9.2. Exposure scenario 2: Use at industrial sites - Use of disilver oxide in the production of batteries

Market sector: Batteries
Sector of use: SU 16: Manufacture of computer, electronic and optical products, electrical equipment

Environment contributing scenario(s):			**SPERC**
CS 1	Use of disilver oxide in the production of batteries	ERC 5	Eurometaux SPERC 5.2.v3
Worker contributing scenario(s):			**SWED**
CS 2	Raw material handling	**PROC 26**, PROC 1, PROC 3	
CS 3	Mixing	PROC 5	
CS 4	Pelletizing	PROC 14	
CS 5	Final handling	PROC 21	
CS 6	Cleaning and maintenance	PROC 28	

Subsequent service life exposure scenario(s):
ES3: Service life (consumers) - Service life / Use of batteries

9.2.1. Env CS 1: Use of disilver oxide in the production of batteries (ERC 5)

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)
• Annual use amount at site: <= 10 tonnes/year *Typically between 5 - 10T are used on a site.* *All the amounts are expressed as Ag as this is the driver for the environmental risk assessment.*
• Daily use amount at site: <= 0.045 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. 220 is the 10th percentile of reported site-specific number of emission days for 67 sites.*
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: Site specific [Effectiveness Water: 80.1%]
• Discharge rate of STP: >= 2E3 m3/day
• Application of the STP sludge on agricultural soil: No
Conditions and measures related to external treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low concentration) *Particular risks from waste treatment unlikely due low concentration of substance in waste stream. Waste disposal according to national/local legislation is sufficient. If the metal content of the waste is elevated enough, internal or external recovery/recycling is considered.*

Fate (release percentage) in the biological sewage treatment plant

The biological STP is site specific and the releases to the various compartments have been set by the assessor for some assessment entities. They are distributed in the following way:

Assessment entities	**Ag dissolved**
Release to water	19.9%
Release to air	0%
Release to sludge	80.1%
Release degraded	0%

Explanation for Ag dissolved:
Based on available monitoring data and values cited in the literature

9.2.1.2. Releases

The releases have been estimated on the basis of SPERC Eurometaux SPERC 5.2.v3: Industrial use of metals (compounds) in batteries
Modification date: 09/09/2021

Description of activities/processes covered by the SPERC

Since metal SPERCs are 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. Semi-finished products are further processed through a variety of mechanical processes to a variety of metal and alloy industrial and consumer products: machining (all processes in which a workpiece is modified by removing unwanted material in the form of turnings with the aim to obtain the desired shape, includes: turning, drilling, countersinking, reaming, planning, shaping, broaching, sawing, filing, rasping and grinding), cold forming, mechanical polishing (mechanical abrasion). Batch annealing where each workpiece is loaded into a furnace for static exposure to heat. Strand annealing where the workpiece passes continuously through the controlled atmosphere.Conform, heating and forming under pressure. Forging, heating of the workpiece; manual or automatic loading of the workpiece into a press containig two halves of a die; closing the dies around the metal to form the desired piece; ejection of workpiece; removal of the excess metal (flash) around the piece.

Product/substance domain:

Scope of the SPERC
User groups: Industrial use of metals (compounds) in batteries
Substance groups or functions: Metal (compounds)

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.
SPERC valid for metals with solid water partition coefficient for suspended matter between 25,000 L/kg and 300,000 L/kg.
Types of products: Metal and/or metal compounds (salts in solution)

Sub-SPERC Eurometaux SPERC 5.2.v3 is used for Ag dissolved:

Explanation for the release factor to water:

release after RMM
Default release factors are derived from a multi-metal background database of measured site-specific release factors collected from peer-reviewed EU Risk Assessment Reports under the former Directive of New and Existing Substances and REACH 2010 registration dossiers.
The 90th percentile of reported site-specific release factors to wastewater for 78 sites.

Explanation for the release factor to air:

release after RMM
Default release factors are derived from a multi-metal background database of measured site-specific release factors collected from peer-reviewed EU Risk Assessment Reports under the former Directive of New and Existing Substances and REACH 2010 registration dossiers.
The 90th percentile of reported site-specific release factors to air for 66 sites.

Explanation for the release factor to soil:

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

Table 9.17. Local releases to the environment

Release	Assessment entity	Release factor	Local release rate
Water	Ag dissolved	3E-3%	1.36E-3 kg/day
Air	Ag dissolved	3E-3%	1.36E-3 kg/day
Non agricultural soil	Ag dissolved	1%	- kg/day

Releases to waste

Release factor to external waste: 1 %
Default release factors are derived from a multi-metal background database of measured site-specific release factors collected from peer-reviewed EU Risk Assessment Reports under the former Directive of New and Existing Substances and REACH 2010 registration dossiers.
The 90th percentile of reported site-specific release factors to solid waste for 32 downstream user sites covering zinc, nickel, lead, 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 9.18. 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:** 9.58E-6 mg/L RCR = 0.208	Final RCR = 0.208
Sediment (freshwater)	Ag dissolved	**Local PEC:** 1.825 mg/kg dw RCR = 4.17E-3	Final RCR < 0.01
Marine water	Ag dissolved	**Local PEC:** 2.26E-6 mg/L RCR = 2.63E-3	Final RCR < 0.01
Sediment (marine water)	Ag dissolved	**Local PEC:** 0.431 mg/kg dw RCR = 9.84E-4	Final RCR < 0.01
Sewage Treatment	Ag dissolved	**Local PEC:** 1.36E-4 mg/L	Final RCR < 0.01

Protection target	Assessment entity	Exposure concentration	Risk quantification
Plant		RCR = 5.43E-3	
Agricultural soil	Ag dissolved	**Local PEC:** 0.096 mg/kg dw RCR = 0.092	Final RCR = 0.092
Man via environment - Inhalation (systemic effects)	Ag dissolved	**Concentration in air:** 3.14E-7 mg/m³ RCR = 2.09E-6	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.

9.2.2. Worker CS 2: Raw material handling (PROC 26, PROC 1, PROC 3)

Assessment entity group used for the assessment of this contributing scenario: HHRA
powder handling, weighing, mixing

9.2.2.1. 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
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%] *Standard efficiency* Inhalation explanation: *Efficiency for industrial use*	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	

	Method
• Place of use: Indoor	

9.2.2.2. Exposure and risks for workers

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

Table 9.19. 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/m³ (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

9.2.3. Worker CS 3: Mixing (PROC 5)

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

9.2.3.1. 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
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%] *Standard efficiency* Inhalation explanation: *Efficiency for industrial use*	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	

9.2.3.2. Exposure and risks for workers

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

Table 9.20. 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/m³ (MEASE 1.02.01) RCR = 0.423	Final RCR = 0.423
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 = 0.498

Risk characterisation

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

9.2.4. Worker CS 4: Pelletizing (PROC 14)

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

9.2.4.1. 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
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%] *Standard efficiency* Inhalation explanation: *Efficiency for industrial use*	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	

9.2.4.2. Exposure and risks for workers

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

Table 9.21. 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	0.034 mg/m³ (MEASE 1.02.01) RCR = 0.026	Final RCR = 0.026
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 = 0.101

Risk characterisation

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

9.2.5. Worker CS 5: Final handling (PROC 21)

Assessment entity group used for the assessment of this contributing scenario: HHRA battery assembly and packaging

9.2.5.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid object *'Massive object' 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
• 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	

9.2.5.2. Exposure and risks for workers

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

Table 9.22. 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/m³ (MEASE 1.02.01) RCR = 0.038	Final RCR = 0.038
Dermal, systemic,	Disilver oxide	0.141 mg/kg bw/day (MEASE 1.02.01)	Final RCR = 0.307

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
long term		RCR = 0.307	
Combined routes, systemic, long-term			Final RCR = 0.345

Risk characterisation

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

9.2.6. Worker CS 6: 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 or as waste

9.2.6.1. 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
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%] *Standard efficiency* Inhalation explanation: *Efficiency for industrial use*	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 >= 20)	MEASE 1.02.01
Other conditions affecting workers exposure	
• Place of use: Indoor	

9.2.6.2. Exposure and risks for workers

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

Table 9.23. 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/m³ (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

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
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