

Industrial use of cobalt in the manufacture of inorganic pigments & frits, glass, ceramic ware, varistors and magnets (calcination/sintering processes)

Systematic title based on use descriptor	SU3 (Industrial use), SU8, SU9, SU13, SU15, SU16 PC7, PC32, PC33, AC2, AC4, AC7, ERC1, ERC2, ERC3, ERC5, ERC6a (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, tableting, acid leaching, dissolving, filtration, scraping, purification, cementation, de-ironing (Hydrolysis)	1, 2, 3, 4, 5
Wet process	Precipitation, solvent extraction, back stripping, drying	1, 4
Preparation of pre-sintered materials	Powder handling, mixing, pressing	3, 5, 8b, 14, 26
Hot process/sintering	Pyrolysis, calcination, melting, casting, thermal treatment, sintering	1, 22, 23
Formulation and filling	Formulation , filling	3, 8b, 9
Packaging of massive objects	Packaging	21
Packaging of magnets	Packaging	21
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
Preparation of pre-sintered materials	No restriction	Powder
Hot process/sintering	No restriction	Solid / molten, Powder
Formulation and filling	No restriction	Solution
Packaging of massive objects	Bound in matrix in glass, ceramics and varistors. Chemical transformation of cobalt in pigments. (<5% in preparation)	Massive
Packaging of magnets	Yes (No restriction)	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 m ³ / 8 h (full shift).		

Other given operational conditions affecting workers exposure				
Room volume > 1,000 m ³ , process temperature or pressure ambient or no restriction respectively for all workplace except: preparation of raw material – process temperature up to 95°C, hot processing/sintering – process temperature up to 1600°C, 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				
Raw material handling closed system (reaction vessels), preparation of raw material closed system (closed pipe system, closed reaction vessels), hot process/sintering 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
Preparation of pre-sintered materials		Local exhaust ventilation in powder handling areas	78%	-
Hot process/sintering	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	Not applicable	-
Packaging of magnets		Local exhaust ventilation is required	78%	-
Cleaning & maintenance		No measures required	No measures required	Not applicable
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 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 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				
Preparation of pre-sintered materials				
Hot process/sintering	No measures required	Not applicable		
Formulation and filling				
Packaging of massive objects				
Packaging of magnets	Mask type: FFP2 (low – medium dusty materials)	APF=10		
Cleaning & maintenance		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 Co/annum/site for pigments/frits manufacturing 1.5 tonnes Co/annum/site for glass/ceramics/electronics manufacturing
Frequency and duration of use/exposure
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): <ul style="list-style-type: none"> - 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
<u>Water</u> : 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: <ul style="list-style-type: none"> - 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
<u>Air</u> : 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: <ul style="list-style-type: none"> - 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): < 5mg/Nm³ (membrane filtration achieves < 1 mg/Nm³) - Ceramic and metal mesh filters. PM10 particles are removed: 0.1 mg/Nm³ - Wet scrubbers: < 4 mg/Nm³
<u>Soil</u> : No measures to reduce emissions to soil
The release factors to both the water and air compartments after on-site treatment for inorganic pigment/frits are: <ul style="list-style-type: none"> - Estimated fraction released to water (g Co/tonne): 100 (SPERC production) - Estimated fraction released to air (g Co/tonne): 100 (SPERC production)
The release factors to both the water and air compartments after on-site treatment for ceramics, glass and varistors are: <ul style="list-style-type: none"> - Estimated fraction released to water (g Co/tonne): 3000 (SPERC use) - Estimated fraction released to air (g Co/tonne): 2000 (SPERC use)
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 m ³ /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				
<p>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%</p> <p>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</p>				
3. Exposure estimation and reference to its source				
Occupational exposure				
<p>The risk characterisation ratio (RCR) is the quotient of the exposure estimate and the respective Derived No Effect Level (DNEL) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on a DNEL for cobalt of 40 µg/m³.</p>				
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	16 µg/m ³ (0.4)	Since cobalt 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	5 µg/m ³ (0.13)		
Wet process	analogous data	4 µg/m ³ (0.1)		
Preparation of pre-sintered materials	measured data	12 µg/m ³ (0.31)		
Hot process/sintering	analogous data	16 µg/m ³ (0.4)		
Formulation and filling	MEASE	10 µg/m ³ (0.25)		
Packaging of massive objects	MEASE	10 µg/m ³ (0.25)		
Packaging of magnets	MEASE	11 µg/m ³ (0.275)		
Cleaning & maintenance	analogous data	21 µg/m ³ (0.53) (low – medium dusty materials)		
		24 µg/m ³ (0.61) (high dusty materials)		
Environmental emissions				
<p>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.</p>				
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	0.09	

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.