



9.4. Exposure scenario 4: Use at industrial sites - Use of silver nitrate in the production of catalysts

Product category used: PC 7: Base metals and alloys

Sector of use: SU 8: Manufacture of bulk, large scale chemicals (including petroleum products); SU 9: Manufacture of fine chemicals

Environment contributing scenario(s):		
CS 1	Industrial production of catalysts	ERC 5
Worker contributing scenario(s):		
CS 2	Mixing or blending in batch processes	PROC 5
CS 3	Transfer of substance or mixture (charging and discharging) at non-dedicated facilities	PROC 8a
CS 4	Transfer of substance or mixture into small containers (dedicated filling line, including weighing)	PROC 9

Subsequent service life exposure scenario(s):

ES10: Service life (consumers) - Service life of articles coated with metallic silver

9.4.1. Env CS 1: Industrial production of catalysts (ERC 5)

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

9.4.1.1. 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: ≤ 3 tonnes/year <i>All the amounts are expressed as Ag as this is the driver for the environmental risk assessment.</i> Daily use amount at site: $\leq 8.8E-3$ tonnes/day <i>The number of release days is taken from the SpERC. Values for emission days per year were provided by 13 sites across Europe producing catalysts. The median value of 340 days per year was selected.</i>
Technical and organisational conditions and measures
<ul style="list-style-type: none"> Direct emissions to air should be mitigated by application of one or more of the following RMMs: <ul style="list-style-type: none"> HEPA filtration, Fabric filters and Bag or Ceramic Filters Wet Scrubbers Dry or semi-dry Scrubbers Metallic Grids <i>Data on removal efficiency were provided by Catalysts Europe member companies. One or more of these RMMs (of which HEPA/bag filtration and wet scrubbers are the most common) were reported to be present in more than 88% of sites. RMM efficiency (RE_{sperc}) was reported to be $\geq 99\%$.</i> Direct emissions to water should be mitigated by application of one or more of the following RMMs: <ul style="list-style-type: none"> Precipitation Sedimentation Filtration Distillation Ion Exchange <i>Data on removal efficiency were provided by Catalysts Europe member companies. One or more of these RMMs (of which chemical precipitation is the most common) were reported to be present in more than 70% of sites. RMM efficiency was reported as 95-99.9%. RE_{sperc} is taken to be 99% (50th percentile of reported site-specific RE).</i>
Conditions and measures related to biological sewage treatment plant
<ul style="list-style-type: none"> 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)



<ul style="list-style-type: none"> Particular considerations on the waste treatment operations: No (low concentration) <i>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.</i> <i>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</i> <i>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%</i> <i>A detailed assessment has been performed on modelled and measured data and is reported in the Waste report (ARCHE, 2013)</i>
Other conditions affecting environmental exposure
<ul style="list-style-type: none"> Receiving surface water flow rate: $\geq 1.8E4$ m³/day

9.4.1.2. 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 9.51. Local releases to the environment

Release	Assessment entity	Release estimation method	Explanations
Water	Ag dissolved	Estimated release factor (Catalysts Europe SPERC 2,1 v1.0)	<p>Release factor before on site RMM: 0.04% Release factor after on site RMM: 0.04% Local release rate: 3.52E-3 kg/day Explanation: The release factor to water is derived from measured wastewater emission data from catalyst manufacturers in various EU member states between 2012-2016. The release factor is calculated as a realistic worst-case value based on metal-specific 90th percentile site-specific release factors from 13 sites for production of metal-containing catalysts.</p>
Air	Ag dissolved	Estimated release factor (Catalysts Europe SPERC 2,1 v1.0)	<p>Release factor before on site RMM: 0.018% Release factor after on site RMM: 0.018% Local release rate: 1.58E-3 kg/day Explanation: The release factor to air is derived from measured stack emission data from catalyst manufacturers in various EU member states between 2012-2016. The release factor is calculated as a realistic worst-case value based on metal-specific 90th percentile site specific release factors from 13 sites for production of metal-containing catalysts.</p>
Non agricultural soil	Ag dissolved	Estimated release factor (Catalysts Europe SPERC 2,1 v1.0)	<p>Release factor after on site RMM: 0% Explanation: There are no emissions to soil during manufacture or regeneration of catalysts.</p>

9.4.1.3. 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 9.52. 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: 1.51E-5 mg/L RCR = 0.329	Final RCR = 0.329
Sediment (freshwater)	Ag dissolved	Local PEC: 2.885 mg/kg dw RCR = 6.58E-3	Final RCR < 0.01
Marine water	Ag dissolved	Local PEC: 2.82E-6 mg/L RCR = 3.28E-3	Final RCR < 0.01
Sediment (marine water)	Ag dissolved	Local PEC: 0.537 mg/kg dw RCR = 1.23E-3	Final RCR < 0.01
Sewage Treatment Plant	Ag dissolved	Local PEC: 3.5E-4 mg/L RCR = 0.014	Final RCR = 0.014
Agricultural soil	Ag dissolved	Local PEC: 0.155 mg/kg dw RCR = 0.148	Final RCR = 0.148
Man via environment - Inhalation (systemic effects)	Ag dissolved	Concentration in air: 4.97E-7 mg/m ³ RCR = 3.31E-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.

9.4.2. Worker CS 2: Mixing or blending in batch processes (PROC 5)

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

Includes mixing of impregnation solution with inert carrier

9.4.2.1. Conditions of use

	Method
Product (article) characteristics	
• Percentage (w/w) of substance in mixture/article: <= 100 %	MEASE 1.02.01
• Physical form of the used product: Liquid, including paste/slurry/suspension <i>Note that 'aqueous solution' was selected in MEASE to reflect the very low emission potential of the substance.</i>	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
Conditions and measures related to personal protection, hygiene and health evaluation	



	Method
<ul style="list-style-type: none"> • Dermal protection: Chemical resistant dermal protection with basic employee training. (effectiveness $\geq 90\%$) 	MEASE 1.02.01
<ul style="list-style-type: none"> • Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i> 	
<ul style="list-style-type: none"> • Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i> 	
<ul style="list-style-type: none"> • Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i> 	
Other conditions affecting workers exposure	
<ul style="list-style-type: none"> • Place of use: Indoor 	

9.4.2.2. Exposure and risks for workers

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

Table 9.53. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Silver nitrate	0.05 mg/m ³ (MEASE 1.02.01) RCR = 0.052	Final RCR = 0.052
Inhalation, local, long term	Silver nitrate	0.05 mg/m ³ (MEASE 1.02.01)	Qualitative risk
Dermal, systemic, long term	Silver nitrate	0.034 mg/kg bw/day (MEASE 1.02.01) RCR = 0.101	Final RCR = 0.101
Combined routes, systemic, long-term			Final RCR = 0.153

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

See section 9.0.4.2

9.4.3. Worker CS 3: Transfer of substance or mixture (charging and discharging) at non-dedicated facilities (PROC 8a)

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

Includes moving of wet, impregnated carrier in the plant

9.4.3.1. Conditions of use

	Method
Product (article) characteristics	
<ul style="list-style-type: none"> • Percentage (w/w) of substance in mixture/article: $\leq 100\%$ 	MEASE 1.02.01
<ul style="list-style-type: none"> • Physical form of the used product: Solid (material with low dustiness) 	MEASE 1.02.01



	Method
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
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
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i>	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i>	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i>	
Other conditions affecting workers exposure	
• Place of use: Indoor	

9.4.3.2. Exposure and risks for workers

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

Table 9.54. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Silver nitrate	0.5 mg/m ³ (MEASE 1.02.01) RCR = 0.521	Final RCR = 0.521
Inhalation, local, long term	Silver nitrate	0.5 mg/m ³ (MEASE 1.02.01)	Qualitative risk
Dermal, systemic, long term	Silver nitrate	0.069 mg/kg bw/day (MEASE 1.02.01) RCR = 0.202	Final RCR = 0.202
Combined routes, systemic, long-term			Final RCR = 0.723

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

See section 9.0.4.2

9.4.4. Worker CS 4: Transfer of substance or mixture into small containers

**(dedicated filling line, including weighing) (PROC 9)**

Assessment entity group used for the assessment of this contributing scenario: HH RA
Includes automated filling and weighing of drums

9.4.4.1. Conditions of use

	Method
Product (article) characteristics	
• Percentage (w/w) of substance in mixture/article: <= 100 %	MEASE 1.02.01
• Physical form of the used product: Solid (material with low dustiness)	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
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
• Respiratory protective equipment (RPE) as precautionary measure: RPE protecting from local effects via inhalation <i>Due to potential adverse effects of the substance to the respiratory tract, RPE is prescribed on a precautionary basis for all workplaces unless inhalation exposure to the substance can be excluded.</i>	
• Gloves as precautionary measure: Gloves protecting from local effects to the skin (high hazard) <i>Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 have to be worn at all workplaces. Additionally, face protection is required to be worn as appropriate.</i>	
• Eye protection: Eye protection to be worn to protect from adverse effects to the eyes <i>Due to the adverse effects of the substance to the eyes, direct contact of the eyes with the substance is to be avoided including hand to eye transfer after touching contaminated surfaces. Suitable eye protection equipment (e.g. goggles or visors) must be worn.</i>	
Other conditions affecting workers exposure	
• Place of use: Indoor	

9.4.4.2. Exposure and risks for workers

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

Table 9.55. Exposure concentrations and risks for workers

Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Inhalation, systemic, long term	Silver nitrate	0.1 mg/m ³ (MEASE 1.02.01) RCR = 0.104	Final RCR = 0.104
Inhalation, local, long term	Silver nitrate	0.1 mg/m ³ (MEASE 1.02.01)	Qualitative risk
Dermal, systemic, long term	Silver nitrate	0.034 mg/kg bw/day (MEASE 1.02.01) RCR = 0.101	Final RCR = 0.101



Route of exposure and type of effects	Assessment entity	Exposure concentration	Risk quantification
Combined routes, systemic, long-term			Final RCR = 0.205

Risk characterisation

Qualitative risk characterisation (Inhalation, local, long term, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute, Eye, local):

See section 9.0.4.2