
Daily dose through intake of milk	[redacted]	[mg.kg-1.d-1]	O
Fraction of total dose through intake of milk	[redacted]	[-]	O
Daily dose through intake of air	[redacted]	[mg.kg-1.d-1]	O
Fraction of total dose through intake of air	[redacted]	[-]	O
Local total daily intake for humans	[redacted]	[mg.kg-1.d-1]	O

Annex 7 Biomonitoring values

Table 43: Results urinary biomonitoring of total chromium (µmol chromium /mol creatinine; Guidance Value: 10 µmol/mol creatinine)

Job role	Work area	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Current employees											
Maintenance Manager	Maintenance	1.2	1.2	0.5	1.2	0.8	0.5	0.7	1.7	0.5	0.8
Factory maintanance	Maintenance	0.6	0.4	0.3	0.9	0.5	0.2	0.6	1.2	0.4	0.6
Factory maintanance	Maintenance	0.9	0.6		1.2	0.4	ND	0.7	2.6	0.4	0.4
Factory maintanance	Maintenance	1.4	0.6	0.4	1.2	0.7	0.8	0.7		1.0	0.5
Colour line 3 operator	Colouring Plant	1.0	1.1	1.1	2.0	0.8	2.2	1.1	1.3	1.9	0.6
E.O.L / Colour	Colouring Plant										13.5 d[b]
Colour Plant Foreman	Colouring Plant	1.2	1.1	2.1	1.6	1.3	0.4	0.7	4	0.5	0.5
AFP / E.O.L	AFP										0.4
AFP / E.O.L	AFP										0.5
E.O.L / Mirror polish	Colouring Plant	0.7	0.6	0.8	2.1	0.7		0.7	2.5	1.1	0.4
E.O.L	Colouring Plant	1.5	1.2	4.0	2.4	2.4	1.0	1.7	1.1	0.9	
Electropolishing operator	Colouring Plant										1.7
Electropolishing operator	Colouring Plant	1.3	0.7	3.3	1.9	1.7	1.0	0.7	1.4	1.2	0.5
Colour line 1 operator	Colouring Plant	1.9	1.0	2.f0	6.0	3.7	1.7	1.5	1.2	2.0	2.8
E.O.L	Colouring Plant							0.5		1.1	0.5
E.O.L	Colouring Plant		1.4	1.9	3.5	2.6	0.9	1.0	1.6	6.4	0.5
E.O.L / Mirror Polish / electro	Colouring Plant	1.2	1.4	1.1	1.8	1.0	0.8	3.6	1.8	1	0.5
Colouring Plant technician	Colouring Plant				5.0	1.6	2.0	2.1	3.2	2.4	0.9
Colour Plant chemist	Colouring Plant	8.3	31.7	4.7 [a]	13.5	6.0 [b]	10.1	2.6 [c]	5.9	3.1	1.9
Safety & Quality Manager	Main Office	0.9	0.3		1.7	0.5				0.5	0.5
Colour plant Manager	Colouring Plant							0.6	1.2	0.3	0.3
QA Manager	Quality			0.2		0.4	0.4		1.2		
QA	Quality		1.2	0.3		0.2					
Embossing factory manager	Embossing						0.2	0.2			
Forklift operator	Colouring Plant	1.0	1.0	0.7	1.2	0.7					

Forklift operator	Despatch							0.7	2.3	1.5	
Inspection	Colouring Plant										0.9
E.O.L	Colouring Plant								2.5		
Polishing / hilite	Embossing	2.2									
Inspection	Colouring Plant							0.5	4.5		
BeadBlast operator	Polishing Division	0.8	0.6	ND	0.9	0.3					
Sales	Main Office		0.5		0.4	0.3					
6WL operator	Embossing	0.7									
Samples	Samples Office	0.4									
BeadBlast operator	Polishing Division	0.7									
Former employees											
Colour line operator	Colouring Plant					0.7	0.4	0.5	4.2	0.3	
E.O.L	Colouring Plant						0.7	1.3			
E.O.L	Colouring Plant							0.9			
E.O.L	Colouring Plant							1.1			
Electropolishing operator	Colouring Plant	1.8			2.1	1.1	0.8				
E.O.L / Metal Art	Colouring Plant	0.9	0.9		2.4		0.6				
Colour line 2 operator	Colouring Plant				4.3	2.4	1.3				
Colour plant maintenance	Colouring Plant	1.0	1.5	3.7	2.1	1.5	1.0				
Forklift operator	Colouring Plant						0.4				
E.O.L	Colouring Plant						0.8				
Inspection	Colouring Plant			0.8			0.3				
Colour plant manager	Colouring Plant	0.8	0.9	0.5	1.0	0.5					
Inspection	Colouring Plant	0.8	0.5	0.4	0.9	0.4					
E.O.L	Colouring Plant					2.6					
E.O.L	Colouring Plant					1.0					
E.O.L	Colouring Plant			1.1	2.5						
E.O.L	Colouring Plant				2.8						
Forklift operator	Despatch	0.5	0.3	0.4	0.4						
E.O.L	Colouring Plant				1.5						
Cut to length	Embossing		0.3								

Colour line 2 operator	Colouring Plant		0.7	1.2							
E.O.L	Colouring Plant	2.0	1.4	1.1							
QA Manager	Main Office	1.1	0.8	0.8							
Colour line operator	Colouring Plant		1.3	1.4							
Colour Plant Foreman	Colouring Plant	1.2									
Colour plant maintenance	Colouring Plant	6.2									
Colour plant maintenance	Colouring Plant	2.6									
Production Manager	Main Office	0.7									
Inspection	Colouring Plant	1.4									

a: one week of retest after initital high result from 2017 test (4.3; 3.1; 3.9; 3.9; 4.0)
b: one week of retest after initital high result from 2019 test (7.3; 9.6; 5.9; 6.9)
c: one week of retest after initital high result from 2021 test (2.4; 2.7; 5.7; 7.9; 3.0)
d: retest result (0.3)

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