9.3. Exposure scenario 3: Formulation or re-packing - Formulation of surface treatment solutions

Product category formulated: PC 14: Metal surface treatment products

Environment contributing scenario(s):		
CS 1	Formulation of surface treatment solutions	ERC 2
Worker contributing scenario(s):		
CS 2	Closed batch process (PROC 3)	PROC 3
CS 3	Open or semi-closed reaction process (PROC 4)	PROC 4
CS 4	Small scale handling/transfer of solutions (PROC 9)	PROC 9
CS 5	Vacuum cleaning (PROC 26)	PROC 26
CS 6	Production of metal powders (wet processes) (PROC 27b)	PROC 27b

9.3.1. Env CS 1: Formulation of surface treatment solutions (ERC 2)

9.3.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Daily use amount at site: <= 5.3E-3 tonnes/day *Based on 330 emission days per year*
• Annual use amount at site: <= 1.75 tonnes/year
Conditions and measures related to biological sewage treatment plant
• Biological STP: Site specific [Effectiveness Water: 46%]
• Discharge rate of STP: >= 2E3 m3/day
• Application of the STP sludge on agricultural soil: No
Conditions and measures related to external treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low risk) *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.* *Fraction of daily/annual use expected in waste: 0%* *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* *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%* *A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2017)*
Other conditions affecting environmental exposure
• Receiving surface water flow rate: >= 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%

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

9.3.1.2. 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 9.33. Local releases to the environment

Release	Release estimation method	Explanations
Water	Estimated release factor (1 % of SpERC)	**Release factor before on site RMM:** 0.02% **Release factor after on site RMM:** 0.02% **Local release rate:** 1.06E-3 kg/day **Explanation:** This SpERC does not take into account on-site WWTP so an additional correction factor has been applied resulting in a corrected SpERC for WWTP + monetary value of Ru.
Air	Estimated release factor (SpERC)	**Release factor before on site RMM:** 0.01% **Release factor after on site RMM:** 0.01% **Local release rate:** 5.3E-4 kg/day
Non agricultural soil	Estimated release factor (Best practice)	**Release factor after on site RMM:** 0%

9.3.1.3. 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 9.34. Exposure concentrations and risks for the environment and man via the environment

Protection target	Exposure concentration	Risk quantification
Fresh water	**Local PEC:** 2E-5 mg/L	RCR = 0.082
Sediment (freshwater)	**Local PEC:** 0.631 mg/kg dw	RCR = 0.083
Marine water	**Local PEC:** 2.01E-6 mg/L	RCR = 0.082
Sediment (marine water)	**Local PEC:** 0.063 mg/kg dw	RCR = 0.083
Sewage Treatment Plant	**Local PEC:** 2.86E-4 mg/L	RCR < 0.01
Agricultural soil	**Local PEC:** 6.69E-3 mg/kg dw	RCR < 0.01

9.3.2. Worker CS 2: Closed batch process (PROC 3) (PROC 3)

9.3.2.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solution	
• Maximum emission potential of the substance: Very low *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.*	
• 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	
• Level of containment: Closed process	

	Method
• 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: *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%]*	
• Eye protection: *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.)*	
• Respiratory protective equipment (RPE) as precautionary measure: *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.)*	

9.3.2.2. Exposure and risks for workers

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

Table 9.35. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	10 µg/m³ (MEASE 1.02.01)	RCR = 0.026
Dermal, systemic, long term	0.17 µg/kg bw/day (MEASE 1.02.01)	RCR < 0.01
Combined routes, systemic, long-term		RCR = 0.027

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.

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

9.3.3.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solution	
• Maximum emission potential of the substance: Very low *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.*	
• 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: *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%]*	
• Eye protection: *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.)*	
• Respiratory protective equipment (RPE) as precautionary measure: *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.)*	

9.3.3.2. Exposure and risks for workers

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

Table 9.36. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	50 µg/m³ (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.

9.3.4. Worker CS 4: Small scale handling/transfer of solutions (PROC 9) (PROC 9)

9.3.4.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solution	
• Maximum emission potential of the substance: Very low *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.*	
• 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: *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%]*	
• Eye protection: *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.)*	
• Respiratory protective equipment (RPE) as precautionary measure: *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.)*	
• Respiratory protective equipment (RPE): RPE with minimum APF = 4 [Effectiveness Inhalation: 75%] *APF = assigned protection factor according to EN 529. At minimum any combination of particle filter class P1 with mask according to EN 140, EN 1827 or EN 136 or filtering half mask (FF P1) according to EN 149 or any RPE providing higher APFs according to EN 529 is required.*	

9.3.4.2. Exposure and risks for workers

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

Table 9.37. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	10 µg/m³ (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.

9.3.5. Worker CS 5: Vacuum cleaning (PROC 26) (PROC 26)

9.3.5.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solid, powder / dust	
• Maximum emission potential of the substance: High *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.*	
• 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	
• Integrated local exhaust ventilation: Lower confidence limit (industrial use) [Effectiveness Inhalation: 84%] *Surrogate exposure determinant used to reflect the efficiency of a vacuum cleaner.* Inhalation explanation: *Efficiency for industrial use*	
• Dermal pattern of use: Non-dispersive use	
• Dermal pattern of exposure control: Non-direct handling	
• Dermal contact level: Extensive	
• Additional operational conditions for cleaning: No direct manual removal of dust.	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE): RPE with minimum APF = 20 [Effectiveness Inhalation: 95%] *APF = assigned protection factor according to EN 529. At minimum any combination of particle filter class P3 with mask according to EN 140, EN 1827 or filtering half mask (FF P3) according to EN 149 or combination of P2 filter with face piece*	

	Method
according to EN 12941 or EN 12942 or any RPE providing higher APFs according to EN 529 is required.	
• Gloves/face protection: *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%]*	
• Eye protection: *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.)*	

9.3.5.2. Exposure and risks for workers

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

Table 9.38. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	0.08 mg/m³ (MEASE 1.02.01)	RCR = 0.211
Dermal, systemic, long term	1.4 µg/kg bw/day (MEASE 1.02.01)	RCR < 0.01
Combined routes, systemic, long-term		RCR = 0.216

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.

9.3.6. Worker CS 6: Production of metal powders (wet processes) (PROC 27b) (PROC 27b)

9.3.6.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solution	
• Maximum emission potential of the substance: Very low *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.*	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	

	Method
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: *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%]*	
• Eye protection: *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.)*	
• Respiratory protective equipment (RPE) as precautionary measure: *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.)*	

9.3.6.2. Exposure and risks for workers

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

Table 9.39. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	0.1 mg/m³ (MEASE 1.02.01)	RCR = 0.263
Dermal, systemic, long term	0.34 µg/kg bw/day (MEASE 1.02.01)	RCR < 0.01
Combined routes, systemic, long-term		RCR = 0.264

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.