9.10. Exposure scenario 10: Use at industrial sites - Use of silver as catalyst

Environment contributing scenario(s):		
CS 1	Use of silver as catalyst	ERC 5
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

Subsequent service life exposure scenario(s):
ES20: Service life (consumers) - Service life of articles containing silver being encapsulated in the internal part of the product

9.10.1. Env CS 1: Use of silver as catalyst (ERC 5)

Assessment entity group used for the assessment of this contributing scenario: Silver in powder form
Use of homogeneous catalyst remaining in article

9.10.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Daily use amount at site: <= 0.01 tonnes/day
• Annual use amount at site: <= 1 tonnes/year
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
• Receiving surface water flow rate: >= 1.8E4 m3/day
• Discharge rate of effluent: >= 2E3 m3/day

9.10.1.2. 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 9.33. 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)	**Release factor before on site RMM:** 0.01% **Release factor after on site RMM:** 0.01% **Local release rate:** 1E-3 kg/day **Explanation:** No information was available for this use. The assumption is that silver powder is mixed to catalyse a reaction as such the SPERC for formulation of metal compounds 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:** 5E-4 kg/day **Explanation:** No information was available for this use. The assumption is that silver powder is mixed to catalyse a reaction as such the SPERC for formulation of metal compounds has been taken as surrogate for the emissions.

Release	Assessment entity	Release estimation method	Explanations
Non agricultural soil	Silver in powder form	Estimated release factor	**Release factor after on site RMM:** 0% **Explanation:** No direct release to soil

9.10.1.3. 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 9.34. 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:** 1.9E-5 mg/L RCR = 0.475	Final RCR = 0.475
Sediment (freshwater)	Silver in powder form	**Local PEC:** 3.624 mg/kg dw RCR = 8.27E-3	Final RCR < 0.01
Marine water	Silver in powder form	**Local PEC:** 3.21E-6 mg/L RCR = 3.73E-3	Final RCR < 0.01
Sediment (marine water)	Silver in powder form	**Local PEC:** 0.611 mg/kg dw RCR = 1.39E-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

9.10.2. 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).

9.10.3. 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).

9.10.4. 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).

9.10.5. 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).

9.10.6. 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).

9.10.7. 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).

9.10.8. 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).

9.10.9. 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).

9.10.10. 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).