

## 9.2. Exposure scenario 2: Formulation - Formulation

**Market sector:** Electroplating and surface treatment

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

<b>Environment contributing scenario(s):</b>	
Formulation	ERC 2
<b>Worker contributing scenario(s):</b>	
Handling of high dusty materials	PROC 26
Handling of solutions	PROC 8b
Small scale handling of solutions	PROC 9
Batch process involving solutions	PROC 4
Mixing/Blending of solutions	PROC 5
Batch process involving solids	PROC 4
Mixing/Blending of solids	PROC 5
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 potassium dicyanoaurate to waste-water and air during formulation at an industrial facility. 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<sup>1</sup> ('formulation of metal compounds in other than plastics and paint sectors) and calculation of the maximum tonnage (M<sub>safe</sub>) of KAu(CN)<sub>2</sub> that can be formulated without risk to the environment. The release factor for waste-water in this SpERC is given as '2% before on-site treatment'. However, all sites formulating KAu(CN)<sub>2</sub> will have waste-water treatment plants (WWTPs), predominantly using pH adjustment and precipitation. The M<sub>safe</sub> 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%).

<sup>1</sup> <http://www.arche-consulting.be/content/documents/Eurometaux-2.2a-c.v2.1.pdf>

A summary of the emission characteristics used to quantify the environmental aspects of the generic exposure scenario (GES) for formulation of  $\text{KAu}(\text{CN})_2$  is detailed below:

<b>1. Title</b>	
<b>ES2: Formulation</b>	
<b>Life cycle</b>	Formulation - Formulation
<b>Systematic title based on use descriptor</b>	ERC: ERC 2 Formulation
<b>2. Operational conditions and risk management measures</b>	
<b>2.1 Control of environmental exposure</b>	
<b>Environmental related free short title</b>	Formulation
<b>Systematic title based on use descriptor (environment)</b>	ERC 2 Formulation
<b>Processes, tasks, activities covered (environment)</b>	Formulation
<b>Environmental Assessment Method</b>	Estimates based on SpERCs and available monitoring data of emissions and default values are used for calculation of maximum tonnage that can be safely used without risk to the environment
<b>Product characteristics</b>	
Potassium dicyanoaurate as solid or aqueous solution.	
Environmental assessment is based on the modelled emission of $\text{KAu}(\text{CN})_2$ in waste-water discharge and total $\text{KAu}(\text{CN})_2$ emissions to air.	
<b>Amounts used</b>	
<b>Maximum annual safe use at a site (Msafe)</b>	1.35 tonnes $\text{KAu}(\text{CN})_2$
<b>Frequency and duration of use</b>	
<b>Pattern of release to the environment</b>	300 days per year per site (based on sector data)
<b>Environment factors not influenced by risk management</b>	
<b>Receiving surface water flow rate</b>	STP: 2,000 m <sup>3</sup> /d (default) Receiving water: 18,000 m <sup>3</sup> /d (default)
<b>Dilution capacity, freshwater</b>	Env ES 2 Discharge to freshwater via STP: DF = 10 (default)
<b>Dilution capacity, marine</b>	Not applicable
<b>Other given operational conditions affecting environmental exposure</b>	
None	

<b>Technical conditions and measures at process level (source) to prevent release</b>	
Appropriate process control systems shall be implemented.	
<b>Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil</b>	
<b>Waste water:</b>	
ES 2 Discharge to freshwater via STP:	
On-site wastewater treatment by chemical precipitation, sedimentation and/or filtration.	
Efficiency 99.9 % (Based on available company data)	
and off-site wastewater treatment plant, municipal STP	
Efficiency 63.9 % (based on standard TGD parameters & known Au partition coefficient for SPM)	
Release factor after on-site treatment: 200 g/T (99% treatment WWTP efficiency applied to 2% RF before on-site treatment)	
<b>Air:</b>	
No data; release factor after on-site treatment: 10 g/T (SpERC RF for 'Formulation of metal compounds' adjusted to 10% based on the monetary value of Au as detailed in section 9.02)	
<b>Organizational measures to prevent/limit release from site</b>	
Regular operator training.	
<b>Conditions and measures related to municipal sewage treatment plant (if applicable)</b>	
<b>Municipal Sewage Treatment Plant (STP)</b>	Yes
<b>Discharge rate of the Municipal STP</b>	2 000 m <sup>3</sup> /d
<b>Fate of the sludge from Municipal STP</b>	The sludge is incinerated (with ash going to landfill)
<b>Conditions and measures related to external treatment of waste for disposal</b>	
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 gold content of the waste is elevated enough, internal or external recovery/recycling should be considered.	
<b>Fraction of daily/annual use</b> expected in waste: 0%	
<b>Appropriate waste codes:</b> 06 03 11*, 06 04 05*, 06 05 02*, 10 07 01, 11 01 05*, 11 01 09*, 11 01 11*, 11 01 16*, 11 03 01*, 15 02 02*, 16 01 18, 16 08 01, 17 04 07, 19 08 06*, 20 01 40, ...	
<b>Suitable disposal:</b> 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 gold is recycled for almost a 100%	
A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2016)	

<b>Conditions and measures related to external recovery of waste</b>							
KAu(CN) <sub>2</sub> -containing waste suitable for recycling may be recycled either internally or at licensed recycling facility.							
The sludge from the on-site treatment plant is processed for metal reclamation (recycling).							
<b>3. Exposure and risk estimation</b>							
<b>Environment [based on total KAu(CN)<sub>2</sub> emissions]</b>							
ERC 2							
<b>ES 2 Formulation of KAu(CN)<sub>2</sub></b>							
<b>Compartment</b>	<b>Unit</b>	<b>PNEC</b>	<b>PEC<sub>regional</sub></b>	<b>C<sub>local</sub></b>	<b>PEC</b>	<b>RCR</b>	<b>Methods for calculation of environmental concentrations</b>
Discharge to STP	mg/L as KAu(CN) <sub>2</sub>	6.0 mg/L	5.02 x10 <sup>-8</sup> mg/L	1.62 x10 <sup>-4</sup> mg/L	1.62 x10 <sup>-4</sup> mg/L	2.70 x10 <sup>-5</sup>	SpERC RFs applied to Msafe tonnage and dilution factor at municipal sewage works
Freshwater via STP	mg/L as KAu(CN) <sub>2</sub>	2.0 x10 <sup>-4</sup> mg/L	5.02 x10 <sup>-8</sup> mg/L	1.58 x10 <sup>-5</sup> mg/L	1.59 x10 <sup>-5</sup> mg/L	0.080	SpERC RFs applied to Msafe tonnage and calculated values for STP removal efficiency based on standard guidance and default value for dilution in ultimate receiving water body
Freshwater sediment via STP	mg/kg w.w. as KAu(CN) <sub>2</sub>	7.3 x10 <sup>-2</sup> mg/kg	3.27 x10 <sup>-5</sup> mg/kg	5.76 x10 <sup>-3</sup> mg/kg	5.79 x10 <sup>-3</sup> mg/kg	0.80	SpERC RFs applied to Msafe tonnage. STP removal calculated following standard ECHA guidance in ultimate receiving water body. Additional factor of 10 included in RCR due to equilibrium partitioning
Terrestrial (all scenarios)	mg/kg w.w. as KAu(CN) <sub>2</sub>	5.9 x10 <sup>-2</sup> mg/kg	3.0 x10 <sup>-5</sup> mg/kg	2.70 x10 <sup>-7</sup> mg/kg	3.0 x10 <sup>-5</sup> mg/kg	5.1 x10 <sup>-4</sup>	Modelled increase in soil concentrations due to deposition from atmospheric emissions (i.e. assuming no application of sewage sludge to land)

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES
<p><b>Environment</b></p> <p>Scaling tool: Metals EUSES IT tool (free download: <a href="http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool">http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool</a>)</p> <p>Scaling of the release to air and water environment includes:</p> <ul style="list-style-type: none"> <li>Refining of the release factor to air and waste water and/or and the efficiency of the air filter and wastewater treatment facility.</li> <li>Adjustment of the flow rate for the receiving water body and subsequent dilution factor.</li> </ul>

### 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  $\text{KAu}(\text{CN})_2$  released to the atmosphere during the manufacture of  $\text{KAu}(\text{CN})_2$ .

Annual emission to air (kg $\text{KAu}(\text{CN})_2$ )	Emission days per year	Concentration in local air (mg $\text{KAu}(\text{CN})_2/\text{m}^3$ )	Annual average concentration in air (mg $\text{KAu}(\text{CN})_2/\text{m}^3$ )	DNEL <sup>2</sup> (mg $\text{KAu}(\text{CN})_2/\text{m}^3$ )	RCR
0.014	300	$1.25 \times 10^{-8}$	$1.03 \times 10^{-7}$	0.0071	$1.76 \times 10^{-6}$

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

### 9.2.2.1. Conditions of use

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

	Method
<b>Product (article) characteristics</b>	
• Physical form of substance: Solid	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)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	

<sup>2</sup> DNEL based on the systematic long-term worker inhalation exposure

	Method
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
• Generic local exhaust ventilation: Lower confidence limit (industrial use) (Standard efficiency) [Effectiveness Inhal: 78%]	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• Respiratory protective equipment (RPE): RPE with minimum APF = 40 (APF = assigned protection factor according to EN 529. At minimum combination of particle filter class P3 with face piece according to EN 136, EN 12941 or EN 12942 or any RPE providing higher APFs according to EN 529 is required.) [Effectiveness Inhal: 97.5%]	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.)	

### 9.2.2.2. Exposure and risks for workers

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

**Table 1. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	<b>55 µg/m<sup>3</sup></b> (External Tool (MEASE))	RCR = 0.775
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	<b>14.14 µg/kg bw/day</b> (External Tool (MEASE))	RCR = 0.141

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.916

### 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 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
<b>Product (article) characteristics</b>	
• 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)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	

	Method
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• 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 (high 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 2. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	<b>10 µg/m<sup>3</sup></b> (External Tool (MEASE))	RCR = 0.141
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	<b>34.29 µg/kg bw/day</b> (External Tool (MEASE))	RCR = 0.343



Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.484

### 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 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
<b>Product (article) characteristics</b>	
• 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)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	

	Method
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Direct handling	External Tool (MEASE)
• Contact level: Intermittent	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• 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 (high 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.)	

#### 9.2.4.2. 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	<b>10 µg/m<sup>3</sup></b> (External Tool (MEASE))	RCR = 0.141
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	<b>34.29 µg/kg bw/day</b> (External Tool (MEASE))	RCR = 0.343

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.484

### 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 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
<b>Product (article) characteristics</b>	
• 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)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	

	Method
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• 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)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• 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 (high 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 4. Exposure concentrations and risks for workers**

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	<b>50 µg/m<sup>3</sup></b> (External Tool (MEASE))	RCR = 0.704
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	<b>3.43 µg/kg bw/day</b> (External Tool (MEASE))	RCR = 0.034

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.738

### 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 below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

## 9.2.6. Worker contributing scenario 5: Mixing/Blending of solutions (PROC 5)

### 9.2.6.1. Conditions of use

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

	Method
<b>Product (article) characteristics</b>	
• 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)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	

	Method
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• 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)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• 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 (high 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.)	

### 9.2.6.2. 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	<b>50 µg/m<sup>3</sup></b> (External Tool (MEASE))	RCR = 0.704
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	<b>3.43 µg/kg bw/day</b> (External Tool (MEASE))	RCR = 0.034

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.738

### 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 below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

## 9.2.7. Worker contributing scenario 6: Batch process involving solids (PROC 4)

### 9.2.7.1. Conditions of use

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

	Method
<b>Product (article) characteristics</b>	
• Physical form of substance: Solid	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)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	

	Method
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• 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)
• Integrated local exhaust ventilation: Upper confidence limit (industrial use) (High efficiency) [Effectiveness Inhal: 90%]	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• Respiratory protective equipment (RPE): RPE with minimum APF = 40 (APF = assigned protection factor according to EN 529. At minimum combination of particle filter class P3 with face piece according to EN 136, EN 12941 or EN 12942 or any RPE providing higher APFs according to EN 529 is required.) [Effectiveness Inhal: 97.5%]	External Tool (MEASE)
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high 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.)	

### 9.2.7.2. 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	63 µg/m <sup>3</sup> (External Tool (MEASE))	RCR = 0.887
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)



Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, systemic, long-term	3.43 µg/kg bw/day (External Tool (MEASE))	RCR = 0.034
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.922

#### 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 below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

## 9.2.8. Worker contributing scenario 7: Mixing/Blending of solids (PROC 5)

### 9.2.8.1. Conditions of use

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

	Method
<b>Product (article) characteristics</b>	
• Physical form of substance: Solid	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)

	Method
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• 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)
• Integrated local exhaust ventilation: Upper confidence limit (industrial use) (High efficiency) [Effectiveness Inhal: 90%]	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• Respiratory protective equipment (RPE): RPE with minimum APF = 40 (APF = assigned protection factor according to EN 529. At minimum combination of particle filter class P3 with face piece according to EN 136, EN 12941 or EN 12942 or any RPE providing higher APFs according to EN 529 is required.) [Effectiveness Inhal: 97.5%]	External Tool (MEASE)
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high 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.)	

### 9.2.8.2. 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	63 µg/m <sup>3</sup> (External Tool (MEASE))	RCR = 0.887
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	<b>3.43 µg/kg bw/day</b> (External Tool (MEASE))	RCR = 0.034
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.922

### 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 below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

## 9.2.9. Worker contributing scenario 8: Wet cleaning (PROC 8a)

### 9.2.9.1. Conditions of use

	Method
<b>Product (article) characteristics</b>	
• 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)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	

	Method
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	
• Pattern of use: Non-dispersive use	External Tool (MEASE)
• Pattern of exposure control: Direct handling	External Tool (MEASE)
• Contact level: Extensive	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• 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.)	

### 9.2.9.2. 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	<b>5 µg/m<sup>3</sup></b> (External Tool (MEASE))	RCR = 0.07
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	<b>34.29 µg/kg bw/day</b> (External Tool (MEASE))	RCR = 0.343

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, local, long-term		Qualitative (see below)
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.413

### 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 below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.

## 9.2.10. Worker contributing scenario 9: Vacuum cleaning (PROC 26)

### 9.2.10.1. Conditions of use

	Method
<b>Product (article) characteristics</b>	
• 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)
<b>Amount used (or contained in articles), frequency and duration of use/exposure</b>	
• Maximum duration of exposure: > 240 min (not restricted) [Effectiveness Inhal: 0%; Dermal: 0%]	External Tool (MEASE)
<b>Technical and organisational conditions and measures</b>	

	Method
• 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%] <i>Surrogate exposure determinant used to reflect the efficiency of a vacuum cleaner.</i>	External Tool (MEASE)
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
• Respiratory protective equipment (RPE): RPE with minimum APF = 40 (APF = assigned protection factor according to EN 529. At minimum combination of particle filter class P3 with face piece according to EN 136, EN 12941 or EN 12942 or any RPE providing higher APFs according to EN 529 is required.) [Effectiveness Inhal: 97.5%]	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.)	

### 9.2.10.2. 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	<b>40 µg/m<sup>3</sup></b> (External Tool (MEASE))	RCR = 0.563
Inhalation, systemic, acute		Qualitative (see below)
Inhalation, local, long-term		Qualitative (see below)
Inhalation, local, acute		Qualitative (see below)
Dermal, systemic, long-term	<b>1.41 µg/kg bw/day</b> (External Tool (MEASE))	RCR = 0.014
Dermal, local, long-term		Qualitative (see below)

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.578

**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 below the DNELs and local effects are not expected. Therefore, risks are adequately controlled.