Industrial use of cobalt carbonate in the manufacture of inorganic pigments & frits, glass and ceramic ware (intermediate use)

Systematic title based on use descriptor	SU3 (Industrial use), SU8, SU9, SU13 PC19, PC32, PC33 (appropriate PROCs are given in Section 2 below)

2. Operational conditions and risk management measures

Workplace	Involved task	Involved PROCs
Raw material handling	Handling, unloading, Loading of reaction vessel	8b (solution), 21 (Chips), 26 (Powder)
Preparation of raw material	Sampling, weighing, mixing, grinding in mills, spray drying, tabletting, acid leaching, dissolving, Filtration, scraping, purification, cementation, de-ironing (Hydrolysis)	1, 2, 3, 4, 5, 14
Wet process	Precipitation, solvent extraction, back stripping, drying	1, 4
Hot process	pyrolysis, calcination, melting, casting, thermal treatment	1, 22, 23
Formulation and filling	formulation, filling	3, 8b, 9
Packaging of massive objects	Packaging.	21 Note: Cobalt carbonate has been chemically transformed into another substance (used as an intermediate).
cleaning & maintenance	Manual cleaning, repair and maintenance operations, removal of residuals from e.g. filters/overspill or as waste	8a, 26

2.1 Control of workers exposure

Product characteristics

Workplace	Use in preparation and content in preparation	Physical form of the product
Raw material handling	Yes (cobalt-containing feed material). Varying content of cobalt (No restriction)	Various (Powder, Chips, solution)
Preparation of raw material	Yes (cobalt-containing feed material). Varying content of cobalt (No restriction)	solution
Wet process	Yes (cobalt-containing feed material). Varying content of cobalt (No restriction)	solution
Hot process	No restriction	Solid / molten, Powder
Formulation and filling	No restriction	solution
Packaging of massive objects	Bound in matrix in glass and ceramics. Chemical transformation of cobalt in pigments. (<25% in preparation)	Massive
cleaning & maintenance	Not applicable	Powder, Dust

Amounts used

No restriction.

Frequency and duration of use/exposure

No restriction.

Human factors not influenced by risk management

The shift breathing volume 10 m³/ 8 h (full shift).

Other given operational conditions affecting workers exposure

room volume >1,000 m³, process temperature or pressure ambient or no restriction respectively for all workplace except: preparation of raw material – process temperature up to 95oC, hot processing~~/sintering~~ – process temperature up to 1600oC, cleaning & maintenance – room volume No restriction, process temperature or pressure ambient (system not in operation). Indoor use.

Technical conditions and measures at process level (source) to prevent release

Preparation of raw material closed system (reaction vessels), wet process closed system (closed pipe system, closed reaction vessels), hot process closed furnace or well-extracted open induction furnace. Other workplace level of containment/segregation not required.

Technical conditions and measures to control dispersion from source towards the worker				
Workplace	**Level of separation**	**Localised controls (LC)**	**Efficiency of LC (according to MEASE)**	**Additional information**
Raw material handling	Level of separation if required see frequency and duration of exposure section. Installation of ventilated (positive pressure) control rooms can also reduce exposure.	No measures required.	Not applicable	-
Preparation of raw material		reactor equipped with local exhaust ventilation	90%	-
Wet process		vapour extraction units in the tank	90%	semi-automatic process
Hot process	control room during furnace operations	high-efficient extraction	90%	-
Formulation and filling	No measures required.	No measures required.	Not applicable	-
Packaging of massive objects	No measures required.	No measures required.	Not applicable	-
cleaning & maintenance	No measures required.	No measures required.	Not applicable	Maintenance and repair work only at facilities which are not in operation. Minor cleaning tasks may be conducted under operation

Organisational measures to prevent/limit releases, dispersion and exposure
Additional information See Section: 7, 8, 11 (SDS).

Conditions and measures related to personal protection, hygiene and health evaluation			
Workplace	**Specification of respiratory protective equipment (RPE)**	**RPE efficiency (assigned protection factor, APF)**	**Specification of gloves and further personal protective equipment (PPE)**
Raw material handling	Mask type: FFP2 (Handling: Powder)	APF=10	Since cobalt carbonate has sensitising properties, the use of suitable chemical resistant gloves (EN 374) providing protection for the duration of activity (e.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), butyl rubber (0.7 mm) is a prerequisite for all process steps in which direct contact to cobalt substances is possible. In cases where direct contact with cobalt carbonate cannot be avoided, a protective suit conforming to EN13982 should be worn. As a general requirement for the conducted processes: standard working clothes (long-sleeve overall) and safety shoes.
Preparation of raw material	Mask type: FFP2		
Wet process			
Hot process			
Formulation and filling	No measures required.	Not applicable	
Packaging of massive objects			
cleaning & maintenance	Mask type: FFP2 (low - medium dusty materials)	APF=10	
	Mask type: powered filtering device incorporating a hood or a helmet, TH3 (high dusty materials)	APF=40	

2.2 Control of environmental exposure

Amounts used

34 tonnes/annum/site for pigments/frits manufacturing
1.5 tonnes/annum/site for glass/ceramics/electronics manufacturing

Frequency and duration of use

Continuous use/release. More than 315 days/year to the air and water compartment for pigments/frits sites and 365 days/year for glass/ceramics/electronics.

Environment factors not influenced by risk management

The dilution capacity of the receiving surface water (calculated as the ratio between the flow rate of the river/lake/estuary/sea to the effluent discharge rate):

- Dilution factor for the freshwater environment (Fresh water – STP ES): 100
- Dilution factor for the freshwater environment (Fresh water- direct discharge ES): 100
- Dilution factor for the marine environment: 100

Other given operational conditions affecting environmental exposure

Not applicable.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Water: One or more of the following measures (as set out in the BAT Reference Document on Non-Ferrous Metal Processes), to be taken for emissions to water:

- Chemical precipitation: used primarily to remove the metal ions
- Sedimentation
- Filtration: used as final clarification step
- Electrolysis: for low metal concentration
- Reverse Osmosis (OR): extensively used for the removal of dissolved metals
- Ion exchange: final cleaning step in the removal of heavy metal from process wastewater

Air: One or more of the following measures (as set out in the BAT Reference Document on Non-Ferrous Metal Processes), to be taken for emissions to air:

- Electrostatic precipitators using wide electrode spacing: 5 – 15 mg/Nm³
- Wet electrostatic precipitators: < 5 mg/Nm³
- Cyclones, but as primary collector: < 50 mg/Nm³
- Fabric or bag filters: high efficiency in controlling fine particulate (melting): achieve emission values < 5 mg/Nm³. Membrane filtration techniques can achieve < 1 mg/Nm³.
- Ceramic and metal mesh filters. PM10 particles are removed: 0.1 mg/Nm³.
- Wet scrubbers: < 4 mg/Nm³.

Soil: No measures to reduce emissions to soil

The release factors to both the water and air compartments after on-site treatment are:

- Estimated fraction released to water (g/tonne): 100
- Estimated fraction released to air (g/tonne): 100

The release factors to both the water and air compartments after on-site treatment for ceramics, glass and varistors are:

- Estimated fraction released to water (g/tonne): 3000
- Estimated fraction released to air (g/tonne): 2000

Organisational measures to prevent/limit release from site

Please see section 8 SDS for more details.

Conditions and measures related to municipal sewage treatment plant

Two different exposure scenarios (ES) for the freshwater environment were considered. As default exposure scenario, an offsite municipal STP is included and sludge is applied to agricultural soil. As a second exposure scenario, no off-site municipal STP (direct discharge) is included and no sludge is applied to agricultural soil. For the marine environment, the ES considers no off-site municipal STP (direct discharge) treatment and no sludge application to agricultural soil. The assumption by default for the off site municipal sewage treatment plant is 2,000 m³/day. The fraction of Co removed by the municipal STP is set at 40 %.

Conditions and measures related to external treatment of waste for disposal

Suitable disposal: 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 (Council Directive 2008/98/EC, Directive 2000/76/EC and BAT Reference Document 2006) or hazardous waste landfills as hazardous waste (Directive 1999/31/EC). 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. **Fraction of daily/annual use expected in waste:** 0.001 or 0.1%. **Appropriate waste codes:** 01 03 07*; 11 02 07*; 06 05 02*; 15 01 10*; 10 08 04; 10 10 11*; 12 01 03; 12 01 04; 06 03 13*; 06 03 15*; 06 04 05*; 10 10 03; 10 10 05*;10 10 07*; 16 06 05; 16 08 02* 16 08 03

3. Exposure estimation and reference to its source

Occupational exposure

The risk characterisation ratio (RCR) is the quotient of the exposure estimate (as cobalt carbonate) and the respective DNEL (Derived No Effect Level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL of 81 µg/m³ (as cobalt carbonate).

Workplace	Method used for inhalation exposure assessment	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Raw material handling	analogous data	32 µg/m³ (0.4)	Since cobalt carbonate has sensitising properties, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Preparation of raw material	analogous data	10 µg/m³ (0.13)		
Wet process	analogous data	8 µg/m³ (0.1)		
Hot process	analogous data	33 µg/m³ (0.41)		
Formulation and filling	MEASE	10 µg/m³ (0.124)		
Packaging of massive objects	MEASE	10 µg/m³ (0.124)		
cleaning & maintenance	analogous data	42 µg/m³ (0.53) (low - medium dusty materials)		
		49 µg/m³ (0.61) (high dusty materials)		

Environmental emissions

The risk characterisation ratio (RCR) is the quotient of the local Predicted Environmental Concentration (PEC) and the respective PNEC (Predicted No Effect Concentration) and has to be below 1 to demonstrate a safe use.

Compartment Inorganic pigments/frits	Predicted Environmental Concentration	Predicted No Effect Concentration	Risk characterisation ratio
Fresh water – STP	0.12 µg/l	0.51 µg/l	0.24
Fresh water – direct discharge	0.13 µg/l	0.51 µg/l	0.26
Sea water	0.04 µg/l	2.36 µg/l	0.02
Freshwater sediment – STP	5.05 mg/kg	9.5 mg/kg dw	0.53
Freshwater sediment – direct discharge	5.57 mg/kg	9.5 mg/kg dw	0.59
Marine water sediment	2.66 mg/kg	9.5 mg/kg dw	0.28
Terrestrial - sludge application	0.11 mg/kg	10.9 mg/kg dw	0.01
Terrestrial - no sludge application	0.01 mg/kg	10.9 mg/kg dw	0.001
Sewage treatment plant	0.003 mg/l	0.37 mg/l	0.009

Compartment ceramics, glass, varistors	Predicted Environmental Concentration	Predicted No Effect Concentration	Risk characterisation ratio
Fresh water – STP	0.12 µg/l	0.51 µg/l	0.24
Fresh water – direct discharge	0.14 µg/l	0.51 µg/l	0.27
Sea water	0.04 µg/l	2.36 µg/l	0.02
Freshwater sediment – STP	5.16 mg/kg	9.5 mg/kg dw	0.54
Freshwater sediment – direct discharge	5.76 mg/kg	9.5 mg/kg dw	0.61
Marine water sediment	2.95 mg/kg	9.5 mg/kg dw	0.31
Terrestrial - sludge application	0.13 mg/kg	10.9 mg/kg dw	0.01
Terrestrial - no sludge application	0.01 mg/kg	10.9 mg/kg dw	0.001
Sewage treatment plant	0.004 mg/l	0.37 mg/l	0.010

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES
Occupational and Environmental exposure
The DU works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the downstream user can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. For human health, this has to be done by showing that they limit the inhalation exposure to a level below the DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. For the environment, this has to be done by showing that they limit the PEC below the PNEC for the respective environmental compartment. If measured data are not available, the DU may make use of an appropriate scaling tool such as the DU-Scaling tool (http://www.arche-consulting.be/Metal-CSA-toolbox/duscaling-tool) to estimate PEC values.