16. Exposure scenario 16: Use at industrial sites - Use in biogas production

Market sector: Use in fermentation processes and biogas production
Product category used: PC 0: Other (Fermentation formulation)
Sector of use: SU 9: Manufacture of fine chemicals

Environment contributing scenario(s):		
CS 1	Use in biogas production ES1 STP Discharge	ERC 4
CS 2	Use in biogas production ES2 Direct Discharge	ERC 4
CS 3	Use in biogas production ES3 Marine Discharge	ERC 4
Worker contributing scenario(s):		
CS 4	Dosing of solid material	PROC 26
CS 5	Dosing of liquid material	PROC 8b, PROC 9

Explanation on the approach taken for the ES

Please refer to IUCLID Section 13 for a detailed description of the specific methodology applied for the occupational exposure assessment.

16.1. Env CS 1: Use in biogas production ES1 STP Discharge (ERC 4)

16.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Daily use at site: <= 0.069 tonnes/day *The tonnage and further exposure is always expressed in cobalt.*
• Annual use at a site: <= 25 tonnes/year *For the generic exposure scenario a tonnage covering 100% of the sector tonnages was selected.*
• Number of release days per year: >= 360 days/year *The selected number of production days per year is the median value based on data from 3 companies.*
Technical and organisational conditions and measures
• Risk management measures: One or more of the following measures should be present to reduce emissions to water: Chemical precipitation, Sedimentation, Filtration, Electrolysis, Reverse osmosis or Ion exchange.
• Risk management measures: One or more of the following measures should be present to reduce emissions to air: Electrostatic precipitators, Wet electrostatic precipitators, Cyclones, but as primary collector, Fabric or bag filters, Ceramic/Metal mesh filters or Wet scrubbers.
Conditions and measures related to sewage treatment plant
• Municipal STP: Yes
• Discharge rate of STP: >= 2E3 m3/d
• Application of the STP sludge on agricultural soil: Yes
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low amount) (Particular risks from waste treatment unlikely due to small fraction of used substance entering into the waste stage. Waste disposal according to national/local legislation is sufficient.) *Wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately or/and with other cobalt compounds waste 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 cobalt content of the waste is elevated enough, internal or external recovery/recycling might be considered. Appropriate waste codes: 01 03 07, 02 01 10*, 06 05 02*, 06 03 13*, 06 03 15*, 06 04 05*, 10 08 04, 10 10 03, 10 10 05*, 10 10 07*, 10 10 10, 10 10 11*, 11 02 07*, 12 01 03*, 12 01 04, 15 01 04*, 15 01 10*, 16 01 04*, 16 01 06*, 16 01 18*, 16 03 03*, 16 06 02*, 16 06 05, 16 08 02*, 16 08 03, 16 10 01*, 17 04 07*, 17 04 09*, 17 09 04*, 19 10 02*, 19 12 03*,… Suitable disposal: Keep separate and dispose of to either - Hazardous waste incineration operated according to Council Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Available Techniques for Waste Incineration of August 2006. - Hazardous landfill operated under Directive 1999/31/EC. A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2011)*
Other conditions affecting environmental exposure
• Discharge rate of effluent: >= 2E3 m3/d
• Receiving surface water flow rate: >= 9.98E5 m3/d
• Final dilution factor: >= 500

16.1.2. Releases

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

Table 9.153. Local releases to the environment

Release	Release factor estimation method	Explanation / Justification
Water	Release factor (SpERC for formulation of metal compounds)	**Initial release factor:** 0.5% **Final release factor:** 0.5% **Local release rate:** 0.347 kg/day **Explanation / Justification:** Eurométaux, 2012, version 2.1 The reported release factor for water is based on emissions before treatment. Reported risk management measures for wastewater is on-site WWTP (removal efficiency >75%). The release factor to water after treatment for this specific use is thus 0.5% (i.e. 5000 g/T) Although ERC4 is selected for this use it is assumed that most releases will occur during the formulation step of Co compounds in a solution.
Air	Release factor (SpERC for formulation of metal compounds)	**Initial release factor:** 0.01% **Final release factor:** 0.01% **Local release rate:** 0.007 kg/day **Explanation / Justification:** Eurométaux, 2012, version 2.1
Soil	Release factor	**Final release factor:** 0% **Explanation / Justification:** No direct release to soil.

Releases to waste

Release factor to external waste: 0.1 %
A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2011)

16.1.3. 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.

Table 9.154. Exposure concentrations and risks for the environment and man via the environment

Protection target	Exposure concentration	Risk characterisation
Freshwater	**Local PEC:** 0.23 µg/l	0.38
Sediment (freshwater)	**Local PEC:** 9.32 mg/kg dw	0.98

Protection target	Exposure concentration	Risk characterisation
Sewage treatment plant	**Local PEC:** 0.10 mg/l	0.28
Air	**Local PEC:** 1.9 ng/m^3	No environmental hazard
Agricultural soil	**Local PEC:** 3.28 mg/kg dw	0.30
Man via Environment - Inhalation	**Local PEC:** 1.9 ng/m^3	< 0.01
Man via Environment - Oral	**Exposure via food consumption:** 0.324 µg/kg/d	< 0.01

Conclusion on risk characterisation

MAN VIA ENVIRONMENT:
The use of EUSES to predict the concentration in food is difficult to apply for metals and associated with much higher uncertainties than using measured data. Therefore, deviations from the TGD food basket approach for the exposure route “ingestion of food”, have been applied as shortly described in section 9.0.3.6..
Furthermore, the exposure assessment is based on the cobalt ion, as this is the toxic species.
The oral exposure concentration in µg/kg bw/day has been derived by taking 2L of drinking water (PEC freshwater taken from the local environmental exposure assessment) + the worst case exposure of 19 µg Co/d from food (97.5th percentile from the 1994 UK total diet study (please refer to section 9.0.3.6) and a default body weight of 60kg into account.
For the risk characterisation the following DNELs based on cobalt were used:
DNEL inhalation, local, long-term of 6.3 µg Co/m^3
DNEL oral, systemic, long-term of 8.6 mg Co/kg bw/day
As such a combined RCR cannot be provided (local and systemic effects).

16.2. Env CS 2: Use in biogas production ES2 Direct Discharge (ERC 4)

16.2.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Daily use at site: <= 0.069 tonnes/day *The tonnage and further exposure is always expressed in cobalt.*
• Annual use at a site: <= 25 tonnes/year *For the generic exposure scenario a tonnage covering 100% of the sector tonnages was selected.*
• Number of release days per year: >= 360 days/year *The selected number of production days per year is the median value based on data from 3 companies.*
Technical and organisational conditions and measures
• Risk management measures: One or more of the following measures should be present to reduce emissions to water: Chemical precipitation, Sedimentation, Filtration, Electrolysis, Reverse osmosis or Ion exchange.
• Risk management measures: One or more of the following measures should be present to reduce emissions to air: Electrostatic precipitators, Wet electrostatic precipitators, Cyclones, but as primary collector, Fabric or bag filters, Ceramic/Metal mesh filters or Wet scrubbers.
Conditions and measures related to sewage treatment plant
• Municipal STP: No [Effectiveness Water: 0%]
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low amount) (Particular risks from waste treatment unlikely due to small fraction of used substance entering into the waste stage. Waste disposal according to national/local legislation is sufficient.) *Wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately or/and with other cobalt compounds waste 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 cobalt content of the waste is elevated enough, internal or external recovery/recycling might be considered. Appropriate waste codes: 01 03 07, 02 01 10*, 06 05 02*, 06 03 13*, 06 03 15*, 06 04 05*, 10 08 04, 10 10 03, 10 10 05*, 10 10 07*, 10 10 10, 10 10 11*, 11 02 07*, 12 01 03*, 12 01 04, 15 01 04*, 15 01 10*, 16 01 04*, 16 01 06*, 16 01 18*, 16 03 03*, 16 06 02*, 16 06 05, 16 08 02*, 16 08 03, 16 10 01*, 17 04 07*, 17 04 09*, 17 09 04*, 19 10 02*, 19 12 03*,… Suitable disposal: Keep separate and dispose of to either - Hazardous waste incineration operated according to Council Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Available Techniques for Waste Incineration of August 2006. - Hazardous landfill operated under Directive 1999/31/EC. A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2011)*
Other conditions affecting environmental exposure
• Discharge rate of effluent: >= 2E3 m3/d
• Receiving surface water flow rate: >= 1.998E6 m3/d
• Final dilution factor: >= 1E3

16.2.2. Releases

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

Table 9.155. Local releases to the environment

Release	Release factor estimation method	Explanation / Justification
Water	Release factor (SpERC for formulation of metal compounds)	**Initial release factor:** 0.5% **Final release factor:** 0.5% **Local release rate:** 0.347 kg/day **Explanation / Justification:** Eurométaux, 2012, version 2.1 The reported release factor for water is based on emissions before treatment. Reported risk management measures for wastewater is on-site WWTP (removal efficiency >75%). The release factor to water after treatment for this specific use is thus 0.5% (i.e. 5000 g/T) Although ERC4 is selected for this use it is assumed that most releases will occur during the formulation step of Co compounds in a solution.
Air	Release factor (SpERC for formulation of metal compounds)	**Initial release factor:** 0.01% **Final release factor:** 0.01% **Local release rate:** 0.007 kg/day **Explanation / Justification:** Eurométaux, 2012, version 2.1
Soil	Release factor	**Final release factor:** 0% **Explanation / Justification:** No direct release to soil.

Releases to waste

Release factor to external waste: 0.1 %
A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2011)

16.2.3. 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.

Table 9.156. Exposure concentrations and risks for the environment and man via the environment

Protection target	Exposure concentration	Risk characterisation
Freshwater	**Local PEC:** 0.21 µg/l	0.35

Protection target	Exposure concentration	Risk characterisation
Sediment (freshwater)	**Local PEC:** 8.48 mg/kg dw	0.89
Air	**Local PEC:** 1.9 ng/m^3	No environmental hazard
Agricultural soil	**Local PEC:** 0.01 mg/kg dw	< 0.01
Man via Environment - Inhalation	**Local PEC:** 1.9 ng/m^3	< 0.01
Man via Environment - Oral	**Exposure via food consumption:** 0.324 µg/kg/d	< 0.01

Conclusion on risk characterisation

MAN VIA ENVIRONMENT:
The use of EUSES to predict the concentration in food is difficult to apply for metals and associated with much higher uncertainties than using measured data. Therefore, deviations from the TGD food basket approach for the exposure route “ingestion of food”, have been applied as shortly described in section 9.0.3.6..
Furthermore, the exposure assessment is based on the cobalt ion, as this is the toxic species. The oral exposure concentration in µg/kg bw/day has been derived by taking 2L of drinking water (PEC freshwater taken from the local environmental exposure assessment) + the worst case exposure of 19 µg Co/d from food (97.5th percentile from the 1994 UK total diet study (please refer to section 9.0.3.6) and a default body weight of 60kg into account.
For the risk characterisation the following DNELs based on cobalt were used:
DNEL inhalation, local, long-term of 6.3 µg Co/m^3
DNEL oral, systemic, long-term of 8.6 mg Co/kg bw/day
As such a combined RCR cannot be provided (local and systemic effects).

16.3. Env CS 3: Use in biogas production ES3 Marine Discharge (ERC 4)

16.3.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Daily use at site: <= 0.069 tonnes/day *The tonnage and further exposure is always expressed in cobalt.*
• Annual use at a site: <= 25 tonnes/year *For the generic exposure scenario a tonnage covering 100% of the sector tonnages was selected.*
• Number of release days per year: >= 360 days/year *The selected number of production days per year is the median value based on data from 3 companies.*
Technical and organisational conditions and measures
• Risk management measures: One or more of the following measures should be present to reduce emissions to water: Chemical precipitation, Sedimentation, Filtration, Electrolysis, Reverse osmosis or Ion exchange.
• Risk management measures: One or more of the following measures should be present to reduce emissions to air: Electrostatic precipitators, Wet electrostatic precipitators, Cyclones, but as primary collector, Fabric or bag filters, Ceramic/Metal mesh filters or Wet scrubbers.
Conditions and measures related to sewage treatment plant
• Municipal STP: No [Effectiveness Water: 0%]
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low amount) (Particular risks from waste treatment unlikely due to small fraction of used substance entering into the waste stage. Waste disposal according to national/local legislation is sufficient.) *Wastes from onsite risk management measures and solid or liquid wastes from production, use and cleaning processes should be disposed of separately or/and with other cobalt compounds waste 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 cobalt content of the waste is elevated enough, internal or external recovery/recycling might be considered. Appropriate waste codes: 01 03 07, 02 01 10*, 06 05 02*, 06 03 13*, 06 03 15*, 06 04 05*, 10 08 04, 10 10 03, 10 10 05*, 10 10 07*, 10 10 10, 10 10 11*, 11 02 07*, 12 01 03*, 12 01 04, 15 01 04*, 15 01 10*, 16 01 04*, 16 01 06*, 16 01 18*, 16 03 03*, 16 06 02*, 16 06 05, 16 08 02*, 16 08 03, 16 10 01*, 17 04 07*, 17 04 09*, 17 09 04*, 19 10 02*, 19 12 03*,… Suitable disposal: Keep separate and dispose of to either - Hazardous waste incineration operated according to Council Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Available Techniques for Waste Incineration of August 2006. - Hazardous landfill operated under Directive 1999/31/EC. A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2011)*
Other conditions affecting environmental exposure
• Discharge rate of effluent: >= 2E3 m3/d
• Receiving surface water flow rate: >= 1.598E6 m3/d
• Final dilution factor: >= 800

16.3.2. Releases

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

Table 9.157. Local releases to the environment

Release	Release factor estimation method	Explanation / Justification
Water	Release factor (SpERC for formulation of metal compounds)	**Initial release factor:** 0.5% **Final release factor:** 0.5% **Local release rate:** 0.347 kg/day **Explanation / Justification:** Eurométaux, 2012, version 2.1 The reported release factor for water is based on emissions before treatment. Reported risk management measures for wastewater is on-site WWTP (removal efficiency >75%). The release factor to water after treatment for this specific use is thus 0.5% (i.e. 5000 g/T) Although ERC4 is selected for this use it is assumed that most releases will occur during the formulation step of Co compounds in a solution.
Air	Release factor (SpERC for formulation of metal compounds)	**Initial release factor:** 0.01% **Final release factor:** 0.01% **Local release rate:** 0.007 kg/day **Explanation / Justification:** Eurométaux, 2012, version 2.1
Soil	Release factor	**Final release factor:** 0% **Explanation / Justification:** No direct release to soil.

Releases to waste

Release factor to external waste: 0.1 %
A detailed assessment has been performed and is reported in the Waste report (ARCHE, 2011)

16.3.3. 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.

Table 9.158. Exposure concentrations and risks for the environment and man via the environment

Protection target	Exposure concentration	Risk characterisation
Marine water	**Local PEC:** 0.11 µg/l	0.35

Protection target	Exposure concentration	Risk characterisation
Sediment (marine water)	**Local PEC:** 8.75 mg/kg dw	0.92
Air	**Local PEC:** 1.9 ng/m^3	No environmental hazard
Agricultural soil	**Local PEC:** 0.01 mg/kg dw	< 0.01
Man via Environment - Inhalation	**Local PEC:** 1.9 ng/m³	< 0.01
Man via Environment - Oral	**Exposure via food consumption:** 0.317 µg/kg/d	< 0.01

Conclusion on risk characterisation

MAN VIA ENVIRONMENT:
The use of EUSES to predict the concentration in food is difficult to apply for metals and associated with much higher uncertainties than using measured data. Therefore, deviations from the TGD food basket approach for the exposure route “ingestion of food”, have been applied as shortly described in section 9.0.3.6..
Furthermore, the exposure assessment is based on the cobalt ion, as this is the toxic species. The oral exposure concentration in µg/kg bw/day has been derived by taking 2L of drinking water (PEC freshwater taken from the local environmental exposure assessment) + the worst case exposure of 19 µg Co/d from food (97.5th percentile from the 1994 UK total diet study (please refer to section 9.0.3.6) and a default body weight of 60kg into account.
For the risk characterisation the following DNELs based on cobalt were used:
DNEL inhalation, local, long-term of 6.3 µg Co/m³
DNEL oral, systemic, long-term of 8.6 mg Co/kg bw/day
As such a combined RCR cannot be provided (local and systemic effects).

16.4. Worker CS 4: Dosing of solid material (PROC 26)

Task(s) covered with this contributing scenario: Dosing of solid mixture into reactor.

16.4.1. Conditions of use

	Method
Product (Article) characteristics	
• Maximum emission potential of the substance: Medium *Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.*	
• Content in preparation: < 1 % [Effectiveness Inhalation: 90%, Dermal: 90%]	
• Physical form of substance: Solid	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration per shift: = 15.0 min	
• Shifts per year: = 240.0 Shifts/year *Typical number of shifts per year during which this task is conducted considering a single worker. This value has been taken into account in the calculation of excess cancer risk.*	
Technical and organisational conditions and measures	
• Process temperature: Ambient	
• Indoor or outdoor use: Outdoors	
Conditions and measures related to personal protection, hygiene and health evaluation	
• General good occupational hygiene practices *Required good occupational hygiene practices to ensure a safe handling of the substance involve measures (e.g. shower and change clothes at end of work shift) to avoid any contamination of private households via the work-home-interface and housekeeping practices (i.e. regular cleaning with suitable*	

	Method
cleaning devices), no eating and smoking in the workplace. In general, inhalation and ingestion should be avoided. Unless otherwise stated below, certified working clothing and shoes should be worn during work. Any contaminated clothing should not be taken home. Good general ventilation in the workplace should be ensured. Dust should not be blown off (e.g. from dried splashes) with compressed air. Regular training in workplace hygiene practice and proper use of personal protective equipment (if relevant) is required.	
• Gloves: Gloves protecting from sensitizing properties to skin, continuous supervision of workers required *Due to the skin sensitizing effect of the substance, protective gloves according to EN 374 have to be worn at all workplaces unless any exposure to the substance can be excluded when taking into account the nature of the conducted process, applied exposure prevention measures and physical appearance of the substance of concern in the specific type of application (e.g. protecting from splashes by containment of emission source). Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. Additionally, face protection is required to be worn as appropriate. This level of protection is to be achieved by continuous supervision and training of workers wearing gloves.*	
• Certified safety clothing and shoes *Certified safety clothing including coveralls and safety shoes are to be worn as appropriate. Face protection may be worn if the type of process is associated with the risk of face injuries due to thermal or mechanical stress.*	
• Chemical protective suit according to EN 13982 *In cases where direct contact with the substance cannot be avoided, a protective suit conforming to EN 13982 should be worn.*	

16.4.2. Exposure and risks for workers

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

Table 9.159. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, local, long term	0.032 µg/m³ (Measured data: Monitoring data)	RCR = < 0.01

Remarks on measured exposure:

Monitoring data
Identity of the substance used: Exposure reported as substance
Inhalation exposure, long term concentration: Number of measured data points: 6; GSD: 1

Risk characterisation

Qualitative risk characterisation:
The risk characterisation for local dermal effects is given in Section 9.0.4.2.

16.5. Worker CS 5: Dosing of liquid material (PROC 8b, PROC 9)

Task(s) covered with this contributing scenario: Dosing of solutions into reactor.

16.5.1. Conditions of use

	Method
Product (Article) characteristics	

	Method
• Maximum emission potential of the substance: Very low *Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus automatically covered in this assessment.*	
• Content in preparation: < 1 % [Effectiveness Inhalation: 90%, Dermal: 90%]	
• Physical form of substance: Aqueous solution	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration per shift: = 15.0 min	
• Shifts per year: = 240.0 Shifts/year *Typical number of shifts per year during which this task is conducted considering a single worker. This value has been taken into account in the calculation of excess cancer risk.*	
Technical and organisational conditions and measures	
• Process temperature: Ambient	
• Indoor or outdoor use: Outdoors	
Conditions and measures related to personal protection, hygiene and health evaluation	
• General good occupational hygiene practices *Required good occupational hygiene practices to ensure a safe handling of the substance involve measures (e.g. shower and change clothes at end of work shift) to avoid any contamination of private households via the work-home-interface and housekeeping practices (i.e. regular cleaning with suitable cleaning devices), no eating and smoking in the workplace. In general, inhalation and ingestion should be avoided. Unless otherwise stated below, certified working clothing and shoes should be worn during work. Any contaminated clothing should not be taken home. Good general ventilation in the workplace should be ensured. Dust should not be blown off (e.g. from dried splashes) with compressed air. Regular training in workplace hygiene practice and proper use of personal protective equipment (if relevant) is required.*	
• Gloves: Gloves protecting from sensitizing properties to skin, continuous supervision of workers required *Due to the skin sensitizing effect of the substance, protective gloves according to EN 374 have to be worn at all workplaces unless any exposure to the substance can be excluded when taking into account the nature of the conducted process, applied exposure prevention measures and physical appearance of the substance of concern in the specific type of application (e.g. protecting from splashes by containment of emission source). Gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier. Additionally, face protection is required to be worn as appropriate. This level of protection is to be achieved by continuous supervision and training of workers wearing gloves.*	
• Certified safety clothing and shoes *Certified safety clothing including coveralls and safety shoes are to be worn as appropriate. Face protection may be worn if the type of process is associated with the risk of face injuries due to thermal or mechanical stress.*	

16.5.2. Exposure and risks for workers

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

Table 9.160. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, local, long term	0.032 µg/m³ (Measured data: Analogous data)	RCR < 0.01

Remarks on measured exposure:

Analogous data
Identity of the substance used: Exposure reported as substance
Inhalation exposure, long term concentration: Number of measured data points: 6; GSD: 1

Risk characterisation

Qualitative risk characterisation:
The risk characterisation for local dermal effects is given in Section 9.0.4.2.