9.9. Exposure scenario 9: Use at industrial sites - Use of silver in the production of other silver compounds

Sector of use: SU 9: Manufacture of fine chemicals

Environment contributing scenario(s):		
CS 1	Use of silver in the production of other silver compounds	ERC 6a
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 26

9.9.1. Env CS 1: Use of silver in the production of other silver compounds (ERC 6a)

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

9.9.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Annual use amount at site: <= 20 tonnes/year *Estimated volume based on previous data collection.*
• Daily use amount at site: <= 0.11 tonnes/day *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.* *182 days/year is the 10th percentile of reported site-specific number of emission days for 168 sites from production of metal compounds.*
Technical and organisational conditions and measures
• 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 *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):* *• Electrostatic precipitators using wide electrode spacing: 5 – 15 mg/Nm³* *• Wet electrostatic precipitators: < 5 mg/Nm³* *• Cyclones, but as primary collector: < 50 mg/Nm³* *• Fabric or bag filters: high efficiency in controlling fine particulate (melting): achieve emission values < 5mg/Nm³. Membrane filtration techniques can achieve < 1 mg/Nm³* *• Ceramic and metal mesh filters. PM10 particles are removed: 0.1 mg/Nm³* *Wet scrubbers: < 4 mg/Nm3*
• 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

Direct water emissions should be reduced by implementing one or more of the following RMMs: *• 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)* *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).*
Conditions and measures related to biological sewage treatment plant
• Biological STP: None [Effectiveness Water: 0%]
Conditions and measures related to external treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low concentration) *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.* *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* *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 on modelled and measured data and is reported in the Waste report (ARCHE, 2013)*
Other conditions affecting environmental exposure
• Discharge rate of effluent: >= 2E3 m3/day

9.9.1.2. 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 9.31. 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 6a.1.v3)	**Release factor before on site RMM:** 2E-3% **Release factor after on site RMM:** 2E-3% **Local release rate:** 2.2E-3 kg/day **Explanation:** After on-site STP. Realistic worst-case regression line (RF = 10^(1.59 – 1.14 x 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 Kd and the release factor to water can be justified because the Kd expresses the distribution between aqueous phase and

Release	Assessment entity	Release estimation method	Explanations
			suspended matter. Kd 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
Air	Silver in powder form	Estimated release factor (based on SPERC Eurometaux SPERC 6a.1.v3)	**Release factor before on site RMM:** 0.03% **Release factor after on site RMM:** 0.03% **Local release rate:** 0.033 kg/day **Explanation:** Release after RMM. The 90th percentile of reported site-specific release factors to air for 145 sites from the production of massive metal and metal powder
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)

9.9.1.3. 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 9.32. 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:** 0.098 mg/kg dw RCR = 0.07	Final RCR = 0.07

9.9.2. 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).

9.9.3. 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).

9.9.4. 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).

9.9.5. 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).

9.9.6. 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).

9.9.7. 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).

9.9.8. 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).

9.9.9. 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).

9.9.10. Worker CS 10: Cleaning and maintenance (PROC 8a, 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).