



9.2. Exposure scenario 2: Use at industrial sites - Use of silver chloride as an intermediate in the manufacture / recycling / refining of silver

Sector of use: SU 14: Manufacture of basic metals, including alloys

Environment contributing scenario(s):			SPERC
CS 1	Use of silver chloride as an intermediate in the manufacture / recycling / refining of silver	ERC 6a	Eurometaux SPERC 6a.1.v3
Worker contributing scenario(s):			SWED
CS 2	Handling of silver chloride	PROC 26	
CS 3	Alternative I: Hot processes	PROC 22	
CS 4	Alternative II: Wet processes	PROC 4	
CS 5	Cleaning and maintenance	PROC 28	

9.2.1. Env CS 1: Use of silver chloride as an intermediate in the manufacture / recycling / refining of silver (ERC 6a)

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

9.2.1.1. 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: ≤ 10 tonnes/year <i>Maximum amount reported in the questionnaires for non photographic use.</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: ≤ 0.055 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"> 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"> Electrostatic precipitators using wide electrode spacing: $5 - 15 \text{ mg/Nm}^3$ Wet electrostatic precipitators: $< 5 \text{ mg/Nm}^3$ Cyclones, but as primary collector: $< 50 \text{ mg/Nm}^3$ Fabric or bag filters: high efficiency in controlling fine particulate (melting): achieve emission values $< 5 \text{ mg/Nm}^3$. Membrane filtration techniques can achieve $< 1 \text{ mg/Nm}^3$ Ceramic and metal mesh filters. PM10 particles are removed: 0.1 mg/Nm^3 Wet scrubbers: $< 4 \text{ mg/Nm}^3$ 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"> 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. 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) 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: Standard [Effectiveness Water: 80.1%]

- Discharge rate of STP: $\geq 2E3$ m³/day

- Application of the STP sludge on agricultural soil: Yes

Conditions and measures related to external treatment of waste (including article waste)

- Particular considerations on the waste treatment operations: Other

Waste includes sludge, filter cakes and solid waste. waste shall be handled according to the Waste Framework Directive and disposed of according to national/local legislation. If the metal content of the waste is elevated, internal or external recovery/recycling is considered.

9.2.1.2. Releases

The releases have been estimated on the basis of SPERC Eurometaux SPERC 6a.1.v3: Intermediate use of metal compounds

Modification date: 09/09/2021

Description of activities/processes covered by the SPERC

Since this metal SPERC is based on measured data at end-of-pipe on-site, all indicated PROCs are integrated in the release fractions from raw materials handling to cleaning and maintenance.

Product/substance domain:

Substance groups or functions:

SPERC valid for metals with solid water partition coefficient for suspended matter between 1,000 L/kg and 400,000 L/kg.

Included in the metal definition (Eurometaux SPERCs): alkali metals, alkaline earth metals, transition metals, post-transition metals, metalloids and their compounds

Excluded from the metal definition: non-metals, halogens, noble gases and metallo-organic compounds.

Explanation for the release factor to soil:

ERC default

Sub-SPERC Eurometaux SPERC 6a.1g.v3 is used for Ag dissolved:

Explanation for the release factor to water:

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

Explanation for the release factor to air:

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

The local releases to the environment are reported in the following table.

Table 9.13. Local releases to the environment



Release	Assessment entity	Release factor	Local release rate
Water	Ag dissolved	2E-3%	1.1E-3 kg/day
Air	Ag dissolved	0.03%	0.016 kg/day
Non agricultural soil	Ag dissolved	0.01%	- kg/day

Releases to waste

Release factor to external waste: 2.3 %

The 90th percentile of reported site-specific release factors to solid waste for 62 manufacturing sites covering zinc, nickel, lead, cobalt, cadmium, antimony

9.2.1.3. 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 9.14. 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: 8.89E-6 mg/L RCR = 0.193	Final RCR = 0.193
Sediment (freshwater)	Ag dissolved	Local PEC: 1.695 mg/kg dw RCR = 3.87E-3	Final RCR < 0.01
Marine water	Ag dissolved	Local PEC: 2.19E-6 mg/L RCR = 2.55E-3	Final RCR < 0.01
Sediment (marine water)	Ag dissolved	Local PEC: 0.418 mg/kg dw RCR = 9.54E-4	Final RCR < 0.01
Sewage Treatment Plant	Ag dissolved	Local PEC: 1.09E-4 mg/L RCR = 4.37E-3	Final RCR < 0.01
Agricultural soil	Ag dissolved	Local PEC: 0.115 mg/kg dw RCR = 0.109	Final RCR = 0.109

9.2.2. Worker CS 2: Handling of silver chloride (PROC 26)

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

Unloading of silver chloride from reaction tank or filter press, manual removal with shovels, storage in drums, unloading of drums into furnace, reaction tank or filter box

9.2.2.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with low dustiness)	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
• 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
• 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
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal protection: Chemical resistant dermal protection with basic employee training. (effectiveness $\geq 90\%$)	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	
• Operating temperature: ≤ 40 °C	

9.2.2.2. Exposure and risks for workers

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

Table 9.15. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Silver chloride	0.33 mg/m ³ (MEASE 1.02.01) RCR = 0.407	Final RCR = 0.407
Dermal, systemic, long term	Silver chloride	0.14 mg/kg bw/day (MEASE 1.02.01) RCR = 0.483	Final RCR = 0.483
Combined routes, systemic, long-term			Final RCR = 0.89

9.2.3. Worker CS 3: Alternative I: Hot processes (PROC 22)

Assessment entity group used for the assessment of this contributing scenario: HHRA furnace operation for the manufacture of silver, silver chloride is not available anymore after this process step

9.2.3.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with low dustiness)	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
• 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
• Pattern of use: Non-dispersive use	MEASE 1.02.01
• Pattern of exposure control: Non-direct handling	MEASE 1.02.01
• Contact level: Incidental	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 $\geq 90\%$)	MEASE 1.02.01
• Face/eye protection: Eye protection	



	Method
• Respiratory protection: No	MEASE 1.02.01
Other conditions affecting workers exposure	
• Place of use: Indoor	
• Operating temperature: ≤ 40 °C	

9.2.3.2. Exposure and risks for workers

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

Table 9.16. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Silver chloride	0.22 mg/m ³ (MEASE 1.02.01) RCR = 0.272	Final RCR = 0.272
Dermal, systemic, long term	Silver chloride	1.4E-3 mg/kg bw/day (MEASE 1.02.01) RCR = 4.83E-3	Final RCR < 0.01
Combined routes, systemic, long-term			Final RCR = 0.276

9.2.4. Worker CS 4: Alternative II: Wet processes (PROC 4)

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

Reaction step for the manufacture of silver, silver chloride is not available anymore after this reaction step

9.2.4.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with no or very low dustiness) <i>wet powder/filtercake (water content >30 %)</i> <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	
• 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
• 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
• 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
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	



	Method
• Place of use: Indoor	
• Operating temperature: ≤ 40 °C	

9.2.4.2. Exposure and risks for workers

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

Table 9.17. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Silver chloride	0.011 mg/m ³ (MEASE 1.02.01) RCR = 0.014	Final RCR = 0.014
Dermal, systemic, long term	Silver chloride	0.034 mg/kg bw/day (MEASE 1.02.01) RCR = 0.118	Final RCR = 0.118
Combined routes, systemic, long-term			Final RCR = 0.132

9.2.5. Worker CS 5: Cleaning and maintenance (PROC 28)

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

9.2.5.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with low dustiness)	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
• 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
• 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
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	
• Operating temperature: ≤ 40 °C	

9.2.5.2. Exposure and risks for workers



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

Table 9.18. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Silver chloride	0.11 mg/m ³ (MEASE 1.02.01) RCR = 0.136	Final RCR = 0.136
Dermal, systemic, long term	Silver chloride	0.068 mg/kg bw/day (MEASE 1.02.01) RCR = 0.234	Final RCR = 0.234
Combined routes, systemic, long-term			Final RCR = 0.37

Remarks on exposure data from external estimation tools:

MEASE 1.02.01 for Silver chloride:

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.