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| 1. Title | |
| GES 2 Metal surface treatment – nickel electroplating, nickel electroforming and electroless nickel plating | |
| Life cycle | Intermediate use of NiCl ₂ |
| 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 use</p> <p>ERC: ERC5: Industrial use resulting in inclusion into or onto a matrix</p> <p>PROC:</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 and nickel electroforming. Use of nickel chloride as 'make-up' salt in electrolytic nickel plating, in electroforming and electroless nickel plating |
| Processes, tasks, activities covered (workers) | <p>Contributing exposure scenario ES 2.1:</p> <p>Operations involving dry salts</p> <p>Contributing exposure scenario ES 2.2:</p> <p>Operations with salt solutions</p> |
| 2. Operational conditions and risk management measures | |
| 2.1 Control of environmental exposure | |
| Environmental related free short title | Metal surface treatment– nickel electroplating and nickel electroforming |
| Systematic title based on use descriptor (environment) | ERC5: Industrial use resulting in inclusion into or onto a matrix |
| Processes, tasks, activities covered (environment) | Metal surface treatment- nickel electroplating and nickel electroforming. Use of nickel chloride as 'make-up' salt in electrolytic nickel plating and in electroforming. |
| Environmental Assessment Method | Estimates based on monitoring local and regional concentrations are used for calculation of PEC |
| Product characteristics | |
| Ni chloride: Dry 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> <p>ES 3: 3.9 tonnes (25th %, 2007); Direct discharge</p> |
| Frequency and duration of use | |
| Pattern of release to the environment | Air: 220 days per year per site (50 th %) |
| Environment factors not influenced by risk management | |
| Receiving surface water flow rate | <p>ES 1 discharge to STP: 1.8xE4 m³/d</p> <p>ES 2 discharge to STP: 2.0xE6 m³/d</p> <p>ES 3 direct discharge: 1.6xE2 m³/d</p> |
| Dilution capacity, freshwater | <p>ES 1: 10 (50th %)</p> <p>ES 2: 1000 (max)</p> |

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| | 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 | |
| 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% | |
| ES1 freshwater Discharge to STP and Marine: 131 g/T (median) | |
| ES2 freshwater Discharge to STP: 827 g/T (75%) | |
| ES3 Direct discharge to freshwater: 63 g/T (25 th %) | |
| Air: | |
| Treatment of stack air emission by wet scrubbers. Efficiency 99% | |
| Release factor after on-site treatment: 80 g/T (max) | |
| Organizational measures to prevent/limit release from site | |
| Regular and documented controls may be applied including checking the galvanic-line and chemical storage for leaks. | |
| 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 | The 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 generic cutoffs (for mixtures) as stated in regulation (EC) No. 1272/2008. Ni bearing waste mixtures may be assessed as substances 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 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 chloride solution |

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| | Cleaning and maintenance |
| Assessment Method | Estimation of acute inhalation 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 chloride: Dry salt of approximately 100 % or solution of 25-50% | |
| Amounts used | |
| Not relevant | |
| Frequency and duration of use/exposure | |
| Addition of Ni chloride 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 chloride 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 of 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 | |
| <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 chloride to tank Dipping of items to be coated Removal of coated items Rinsing of coated items |

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| | Removal of spent solution/rinse water from tank Wastewater handling – rinse water Cleaning and maintenance |
| Assessment Method | Estimation of exposure based on measured data for an analogous substance. |
| Product characteristic | |
| Ni chloride: Solution of 25-50% | |
| Amounts used | |
| Not relevant | |
| Frequency and duration of use/exposure | |
| 8 hour shifts. Duration and frequency are regulated to type of working: 8 hours per shift by manual dipping and less than half hour by automatic lines. | |
| 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 | Not relevant |
| Body weight | Not relevant |
| Other given operational conditions affecting workers exposure | |
| Ni chloride is added to the plating bath in solution. Plating process involves immersion of piece into plating tank followed by immersion of piece into rinse tanks. Temperature of plating baths is typically 25-70°C. Plating bath is agitated by bubbling air through the electrolyte solution or strong floating rate to ensure even availability of Ni salt to piece being plated. Maintain a clean workplace. 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. Plating is either manual, semi-automated or automated: Manual plating - parts are placed on racks or hangers and manually transferred from tank to tank Semi-automated plating - parts are manually loaded on to jigs that are moved between the baths using an overhead hoist Automated plating – as semi-automated process except jigs moved electronically 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). Tank should be covered if not enclosed (e.g. by use of floating cover). Storage vessels used for electroplating solutions should be capped. | |
| 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 | |
| <u>Inhalation:</u> Use of RPE (APF 20) is required for cleaning and maintenance operations. <u>Dermal:</u> Gloves and other suitable protective clothing are required to minimise dermal contact with solution (acid resistant) | |
| 3. Exposure and risk estimation | |
| Environment | |

| ERC 5 Metal surface treatment– nickel electroplating and nickel electroforming | | | | | | | |
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| 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 | |
| Terrestrial ES 2 – no sludge application | mg Ni/kg | 29.9 | 16.2 | 0.01 | 16.21 | 0.54 | |
| 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. Use of LEV and properly designed gloves is assumed. | |
| Inhalation | | | | | | | |
| Acute systemic | | mg Ni/m ³ | 16 | 0.099 | 0.006 | 3 X long-term exposure value | |
| 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. Use of LEV, RPE (APF 20) and properly designed gloves is assumed. | |
| Long-term local | | mg Ni/m ³ | 0.05 | 0.033 | 0.66 | | |
| 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 | 7x10 ⁻⁵ | 0.16 | Estimated 75 th percentile exposure to soluble Ni assuming suitable protective clothing employed | |

| Inhalation | | | | | |
|--------------------|----------------------|------|------|-------|---|
| Acute systemic | mg Ni/m ³ | 16 | 0.06 | 0.004 | Estimated as 3x the estimated 75 th percentile exposure to airborne soluble Ni |
| Acute local | mg Ni/m ³ | 0.7 | 0.06 | 0.09 | Estimated as 3x the estimated 75 th percentile exposure to airborne soluble Ni |
| 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 | Estimated 75 th percentile exposure to airborne soluble Ni assuming manual plating process with effective LEV in place |

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 Environment exposure and risk characterisation assessments for the use of nickel chloride in metal surface treatment

For each sector, an overview of the range of operational conditions (OC) 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 _{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 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 4000g/T.