



9.4. Exposure scenario 4: Formulation or re-packing - Use of silver in the formulation of silver-containing preparations/mixtures

Product category formulated: PC 1: Adhesives, Sealants; PC 9a: Coatings and Paints, Thinners, paint removers; PC 14: Metal surface treatment products; PC 18: Ink and Toners; PC 21: Laboratory Chemicals; PC 24: Lubricants, Greases, Release Products; PC 25: Metal Working Fluids; PC 29: Pharmaceuticals; PC 42: Electrolytes for batteries

Environment contributing scenario(s):		
CS 1	Use of silver in the formulation of silver-containing preparations/mixtures	ERC 2
Worker contributing scenario(s):		
CS 2	Raw material handling	PROC 8b , PROC 21
CS 3	Powder handling	PROC 4 , PROC 26
CS 4	Handling of solutions/suspensions	PROC 8b , PROC 9
CS 5	Wet process	PROC 1 , PROC 13, PROC 15, PROC 3, PROC 4, PROC 5
CS 6	Hot process	PROC 22 , PROC 23
CS 7	Mechanical processes	PROC 14 , PROC 17, PROC 18
CS 8	Spraying	PROC 7
CS 9	Packaging	PROC 8b , PROC 21, PROC 9
CS 10	Cleaning and maintenance	PROC 8a , PROC 19, PROC 26, PROC 28

9.4.1. Env CS 1: Use of silver in the formulation of silver-containing preparations/mixtures (ERC 2)

Assessment entity group used for the assessment of this contributing scenario: Silver in powder form

9.4.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
<ul style="list-style-type: none"> Daily use amount at site: ≤ 0.022 tonnes/day <i>The 90th percentile from the daily use amount reported in the questionnaires by 6 companies has been taken forward.</i> Annual use amount at site: ≤ 6 tonnes/year <i>Based on 270 days/year reported as the median value in the questionnaires based on 6 companies</i>
Technical and organisational conditions and measures
<ul style="list-style-type: none"> On site treatment of off-air: Electrostatic precipitators or wet electrostatic precipitators or cyclones or fabric/bag filter or ceramic/metal mesh filter according to the BAT Reference Document in the Non-Ferrous Metals Industry <i>Direct air emissions should be reduced by implementing one or more of the following RMMs (air concentration range for which the RMM is suitable is specified in parenthesis):</i> <ul style="list-style-type: none"> <i>Electrostatic precipitators using wide electrode spacing: $5 - 15 \text{ mg/Nm}^3$</i> <i>Wet electrostatic precipitators: $< 5 \text{ mg/Nm}^3$</i> <i>Cyclones, but as primary collector: $< 50 \text{ mg/Nm}^3$</i> <i>Fabric or bag filters: high efficiency in controlling fine particulate (melting): achieve emission values $< 5 \text{ mg/Nm}^3$. Membrane filtration techniques can achieve $< 1 \text{ mg/Nm}^3$</i> <i>Ceramic and metal mesh filters. PM10 particles are removed: 0.1 mg/Nm^3</i>



Wet scrubbers: < 4 mg/Nm ³
<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> Chemical precipitation: used primarily to remove the metal ions (e.g. the use of Ca(OH)₂ to a pH 11: >99% removal efficiency; the use of Fe(OH)₃ to a pH 11: 96% removal efficiency) Sedimentation (e.g. Na₂S, 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) 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) <p>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).</p>
Conditions and measures related to biological sewage treatment plant
<ul style="list-style-type: none"> Biological STP: None [Effectiveness Water: 0%]
Conditions and measures related to external treatment of waste (including article waste)
<ul style="list-style-type: none"> Particular considerations on the waste treatment operations: No (low concentration) <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> <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> <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> <i>A detailed assessment has been performed on modelled and measured data and is reported in the Waste report (ARCHE, 2013)</i>
Other conditions affecting environmental exposure
<ul style="list-style-type: none"> Receiving surface water flow rate: >= 1.8E4 m³/day Discharge rate of effluent: >= 2E3 m³/day

9.4.1.2. Releases

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

Table 9.21. Local releases to the environment

Release	Assessment entity	Release estimation method	Explanations
Water	Silver in powder form	Estimated release factor (based on SPERC Eurometaux SPERC 2.5 v2.1)	<p>Release factor before on site RMM: 0.01%</p> <p>Release factor after on site RMM: 0.01%</p> <p>Local release rate: 2.2E-3 kg/day</p> <p>Explanation:</p> <p>Limited information was available for this use in the questionnaires. 5 out of 7 companies reported no emissions to water. The other two had emissions but could not be attributed specifically to this use. As such the SPERC for formulation of metal compounds</p>



Release	Assessment entity	Release estimation method	Explanations
			has been taken as surrogate for the emissions.
Air	Silver in powder form	Estimated release factor (based on SPERC Eurometaux SPERC 2.5 v2.1)	Release factor before on site RMM: 5E-3% Release factor after on site RMM: 5E-3% Local release rate: 1.1E-3 kg/day Explanation: Limited information was available for this use in the questionnaires. 3 out of 7 companies reported no emissions to air. The other had emissions but could not be quantified. As such the SPERC for formulation of metal compounds has been taken as surrogate for the emissions.
Non agricultural soil	Silver in powder form	Estimated release factor	Release factor after on site RMM: 0% Explanation: No direct release to soil

Releases to waste

Release factor to external waste: 0 %

A detailed assessment has been performed on modelled and measured data and is reported in the Waste report (ARCHE, 2013)

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

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

Table 9.22. Exposure concentrations and risks for the environment and man via the environment

Protection target	Assessment entity	Exposure concentration	Risk quantification
Fresh water	Silver in powder form	Local PEC: 3.46E-5 mg/L RCR = 0.864	Final RCR = 0.864
Sediment (freshwater)	Silver in powder form	Local PEC: 6.587 mg/kg dw RCR = 0.015	Final RCR = 0.015
Marine water	Silver in powder form	Local PEC: 4.76E-6 mg/L RCR = 5.54E-3	Final RCR < 0.01
Sediment (marine water)	Silver in powder form	Local PEC: 0.907 mg/kg dw RCR = 2.07E-3	Final RCR < 0.01
Sewage Treatment Plant	Silver in powder form	Local PEC: 0 mg/L RCR = 0	Final RCR < 0.01
Agricultural soil	Silver in powder form	Local PEC: 0.096 mg/kg dw RCR = 0.068	Final RCR = 0.068

9.4.2. Worker CS 2: Raw material handling (PROC 8b, PROC 21)

Assessment entity group used for the assessment of this contributing scenario: Silver in powder form
Exposure assessment and risk characterisation are not required (see scope under 9.0.4).

9.4.3. Worker CS 3: Powder handling (PROC 4, PROC 26)

Assessment entity group used for the assessment of this contributing scenario: Silver in powder form
Exposure assessment and risk characterisation are not required (see scope under 9.0.4).

9.4.4. Worker CS 4: Handling of solutions/suspensions (PROC 8b, PROC 9)



Assessment entity group used for the assessment of this contributing scenario: Silver in powder form
Exposure assessment and risk characterisation are not required (see scope under 9.0.4).

9.4.5. Worker CS 5: Wet process (PROC 1, PROC 13, PROC 15, PROC 3, PROC 4, PROC 5)

Assessment entity group used for the assessment of this contributing scenario: Silver in powder form
Exposure assessment and risk characterisation are not required (see scope under 9.0.4).

9.4.6. Worker CS 6: Hot process (PROC 22, PROC 23)

Assessment entity group used for the assessment of this contributing scenario: Silver in powder form
Exposure assessment and risk characterisation are not required (see scope under 9.0.4).

9.4.7. Worker CS 7: Mechanical processes (PROC 14, PROC 17, PROC 18)

Assessment entity group used for the assessment of this contributing scenario: Silver in powder form
Exposure assessment and risk characterisation are not required (see scope under 9.0.4).

9.4.8. Worker CS 8: Spraying (PROC 7)

Assessment entity group used for the assessment of this contributing scenario: Silver in powder form
Exposure assessment and risk characterisation are not required (see scope under 9.0.4).

9.4.9. Worker CS 9: Packaging (PROC 8b, PROC 21, PROC 9)

Assessment entity group used for the assessment of this contributing scenario: Silver in powder form
Exposure assessment and risk characterisation are not required (see scope under 9.0.4).

9.4.10. Worker CS 10: Cleaning and maintenance (PROC 8a, PROC 19, PROC 26, PROC 28)

Assessment entity group used for the assessment of this contributing scenario: Silver in powder form
Exposure assessment and risk characterisation are not required (see scope under 9.0.4).