

4. Exposure scenario 4: Use at industrial sites - Industrial use of RM as intermediate for the production of another substance in catalyst or catalyst precursor manufacture

Market sector: Manufacture of other cobalt substances (intermediate use)

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 use of RM as intermediate for the production of another substance in catalyst or catalyst precursor manufacture ES1 STP Discharge	ERC 6a
CS 2	Industrial use of RM as intermediate for the production of another substance in catalyst or catalyst precursor manufacture ES2 Direct Discharge	ERC 6a
CS 3	Industrial use of RM as intermediate for the production of another substance in catalyst or catalyst precursor manufacture ES3 Marine Discharge	ERC 6a
Worker contributing scenario(s):		
CS 4	C1: Delivery and storage of cobalt carbonate raw material	PROC 8b; PROC 4; PROC 3; PROC 9
CS 5	C2: Dissolution of cobalt carbonate raw material	PROC 3, PROC 9
CS 6	C3: Impregnation and drying of cobalt carbonate raw material on carrier	PROC 4, PROC 2; PROC 3
CS 7	C4: Filtration and drying of cobalt carbonate precipitate	PROC 4, PROC 2, PROC 3, PROC 14
CS 8	C5: Calcination of cobalt carbonate precipitate/supports, or impregnated CoCO ₃ on support	PROC 4, PROC 1; PROC 2; PROC 3
CS 9	C6: Reduction of cobalt carbonate precipitate	PROC 3, PROC 1; PROC 2
CS 10	CCM: Cleaning and maintenance	PROC 28

Further description of the use:

A variety of Co containing compounds are used in the production of Co containing catalysts. Please note that for environment, very often, emissions cannot be allocated to a distinct activity or process merely because emissions are treated in a central treatment plant and discharged as a single stream (e.g. wastewater emissions). As a consequence, the environmental exposure estimates relate to the Co-ion originating from the production and use of Co compounds in the catalyst industry. A sector approach is taken instead of a substance approach.

General process description (Source: ECMA, GES mapping, version 31/10/2014)

- Raw materials delivery and handling: bulk delivery of solid raw materials (e.g. tank, silo, car); semi-bulk delivery of solid raw materials (e.g. bags, drums), delivery of liquid raw materials, storage of solid and liquid raw materials, transfer of raw materials from delivery containers into container or central supply system, conveying raw materials (transport to machine for processing).
- Catalyst manufacture: dissolving, precipitating, filtrating, drying/heat treatment, mixing, forming, impregnation (continuous, batch), calcination (oxidation at elevated temperatures), reduction, stabilisation, screening (adjusting particle size distribution)

- Fresh catalyst packaging: filling operations (transfer to transport containers)
- Cleaning and maintenance
- Fresh catalyst storage: final product storage

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.

It is noted that this exposure scenario focusses on exposure to the registered substance. Please refer to information on safe use for the handling of the individual manufactured substances for process steps commencing the chemical transformation step.

4.1. Env CS 1: Industrial use of RM as intermediate for the production of another substance in catalyst or catalyst precursor manufacture ES1 STP Discharge (ERC 6a)

4.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
<ul style="list-style-type: none"> • Daily use at site: <= 0.766 tonnes/day <i>The tonnage and further exposure is always expressed in cobalt.</i>
<ul style="list-style-type: none"> • Annual use at a site: <= 226.1 tonnes/year <i>For the generic exposure scenario a tonnage covering 90% of the sector tonnages was selected.</i>
<ul style="list-style-type: none"> • Number of release days per year: >= 295 days/year <i>The selected number of production days per year is the median value based on data from 5 companies.</i>
Technical and organisational conditions and measures
<ul style="list-style-type: none"> • 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.
<ul style="list-style-type: none"> • 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
<ul style="list-style-type: none"> • Municipal STP: Yes
<ul style="list-style-type: none"> • Discharge rate of STP: >= 2E3 m3/d
<ul style="list-style-type: none"> • Application of the STP sludge on agricultural soil: Yes
Conditions and measures related to treatment of waste (including article waste)
<ul style="list-style-type: none"> • 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.) <i>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)</i>
Other conditions affecting environmental exposure

• Discharge rate of effluent: ≥ 818 m ³ /d <i>The selected effluent discharge rate is the 70th percentile based on data from 6 companies.</i>
• Receiving surface water flow rate: $\geq 8.098E4$ m ³ /d
• Final dilution factor: ≥ 100

4.1.2. Releases

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

Table 9.39. Local releases to the environment

Release	Release factor estimation method	Explanation / Justification
Water	Release factor	Initial release factor: 0.003% Final release factor: 0.003% Local release rate: 0.025 kg/day Explanation / Justification: This release factor is based on reported emissions after on-site treatment. The selected value is the 50th percentile of 6 companies.
Air	Release factor	Initial release factor: 0.004% Final release factor: 0.004% Local release rate: 0.03 kg/day Explanation / Justification: This release factor is based on reported emissions after on-site treatment. The selected value is the 50th percentile of 7 companies.
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)

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.

Table 9.40. Exposure concentrations and risks for the environment and man via the environment

Protection target	Exposure concentration	Risk characterisation
Freshwater	Local PEC: 0.15 µg/l	0.25
Sediment (freshwater)	Local PEC: 6.05 mg/kg dw	0.64
Sewage treatment plant	Local PEC: 0.01 mg/l	0.03
Air	Local PEC: 6.7 ng/m ³	No environmental hazard
Agricultural soil	Local PEC: 0.25 mg/kg dw	0.02
Man via Environment - Inhalation	Local PEC: 6.7 ng/m ³	< 0.01
Man via Environment - Oral	Exposure via food consumption: 0.322 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).

4.2. Env CS 2: Industrial use of RM as intermediate for the production of another substance in catalyst or catalyst precursor manufacture ES2 Direct Discharge (ERC 6a)

4.2.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Daily use at site: <= 0.766 tonnes/day
• Annual use at a site: <= 226.1 tonnes/year <i>For the generic exposure scenario a tonnage covering 90% of the sector tonnages was selected.</i>
• Number of release days per year: >= 295 days/year <i>The selected number of production days per year is the median value based on data from 5 companies.</i>
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.) <i>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</i>

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: ≥ 818 m³/d
The selected effluent discharge rate is the 70th percentile based on data from 6 companies.

• Receiving surface water flow rate: $\geq 1.628E5$ m³/d

• Final dilution factor: ≥ 200

4.2.2. Releases

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

Table 9.41. Local releases to the environment

Release	Release factor estimation method	Explanation / Justification
Water	Release factor	Initial release factor: 0.003% Final release factor: 0.003% Local release rate: 0.025 kg/day Explanation / Justification: This release factor is based on reported emissions after on-site treatment. The selected value is the 50th percentile of 6 companies.
Air	Release factor	Initial release factor: 0.004% Final release factor: 0.004% Local release rate: 0.03 kg/day Explanation / Justification: This release factor is based on reported emissions after on-site treatment. The selected value is the 50th percentile of 7 companies.
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)

4.2.3. 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 9.42. Exposure concentrations and risks for the environment and man via the environment

Protection target	Exposure concentration	Risk characterisation
Freshwater	Local PEC: 0.19 µg/l	0.32
Sediment (freshwater)	Local PEC: 7.90 mg/kg dw	0.83
Air	Local PEC: 6.7 ng/m ³	No environmental hazard
Agricultural soil	Local PEC: 0.02 mg/kg dw	< 0.01
Man via Environment - Inhalation	Local PEC: 6.7 ng/m ³	< 0.01
Man via Environment - Oral	Exposure via food consumption: 0.323 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).

4.3. Env CS 3: Industrial use of RM as intermediate for the production of another substance in catalyst or catalyst precursor manufacture ES3 Marine Discharge (ERC 6a)

4.3.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Daily use at site: <= 0.766 tonnes/day
• Annual use at a site: <= 226.1 tonnes/year <i>For the generic exposure scenario a tonnage covering 90% of the sector tonnages was selected.</i>
• Number of release days per year: >= 295 days/year <i>The selected number of production days per year is the median value based on data from 5 companies.</i>
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.) <i>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</i>

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: ≥ 818 m³/d
The selected effluent discharge rate is the 70th percentile based on data from 6 companies.
- Receiving surface water flow rate: $\geq 1.219E5$ m³/d
- Final dilution factor: ≥ 150

4.3.2. Releases

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

Table 9.43. Local releases to the environment

Release	Release factor estimation method	Explanation / Justification
Water	Release factor	Initial release factor: 0.003% Final release factor: 0.003% Local release rate: 0.025 kg/day Explanation / Justification: This release factor is based on reported emissions after on-site treatment. The selected value is the 50th percentile of 6 companies.
Air	Release factor	Initial release factor: 0.004% Final release factor: 0.004% Local release rate: 0.03 kg/day Explanation / Justification: This release factor is based on reported emissions after on-site treatment. The selected value is the 50th percentile of 7 companies.
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)

4.3.3. 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 9.44. Exposure concentrations and risks for the environment and man via the environment

Protection target	Exposure concentration	Risk characterisation
Marine water	Local PEC: 0.10 µg/l	0.04
Sediment (marine water)	Local PEC: 8.11 mg/kg dw	0.85
Air	Local PEC: 6.7 ng/m ³	No environmental hazard
Agricultural soil	Local PEC: 0.02 mg/kg dw	< 0.01
Man via Environment - Inhalation	Local PEC: 6.7 ng/m ³	< 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).

4.4. Worker CS 4: C1: Delivery and storage of cobalt carbonate raw material (PROC 8b, PROC 3; PROC 4; PROC 9)

Task(s) covered with this contributing scenario: Delivery, transfer, storage.

4.4.1. Conditions of use

	Method
Product (Article) characteristics	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	
• Physical form of substance: Solid, powder / dust	
• Maximum emission potential of the substance: High <i>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.</i>	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration per shift: = 66.0 min	
• Shifts per year: = 51.0 Shifts/year <i>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.</i>	
Technical and organisational conditions and measures	
• Level of containment <i>Predominantly closed process. Occasionally open process with generic local exhaust ventilation.</i>	
Conditions and measures related to personal protection, hygiene and health evaluation	
• General good occupational hygiene practices <i>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</i>	

	Method
<i>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.</i>	
<ul style="list-style-type: none"> Gloves: Gloves protecting from sensitizing properties to skin, continuous supervision of workers required <i>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.</i> 	
<ul style="list-style-type: none"> Certified safety clothing and shoes <i>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.</i> 	
<ul style="list-style-type: none"> Chemical protective suit according to EN 13982 <i>In cases where direct contact with the substance cannot be avoided, a protective suit conforming to EN 13982 should be worn.</i> 	

4.4.2. Exposure and risks for workers

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

Table 9.45. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, local, long term	0.8 µg/m ³ (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: 27; GSD: 2.2

Risk characterisation

Qualitative risk characterisation:

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

4.5. Worker CS 5: C2: Dissolution of cobalt carbonate raw material (PROC 3, PROC 9)

Task(s) covered with this contributing scenario: Addition of reagents, dissolution, sampling.

4.5.1. Conditions of use

	Method
Product (Article) characteristics	
<ul style="list-style-type: none"> Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%] 	
<ul style="list-style-type: none"> Physical form of substance: Solid, powder / dust, forming aqueous solutions 	

	Method
<ul style="list-style-type: none"> Maximum emission potential of the substance: High <i>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.</i> 	
Amount used (or contained in articles), frequency and duration of use/exposure	
<ul style="list-style-type: none"> Duration per shift: = 66.0 min 	
<ul style="list-style-type: none"> Shifts per year: = 37.0 Shifts/year <i>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.</i> 	
Technical and organisational conditions and measures	
<ul style="list-style-type: none"> Level of containment: Closed process with occasional opening <i>Addition of reagents and dissolution in a closed process, semi-closed sampling.</i> 	
Conditions and measures related to personal protection, hygiene and health evaluation	
<ul style="list-style-type: none"> General good occupational hygiene practices <i>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.</i> 	
<ul style="list-style-type: none"> Gloves: Gloves protecting from sensitizing properties to skin, continuous supervision of workers required <i>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.</i> 	
<ul style="list-style-type: none"> Certified safety clothing and shoes <i>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.</i> 	
<ul style="list-style-type: none"> Chemical protective suit according to EN 13982 <i>In cases where direct contact with the substance cannot be avoided, a protective suit conforming to EN 13982 should be worn.</i> 	

4.5.2. Exposure and risks for workers

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

Table 9.46. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, local, long term	1.5 µg/m ³ (Measured data: Monitoring data)	RCR = 0.019

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: 3

Risk characterisation

Qualitative risk characterisation:

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

4.6. Worker CS 6: C3: Impregnation and drying of cobalt carbonate raw material on carrier (PROC 4, PROC 2; PROC 3)

Task(s) covered with this contributing scenario: Addition of reagents, impregnation, transfer to dryer, drying.

4.6.1. Conditions of use

	Method
Product (Article) characteristics	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	
• Physical form of substance: Aqueous solution, forming non-dusty solids (impregnated supports)	
• Maximum emission potential of the substance: Very low <i>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.</i>	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration per shift: = 10.0 min	
• Shifts per year: = 6.0 Shifts/year <i>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.</i>	
Technical and organisational conditions and measures	
• Level of containment: Addition of reagents, impregnation and drying are closed processes. Transfer can be closed or semi-closed process.	
Conditions and measures related to personal protection, hygiene and health evaluation	
• General good occupational hygiene practices <i>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.</i>	
• Gloves: Gloves protecting from sensitizing properties to skin, continuous	

	Method
<p>supervision of workers required</p> <p><i>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.</i></p>	
<ul style="list-style-type: none"> • Certified safety clothing and shoes <p><i>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.</i></p>	

4.6.2. Exposure and risks for workers

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

Table 9.47. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, local, long term	0.4 µg/m ³ (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: 4; GSD: 2.2

Risk characterisation

Qualitative risk characterisation:

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

4.7. Worker CS 7: C4: Filtration and drying of cobalt carbonate precipitate (PROC 4, PROC 2, PROC 3, PROC 14)

Task(s) covered with this contributing scenario: Filtration, discharge of wet filter cake from filter unit, extrusion, transfer to dryer, drying.

4.7.1. Conditions of use

	Method
Product (Article) characteristics	
<ul style="list-style-type: none"> • Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%] 	
<ul style="list-style-type: none"> • Physical form of substance: Wet filter cake 	
<ul style="list-style-type: none"> • Additional physical form of substance: Slurry <i>Precipitate</i> 	
<ul style="list-style-type: none"> • Additional physical form of substance: Non-dusty solids 	
<ul style="list-style-type: none"> • Maximum emission potential of the substance: Very low <p><i>Only the highest emission potential (EP) is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel) are thus</i></p>	

	Method
<i>automatically covered in this assessment.</i>	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration per shift: = 155.0 min	
• Shifts per year: = 31.0 Shifts/year <i>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.</i>	
Technical and organisational conditions and measures	
• Level of containment: Semi-closed processes. Closed drying.	
Conditions and measures related to personal protection, hygiene and health evaluation	
• General good occupational hygiene practices <i>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.</i>	
• Gloves: Gloves protecting from sensitizing properties to skin, continuous supervision of workers required <i>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.</i>	
• Certified safety clothing and shoes <i>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.</i>	

4.7.2. Exposure and risks for workers

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

Table 9.48. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, local, long term	6.8 µg/m ³ (Measured data: Monitoring data)	RCR = 0.084

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: 4; GSD: 2.2

Risk characterisation

Qualitative risk characterisation:

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

4.8. Worker CS 8: C5: Calcination of cobalt carbonate precipitate/supports, or impregnated CoCO₃ on support (PROC 4, PROC 1; PROC 2; PROC 3)

Task(s) covered with this contributing scenario: Transfer to calciner, calcination.

4.8.1. Conditions of use

	Method
Product (Article) characteristics	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	
• Physical form of substance: Wet filter cake	
• Additional physical form of substance: Non-dusty solids <i>Extrudates, impregnated supports</i>	
• Maximum emission potential of the substance: Very low <i>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.</i>	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration per shift: = 15.0 min	
• Shifts per year: = 45.0 Shifts/year <i>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.</i>	
Technical and organisational conditions and measures	
• Level of containment: Closed furnace <i>In case of calcination operation.</i>	
• Level of containment: Semi-closed transfers	
Conditions and measures related to personal protection, hygiene and health evaluation	
• General good occupational hygiene practices <i>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.</i>	
• Gloves: Gloves protecting from sensitizing properties to skin, continuous supervision of workers required <i>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</i>	

	Method
<i>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.</i>	
<ul style="list-style-type: none"> • 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. 	
<ul style="list-style-type: none"> • Respiratory protective equipment (RPE): RPE with minimum APF = 20 [Effectiveness Inhalation: 95%] APF = assigned protection factor according to EN 529. At minimum any combination of particle filter class P3 with mask according to EN 140, EN 1827 or filtering half mask (FF P3) according to EN 149 or combination of P2 filter with face piece according to EN 12941 or EN 12942 or any RPE providing higher APFs according to EN 529 is required. 	

4.8.2. Exposure and risks for workers

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

Table 9.49. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, local, long term	0.06 µg/m ³ (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: 8; GSD: 2.4

Risk characterisation

Qualitative risk characterisation:

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

4.9. Worker CS 9: C6: Reduction of cobalt carbonate precipitate (PROC 3, PROC 1; PROC 2)

Task(s) covered with this contributing scenario: Transfer to reducer; reduction.

4.9.1. Conditions of use

	Method
Product (Article) characteristics	
<ul style="list-style-type: none"> • Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%] 	
<ul style="list-style-type: none"> • Physical form of substance: Extrudates (Non-dusty solid) 	
<ul style="list-style-type: none"> • 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. 	
Amount used (or contained in articles), frequency and duration of use/exposure	

	Method
<ul style="list-style-type: none"> Shifts per year: = 32.0 Shifts/year <i>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.</i> 	
<ul style="list-style-type: none"> Duration per shift: = 60.0 min 	
Technical and organisational conditions and measures	
<ul style="list-style-type: none"> Level of containment: Automated, closed process 	
<ul style="list-style-type: none"> Integrated local exhaust ventilation: Upper confidence limit (industrial use) [Effectiveness Inhalation: 90%] <i>High efficiency</i> 	
Conditions and measures related to personal protection, hygiene and health evaluation	
<ul style="list-style-type: none"> General good occupational hygiene practices <i>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.</i> 	
<ul style="list-style-type: none"> Gloves: Gloves protecting from sensitizing properties to skin, continuous supervision of workers required <i>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.</i> 	
<ul style="list-style-type: none"> Certified safety clothing and shoes <i>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.</i> 	

4.9.2. Exposure and risks for workers

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

Table 9.50. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, local, long term	5.4 µg/m ³ (Measured data: Monitoring data)	RCR = 0.067

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: 8; GSD: 2.4

Explanation: It is noted that the reported exposure estimate is based on monitoring data from actual workplaces. At some sites, subsequent process steps (e.g. screening, drum filling) involving the reduced cobalt substance, typically cobalt metal may be conducted in the vicinity of this workplace. As such the exposure estimate is considered to be more representative of the subsequent process steps rather than of this closed reduction process.

Risk characterisation

Qualitative risk characterisation:

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

4.10. Worker CS 10: CCM: Cleaning and maintenance (PROC 28)

Task(s) covered with this contributing scenario: Cleaning and maintenance. Manual cleaning, repair and maintenance operations; Removal of residuals from e.g. filters/overspill or as waste. Maintenance and repair work only at facilities which are not in operation. Minor cleaning tasks may be conducted under operation.

4.10.1. Conditions of use

	Method
Product (Article) characteristics	
• Content in preparation: Not restricted [Effectiveness Inhalation: 0%, Dermal: 0%]	
• Physical form of substance: Various	
• Maximum emission potential of the substance: Low <i>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.</i>	
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration per shift: = 120.0 min	
• Shifts per year: = 48.0 Shifts/year <i>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.</i>	
Technical and organisational conditions and measures	
• Process temperature: Ambient	
• Process pressure: Ambient	
Conditions and measures related to personal protection, hygiene and health evaluation	
• General good occupational hygiene practices <i>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</i>	

	Method
<i>and proper use of personal protective equipment (if relevant) is required.</i>	
<ul style="list-style-type: none"> Respiratory protective equipment (RPE): RPE with minimum APF = 20 [Effectiveness Inhalation: 95%] <i>APF = assigned protection factor according to EN 529. At minimum any combination of particle filter class P3 with mask according to EN 140, EN 1827 or filtering half mask (FF P3) according to EN 149 or combination of P2 filter with face piece according to EN 12941 or EN 12942 or any RPE providing higher APFs according to EN 529 is required.</i> 	
<ul style="list-style-type: none"> Gloves: Gloves protecting from sensitizing properties to skin, continuous supervision of workers required <i>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.</i> 	
<ul style="list-style-type: none"> Certified safety clothing and shoes <i>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.</i> 	
<ul style="list-style-type: none"> Chemical protective suit according to EN 13982 <i>In cases where direct contact with the substance cannot be avoided, a protective suit conforming to EN 13982 should be worn.</i> 	

4.10.2. Exposure and risks for workers

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

Table 9.51. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, local, long term	2.5 µg/m ³ (Measured data: Monitoring data)	RCR = 0.031

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: 26; GSD: 4.3

Risk characterisation

Qualitative risk characterisation:

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