9.6. Exposure scenario 6: Use at industrial sites - Industrial use of silver chloride emulsion in the photographic industry

Market sector: Photography
Sector of use: SU 6b: Manufacture of pulp, paper and paper products

Environment contributing scenario(s):		
CS 1	Industrial use of silver chloride emulsion in the photographic industry	ERC 5
Worker contributing scenario(s):		
CS 2	Use of silver chloride emulsion in the photographic industry	PROC 3
CS 3	Mixing of silver chloride in photographic emulsion	PROC 5
CS 4	Transfer of the substance	**PROC 8b**, PROC 9
CS 5	Treatment of articles by dipping and pouring	PROC 13
CS 6	Handling of coated paper/film articles	PROC 21
CS 7	Cleaning and maintenance	PROC 28

Subsequent service life exposure scenario(s):
ES8: Service life (professional worker) - Processing of silver containing films and photopapers by professionals
ES7: Service life (worker at industrial site) - Processing of silver containing films and photopapers at industrial sites

9.6.1. Env CS 1: Industrial use of silver chloride emulsion in the photographic industry (ERC 5)

Assessment entity group used for the assessment of this contributing scenario: ERA
The manufacture and application of silver halides to photo film is done by the same companies hence the same assessment is used.

9.6.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Annual use amount at site: <= 100 tonnes/year *All the amounts are expressed as Ag as this is the driver for the environmental risk assessment.*
• Daily use amount at site: <= 0.549 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 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).
• The substance should not be released to air *Silver halides are manufactured in a gelatine matrix. As a result there are no emissions to air.*
Conditions and measures related to biological sewage treatment plant
• Biological STP: Standard [Effectiveness Water: 80.1%]
• Discharge rate of STP: >= 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.*
Other conditions affecting environmental exposure
• Receiving surface water flow rate: >= 1.8E4 m3/day

9.6.1.2. 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 9.34. Local releases to the environment

Release	Assessment entity	Release estimation method	Explanations
Water	Ag dissolved	Estimated release factor (based on SPERC Eurometaux SPERC 1.2.v3)	**Release factor before on site RMM:** 2E-3% **Release factor after on site RMM:** 2E-3% **Local release rate:** 0.011 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 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	Ag dissolved	Estimated release factor	**Release factor before on site RMM:** 0% **Release factor after on site RMM:** 0% **Local release rate:** 0 kg/day **Explanation:** Silver halides are manufactured in a gelatine matrix. As a result there are no emissions to air.
Non agricultural soil	Ag dissolved	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 %

9.6.1.3. 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 9.35. 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:** 3.44E-5 mg/L RCR = 0.747	Final RCR = 0.747
Sediment (freshwater)	Ag dissolved	**Local PEC:** 6.55 mg/kg dw RCR = 0.015	Final RCR = 0.015
Marine water	Ag dissolved	**Local PEC:** 4.74E-6 mg/L RCR = 5.51E-3	Final RCR < 0.01
Sediment (marine water)	Ag dissolved	**Local PEC:** 0.904 mg/kg dw RCR = 2.06E-3	Final RCR < 0.01
Sewage Treatment Plant	Ag dissolved	**Local PEC:** 1.09E-3 mg/L RCR = 0.044	Final RCR = 0.044
Agricultural soil	Ag dissolved	**Local PEC:** 0.281 mg/kg dw RCR = 0.268	Final RCR = 0.268

9.6.2. Worker CS 2: Use of silver chloride emulsion in the photographic industry (PROC 3)

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

9.6.2.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Liquid, including paste/slurry/suspension *The physical form "aqueous solution" is used as surrogate in MEASE to reflect the very low exposure potential of the crystals in the gelatine solution.*	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
• Local exhaust ventilation: No	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	

9.6.2.2. Exposure and risks for workers

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

Table 9.36. 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	0.01 mg/m³ (MEASE 1.02.01) RCR = 0.012	Final RCR = 0.012
Dermal, systemic, long term	Silver chloride	0.017 mg/kg bw/day (MEASE 1.02.01) RCR = 0.059	Final RCR = 0.059
Combined routes, systemic, long-term			Final RCR = 0.071

9.6.3. Worker CS 3: Mixing of silver chloride in photographic emulsion (PROC 5)

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

9.6.3.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Liquid, including paste/slurry/suspension *The physical form "aqueous solution" is used as surrogate in MEASE to reflect the very low exposure potential of the crystals in the gelatine solution.*	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
• Local exhaust ventilation: No	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	

9.6.3.2. Exposure and risks for workers

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

Table 9.37. 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	0.05 mg/m³ (MEASE 1.02.01) RCR = 0.062	Final RCR = 0.062
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 = 0.18

9.6.4. Worker CS 4: Transfer of the substance (PROC 8b, PROC 9)

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

9.6.4.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Liquid, including paste/slurry/suspension *The physical form "aqueous solution" is used as surrogate in MEASE to reflect the very low exposure potential of the crystals in the gelatine solution.*	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
• Local exhaust ventilation: No	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	

9.6.4.2. Exposure and risks for workers

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

Table 9.38. 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	0.01 mg/m³ (MEASE 1.02.01) RCR = 0.012	Final RCR = 0.012
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,			Final RCR = 0.131

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
systemic, long-term			

9.6.5. Worker CS 5: Treatment of articles by dipping and pouring (PROC 13)

Assessment entity group used for the assessment of this contributing scenario: HHRA
Immersion operations, dipping, coating

9.6.5.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Liquid, including paste/slurry/suspension *The physical form "aqueous solution" is used as surrogate in MEASE to reflect the very low exposure potential of the crystals in the gelatine solution.*	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
• Local exhaust ventilation: No	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	

9.6.5.2. Exposure and risks for workers

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

Table 9.39. 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	0.01 mg/m³ (MEASE 1.02.01) RCR = 0.012	Final RCR = 0.012
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 = 0.131

9.6.6. Worker CS 6: Handling of coated paper/film articles (PROC 21)

Assessment entity group used for the assessment of this contributing scenario: HHRA
Manual cutting, handling

9.6.6.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with no or very low dustiness) *The physical form "massive object" is used as surrogate to reflect the very low exposure potential of the coated paper/film articles.*	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
• Local exhaust ventilation: No	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	

9.6.6.2. Exposure and risks for workers

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

Table 9.40. 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	0.05 mg/m³ (MEASE 1.02.01) RCR = 0.062	Final RCR = 0.062
Dermal, systemic, long term	Silver chloride	0.141 mg/kg bw/day (MEASE 1.02.01) RCR = 0.486	Final RCR = 0.486
Combined routes, systemic, long-term			Final RCR = 0.548

9.6.7. Worker CS 7: 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

9.6.7.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid (material with low dustiness)	MEASE 1.02.01

	Method
• 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%] *Standard efficiency* Inhalation explanation: *Efficiency for industrial use*	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	

9.6.7.2. Exposure and risks for workers

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

Table 9.41. 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/m³ (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.