



9.4. Exposure scenario 4: Use at industrial sites - Use in electroplating - Industrial

Product category used: PC 14: Metal surface treatment products

Environment contributing scenario(s):		
CS 1	Use in electroplating - Industrial	ERC 5
Worker contributing scenario(s):		
CS 2	Closed continuous process with occasional controlled exposure (PROC 2)	PROC 2
CS 3	Open or semi-closed reaction process (PROC 4)	PROC 4
CS 4	Filling/handling/transfer of solutions (PROC 8b)	PROC 8b
CS 5	Small scale handling/transfer of solutions/suspensions (PROC 9)	PROC 9
CS 6	Treatment of articles by dipping and pouring (PROC 13)	PROC 13
CS 7	Hand mixing (PROC 19)	PROC 19

9.4.1. Env CS 1: Use in electroplating - Industrial (ERC 5)

9.4.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
<ul style="list-style-type: none"> Daily use amount at site: $\leq 2.14E-3$ tonnes/day <i>Based on SpERC value of 220 emission days per year</i> Annual use amount at site: ≤ 0.47 tonnes/year
Conditions and measures related to biological sewage treatment plant
<ul style="list-style-type: none"> Biological STP: Site specific [Effectiveness Water: 46%] Discharge rate of STP: $\geq 2E3$ m³/day Application of the STP sludge on agricultural soil: No
Conditions and measures related to external treatment of waste (including article waste)
<ul style="list-style-type: none"> Particular considerations on the waste treatment operations: No (low risk) <i>Hazardous wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately to hazardous waste incineration plants or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the ruthenium content of the waste is elevated enough, internal or external recovery/recycling should be considered.</i> <i>Fraction of daily/annual use expected in waste: 0%</i> <i>Appropriate waste codes: 06 04 05*, 06 05 02*, 10 08 09, 10 08 11, 10 08 16, 10 08 18, 15 02 02*, 16 08 03, 16 08 06*, 16 08 07*, 19 08 06*, 20 01 40</i> <i>Suitable disposal: Hazardous waste produced during the manufacture and downstream use is sent to a recycler only marginal amounts are sent to a landfill or an incinerator. Waste containing ruthenium is recycled for almost a 100%</i> <i>A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2017)</i>
Other conditions affecting environmental exposure
<ul style="list-style-type: none"> Receiving surface water flow rate: $\geq 1.8E4$ m³/day

Fate (release percentage) in the biological sewage treatment plant

The biological STP is site specific and the releases to the various compartments have been set by the assessor. They are distributed in the following way:

Release to water	54%
Release to air	0%
Release to sludge	46%



Release degraded	0%
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Explanation:

Data from an STP monitoring program conducted at three STPs in Europe (1 in the UK, 2 in Germany)

9.4.1.2. Releases

The local releases to the environment are reported in the following table. Note that the releases reported do not account for the removal in the modelled biological STP.

Table 9.40. Local releases to the environment

Release	Release estimation method	Explanations
Water	Estimated release factor (10 % of SpERC)	Release factor before on site RMM: 0.05% Release factor after on site RMM: 0.05% Local release rate: 1.07E-3 kg/day
Air	Estimated release factor (SpERC)	Release factor before on site RMM: 0.2% Release factor after on site RMM: 0.2% Local release rate: 4.27E-3 kg/day
Non agricultural soil	ERC	Release factor after on site RMM: 1%

9.4.1.3. Exposure and risks for the environment and man via the environment

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table. The exposure estimates have been obtained with EUSES 2.1.2 unless stated otherwise.

Table 9.41. Exposure concentrations and risks for the environment and man via the environment

Protection target	Exposure concentration	Risk quantification
Fresh water	Local PEC: 2.01E-5 mg/L	RCR = 0.082
Sediment (freshwater)	Local PEC: 0.636 mg/kg dw	RCR = 0.083
Marine water	Local PEC: 2.02E-6 mg/L	RCR = 0.083
Sediment (marine water)	Local PEC: 0.064 mg/kg dw	RCR = 0.084
Sewage Treatment Plant	Local PEC: 2.88E-4 mg/L	RCR < 0.01
Agricultural soil	Local PEC: 6.94E-3 mg/kg dw	RCR < 0.01

9.4.2. Worker CS 2: Closed continuous process with occasional controlled exposure (PROC 2) (PROC 2)

9.4.2.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solution	
• Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i>	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	
Technical and organisational conditions and measures	
• Dermal pattern of use: Non-dispersive use	



	Method
• Dermal pattern of exposure control: Non-direct handling	
• Dermal contact level: Intermittent	
• Level of containment: Closed process	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Gloves/face protection: <i>Due to the potential adverse effects of the substance to skin (moderate hazard), protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]</i>	
• Eye protection: <i>Eye protection to be worn to protect from adverse effects to the eyes (moderate hazard). (Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.)</i>	
• Respiratory protective equipment (RPE) as precautionary measure: <i>RPE protecting from local effects via inhalation (moderate hazard). (Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.)</i>	

9.4.2.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.42. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	1 µg/m ³ (MEASE 1.02.01)	RCR < 0.01
Dermal, systemic, long term	0.34 µg/kg bw/day (MEASE 1.02.01)	RCR < 0.01
Combined routes, systemic, long-term		RCR < 0.01

Remarks on exposure data from external estimation tools:

MEASE 1.02.01:

Explanation: For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Under the prescribed conditions of use, quantitative estimated exposures are below the respective DNELs (RCRs < 1).

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

On this basis, systemic and local risks are considered to be adequately controlled.

9.4.3. Worker CS 3: Open or semi-closed reaction process (PROC 4) (PROC 4)

9.4.3.1. Conditions of use



	Method
Product (article) characteristics	
• Physical form of substance: Solution	
• Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i>	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	
Technical and organisational conditions and measures	
• Dermal pattern of use: Non-dispersive use	
• Dermal pattern of exposure control: Non-direct handling	
• Dermal contact level: Intermittent	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Gloves/face protection: <i>Due to the potential adverse effects of the substance to skin (moderate hazard), protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]</i>	
• Eye protection: <i>Eye protection to be worn to protect from adverse effects to the eyes (moderate hazard). (Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.)</i>	
• Respiratory protective equipment (RPE) as precautionary measure: <i>RPE protecting from local effects via inhalation (moderate hazard). (Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.)</i>	

9.4.3.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.43. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	50 µg/m ³ (MEASE 1.02.01)	RCR = 0.132
Dermal, systemic, long term	0.34 µg/kg bw/day (MEASE 1.02.01)	RCR < 0.01
Combined routes, systemic, long-term		RCR = 0.133

Remarks on exposure data from external estimation tools:

MEASE 1.02.01:

Explanation: For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term,



Dermal, local, acute, Eye, local):

Under the prescribed conditions of use, quantitative estimated exposures are below the respective DNELs (RCRs < 1).

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

On this basis, systemic and local risks are considered to be adequately controlled.

9.4.4. Worker CS 4: Filling/handling/transfer of solutions (PROC 8b) (PROC 8b)

9.4.4.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solution	
• Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i>	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	
Technical and organisational conditions and measures	
• Dermal pattern of use: Non-dispersive use	
• Dermal pattern of exposure control: Non-direct handling	
• Dermal contact level: Intermittent	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Gloves/face protection: <i>Due to the potential adverse effects of the substance to skin (moderate hazard), protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]</i>	
• Eye protection: <i>Eye protection to be worn to protect from adverse effects to the eyes (moderate hazard). (Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.)</i>	
• Respiratory protective equipment (RPE) as precautionary measure: <i>RPE protecting from local effects via inhalation (moderate hazard). (Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.)</i>	

9.4.4.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.44. Exposure concentrations and risks for workers



Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	10 µg/m ³ (MEASE 1.02.01)	RCR = 0.026
Dermal, systemic, long term	0.34 µg/kg bw/day (MEASE 1.02.01)	RCR < 0.01
Combined routes, systemic, long-term		RCR = 0.028

Remarks on exposure data from external estimation tools:**MEASE 1.02.01:**

Explanation: For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Under the prescribed conditions of use, quantitative estimated exposures are below the respective DNELs (RCRs < 1).

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

On this basis, systemic and local risks are considered to be adequately controlled.

9.4.5. Worker CS 5: Small scale handling/transfer of solutions/suspensions (PROC 9) (PROC 9)

9.4.5.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solution	
• Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i>	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	
Technical and organisational conditions and measures	
• Dermal pattern of use: Non-dispersive use	
• Dermal pattern of exposure control: Direct handling	
• Dermal contact level: Intermittent	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Gloves/face protection: <i>Due to the potential adverse effects of the substance to skin (moderate hazard), protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]</i>	
• Eye protection: <i>Eye protection to be worn to protect from adverse effects to the eyes (moderate hazard). (Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must</i>	



	Method
<i>be worn.)</i>	
<ul style="list-style-type: none"> Respiratory protective equipment (RPE) as precautionary measure: <i>RPE protecting from local effects via inhalation (moderate hazard). (Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.)</i> 	

9.4.5.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.45. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	10 µg/m ³ (MEASE 1.02.01)	RCR = 0.026
Dermal, systemic, long term	3.4 µg/kg bw/day (MEASE 1.02.01)	RCR = 0.013
Combined routes, systemic, long-term		RCR = 0.039

Remarks on exposure data from external estimation tools:

MEASE 1.02.01:

Explanation: For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Under the prescribed conditions of use, quantitative estimated exposures are below the respective DNELs (RCRs < 1).

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

On this basis, systemic and local risks are considered to be adequately controlled.

9.4.6. Worker CS 6: Treatment of articles by dipping and pouring (PROC 13) (PROC 13)

9.4.6.1. Conditions of use

	Method
Product (article) characteristics	
<ul style="list-style-type: none"> Physical form of substance: Solution 	
<ul style="list-style-type: none"> Maximum emission potential of the substance: Very low <i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i> 	
<ul style="list-style-type: none"> Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%] 	
Amount used (or contained in articles), frequency and duration of use/exposure	
<ul style="list-style-type: none"> Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%] 	
Technical and organisational conditions and measures	
<ul style="list-style-type: none"> Dermal pattern of use: Non-dispersive use 	
<ul style="list-style-type: none"> Dermal pattern of exposure control: Direct handling 	



	Method
• Dermal contact level: Intermittent	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Gloves/face protection: <i>Due to the potential adverse effects of the substance to skin (moderate hazard), protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]</i>	
• Eye protection: <i>Eye protection to be worn to protect from adverse effects to the eyes (moderate hazard). (Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.)</i>	
• Respiratory protective equipment (RPE) as precautionary measure: <i>RPE protecting from local effects via inhalation (moderate hazard). (Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.)</i>	

9.4.6.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.46. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	10 µg/m ³ (MEASE 1.02.01)	RCR = 0.026
Dermal, systemic, long term	3.4 µg/kg bw/day (MEASE 1.02.01)	RCR = 0.013
Combined routes, systemic, long-term		RCR = 0.039

Remarks on exposure data from external estimation tools:

MEASE 1.02.01:

Explanation: For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Under the prescribed conditions of use, quantitative estimated exposures are below the respective DNELs (RCRs < 1).

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local effects to the eyes is given in Section 9.0.2.3.

On this basis, systemic and local risks are considered to be adequately controlled.

9.4.7. Worker CS 7: Hand mixing (PROC 19) (PROC 19)

9.4.7.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solution	
• Maximum emission potential of the substance: Very low	



	Method
<i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.</i>	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhalation: 0%, Dermal: 0%]	
Technical and organisational conditions and measures	
• Dermal pattern of use: Non-dispersive use	
• Dermal pattern of exposure control: Direct handling	
• Dermal contact level: Extensive	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Gloves/face protection: <i>Due to the potential adverse effects of the substance to skin (moderate hazard), protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier.</i> [Effectiveness Dermal: 90%]	
• Eye protection: <i>Eye protection to be worn to protect from adverse effects to the eyes (moderate hazard). (Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.)</i>	
• Respiratory protective equipment (RPE) as precautionary measure: <i>RPE protecting from local effects via inhalation (moderate hazard). (Due to potential adverse effects of the substance to the respiratory tract, RPE (minimum assigned protection factor of 10) is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.)</i>	

9.4.7.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.47. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	50 µg/m ³ (MEASE 1.02.01)	RCR = 0.132
Dermal, systemic, long term	34 µg/kg bw/day (MEASE 1.02.01)	RCR = 0.126
Combined routes, systemic, long-term		RCR = 0.258

Remarks on exposure data from external estimation tools:

MEASE 1.02.01:

Explanation: For calculation of systemic exposure, the exposure estimate for total dermal loading as obtained in MEASE (reported in mg/day) is divided by a body weight of 70 kg for workers.

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

Under the prescribed conditions of use, quantitative estimated exposures are below the respective DNELs (RCRs < 1).

Further information on the risk characterisation for local effects via inhalation, for local dermal effects and local



effects to the eyes is given in Section 9.0.2.3.

On this basis, systemic and local risks are considered to be adequately controlled.