

ES FOR COMMUNICATION

Substance Name: NICKEL SUBSULPHIDE (update 2017)

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0. General provisions related to conditions of use and guidance to downstream users

All provisions given in this section generally apply to each exposure scenario (ES) included below. They are to be supplemented or exchanged by more specific measures as given in the applicable exposure scenario as appropriate.

0.1. Good occupational hygiene practice

Good occupational hygiene practices are required to ensure safe handling of the substance. In general, inhalation (e.g. dust should not be blown off with compressed air) and ingestion must be avoided (e.g. no eating and smoking in the workplace, regular cleaning with suitable cleaning devices). Any contaminated clothing should not be taken home. Good general ventilation in the workplace should ensure an adequate supply of fresh air. Regular training in workplace hygiene practice and proper use of personal protective equipment (if relevant) are required.

0.2. General provisions related to personal protective equipment for workers

Use of personal protective equipment (PPE) for each of the exposure routes listed below is required as described here, unless exposure to the substance can be excluded for the respective route(s) of exposure. Such exclusion of exposure may be determined by:

- (i) the physical appearance of the substance in the specific type of application (e.g. wetting the substance can effectively prevent from the emission of dust),
- (ii) the emission potential resulting from the nature of the process (e.g. splashes, emission of dust can be excluded in a closed process),
- (iii) applied exposure prevention measures (segregation of the emission source or separation of the worker from the emission source), and
- (iv) the amount of the handled/emitted material during use in relation to the room size (i.e. dilution factor) under consideration of the prevailing air exchange rates during use.

If PPE needs to be used, refer to section 8 of the SDS for further specification of such equipment.

0.2.1. Dermal route (skin protection)

Skin protective equipment should be selected in consideration of mechanical, cold or heat stress or any other physico-chemical hazards as relevant for the conducted tasks and working environment in addition to the effectiveness of the equipment to control exposure. Certified safety clothing including coveralls and safety shoes have to be worn. The following requirements for gloves are to be met:

- Due to the classification of the substance, gloves and skin protective clothing have to be worn for precautionary reasons unless dermal exposure can be excluded (please see above).
- If gloves are to be worn, either due to these general provisions or due to specific requirements set in the ES, they have to comply with EN 374.
- Any prescribed gloves have to be changed according to manufacturer's information or when damaged, whatever is the earlier.

0.2.2. Inhalation route (respiratory protection)

Specific information on the required assigned protection factor (APF) may be provided in the occupational exposure scenarios below. RPE should be selected based on the given APF according to EN 529 and should comply with national legislation. The following requirements for respiratory protective equipment (RPE) are to be met in any case:

- Due to the classification of the substance, RPE has to be worn for precautionary reasons unless inhalation exposure can be excluded (please see above).

- If RPE has to be worn, either due to these general provisions or due to specific requirements set in the ES, an APF of 10 represents the required minimum level of protection.

0.2.3. Eye/face protection

Eye/face protective equipment should be selected in consideration of mechanical, cold or heat stress or any other physico-chemical hazards as relevant for the conducted tasks and working environment in addition to the effectiveness of the equipment to control exposure. The following requirements for eye/face protective equipment are to be met:

- Avoid direct contact of the eyes with the substance.
- Suitable eye protection equipment (e.g. goggles or visors) must be worn.
- Face protection must be worn unless face protection is already provided by eye protection (e.g. face covering visor) worn and/or RPE.

0.3. Generic guidance to DU to evaluate whether he works inside the boundaries set by the ES

In any of the included exposure scenarios (ES) below, the downstream user (DU) works inside the boundaries set by the ES if the given operational conditions (OCs) and risk management measures (RMMs) as described in the ES are met. In cases in which the DU's conditions are not explicitly included in the generic conditions described in the ES, the DU has to ensure that his specific OCs and implemented RMMs are compliant. If the concentration of the substance in mixture is not explicitly stated in the ES this does not represent a restriction (i.e. up to 100 % of the substance could be used). Depending on the basis for the exposure assessment conducted for the ES, this needs to be done in different ways as described separately for environmental and occupational ES below.

0.3.1. Occupational exposure scenarios

The occupational exposure assessment may be either based on monitoring data (including analogous or published data) or based on exposure assessment models. Depending on which method has been used for exposure assessment, different ways for compliance checking are to be followed as given below.

0.3.1.1. Monitoring data used as basis for assessment

If the exposure assessment in the ES is based on monitoring data, the same approach can be used by DUs for compliance checking. Please note that 6 measurements per workplace are required for an exposure assessment as a minimum. Depending on the variability of the data sets (expressed as the geometric standard deviation) and the level of the resulting risk characterisation ratio, additional measurements may be required. Only measurements of personal exposure to the inhalable fraction of airborne dust (according to EN 481) should be used. The exposure data shall either be applicable to the length of a specific task to be assessed or to a full-shift (i.e. sampled over a duration of at least 120 min) if the task to be assessed is conducted for a significant portion of the work shift. From the exposure data set, the maximum likelihood estimate of the upper 90 % confidence limit for the 75th percentile of the exposure distribution is to be used as a reasonable worst case estimate for comparison with the reported exposure level in the associated contributing ES. Respiratory protective equipment (RPE) may be taken into account by applying the assigned protection factor as given in EN 529:2005.

0.3.1.1.1. Specific considerations for efficiency values for RMMs prescribed in occupational exposure scenarios

When personal exposure data are used to evaluate whether the conditions prescribed in the ES are met, the efficiency of the RMMs implemented does not need to be separately assessed given that monitored exposure levels are in compliance with those reported for the ES after consideration of any PPE worn.

0.3.1.1.2. Deviations from the conditions of use if monitoring data were used for exposure assessment

Any deviations from the given conditions of use require either to:

- (i) inform the supplier of the SDS about these deviations and to request a reflection of these deviations in an ES or
- (ii) prepare a DU CSR (according to Article 37(4)) to be notified to ECHA and to be kept as in-house documentation.

0.3.1.2. Use of exposure models

If the exposure assessment in the ES is based on modelled data, the same model can be used to justify specific slight deviations from the generic conditions described in the ES. All parameters needed to run the exposure estimation tool MEASE (version 1.02.01; available on www.ebrc.de/mease.html) can be found in the ES. It is noted that the installation of the prescribed RMMs is mandatory and that exclusively the modification of the personal protective equipment (PPE) used is allowed as deviation. The only parameters which may therefore be modified in the MEASE-calculation are consequently:

- (i) concentration in mixture (only lower concentrations),
- (ii) efficiency of the installed RMMs (only higher efficiencies), and
- (iii) type of PPE to be used.

0.3.1.2.1. Specific considerations for efficiency values for RMMs prescribed in occupational exposure scenarios

Any efficiency values reported in the ES represent typical efficiencies for a given industry sector after evaluating conditions of use as made available to the consultants and are therefore considered to adequately approximate to actual efficiencies. If downstream users want to evaluate whether prescribed efficiencies are met, exposure monitoring could be conducted. In such a case, monitored exposure levels should be at or lower than reported for the ES after consideration of any PPE worn. Further information on efficiency values can be found in the glossary of MEASE.

0.3.1.2.2. Deviations from the conditions of use if exposure models were used for exposure assessment

Further deviations from the given conditions of use or if the DU assessment is to be based on monitoring data require either to:

- (i) inform the supplier of the SDS about these deviations and to request a reflection of these deviations in an ES or
- (ii) prepare a DU CSR (according to Article 37(4)) to be notified to ECHA and to be kept as in-house documentation.

0.3.2. Environmental exposure scenarios

0.3.2.1. Deviations from the conditions of use

This can be done by using the MetalEUSES scaling tool (free download: <http://www.arche-consulting.be/tools/du-scaling-tool/>) to estimate the associated exposure. Following parameters can be scaled: amount used at local site, number of emission days, discharge effluent rate, dilution factor (or flow rate of the river), presence/absence of municipal sewage treatment plant (STP), removal rate municipal STP, use of municipal sludge on agricultural soil, and release factors to air and water.

0.4. Man via the environment exposure and risk characterisation assessments

Inhalation is the critical exposure pathway for humans via the environment. The PEC for air at site neighbouring residential areas should be lower than the chronic inhalation DNEL for the general public of 60 ng Ni/m³ as annual average in PM10 in order to demonstrate adequate control of risk (RCR<1) for Man via the Environment (MvE). Hereto a safe use Exposure Scenario for MvE was developed based on the EUSES model. The MvE ES is defined as the product of tonnage (T) and emission factor

to air (EF) being lower than 72700 g Ni/year. The value of 72700 g Ni/year is derived by using EUSES model to back-calculate the product of T and EF that results in a local air concentration (C_{local}) of 55.5 ng Ni/m³. The value of 55.5 ng Ni/m³ is derived from the difference between the DNEL of 60 ng Ni/m³ and the EU regional background concentration (C_{regional}) of 4.5 ng Ni/m³ (P90 annual concentration for 2012).

Safe use ES for all sectors according to Tier 1 (EUSES model)

Sector	Tonnage (Ni T /year)	Emission factor (g Ni/T)	Tonnage × emission factor (g /year)	C _{local} (ng/m ³)	C _{regional} (ng/m ³)	PEC _{local} (ng/m ³)	RCR = PEC/DNEL (DNEL= 60 ng/m ³)
All	T	EF	T × EF < 72700	<55.5	4.5*	<60	<1

*: EU average of country P90 annual Ni concentrations (2012)

If a site is not compliant with these conditions, meaning that the product of tonnage and emission factor is above 72700 g Ni/year, a tiered approach including site-specific modelling can be applied to demonstrate safe use.

1. ES 1: Formulation or re-packing; Various products; Formulation of nickel subsulphide-containing catalysts

1.1. Title section

Product category: Laboratory Chemicals (PC 21), Other (PC 0)

Environment	
1: Formulation of nickel subsulphide-containing catalysts Freshwater STP	ERC 2
2: Formulation of nickel subsulphide-containing catalysts Freshwater direct	ERC 2
3: Formulation of nickel subsulphide-containing catalysts Marine direct	ERC 2
Worker	
4: Loading of catalyst into reactor under inert atmosphere	PROC 1
5: Formulation (including impregnation and stabilisation) in closed systems	PROC 1, PROC 3, PROC 2
6: Packaging of catalysts in closed systems	PROC 1
7: Semi-automated packaging of stabilised/passivated catalysts	PROC 8b, PROC 9
8: Cleaning and maintenance at closed systems	PROC 28
9: Cleaning and maintenance at semi-closed systems	PROC 28

1.2. Conditions of use affecting exposure

1.2.1. Control of environmental exposure: Formulation of nickel subsulphide-containing catalysts Freshwater STP (ERC 2)

Amount used, frequency and duration of use (or from service life)
Daily amount per site \leq 0.46 tonnes/day (All the amounts are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site \leq 150.0 tonnes/year
Emission days \geq 327.0 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to biological sewage treatment plant
Municipal sewage treatment plant is assumed
Assumed domestic sewage treatment plant flow \geq 2000 m ³ /day
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to marine water assumed
Receiving water dilution (fresh or marine) \geq 50.0
Receiving surface water flow \geq 98000 m ³ /day

1.2.2. Control of environmental exposure: Formulation of nickel

subsulphide-containing catalysts Freshwater direct (ERC 2)

Amount used, frequency and duration of use (or from service life)
Daily amount per site ≤ 0.46 tonnes/day (All the amounts are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site ≤ 150.0 tonnes/year
Emission days ≥ 327.0 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to marine water assumed
Receiving water dilution (fresh or marine) ≥ 750.0
Receiving surface water flow ≥ 101864 m ³ /day
Assumed effluent discharge flow from site ≥ 136.0 m ³ /day

1.2.3. Control of environmental exposure: Formulation of nickel subsulphide-containing catalysts Marine direct (ERC 2)

Amount used, frequency and duration of use (or from service life)
Daily amount per site ≤ 0.31 tonnes/day (All the amounts are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site ≤ 100.0 tonnes/year
Emission days ≥ 327.0 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to freshwater assumed
Receiving water dilution (fresh or marine) ≥ 200.0
Assumed effluent discharge flow from site ≥ 272.0 m ³ /day

1.2.4. Control of worker exposure: Loading of catalyst into reactor under inert atmosphere (PROC 1)

Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Use in closed process
Automated task

1.2.5. Control of worker exposure: Formulation (including impregnation and stabilisation) in closed systems (PROC 1, PROC 3, PROC 2)

Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Use in closed process
Automated task

1.2.6. Control of worker exposure: Packaging of catalysts in closed systems (PROC 1)

Product (Article) characteristics
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Use in closed process
Automated task

1.2.7. Control of worker exposure: Semi-automated packaging of stabilised/passivated catalysts (PROC 8b, PROC 9)

Product (Article) characteristics
Physical form covered in this ES: Shaped catalyst, encapsulated powders.
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Semi-closed system
Semi-automated task
Use of a local exhaust ventilation with standard efficiency is required.
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 10 (90.0% respiratory protection). For further specification, refer to section 8 of the SDS.

1.2.8. Control of worker exposure: Cleaning and maintenance at closed systems (PROC 28)

Product (Article) characteristics
Physical form covered in this ES: Solutions/Suspensions, residual dust.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
During cleaning use vacuum and/or (pressure) washing with water to remove dusts or powders. No direct handling (use of long-distance tools).

1.2.9. Control of worker exposure: Cleaning and maintenance at semi-closed systems (PROC 28)

Product (Article) characteristics
Physical form covered in this ES: Solutions/Suspensions, residual dust.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
During cleaning use vacuum and/or (pressure) washing with water to remove dusts or powders. No direct handling (use of long-distance tools).
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 10 (90.0% respiratory protection). For further specification, refer to section 8 of the SDS.
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.

1.3. Exposure estimation and reference to its source

1.3.1. Environmental release and exposure: Formulation of nickel subsulphide-containing catalysts Freshwater STP (ERC 2)

Release route	Release rate	Release estimation method
Water	0.279 kg/day	Estimated release factor
Air	0.102 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	4.1E-3 mg/L (EUSES 2.1.2)	0.578
Sediment (freshwater)	65.07 mg/kg dw (PEC sediment calculation method for metals)	0.597
Sewage Treatment Plant	0.084 mg/L (EUSES 2.1.2)	0.254
Agricultural soil	18.55 mg/kg dw (EUSES 2.1.2)	0.621

1.3.2. Environmental release and exposure: Formulation of nickel subsulphide-containing catalysts Freshwater direct (ERC 2)

Release route	Release rate	Release estimation method
Water	0.279 kg/day	Estimated release factor
Air	0.102 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	4.86E-3 mg/L (EUSES 2.1.2)	0.685
Sediment (freshwater)	85.08 mg/kg dw (PEC sediment calculation method for metals)	0.781
Agricultural soil	16.21 mg/kg dw (EUSES 2.1.2)	0.542

1.3.3. Environmental release and exposure: Formulation of nickel subsulphide-containing catalysts Marine direct (ERC 2)

Release route	Release rate	Release estimation method
Water	0.067 kg/day	Estimated release factor
Air	0.068 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Marine water	2.07E-3 mg/L (EUSES 2.1.2)	0.241
Sediment (marine water)	62.76 mg/kg dw (PEC sediment calculation method for metals)	0.576
Agricultural soil	16.21 mg/kg dw (EUSES 2.1.2)	0.542

1.3.4. Worker exposure: Loading of catalyst into reactor under inert atmosphere (PROC 1)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	9E-3 mg/m ³ (Measured data)	0.18
Inhalation, systemic, acute	0.027 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	9E-3 mg/m ³ (Measured data)	0.18
Inhalation, local, acute	0.027 mg/m ³ (Measured data)	0.034
Dermal, local, long term	0.076 µg/cm ² (Measured data)	0.019
Combined, systemic, long term		0.18
Combined, systemic, acute		< 0.01

1.3.5. Worker exposure: Formulation (including impregnation and stabilisation) in closed systems (PROC 1, PROC 3, PROC 2)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.013 mg/m ³ (Measured data)	0.26
Inhalation, systemic, acute	0.052 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.013 mg/m ³ (Measured data)	0.26
Inhalation, local, acute	0.052 mg/m ³ (Measured data)	0.065
Dermal, local, long term	0.076 µg/cm ² (Measured data)	0.019
Combined, systemic, long term		0.26
Combined, systemic, acute		< 0.01

1.3.6. Worker exposure: Packaging of catalysts in closed systems (PROC 1)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	9E-3 mg/m ³ (Measured data)	0.18
Inhalation, systemic, acute	0.027 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	9E-3 mg/m ³ (Measured data)	0.18
Inhalation, local, acute	0.027 mg/m ³ (Measured data)	0.034
Dermal, local, long term	0.076 µg/cm ² (Measured data)	0.019
Combined, systemic, long term		0.18

Route of exposure and type of effects	Exposure estimate	RCR
Combined, systemic, acute		< 0.01

1.3.7. Worker exposure: Semi-automated packaging of stabilised/passivated catalysts (PROC 8b, PROC 9)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.014 mg/m ³ (Measured data)	0.28
Inhalation, systemic, acute	0.071 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.014 mg/m ³ (Measured data)	0.28
Inhalation, local, acute	0.071 mg/m ³ (Measured data)	0.089
Dermal, local, long term	0.76 µg/cm ² (Measured data)	0.19
Combined, systemic, long term		0.28
Combined, systemic, acute		< 0.01

1.3.8. Worker exposure: Cleaning and maintenance at closed systems (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.021 mg/m ³ (Measured data)	0.42
Inhalation, systemic, acute	0.085 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.021 mg/m ³ (Measured data)	0.42
Inhalation, local, acute	0.085 mg/m ³ (Measured data)	0.106
Dermal, local, long term	0.76 µg/cm ² (Measured data)	0.19
Combined, systemic, long term		0.42
Combined, systemic, acute		< 0.01

1.3.9. Worker exposure: Cleaning and maintenance at semi-closed systems (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.018 mg/m ³ (Measured data)	0.36
Inhalation, systemic, acute	0.073 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.018 mg/m ³ (Measured data)	0.36
Inhalation, local, acute	0.073 mg/m ³ (Measured data)	0.091
Dermal, local, long term	0.11 µg/cm ² (Measured data)	0.028
Combined, systemic, long term		0.36
Combined, systemic, acute		< 0.01

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

Guidance: Please refer to Section 0.3 of this "ES for Communication".

2. ES 2: Use at industrial sites; Various products; Various sectors; Use of nickel subsulphide-containing catalysts

2.1. Title section

Product category: Laboratory Chemicals (PC 21), Other (PC 0)

Sector of use: Manufacture of fine chemicals (SU 9), Manufacture of bulk, large scale chemicals (including petroleum products) (SU 8)

Environment	
1: Use of nickel subsulphide-containing catalysts	ERC 4
2: Use of nickel subsulphide-containing catalysts	ERC 6b
Worker	
3: Enclosed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device	PROC 3, PROC 9, PROC 8b
4: Semi-closed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device	PROC 4, PROC 9, PROC 8b
5: Use of catalyst in closed systems	PROC 1, PROC 3, PROC 2
6: Screening of spent catalyst	PROC 4
7: Enclosed unloading/emptying of spent catalyst	PROC 3
8: Semi-closed unloading/emptying of spent catalyst	PROC 8b
9: Manual unloading/emptying of spent catalyst (incl. tasks inside reactors)	PROC 4, PROC 8b
10: Manual handling of (spent) catalysts in dust-reduced form	PROC 4, PROC 8b
11: Transfer of spent catalyst into containers	PROC 8b, PROC 9
12: Cleaning and maintenance at closed systems	PROC 28
13: Cleaning and maintenance at semi-closed systems	PROC 28

2.2. Conditions of use affecting exposure

2.2.1. Control of environmental exposure: Use of nickel subsulphide-containing catalysts (ERC 4)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 6.0 tonnes/day (All the amounts are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 40.0 tonnes/year
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.

2.2.2. Control of environmental exposure: Use of nickel subsulphide-containing catalysts (ERC 6b)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 6.0 tonnes/day (All the amounts are expressed as Ni as this is the driver for the environmental risk assessment.)

Annual amount per site <= 40.0 tonnes/year
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.

2.2.3. Control of worker exposure: Enclosed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device (PROC 3, PROC 9, PROC 8b)

Product (Article) characteristics
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Use in closed process
Automated task

2.2.4. Control of worker exposure: Semi-closed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device (PROC 4, PROC 9, PROC 8b)

Product (Article) characteristics
Physical form covered in this ES: Shaped catalyst, encapsulated powders.
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Semi-closed system
Semi-automated task
Use of a local exhaust ventilation with standard efficiency is required.
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 10 (90.0% respiratory protection). For further specification, refer to section 8 of the SDS.

2.2.5. Control of worker exposure: Use of catalyst in closed systems (PROC 1, PROC 3, PROC 2)

Product (Article) characteristics
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Use in closed process
Automated task

2.2.6. Control of worker exposure: Screening of spent catalyst (PROC 4)

Product (Article) characteristics
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Physical form covered in this ES: Shaped catalyst.
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Process conducted indoors at large workrooms
Low level containment with 90 % exposure reduction during supervision
Canopy hood with 50 % exposure reduction during supervision and occasional opening of the system
Mechanical ventilation giving at least 1 air change per hour during supervision and occasional opening of the system
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 20 (95.0% respiratory protection). For further specification, refer to section 8 of the SDS.

2.2.7. Control of worker exposure: Enclosed unloading/emptying of spent catalyst (PROC 3)

Product (Article) characteristics
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Use in closed process
Automated task

2.2.8. Control of worker exposure: Semi-closed unloading/emptying of spent catalyst (PROC 8b)

Product (Article) characteristics
Physical form covered in this ES: Shaped catalyst, encapsulated powders.
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Semi-closed system
Semi-automated task
Use of a local exhaust ventilation with standard efficiency is required.
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 10 (90.0% respiratory protection). For further specification, refer to section 8 of the SDS.

2.2.9. Control of worker exposure: Manual unloading/emptying of spent catalyst (incl. tasks inside reactors) (PROC 4, PROC 8b)

Product (Article) characteristics
Physical form covered in this ES: Shaped catalyst, encapsulated powders.
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)

Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Highly efficient extraction hose to be used. No direct handling (use of long-distance tools)
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 10 (90% respiratory protection). Under inert gas atmosphere, a self-contained breathing apparatus with higher efficiency is required.
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.

2.2.10. Control of worker exposure: Manual handling of (spent) catalysts in dust-reduced form (PROC 4, PROC 8b)

Product (Article) characteristics
Physical form covered in this ES: Catalyst in dust-reduced (i.e. low dusty) form, e.g. solid cake or in semi-wet state.
20 % nickel concentration in catalyst
Amount used (or contained in articles), frequency and duration of use/exposure
Avoid carrying out activities involving exposure for more than 1 hour. Once per shift or up to 1-2 times per week.
Technical and organisational conditions and measures
Tools providing distance to exposure source to be used (e.g. paddles with long handle)
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 10 (90.0% respiratory protection). For further specification, refer to section 8 of the SDS.
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.

2.2.11. Control of worker exposure: Transfer of spent catalyst into containers (PROC 8b, PROC 9)

Product (Article) characteristics
Physical form covered in this ES: Shaped catalyst, encapsulated powders.
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Semi-closed system
Semi-automated task
Use of a local exhaust ventilation with standard efficiency is required.
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 10 (90.0% respiratory protection). For further specification, refer to section 8 of the SDS.

2.2.12. Control of worker exposure: Cleaning and maintenance at closed systems (PROC 28)

Product (Article) characteristics
Physical form covered in this ES: Solutions/Suspensions, residual dust.
Amount used (or contained in articles), frequency and duration of use/exposure

Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
During cleaning use vacuum and/or (pressure) washing with water to remove dusts or powders. No direct handling (use of long-distance tools).

2.2.13. Control of worker exposure: Cleaning and maintenance at semi-closed systems (PROC 28)

Product (Article) characteristics
Physical form covered in this ES: Solutions/Suspensions, residual dust.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
During cleaning use vacuum and/or (pressure) washing with water to remove dusts or powders. No direct handling (use of long-distance tools).
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 10 (90.0% respiratory protection). For further specification, refer to section 8 of the SDS.
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.

2.3. Exposure estimation and reference to its source

2.3.1. Environmental release and exposure: Use of nickel subsulphide-containing catalysts (ERC 4)

Release route	Release rate	Release estimation method
Water	0 kg/day	Estimated release factor
Air	0 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

2.3.2. Environmental release and exposure: Use of nickel subsulphide-containing catalysts (ERC 6b)

Release route	Release rate	Release estimation method
Water	0 kg/day	Estimated release factor
Air	0 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

2.3.3. Worker exposure: Enclosed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device (PROC 3, PROC 9, PROC 8b)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	9E-3 mg/m ³ (Measured data)	0.18
Inhalation, systemic, acute	0.027 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	9E-3 mg/m ³ (Measured data)	0.18
Inhalation, local, acute	0.027 mg/m ³ (Measured data)	0.034

Route of exposure and type of effects	Exposure estimate	RCR
Dermal, local, long term	0.076 µg/cm ² (Measured data)	0.019
Combined, systemic, long term		0.18
Combined, systemic, acute		< 0.01

2.3.4. Worker exposure: Semi-closed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device (PROC 4, PROC 9, PROC 8b)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.014 mg/m ³ (Measured data)	0.28
Inhalation, systemic, acute	0.071 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.014 mg/m ³ (Measured data)	0.28
Inhalation, local, acute	0.071 mg/m ³ (Measured data)	0.089
Dermal, local, long term	0.76 µg/cm ² (Measured data)	0.19
Combined, systemic, long term		0.28
Combined, systemic, acute		< 0.01

2.3.5. Worker exposure: Use of catalyst in closed systems (PROC 1, PROC 3, PROC 2)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.013 mg/m ³ (Measured data)	0.26
Inhalation, systemic, acute	0.052 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.013 mg/m ³ (Measured data)	0.26
Inhalation, local, acute	0.052 mg/m ³ (Measured data)	0.065
Dermal, local, long term	0.076 µg/cm ² (Measured data)	0.019
Combined, systemic, long term		0.26
Combined, systemic, acute		< 0.01

2.3.6. Worker exposure: Screening of spent catalyst (PROC 4)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.029 mg/m ³ (ART)	0.58
Inhalation, systemic, acute	0.058 mg/m ³ (ART)	< 0.01
Inhalation, local, long term	0.029 mg/m ³ (ART)	0.58
Inhalation, local, acute	0.058 mg/m ³ (ART)	0.073
Dermal, local, long term	0.76 µg/cm ² (Measured data)	0.19
Combined, systemic, long term		0.58
Combined, systemic, acute		< 0.01

2.3.7. Worker exposure: Enclosed unloading/emptying of spent catalyst (PROC 3)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	9E-3 mg/m ³ (Measured data)	0.18
Inhalation, systemic, acute	0.027 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	9E-3 mg/m ³ (Measured data)	0.18
Inhalation, local, acute	0.027 mg/m ³ (Measured data)	0.034
Dermal, local, long term	0.076 µg/cm ² (Measured data)	0.019
Combined, systemic, long term		0.18
Combined, systemic, acute		< 0.01

2.3.8. Worker exposure: Semi-closed unloading/emptying of spent catalyst (PROC 8b)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.014 mg/m ³ (Measured data)	0.28
Inhalation, systemic, acute	0.071 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.014 mg/m ³ (Measured data)	0.28
Inhalation, local, acute	0.071 mg/m ³ (Measured data)	0.089
Dermal, local, long term	0.76 µg/cm ² (Measured data)	0.19
Combined, systemic, long term		0.28
Combined, systemic, acute		< 0.01

2.3.9. Worker exposure: Manual unloading/emptying of spent catalyst (incl. tasks inside reactors) (PROC 4, PROC 8b)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.018 mg/m ³ (Measured data)	0.36
Inhalation, systemic, acute	0.073 µg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.018 mg/m ³ (Measured data)	0.36
Inhalation, local, acute	0.073 µg/m ³ (Measured data)	< 0.01
Dermal, local, long term	0.11 µg/cm ² (Measured data)	0.028
Combined, systemic, long term		0.36
Combined, systemic, acute		< 0.01

2.3.10. Worker exposure: Manual handling of (spent) catalysts in dust-reduced form (PROC 4, PROC 8b)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	6E-3 mg/m ³ (MEASE)	0.12
Inhalation, systemic, acute	0.06 mg/m ³ (MEASE)	< 0.01
Inhalation, local, long term	6E-3 mg/m ³ (MEASE)	0.12
Inhalation, local, acute	0.06 mg/m ³ (MEASE)	0.075
Dermal, local, long term	0.11 µg/cm ² (Measured data)	0.028
Combined, systemic, long term		0.12
Combined, systemic, acute		< 0.01

2.3.11. Worker exposure: Transfer of spent catalyst into containers (PROC 8b, PROC 9)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.014 mg/m ³ (Measured data)	0.28
Inhalation, systemic, acute	0.071 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.014 mg/m ³ (Measured data)	0.28
Inhalation, local, acute	0.071 mg/m ³ (Measured data)	0.089
Dermal, local, long term	0.76 µg/cm ² (Measured data)	0.19
Combined, systemic, long term		0.28
Combined, systemic, acute		< 0.01

2.3.12. Worker exposure: Cleaning and maintenance at closed systems (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.021 mg/m ³ (Measured data)	0.42
Inhalation, systemic, acute	0.085 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.021 mg/m ³ (Measured data)	0.42
Inhalation, local, acute	0.085 mg/m ³ (Measured data)	0.106
Dermal, local, long term	0.76 µg/cm ² (Measured data)	0.19
Combined, systemic, long term		0.42
Combined, systemic, acute		< 0.01

2.3.13. Worker exposure: Cleaning and maintenance at semi-closed systems (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.018 mg/m ³ (Measured data)	0.36
Inhalation, systemic, acute	0.073 µg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.018 mg/m ³ (Measured data)	0.36
Inhalation, local, acute	0.073 µg/m ³ (Measured data)	< 0.01
Dermal, local, long term	0.11 µg/cm ² (Measured data)	0.028
Combined, systemic, long term		0.36
Combined, systemic, acute		< 0.01

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

Guidance: Please refer to Section 0.3 of this "ES for Communication".

3. ES 3: Use at industrial sites; Various sectors; Use of nickel subsulphide-containing catalysts for the manufacture of other nickel substances

3.1. Title section

Sector of use: Manufacture of fine chemicals (SU 9), Manufacture of bulk, large scale chemicals (including petroleum products) (SU 8)

Environment	
1: Use of nickel subsulphide-containing catalysts for the manufacture of other nickel substances Freshwater STP	ERC 6a
2: Use of nickel subsulphide-containing catalysts for the manufacture of other nickel substances Freshwater direct	ERC 6a
3: Use of nickel subsulphide-containing catalysts for the manufacture of other nickel substances Marine direct	ERC 6a
Worker	
4: Enclosed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device	PROC 3, PROC 9, PROC 8b
5: Semi-closed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device	PROC 8b, PROC 9
6: Use of catalyst in closed systems	PROC 1, PROC 3, PROC 2
7: Cleaning and maintenance at closed systems	PROC 28
8: Cleaning and maintenance at semi-closed systems	PROC 28

3.2. Conditions of use affecting exposure

3.2.1. Control of environmental exposure: Use of nickel subsulphide-containing catalysts for the manufacture of other nickel substances Freshwater STP (ERC 6a)

Amount used, frequency and duration of use (or from service life)
Daily amount per site <= 0.41 tonnes/day (All the amounts are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site <= 150.0 tonnes/year
Emission days >= 364.0 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to biological sewage treatment plant
Municipal sewage treatment plant is assumed
Assumed domestic sewage treatment plant flow >= 2000 m3/day
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to marine water assumed

Receiving water dilution (fresh or marine) ≥ 10.0
Receiving surface water flow ≥ 18000 m ³ /day

3.2.2. Control of environmental exposure: Use of nickel subsulphide-containing catalysts for the manufacture of other nickel substances Freshwater direct (ERC 6a)

Amount used, frequency and duration of use (or from service life)
Daily amount per site ≤ 0.41 tonnes/day (All the amounts are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site ≤ 150.0 tonnes/year
Emission days ≥ 364.0 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to marine water assumed
Receiving water dilution (fresh or marine) ≥ 250.0
Receiving surface water flow ≥ 24402 m ³ /day
Assumed effluent discharge flow from site ≥ 98.0 m ³ /day

3.2.3. Control of environmental exposure: Use of nickel subsulphide-containing catalysts for the manufacture of other nickel substances Marine direct (ERC 6a)

Amount used, frequency and duration of use (or from service life)
Daily amount per site ≤ 0.41 tonnes/day (All the amounts are expressed as Ni as this is the driver for the environmental risk assessment.)
Annual amount per site ≤ 150.0 tonnes/year
Emission days ≥ 364.0 days/year
Technical and organisational conditions and measures
Chemical precipitation or sedimentation or filtration or electrolysis or reverse osmosis or ion exchange
Electrostatic precipitator or wet electrostatic precipitator or cyclones or fabric/bag filter or ceramic/metal mesh filter or wet scrubber
Conditions and measures related to external treatment of waste (including article waste)
Dispose of waste product or used containers according to local regulations.
Other conditions affecting environmental exposure
No discharge to freshwater assumed
Receiving water dilution (fresh or marine) ≥ 100.0
Assumed effluent discharge flow from site ≥ 98.0 m ³ /day

3.2.4. Control of worker exposure: Enclosed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device (PROC 3,

PROC 9, PROC 8b)

Product (Article) characteristics
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Use in closed process
Automated task

3.2.5. Control of worker exposure: Semi-closed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device (PROC 8b, PROC 9)

Product (Article) characteristics
Physical form covered in this ES: Shaped catalyst.
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Semi-closed system
Semi-automated task
Use of a local exhaust ventilation with standard efficiency is required.
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 10 (90.0% respiratory protection). For further specification, refer to section 8 of the SDS.

3.2.6. Control of worker exposure: Use of catalyst in closed systems (PROC 1, PROC 3, PROC 2)

Product (Article) characteristics
Limit the substance content in the product to 20 % (Nickel concentration in catalyst)
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
Use in closed process
Automated task

3.2.7. Control of worker exposure: Cleaning and maintenance at closed systems (PROC 28)

Product (Article) characteristics
Physical form covered in this ES: Solutions/Suspensions, residual dust.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
During cleaning use vacuum and/or (pressure) washing with water to remove dusts or powders. No direct handling (use of long-distance tools).

3.2.8. Control of worker exposure: Cleaning and maintenance at semi-closed systems (PROC 28)

Product (Article) characteristics
Physical form covered in this ES: Solutions/Suspensions, residual dust.
Amount used (or contained in articles), frequency and duration of use/exposure
Covers daily exposures up to 8 hours
Technical and organisational conditions and measures
During cleaning use vacuum and/or (pressure) washing with water to remove dusts or powders. No direct handling (use of long-distance tools).
Conditions and measures related to personal protection, hygiene and health evaluation
APF of RPE = 10 (90.0% respiratory protection). For further specification, refer to section 8 of the SDS.
Wear suitable gloves tested to EN374.; For further specification, refer to section 8 of the SDS.

3.3. Exposure estimation and reference to its source

3.3.1. Environmental release and exposure: Use of nickel subsulphide-containing catalysts for the manufacture of other nickel substances Freshwater STP (ERC 6a)

Release route	Release rate	Release estimation method
Water	0.091 kg/day	Estimated release factor
Air	0.092 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	4.85E-3 mg/L (EUSES 2.1.2)	0.683
Sediment (freshwater)	84.81 mg/kg dw (PEC sediment calculation method for metals)	0.778
Sewage Treatment Plant	0.027 mg/L (EUSES 2.1.2)	0.082
Agricultural soil	16.97 mg/kg dw (EUSES 2.1.2)	0.568

3.3.2. Environmental release and exposure: Use of nickel subsulphide-containing catalysts for the manufacture of other nickel substances Freshwater direct (ERC 6a)

Release route	Release rate	Release estimation method
Water	0.091 kg/day	Estimated release factor
Air	0.092 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Fresh water	5.55E-3 mg/L (EUSES 2.1.2)	0.782
Sediment (freshwater)	103.3 mg/kg dw (PEC sediment calculation method for metals)	0.948
Agricultural soil	16.21 mg/kg dw (EUSES 2.1.2)	0.542

3.3.3. Environmental release and exposure: Use of nickel subsulphide-containing catalysts for the manufacture of other nickel substances Marine direct (ERC 6a)

Release route	Release rate	Release estimation method
Water	0.047 kg/day	Estimated release factor
Air	0.092 kg/day	Estimated release factor
Soil	0 kg/day	Estimated release factor

Protection target	Exposure estimate	RCR
Marine water	3.77E-3 mg/L (EUSES 2.1.2)	0.438
Sediment (marine water)	107.3 mg/kg dw (PEC sediment calculation method for metals)	0.985
Agricultural soil	16.21 mg/kg dw (EUSES 2.1.2)	0.542

3.3.4. Worker exposure: Enclosed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device (PROC 3, PROC 9, PROC 8b)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	9E-3 mg/m ³ (Measured data)	0.18
Inhalation, systemic, acute	0.027 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	9E-3 mg/m ³ (Measured data)	0.18
Inhalation, local, acute	0.027 mg/m ³ (Measured data)	0.034
Dermal, local, long term	0.076 µg/cm ² (Measured data)	0.019
Combined, systemic, long term		0.18
Combined, systemic, acute		< 0.01

3.3.5. Worker exposure: Semi-closed transfer/loading of stabilised/passivated catalyst into reactor/vessel/device (PROC 8b, PROC 9)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.014 mg/m ³ (Measured data)	0.28
Inhalation, systemic, acute	0.071 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.014 mg/m ³ (Measured data)	0.28
Inhalation, local, acute	0.071 mg/m ³ (Measured data)	0.089
Dermal, local, long term	0.76 µg/cm ² (Measured data)	0.19
Combined, systemic, long term		0.28
Combined, systemic, acute		< 0.01

3.3.6. Worker exposure: Use of catalyst in closed systems (PROC 1, PROC 3, PROC 2)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.013 mg/m ³ (Measured data)	0.26

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, acute	0.052 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.013 mg/m ³ (Measured data)	0.26
Inhalation, local, acute	0.052 mg/m ³ (Measured data)	0.065
Dermal, local, long term	0.076 µg/cm ² (Measured data)	0.019
Combined, systemic, long term		0.26
Combined, systemic, acute		< 0.01

3.3.7. Worker exposure: Cleaning and maintenance at closed systems (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.021 mg/m ³ (Measured data)	0.42
Inhalation, systemic, acute	0.085 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.021 mg/m ³ (Measured data)	0.42
Inhalation, local, acute	0.085 mg/m ³ (Measured data)	0.106
Dermal, local, long term	0.76 µg/cm ² (Measured data)	0.19
Combined, systemic, long term		0.42
Combined, systemic, acute		< 0.01

3.3.8. Worker exposure: Cleaning and maintenance at semi-closed systems (PROC 28)

Route of exposure and type of effects	Exposure estimate	RCR
Inhalation, systemic, long term	0.018 mg/m ³ (Measured data)	0.36
Inhalation, systemic, acute	0.073 mg/m ³ (Measured data)	< 0.01
Inhalation, local, long term	0.018 mg/m ³ (Measured data)	0.36
Inhalation, local, acute	0.073 mg/m ³ (Measured data)	0.091
Dermal, local, long term	0.11 µg/cm ² (Measured data)	0.028
Combined, systemic, long term		0.36
Combined, systemic, acute		< 0.01

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

Guidance: Please refer to Section 0.3 of this “ES for Communication”.