

1. Title	
GES 2 Use of nickel sulphamate in metal surface treatment – nickel electroplating, nickel electroforming and electroless nickel plating	
Life cycle	Intermediate use of nickel sulphamate, Ni(SO ₃ NH ₂) ₂ xH ₂ O
Free short title	Metal surface treatment – nickel electroplating, nickel electroforming and electroless nickel plating
Systematic title based on use descriptor	<p>SU: SU 3 Industrial use</p> <p>PC: PC 19 Intermediate</p> <p>ERC: ERC5: Industrial use resulting in inclusion into or onto a matrix SPERC for use of nickel metal and compounds in metallic coating</p> <p>PROC: PROC 5: Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)</p> <p>PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC 13: Treatment of articles by dipping and pouring</p> <p>PROC 15: Use as laboratory reagent</p> <p>PROC 0: Cleaning and maintenance</p>
Processes, tasks, activities covered (environment)	Metal surface treatment – nickel electroplating, nickel electroforming and electroless nickel plating. Use of nickel sulphamate as 'make-up' salt in electrolytic nickel plating, nickel electroforming and in electroless nickel plating.
Processes, tasks, activities covered (workers)	<p>Contributing exposure scenario ES 2.1:</p> <p>Operations involving dry salts</p> <p>PROC 5, PROC 8a, PROC 8b, PROC 13, PROC 0</p> <p>Contributing exposure scenario ES 2.2:</p> <p>Operations with salt solutions</p> <p>PROC 8a, PROC 8b, PROC 13, PROC 15, PROC 0</p>
2. Operational conditions and risk management measures	
2.1 Control of environmental exposure	
Environmental related free short title	Metal surface treatment – nickel electroplating, nickel electroforming and electroless nickel plating
Systematic title based on use descriptor (environment)	ERC5: Industrial use resulting in inclusion into or onto a matrix SPERC for use of nickel metal and compounds in metallic coating
Processes, tasks, activities covered (environment)	Metal surface treatment – nickel electroplating, nickel electroforming and electroless nickel plating. Use of nickel sulphamate as 'make-up' salt in electrolytic nickel plating, nickel electroforming and in electroless nickel plating.
Environmental Assessment Method	Estimates based on monitoring local and regional concentrations are used for calculation of PEC. Estimates based on SPERC for use of nickel metal and compounds in metallic coating are used for calculation of air PEC.
Product characteristics	
Ni sulphamate: Hydrated salt of approximately 100 % or solution of 25-50%	
Amounts used	
Maximum daily use at a site	<p>ES 1: 0.05 tonnes/day (median 50th % emission days, 50th % tonnage)</p> <p>ES 2: 1.23 tonnes/day (median 50th % emission days, 75th % tonnage)</p> <p>ES 3: 0.02 tonnes/day (median 50th % emission days, 25th % tonnage)</p>
Maximum annual use at a site	<p>ES 1: 11 tonnes (median 50th %, 2007); Discharge to STP</p> <p>ES 2: 271 tonnes (75th %, 2007); Discharge to STP</p>

	ES 3: 3.9 tonnes (25 th %, 2007); Direct discharge
Frequency and duration of use	
Pattern of release to the environment	220 days per year per site (median 50 th %)
Environment factors not influenced by risk management	
Receiving surface water flow rate	ES 1 discharge to STP: 1.8xE4 m ³ /d ES 2 discharge to STP: 2.0xE6 m ³ /d ES 3 direct discharge: 1.6xE2 m ³ /d
Dilution capacity, freshwater	ES 1: 10 (50 th %) ES 2: 1000 (max) ES 3: 10 (50 th %)
Dilution capacity, marine	100 (default)
Other given operational conditions affecting environmental exposure	
None	
Technical conditions and measures at process level (source) to prevent release	
None	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
<p>Waste water: On-site wastewater treatment in a physico-chemical treatment plant by chemical precipitation, sedimentation, filtration or a combination. Efficiency: 95 - >99% Off-site waste water treatment plant, community sewer system Efficiency 40%</p> <p>ES1 freshwater Discharge to STP and Marine: 131 g/T (median)</p> <p>ES2 freshwater Discharge to STP: 827 g/T (75%)</p> <p>ES3 Direct discharge to freshwater: 63 g/T (25th %)</p> <p>Air: Treatment of stack air emission by wet scrubbers. Efficiency 99% Release factor after on-site treatment: 80 g/T (max)g/T</p>	
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal Sewage Treatment Plant (STP)	Yes
Discharge rate of the Municipal STP	2000 m ³ /d (default)
Incineration of the sludge of the Municipal STP	Sludge is applied to agricultural soil
Conditions and measures related to external treatment of waste for disposal	
Ni bearing waste shall be recovered or recycled if possible. Ni bearing waste shall be considered hazardous if the Ni content is above the cutoff as state in regulation (EC) No. 1272/2008, unless otherwise classified when assessed as a substances placed on the market according to REACH. Ni bearing waste mixtures can be assessed according to regulation (EC) No. 1272/2008 criteria. Disposal of Ni bearing waste shall comply with local, state or national waste legislation and remains the responsibility of the waste treatment operator.	
Conditions and measures related to external recovery of waste	
Not applicable	
2.2 Control of workers exposure for contributing exposure scenario ES 2.1	
Operations involving dry salts	

Workers related free short title	Metal surface treatment – nickel electroplating, nickel electroforming and electroless nickel plating
Use descriptor covered	PROC 5: Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact) PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 13: Treatment of articles by dipping and pouring PROC 0: Cleaning and maintenance
Processes, tasks, activities covered	Raw material handling Preparation of Ni sulphamate solution Cleaning and maintenance
Assessment Method	Estimation of exposure based on measured data for an analogous substance. Estimation of long term inhalation exposure and dermal exposure based on Tier 1 model
Product characteristic	
Ni sulphamate: Hydrated salt of approximately 100 % purity	
Amounts used	
Not relevant	
Frequency and duration of use/exposure	
Addition of Ni sulphamate to tank ranging from once per shift to once every 2 or 3 weeks	
Human factors not influenced by risk management	
Respiration volume under conditions of use	Light to medium level work, 10 m ³ /d
Room size and ventilation rate	Not relevant
Area of skin contact with the substance under conditions of use	960 cm ²
Body weight	70 kg
Other given operational conditions affecting workers exposure	
Ni sulphamate is supplied and handled in dry form as pellets. Ambient temperature and humidity affects exposure. Maintain clean workplace to prevent accumulation of powders and dusts on surfaces. Use water or vacuum fitted with HEPA filter to clear spilled material or accumulations of dust within the work area. Oral: Good workplace hygiene practice	
Technical conditions and measures at process level (source) to prevent release	
Automation and enclosure of processes shall be used where possible	
Technical conditions and measures to control dispersion from source towards the worker	
LEV is required for operations involving handling of powder in open workspace such as ripping and tipping sacks, weighing, mixing, adding powders to solution	
Organisational measures to prevent /limit releases, dispersion and exposure	
None	
Conditions and measures related to personal protection, hygiene and health evaluation	
<u>Inhalation</u> : Use of RPE (FP3; APF 20) is required for cleaning and maintenance operations involving dusts and powders. <u>Dermal</u> : Gloves and other suitable protective clothing is required to minimise dermal contact	
2.3 Control of workers exposure for contributing exposure scenario ES 2.2	
Operations with salt solutions	
Workers related free short title	Metal surface treatment – nickel electroplating, nickel electroforming and electroless nickel plating

Use descriptor covered	PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 13: Treatment of articles by dipping and pouring PROC 15: Use as laboratory reagent PROC 0: Cleaning and maintenance	
Processes, tasks, activities covered	Addition of Ni sulphamate to tank Dipping of items to be coated Removal of coated items Rinsing of coated items Removal of spent solution/rinse water from tank Wastewater handling – rinse water Cleaning and maintenance	
Assessment Method	Estimation of inhalation exposure based on measured data for an analogous substance. Estimation of dermal exposure based on Tier 1 model	
Product characteristic		
Ni sulphamate: Solution of 25-50%		
Amounts used		
Not relevant		
Frequency and duration of use/exposure		
8 hour daily shifts, 5 days per week.		
Human factors not influenced by risk management		
Respiration volume under conditions of use	Not relevant	
Room size and ventilation rate	Not relevant	
Area of skin contact with the substance under conditions of use	960 cm ²	
Body weight	Not relevant	
Other given operational conditions affecting workers exposure		
<p>Ni sulphamate is added to the plating bath in solution. Plating process employs an automated system of immersing the piece in an activating tank, then a plating tank, and finally a rinse tank. An additional cascade rinse with demineralised water and air drying complete the process. Loading and unloading of the conveyor is performed manually at the beginning and end stages of this process.</p> <p>Plating is semi-automated; parts are manually loaded on to jigs that are moved between the baths using an overhead hoist</p> <p>Temperature of plating baths is typically 25-70°C.</p> <p>Plating bath is agitated by bubbling air through the electrolyte solution to ensure even availability of Ni salt to piece being plated.</p> <p>Maintain a clean workplace.</p> <p>Oral: Good workplace hygiene practice</p>		
Technical conditions and measures at process level (source) to prevent release		
<p>Automation and enclosure of processes should be used where possible.</p> <p>If no LEV, automation and enclosure of the following processes are required: Addition of solutions to plating tanks (fluids shall be directly pumped in and out of tanks), dipping and removal of pieces to be plated (plating and rinsing tanks).</p> <p>Tank should be covered if not enclosed. Storage vessels used for electroplating solutions should be capped.</p>		
Technical conditions and measures to control dispersion from source towards the worker		

LEV is required for operations where mists may be created including addition of solutions to plating tanks, dipping and removal of pieces to be plated (plating and rinsing tanks)

Organisational measures to prevent /limit releases, dispersion and exposure

None

Conditions and measures related to personal protection, hygiene and health evaluation

Inhalation: Use of RPE is required for cleaning and maintenance operations.

Dermal: Gloves (acid resistant) and other suitable protective clothing are required to minimise dermal contact with solution

3. Exposure and risk estimation

Environment

ERC 5, SPERC for use of nickel metal and compounds in metallic coating
Metal surface treatment– nickel electroplating and nickel electroforming

Compartment	Unit	PNEC	PEC _{Regional}	C _{local}	PEC	RCR	Methods for calculation of environmental concentrations and PNEC
Freshwater ES 1	µg Ni/L	3.55	2.9	0.14	3.04	0.86	Measured values, Tier 3-RWC
Freshwater ES 2	µg Ni/L	3.55	2.9	0.22	3.12	0.88	
Freshwater ES 3	µg Ni/L	3.55	2.9	0.44	3.34	0.94	
Marine	µg Ni/L	8.6	0.3	6.43	6.73	0.78	
Terrestrial ES 2 - sludge application	mg Ni/kg	29.9	16.2	9.56	25.76	0.86	

Workers

ES 2.1

PROC 5, PROC8a, PROC 8b, PROC 13, PROC 0: Operations involving dry salts

	Unit	DNEL	Exposure concentration	RCR	Methods for calculation of exposure
Dermal					
Acute systemic	mg Ni/kg/day	-	NR	-	
Acute local	mg Ni/cm ² /day	-	NR	-	
Long-term systemic	mg Ni/kg/day	-	NR	-	
Long-term local	mg Ni/cm ² /day	0.00044	0.00003	0.068	Exposure estimated using MEASE model for PROC 8a. It is assumed that dry salts behave like solids with medium dustiness and the exposure to them occurs intermittently for 60 – 240 minutes. Use of LEV is assumed.
Inhalation					
Acute systemic	mg Ni/m ³	16	0.099	0.006	3X the estimated long-term exposure using MEASE
Acute local	mg Ni/m ³	0.7	0.099	0.14	
Long-term systemic	mg Ni/m ³	0.05	0.033	0.66	Exposure estimated using MEASE model for PROC 8a. It is assumed that dry salts behave
Long-term local	mg Ni/m ³	0.05	0.033	0.66	

					like solids with medium dustiness and the exposure to them occurs intermittently for 60 – 240 minutes. Use of LEV and RPE (APF 20) is assumed.
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ES 2.2

PROC8a, PROC 8b, PROC 13, PROC 15, PROC 0: Operations with salt solutions

	Unit	DNEL	Exposure concentration	RCR	Methods for calculation of exposure
Dermal					
Acute systemic	mg Ni/kg/day	-	NR	-	
Acute local	mg Ni/cm ² /day	-	NR	-	
Long-term systemic	mg Ni/kg/day	-	NR	-	
Long-term local	mg Ni/cm ² /day	0.00044	7 x 10 ⁻⁵	0.16	Estimated 75 th percentile of long-term mean dermal exposure to soluble Ni
Inhalation					
Acute systemic	mg Ni/m ³	16	0.06	0.004	Estimated as three times the estimated 75 th percentile exposure to airborne soluble Ni
Acute local	mg Ni/m ³	0.7	0.06	0.09	
Long-term systemic	mg Ni/m ³	0.05	0.02	0.4	Estimated 75 th percentile exposure to airborne soluble Ni assuming manual plating process with effective LEV in place
Long-term local	mg Ni/m ³	0.05	0.02	0.4	

NR. Not relevant because of negligible dermal absorption or lack of dermal irritation.

Notes

Collect process monitoring data. Respirable fraction exposure levels should be kept below 0.01 mg Ni/m³. Use speciation to ensure that the appropriate inhalable DNEL is used (e.g., if only Ni metal and Ni oxide are present, an inhalable exposure of 0.2 mg Ni/m³ could be reasonably assumed to be safe).

Acute local inhalation

Based on respirable size aerosols. Equivalent inhalable fraction levels expected to be at least 3-fold higher

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Environment

Scaling tool: Metals EUSES IT tool (free download: <http://www.arche-consulting.be/Metal-CSA-toolbox/du-scaling-tool>)

Scaling of the release to air and water environment includes:

Refining of the release factor to air and waste water and/or and the efficiency of the air filter and wastewater treatment facility.

Scaling of the PNEC for aquatic environment by using a tiered approach for correction for bioavailability and background concentration (C_{local} approach).

Scaling of the PNEC for soil compartment by using a tiered approach for correction for bioavailability and background concentration (C_{local} approach).

Workers

Scaling considering duration and frequency of use.

Collect process monitoring data. Use aerosol particle size information, when available, to confirm the appropriate use of

an inhalable DNEL (e.g., ≤10% of Nickel mass in respirable fraction).

Man via the environment exposure and risk characterisation assessments for the use of nickel sulphamate in metal surface treatment

For each sector, an overview of the range of operational conditions (OCs) and predicted C_{local} air and PEC air are given below. To assess whether a site is compliant with the GES, the predicted C_{local} needs to be compared to 11.5 ng Ni/m³ or the measured PEC needs to be compared to the DNEL of 20 ng Ni/m³.

Sector overview

	tonnage (T/year)	daily emissions to air (kg/d)	release factor to air (g/T)	Emission days to air per site (d/y)	$C_{\text{local, air}}^*$ (ng Ni/m ³)	PEC air [§] (ng Ni/m ³)
min	4	<0.01	15	220	<1	9
max	1500	0.24	4000	336	43	52
median	14	0.08	2032	235	12	12

*: based on EUSES air model

§: based on measured values and C_{local} predicted + regional background or monitoring data depending on available information.

For two companies calculations were based on a SPERC with a release factor of 4000 g/T.