



9.6. Exposure scenario 6: Use at industrial sites - Reactive use of disilver oxide containing formulations

Product category used: PC 14: Metal surface treatment products; PC 21: Laboratory Chemicals; PC 37: Water treatment chemicals; PC 42: Electrolytes for batteries

Sector of use: SU 9: Manufacture of fine chemicals

Environment contributing scenario(s):		
CS 1	Use of disilver oxide containing formulations	ERC 6b
Worker contributing scenario(s):		
CS 2	Raw material handling	PROC 26, PROC 21
CS 3	Reaction	PROC 4, PROC 1, PROC 15, PROC 3
CS 4	Packaging	PROC 8b, PROC 21
CS 5	Cleaning and maintenance	PROC 28, PROC 8a

9.6.1. Env CS 1: Use of disilver oxide containing formulations (ERC 6b)

Assessment entity group used for the assessment of this contributing scenario: ERA

Since very limited exposure information was available on emissions to water for this use and no SpERCs exist for the use of formulations of metal compounds, the assessment is based on SpERCs for the production of metal compounds since the operation conditions and risk management measure are often very similar.

9.6.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
<ul style="list-style-type: none"> Annual use amount at site: ≤ 50 tonnes/year <i>A realistic site tonnage of 50 tpa has been selected. In the event this modelled tonnage is exceeded scaling of the conditions is allowed.</i> <i>All the amounts are expressed as Ag as this is the driver for the environmental risk assessment.</i>
<ul style="list-style-type: none"> Daily use amount at site: ≤ 0.27 tonnes/day <i>Default number of emission days are derived from a multi-metal background database of measured site-specific release factors collected under the former Directive of New and Existing Substances and REACH 2010 registration dossiers.</i> <i>182 days/year is the 10th percentile of reported site-specific number of emission days for 168 sites from production of metal compounds.</i>
Technical and organisational conditions and measures
<ul style="list-style-type: none"> The substance should not be released to air <i>Emissions to air are not allowed in this scenario</i>
<ul style="list-style-type: none"> On site treatment of wastewater: Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange according to the BAT Reference Document in the Non-Ferrous Metals Industry (2017) applying minimum xx% removal efficiency <i>Direct water emissions should be reduced by implementing one or more of the following RMMs:</i> <ul style="list-style-type: none"> <i>Chemical precipitation: used primarily to remove the metal ions (e.g. the use of $\text{Ca}(\text{OH})_2$ to a pH 11: >99% removal efficiency; the use of $\text{Fe}(\text{OH})_3$ to a pH 11: 96% removal efficiency)</i> <i>Sedimentation (e.g. Na_2S, pH 11, >99% removal efficiency) • Filtration: used as final clarification step (e.g. ultrafiltration, pH 5.1: 93% removal efficiency, nanofiltration: 97% removal efficiency, reverse osmosis, pH 4-11: 99% removal efficiency)</i> <i>Electrolysis: for low metal concentration at about 2 g/L (e.g. electrodialysis: 13% removal efficiency within 2 hours, membrane electrolysis, electrochemical precipitation, pH 4-10, >99% removal efficiency) • Reverse osmosis: extensively used for the removal of dissolved metals; Ion exchange: final cleaning step in the removal of heavy metal from process wastewater (e.g. 90% removal efficiency for clinoptinolite and 100% removal efficiency for synthetic zeolite)</i> <i>Following the Integrated Pollution Prevention and Control – BAT Reference note document, the treatment methods are very much dependent on the specific processes and the metals involved. More information can be found in the BAT Reference Document for the Non-Ferrous Metals Industry (2017).</i>



Conditions and measures related to biological sewage treatment plant
• Biological STP: Standard [Effectiveness Water: 80.1%]
• Discharge rate of STP: $\geq 2E3$ m ³ /day
• Application of the STP sludge on agricultural soil: Yes
Conditions and measures related to external treatment of waste (including article waste)
<p>• Particular considerations on the waste treatment operations: No (low concentration)</p> <p><i>Hazardous wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately to hazardous waste incineration plants or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the silver content of the waste is elevated enough, internal or external recovery/recycling might be considered.</i></p> <p><i>Appropriate waste codes: 06 05 02*, 08 01 11, 08 03 12*, 09 01 01*, 09 01 03*, 09 01 04*, 09 01 05*, 09 01 06*, 09 01 13*, 10 06 06*, 10 07 01, 10 07 02, 10 07 03, 10 07 04, 10 07 05, 11 01 09*, 15 01 10*, 15 02 02*, 16 01 18, 16 03 03*, 16 08 01, 16 11 04</i></p> <p><i>Suitable disposal: Hazardous waste produced during the manufacture and downstream use is sent to a recycler only marginal amounts are sent to a landfill or an incinerator. Waste containing silver is recycled for almost a 100%</i></p> <p><i>A detailed assessment has been performed on modelled and measured data and is reported in the Waste report (ARCHE, 2013)</i></p>
Other conditions affecting environmental exposure
• Receiving surface water flow rate: $\geq 1.8E4$ m ³ /day

9.6.1.2. 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 9.39. Local releases to the environment

Release	Assessment entity	Release estimation method	Explanations
Water	Ag dissolved	Estimated release factor (based on SPERC Eurometaux SPERC 6a.1.v3)	<p>Release factor before on site RMM: 2E-3% Release factor after on site RMM: 2E-3% Local release rate: 5.4E-3 kg/day</p> <p>Explanation: After on-site STP. Realistic worst-case regression line ($RF = 10^{(1.59 - 1.14 \times \log(Kd))}$) of the metal-specific 90th percentile reported site-specific release factors to wastewater for 201 sites from the production of massive metal and metal powder. A relationship between solid-water partitioning coefficient for suspended matter K_d and the release factor to water can be justified because the K_d expresses the distribution between aqueous phase and suspended matter. K_d is an important parameter impacting the removal efficiency especially in sedimentation and precipitation RMMs but also in on-site runoff, cleaning operations, wet processes, etc</p>
Air	Ag dissolved	Estimated release factor	<p>Release factor before on site RMM: 0% Release factor after on site RMM: 0% Local release rate: 0 kg/day</p> <p>Explanation: Based on questionnaire responses none of the companies have emissions to air.</p>
Non agricultural	Ag dissolved	Estimated release	Release factor after on site RMM: 0%



Release	Assessment entity	Release estimation method	Explanations
soil		factor	Explanation: No direct release to soil.

9.6.1.3. 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 9.40. Exposure concentrations and risks for the environment and man via the environment

Protection target	Assessment entity	Exposure concentration	Risk quantification
Fresh water	Ag dissolved	Local PEC: 2E-5 mg/L RCR = 0.434	Final RCR = 0.434
Sediment (freshwater)	Ag dissolved	Local PEC: 3.808 mg/kg dw RCR = 8.69E-3	Final RCR < 0.01
Marine water	Ag dissolved	Local PEC: 3.3E-6 mg/L RCR = 3.84E-3	Final RCR < 0.01
Sediment (marine water)	Ag dissolved	Local PEC: 0.629 mg/kg dw RCR = 1.44E-3	Final RCR < 0.01
Sewage Treatment Plant	Ag dissolved	Local PEC: 5.37E-4 mg/L RCR = 0.021	Final RCR = 0.021
Agricultural soil	Ag dissolved	Local PEC: 0.187 mg/kg dw RCR = 0.178	Final RCR = 0.178
Man via environment - Inhalation (systemic effects)	Ag dissolved	Concentration in air: 8.53E-8 mg/m ³ RCR = 5.69E-7	Final RCR < 0.01
Man via environment - Oral	Ag dissolved	Exposure via food consumption: 3.84 µg/kg bw/day (Measured data: See section 9.0.3.6) RCR = 0.035	Final RCR = 0.035
Man via environment - combined routes			Final RCR = 0.035

Remarks on measured exposure:

See section 9.0.3.6 for Ag dissolved:

Identity of the substance used: Ag

Explanation: Worst case exposure of 3.84 µg Ag/kg bw/day from food (section 9.0.3.6) was taken forward to the risk characterisation.

The intake via drinking water calculated with CHESAR was 3-4 orders of magnitudes lower compared to the intake via food and has thus not been taken into account.

9.6.2. Worker CS 2: Raw material handling (PROC 26, PROC 21)

Assessment entity group used for the assessment of this contributing scenario: HHRA manual handling

9.6.2.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with high dustiness)	MEASE 1.02.01
• Percentage (w/w) of substance in mixture/article: <= 100 %	MEASE 1.02.01



	Method
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	MEASE 1.02.01
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Advanced	MEASE 1.02.01
• Pattern of use: Non-dispersive use	MEASE 1.02.01
• Pattern of exposure control: Direct handling	MEASE 1.02.01
• Contact level: Extensive	MEASE 1.02.01
• Generic local exhaust ventilation: Lower confidence limit (industrial use) [Effectiveness Inhalation: 78%] <i>Standard efficiency</i> Inhalation explanation: <i>Efficiency for industrial use</i>	MEASE 1.02.01
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: Chemical resistant dermal protection with basic employee training. (effectiveness >= 90%)	MEASE 1.02.01
• Face/eye protection: Eye protection	
• Respiratory protection: Yes (APF >= 10)	MEASE 1.02.01
Other conditions affecting workers exposure	
• Place of use: Indoor	

9.6.2.2. Exposure and risks for workers

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

Table 9.41. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Disilver oxide	0.22 mg/m ³ (MEASE 1.02.01) RCR = 0.169	Final RCR = 0.169
Dermal, systemic, long term	Disilver oxide	0.141 mg/kg bw/day (MEASE 1.02.01) RCR = 0.307	Final RCR = 0.307
Combined routes, systemic, long-term			Final RCR = 0.476

Risk characterisation

Qualitative risk characterisation (Eye, local):
See section 9.0.4.2

9.6.3. Worker CS 3: Reaction (PROC 4, PROC 1, PROC 15, PROC 3)

Assessment entity group used for the assessment of this contributing scenario: HHRA mixing

9.6.3.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Liquid, including paste/slurry/suspension <i>'Aqueous solution' was selected in MEASE to reflect the very low fugacity.</i>	MEASE 1.02.01
• Percentage (w/w) of substance in mixture/article: <= 100 %	MEASE 1.02.01
Amount used (or contained in articles), frequency and duration of use/exposure	



	Method
• Duration of activity: ≤ 8 h/day	MEASE 1.02.01
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Advanced	MEASE 1.02.01
• Pattern of use: Non-dispersive use	MEASE 1.02.01
• Pattern of exposure control: Direct handling	MEASE 1.02.01
• Contact level: Extensive	MEASE 1.02.01
• Local exhaust ventilation: No	MEASE 1.02.01
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: Chemical resistant dermal protection with basic employee training. (effectiveness ≥ 90%)	MEASE 1.02.01
• Face/eye protection: Eye protection	
• Respiratory protection: No	MEASE 1.02.01
Other conditions affecting workers exposure	
• Place of use: Indoor	

9.6.3.2. Exposure and risks for workers

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

Table 9.42. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Disilver oxide	0.05 mg/m ³ (MEASE 1.02.01) RCR = 0.038	Final RCR = 0.038
Dermal, systemic, long term	Disilver oxide	0.034 mg/kg bw/day (MEASE 1.02.01) RCR = 0.075	Final RCR = 0.075
Combined routes, systemic, long-term			Final RCR = 0.113

Risk characterisation

Qualitative risk characterisation (Eye, local):
See section 9.0.4.2

9.6.4. Worker CS 4: Packaging (PROC 8b, PROC 21)

Assessment entity group used for the assessment of this contributing scenario: HHRA dispatch

9.6.4.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Liquid, including paste/slurry/suspension 'Aqueous solution' was selected in MEASE to reflect the very low fugacity.	MEASE 1.02.01
• Percentage (w/w) of substance in mixture/article: ≤ 100 %	MEASE 1.02.01
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: ≤ 8 h/day	MEASE 1.02.01
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Advanced	MEASE 1.02.01



	Method
• Pattern of use: Non-dispersive use	MEASE 1.02.01
• Pattern of exposure control: Direct handling	MEASE 1.02.01
• Contact level: Extensive	MEASE 1.02.01
• Local exhaust ventilation: No	MEASE 1.02.01
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: No	MEASE 1.02.01
• Face/eye protection: Eye protection	
• Respiratory protection: No	MEASE 1.02.01
Other conditions affecting workers exposure	
• Place of use: Indoor	

9.6.4.2. Exposure and risks for workers

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

Table 9.43. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Disilver oxide	0.01 mg/m ³ (MEASE 1.02.01) RCR = 7.69E-3	Final RCR < 0.01
Dermal, systemic, long term	Disilver oxide	0.034 mg/kg bw/day (MEASE 1.02.01) RCR = 0.075	Final RCR = 0.075
Combined routes, systemic, long-term			Final RCR = 0.082

Risk characterisation

Qualitative risk characterisation (Eye, local):

See section 9.0.4.2

9.6.5. Worker CS 5: Cleaning and maintenance (PROC 28, PROC 8a)

Assessment entity group used for the assessment of this contributing scenario: HHRA manual cleaning, repair and maintenance operations, removal of residuals from e.g. filters/overspill or as waste

9.6.5.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with high dustiness) <i>Dust with high emission potential has been selected as a worst case (compared to aqueous solution).</i>	MEASE 1.02.01
• Percentage (w/w) of substance in mixture/article: <= 100 %	MEASE 1.02.01
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	MEASE 1.02.01
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Advanced	MEASE 1.02.01
• Pattern of use: Non-dispersive use	MEASE 1.02.01
• Pattern of exposure control: Direct handling	MEASE 1.02.01
• Contact level: Extensive	MEASE 1.02.01



	Method
<ul style="list-style-type: none"> • Generic local exhaust ventilation: Lower confidence limit (industrial use) [Effectiveness Inhalation: 78%] <i>Standard efficiency</i> Inhalation explanation: <i>Efficiency for industrial use</i> 	MEASE 1.02.01
Conditions and measures related to personal protection, hygiene and health evaluation	
<ul style="list-style-type: none"> • Dermal protection: Chemical resistant dermal protection with basic employee training. (effectiveness >= 90%) 	MEASE 1.02.01
<ul style="list-style-type: none"> • Face/eye protection: Eye protection 	
<ul style="list-style-type: none"> • Respiratory protection: Yes (APF >= 20) 	MEASE 1.02.01
Other conditions affecting workers exposure	
<ul style="list-style-type: none"> • Place of use: Indoor 	

9.6.5.2. Exposure and risks for workers

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

Table 9.44. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Disilver oxide	0.55 mg/m ³ (MEASE 1.02.01) RCR = 0.423	Final RCR = 0.423
Dermal, systemic, long term	Disilver oxide	0.069 mg/kg bw/day (MEASE 1.02.01) RCR = 0.149	Final RCR = 0.149
Combined routes, systemic, long-term			Final RCR = 0.572

Remarks on exposure data from external estimation tools:

MEASE 1.02.01 for Disilver oxide:

Explanation:

As the MEASE 1.02.01 exposure estimation tool for workers does not provide exposure estimates for PROC 28, PROC 8a has been used instead as the input parameter assuming that there are similarities in the exposure.

Risk characterisation

Qualitative risk characterisation (Eye, local):

See section 9.0.4.2