9.2. Exposure scenario 2: Formulation - Formulation

Market sector: Electroplating and surface treatment
PC 14: Metal surface treatment products, including galvanic and electroplating products

Environment contributing scenario(s):	
Formulation	ERC 2
Worker contributing scenario(s):	
Handling of medium dusty materials	PROC 26
Handling of solutions	PROC 8b
Small scale handling of solutions	PROC 9
Batch process involving solutions	PROC 4
Batch process involving solids	PROC 4
Wet cleaning	PROC 8a
Vacuum cleaning	PROC 26

9.2.1. Environmental contributing scenario 1: Formulation

9.2.1.1. Conditions of use

The conditions of use are as described in the generic exposure scenario (GES) below.

9.2.1.2. Releases

The GES and associated risk assessment are concerned with releases of silver to waste-water and air during the formulation of silver cyanide. This waste-water is treated at a municipal STP before discharge to fresh waters. Exposure assessment for the aquatic environment is based on parameter values from the SpERC for formulation of metal compounds[8] ('formulation of metal compounds in other than plastics and paint sectors) and calculation of the maximum tonnage (Msafe) of silver cyanide that can be formulated without risk to environment. The release factor for waste-water in this SpERC is given as 2% before on-site treatment. However, all sites formulating AgCN will have waste-water treatment plants (WWTPs), usually using pH adjustment and precipitation. The Msafe tonnage for formulation is therefore calculated using a release factor (RF) adjusted to include a WWTP efficiency of 99% (i.e. the RF for water is reduced from 2% to 0.02%).

A summary of the emission characteristics used to quantify the environmental aspects of the generic exposure scenario (GES) for formulation of AgCN is detailed below.

1. Title **ES2: Formulation**	
Life cycle	Formulation - Formulation
Systematic title based on use descriptor	ERC: ERC 2 Formulation
2. Operational conditions and risk management measures	
2.1 Control of environmental exposure	
Environmental related free short title	Formulation
Systematic title based on use descriptor (environment)	ERC 2 Formulation
Processes, tasks, activities covered (environment)	Formulation
Environmental Assessment Method	Estimates based on monitoring data of emissions and default values are used for calculation of maximum tonnage that can be safely used without risk to the environment

[8] http://www.arche-consulting.be/content/documents/Eurometaux-2.2a-c.v2.1.pdf

Product characteristics Silver cyanide as solid or aqueous solution. Environmental assessment is based on the modelled emission of Ag in waste-water discharge and total Ag emissions to air.	
Amounts used	
Maximum annual safe use at a site (Msafe)[9]	18.6 tonnes AgCN (15 tonnes Ag metal equivalent)
Frequency and duration of use	
Pattern of release to the environment	300 days per year per site (based on silver CSR for manufacture and the assumption that manufacturers are also formulators)
Environment factors not influenced by risk management	
Receiving surface water flow rate	STP: 2,000 m^3/d (default) Receiving water: 18,000 m^3/d (default)
Dilution capacity, freshwater	Env ES 2 Discharge to freshwater via STP: DF = 10 (default)
Dilution capacity, marine	Not applicable
Other given operational conditions affecting environmental exposure	
None	
Technical conditions and measures at process level (source) to prevent release	
Appropriate process control systems shall be implemented.	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Waste water: ES 2 Discharge to STP: On-site wastewater treatment by chemical precipitation, sedimentation and/or filtration. Efficiency 99.9 % (50^{th} %) and off-site wastewater treatment plant, municipal STP Efficiency 80% (based on assessment of available monitoring data and literature) Release factor after on-site treatment: 200 g/T (SpERC for 'Formulation of metal compounds' adjusted for removal in WWTP. 99% treatment WWTP efficiency - applied to 2% RF before on-site treatment) **Air:** No measured data; release factor after on-site treatment: 10 g/T (SpERC for 'Formulation of metal compounds' adjusted to 10% for monetary value of Ag as detailed in section 9.02)	
Organizational measures to prevent/limit release from site	
Regular operator training.	
Conditions and measures related to municipal sewage treatment plant (if applicable)	
Municipal Sewage Treatment Plant (STP)	Yes
Discharge rate of the Municipal STP	2 000 m^3/d
Fate of the sludge from Municipal STP	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 silver is recycled for almost 100%
Conditions and measures related to external treatment of waste for disposal	
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 silver content of the waste is elevated enough, internal or external recovery/recycling should be considered.	

[9] All Msafe exposure scenarios for use of AgCN are based on the maximum amount of silver (metal equivalent) that can be safely used in a specific application without an unacceptable level of risk to the environment. It is therefore important to consider the total use of silver compounds for each specific downstream use at an individual site and where relevant, combine the contribution from each silver compound if a number of different Ag compounds are used for the same downstream use.

Fraction of daily/annual use expected in waste: 0%
Appropriate waste codes: 06 03 11*, 06 04 05*, 06 05 02*, 11 01 05*, 11 01 09*, 11 01 11*, 11 01 16*, 11 03 01*, 15 02 02*, 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 silver is recycled for almost a 100%

A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2016)

Conditions and measures related to external recovery of waste

The focus of the silver industry is on the minimisation of waste by optimising the process and by utilizing residues and wastes as far as possible. The residues arising from different stages of the production process are therefore used as raw materials for other processes and an extensive network of metallurgical operators has been established for many years to increase the recovery of metals and eliminate the quantities of waste for disposal.

3. Exposure and risk estimation

Environment [based on total Ag emissions]
ERC 2

ES2 Formulation of AgCN*

Compartment	Unit	PNEC	$PEC_{regional}$ [10]	C_{local}	PEC	RCR	Methods for calculation of environmental concentrations
Discharge to STP	mg Ag/L	0.025 mg/L	6.06 x10^{-6} mg/L	9.90 x 10^{-4} mg/L	9.90 x 10^{-4} mg/L	0.040	SpERC RFs applied to Msafe tonnage and dilution factor at municipal sewage works
Freshwater via STP	mg Ag/L	4.0 x10^{-5} mg/L	6.06 x10^{-6} mg/L	2.57 x10^{-5} mg/L	3.18 x10^{-5} mg/L	0.79	SpERC RFs applied to Msafe tonnage and Ag-specific values for STP removal efficiency and dilution in ultimate receiving water body
Freshwater sediment via STP	mg /kg w.w.	96.4 mg/kg	2.13 mg/kg	1.316 mg/kg	3.45 mg/kg	0.36	SpERC RFs applied to Msafe tonnage and Ag-specific values for STP removal efficiency and dilution in ultimate receiving water body
Terrestrial (all scenarios)	mg/kg w.w.	1.24 mg/kg	0.086 mg/kg	3.0 x10^{-6} mg/kg	8.60 x10^{-2} mg/kg	0.069	Modelled increase in soil concentrations due to deposition from atmospheric emissions (i.e. assuming no application of sewage sludge to land)

* All concentrations reported as Ag equivalent due to the silver metal PNEC used for assessment.

[10] Regional PEC is based on the measured background concentrations as detailed in the Silver CSR

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES
Environment Scaling tool: Metals EUSES IT tool (free download: http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool) Scaling of the release to air and water environment includes: • Refining of the release factor to air and waste water and/or and the efficiency of the air filter and wastewater treatment facility. • Adjustment of the flow rate for the receiving water body and subsequent dilution factor.

9.2.1.3. Exposure and risks for man via the environment

Assessment of risks for man via the environment is based on inhalation exposure to airborne particulates containing silver released to the atmosphere during the manufacture of AgCN and other silver compounds[11].

Annual emission to air (kg Ag)	Emission days per year	Concentration in local air (mg Ag/m^3)	Annual average concentration in air (mg Ag/m^3)	DNEL (mg Ag/m^3)	RCR
0.2	300	1.4 x10^{-7}	1.1 x10^{-7}	0.04	3.48 x10^{-6}

9.2.2. Worker contributing scenario 1: Handling of medium dusty materials (PROC 26)

9.2.2.1. Conditions of use

Task(s) covered with this contributing scenario: Transfer processes, packaging.

	Method
Product (article) characteristics	
• Physical form of substance: Solid	External Tool (MEASE)
• Maximum emission potential of the substance: Medium (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.)	External Tool (MEASE)
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Technical and organisational conditions and measures	
• Exterior local exhaust ventilation: Lower confidence limit (industrial use) (Standard efficiency) [Effectiveness Inhal: 75%]	External Tool (MEASE)
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE): RPE with minimum APF = 10	External Tool (MEASE)

[11] Long-term worker DNEL for inhalation exposure is 0.1 mg/m^3 for silver and 0.352 mg/m^3 for AgCN. No general population DNEL has been derived for AgCN but comparison of the worker DNELs indicates that used of the silver DNEL is conservative in this instance.

	Method
(APF = assigned protection factor according to EN 529. At minimum any combination of particle filter class P2 with mask according to EN 140, EN 1827 or EN 136 or filtering half mask (FF P2) according to EN 149 or combination of P1 filter with face piece according EN 12942 or any RPE providing higher APFs according to EN 529 is required.) [Effectiveness Inhal: 90%]	
• Gloves: Protective gloves according to EN 374 have to be worn. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]	External Tool (MEASE)
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes (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.)	

9.2.2.2. Exposure and risks for workers

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

Table 3. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**100 µg/m³** (External Tool (MEASE))	RCR = 0.284
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	**14.14 µg/kg bw/day** (External Tool (MEASE))	RCR = 0.028
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.312

Remarks on exposure data

External Tool (MEASE)

- Dermal, systemic, long-term:
  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.

Conclusion on risk characterisation

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

Under the prescribed conditions of use, exposure is well below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

9.2.3. Worker contributing scenario 2: Handling of solutions (PROC 8b)

9.2.3.1. Conditions of use

Task(s) covered with this contributing scenario: Transfer and filling processes.

	Method
Product (article) characteristics	
• Physical form of substance: Solution	External Tool (MEASE)
• 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.)	External Tool (MEASE)
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Technical and organisational conditions and measures	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation (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.)	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (low hazard) (Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes (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.)	

9.2.3.2. Exposure and risks for workers

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

Table 4. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**10 µg/m³** (External Tool (MEASE))	RCR = 0.028
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	**34.29 µg/kg bw/day** (External Tool (MEASE))	RCR = 0.069
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.097

Remarks on exposure data

External Tool (MEASE)

- Dermal, systemic, long-term:
  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.

Conclusion on risk characterisation

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

Under the prescribed conditions of use, exposure is well below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

9.2.4. Worker contributing scenario 3: Small scale handling of solutions (PROC 9)

9.2.4.1. Conditions of use

Task(s) covered with this contributing scenario: Transfer and filling processes.

	Method
Product (article) characteristics	
• Physical form of substance: Solution	External Tool (MEASE)
• 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.)	External Tool (MEASE)
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Technical and organisational conditions and measures	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation (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.)	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (low hazard) (Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as	

	Method
appropriate.)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes (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.)	

9.2.4.2. Exposure and risks for workers

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

Table 5. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**10 µg/m³** (External Tool (MEASE))	RCR = 0.028
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	**34.29 µg/kg bw/day** (External Tool (MEASE))	RCR = 0.069
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.097

Remarks on exposure data

External Tool (MEASE)

- Dermal, systemic, long-term:
  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.

Conclusion on risk characterisation

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

Under the prescribed conditions of use, exposure is well below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

9.2.5. Worker contributing scenario 4: Batch process involving solutions (PROC 4)

9.2.5.1. Conditions of use

Task(s) covered with this contributing scenario: Mixing, formulation.

	Method
Product (article) characteristics	
• Physical form of substance: Solution	External Tool (MEASE)
• Maximum emission potential of the substance: Very low (Only the highest	External Tool (MEASE)

	Method
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 Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Technical and organisational conditions and measures	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Non-direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation (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.)	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (low hazard) (Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes (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.)	

9.2.5.2. Exposure and risks for workers

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

Table 6. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**50 µg/m³** (External Tool (MEASE))	RCR = 0.142
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	**3.43 µg/kg bw/day** (External Tool (MEASE))	RCR < 0.01
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.149

Remarks on exposure data

External Tool (MEASE)

- Dermal, systemic, long-term:
  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.

Conclusion on risk characterisation

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

Under the prescribed conditions of use, exposure is well below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

9.2.6. Worker contributing scenario 5: Batch process involving solids (PROC 4)

9.2.6.1. Conditions of use

Task(s) covered with this contributing scenario: Mixing, formulation.

	Method
Product (article) characteristics	
• Physical form of substance: Solid	External Tool (MEASE)
• Maximum emission potential of the substance: Medium (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.)	External Tool (MEASE)
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Technical and organisational conditions and measures	
• Exterior local exhaust ventilation: Lower confidence limit (industrial use) (Standard efficiency) [Effectiveness Inhal: 75%]	External Tool (MEASE)
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Non-direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE): RPE with minimum APF = 10 (APF = assigned protection factor according to EN 529. At minimum any combination of particle filter class P2 with mask according to EN 140, EN 1827 or EN 136 or filtering half mask (FF P2) according to EN 149 or combination of P1 filter with face piece according EN 12942 or any RPE providing higher APFs according to EN 529 is required.) [Effectiveness Inhal: 90%]	External Tool (MEASE)
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (low hazard) (Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes (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	

	Method
equipment (e.g. goggles or visors) must be worn.)	

9.2.6.2. Exposure and risks for workers

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

Table 7. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**125 µg/m³** (External Tool (MEASE))	RCR = 0.355
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	**3.43 µg/kg bw/day** (External Tool (MEASE))	RCR < 0.01
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.362

Remarks on exposure data

External Tool (MEASE)

- Dermal, systemic, long-term:
  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.

Conclusion on risk characterisation

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

Under the prescribed conditions of use, exposure is well below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

9.2.7. Worker contributing scenario 6: Wet cleaning (PROC 8a)

9.2.7.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solution, suspension	External Tool (MEASE)
• 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.)	External Tool (MEASE)
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness	External Tool (MEASE)

	Method
Inhal: 0%; Dermal: 0%]	
Technical and organisational conditions and measures	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Direct handling	External Tool (MEASE)
• Contact level: Extensive	External Tool (MEASE)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Gloves: Protective gloves according to EN 374 have to be worn. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]	External Tool (MEASE)
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation (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.)	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes (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.)	

9.2.7.2. Exposure and risks for workers

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

Table 8. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**50 µg/m³** (External Tool (MEASE))	RCR = 0.142
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	**34.29 µg/kg bw/day** (External Tool (MEASE))	RCR = 0.069
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.211

Remarks on exposure data

External Tool (MEASE)

- Dermal, systemic, long-term:
  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.

Conclusion on risk characterisation

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

Under the prescribed conditions of use, exposure is well below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

9.2.8. Worker contributing scenario 7: Vacuum cleaning (PROC 26)

9.2.8.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of substance: Solid, powder / dust	External Tool (MEASE)
• 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.)	External Tool (MEASE)
• Content in preparation: Not restricted [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Amount used (or contained in articles), frequency and duration of use/exposure	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
Technical and organisational conditions and measures	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Non-direct handling	External Tool (MEASE)
• Contact level: Extensive	External Tool (MEASE)
• Integrated local exhaust ventilation: Lower confidence limit (industrial use) (Standard efficiency) [Effectiveness Inhal: 84%] *Surrogate exposure determinant used to reflect the efficiency of a vacuum cleaner.*	External Tool (MEASE)
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protective equipment (RPE): RPE with minimum APF = 10 (APF = assigned protection factor according to EN 529. At minimum any combination of particle filter class P2 with mask according to EN 140, EN 1827 or EN 136 or filtering half mask (FF P2) according to EN 149 or combination of P1 filter with face piece according EN 12942 or any RPE providing higher APFs according to EN 529 is required.) [Effectiveness Inhal: 90%]	External Tool (MEASE)
• Gloves: Protective gloves according to EN 374 have to be worn. Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. [Effectiveness Dermal: 90%]	External Tool (MEASE)
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes (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.)	

9.2.8.2. Exposure and risks for workers

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

Table 9. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**160 µg/m³** (External Tool (MEASE))	RCR = 0.454
Inhalation, systemic, acute		Qualitative (see below)

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	**1.41 µg/kg bw/day** (External Tool (MEASE))	RCR < 0.01
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.457

Remarks on exposure data

External Tool (MEASE)

- Dermal, systemic, long-term:
  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.

Conclusion on risk characterisation

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

Under the prescribed conditions of use, exposure is well below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.