

<b>1. Title</b>		<b>Version 2, 2015</b>
<b>GES 39 Use of nickel metal-derived micronutrient powder in biogas production</b>		
<b>Life cycle</b>	Use of nickel metal (Ni)-derived micronutrient additives in the manufacture of biogas	
<b>Free short title</b>	Use of Ni-derived micronutrients for biogas production	
<b>based on use descriptor</b>	SU: SU 1: Agriculture PC: PC 12: Fertilizer ERC: ERC 2: Formulation of preparations PROC: PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises 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 0 – Cleaning and maintenance	
<b>Processes, tasks, activities covered (environment)</b>	Use of Ni powder in the manufacturing of micronutrient additives for biogas production	
<b>Processes, tasks, activities covered (workers)</b>	Contributing exposure scenario ES 39.1: PROC 4 and PROC 8b: Ni-derived micronutrient additives reception Contributing exposure scenario ES 39.2: PROC 8b: Charging the bioreactor with powdered Ni-derived micronutrient additives Contributing exposure scenario ES 39.3: PROC 8a & 8b: Discharging the bioreactor Contributing exposure scenario ES 39.4: PROC 0: Cleaning and Maintenance	
<b>2. Operational conditions and risk management measures</b>		
<b>2.1 Control of environmental exposure</b>		
<b>Environmental related free short title</b>	Use of Ni powder in the manufacturing of micronutrient additives for biogas production	
<b>Systematic title based on use descriptor (environment)</b>	ERC2 – Formulation of preparations	
<b>Processes, tasks, activities covered (environment)</b>	Manufacture of Ni metal-containing micronutrient additives for biogas production	
<b>Environmental Assessment Method</b>	Not Relevant (no release to water or air)	
<b>Product characteristics</b>		
Powder		
<b>Amounts used</b>		
<b>Maximum daily use at a site</b>	25 kg	
<b>Maximum annual use at a site</b>	1-10 tonnes	
<b>Frequency and duration of use</b>		
<b>Pattern of release to the environment</b>	No appreciable release to the environment	
<b>Environment factors not influenced by risk management</b>		
<b>Receiving surface water flow rate</b>	Not relevant	
<b>Dilution capacity, freshwater</b>	Not relevant	
<b>Dilution capacity, marine</b>	Not relevant	
<b>Other given operational conditions affecting environmental exposure</b>		
None		
<b>Technical conditions and measures at process level (source) to prevent release</b>		
There is no discharge to sewer or river. A dust aspiration system used to collect particles that are directed back to the		

mixing system (thus no release to air).	
<b>Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil</b>	
<b>Waste water:</b> There are no discharges to a sewer or river.	
<b>Air:</b> Technical aspiration is present to avoid dust emissions to the environment. A filtration system is present that re-circulates particles back to the mixing system. When the filter elements are reaching their end of life they are replaced.	
<b>Organizational measures to prevent/limit release from site</b>	
None	
<b>Conditions and measures related to municipal sewage treatment plant</b>	
<b>Municipal Sewage Treatment Plant (STP)</b>	Not relevant
<b>Discharge rate of the Municipal STP</b>	Not relevant
<b>Incineration of the sludge of the Municipal STP</b>	Not relevant
<b>Conditions and measures related to external treatment of waste for disposal</b>	
Hazardous 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 or hazardous waste landfills as hazardous waste. Releases to the floor, water and soil are to be prevented. If the nickel content of the waste is elevated enough, internal or external recovery/recycling might be considered.	
<b>Fraction of daily/annual use</b> expected in waste: <ul style="list-style-type: none"> <li>- Nickel producers = 0.05 %</li> <li>- DU: stainless steel and alloy steels = 0.6 %</li> <li>- DU: nickel alloys, copper alloys, foundry, batteries, catalysts, chemicals, dyes and others = 0.5 %</li> <li>- DU: Plating = 3%</li> </ul>	
<b>Appropriate waste codes:</b> 01 03 07*, 02 01 10*, 06 03 13*, 06 03 15*, 06 04 05*, 06 05 02*, 10 08 04, 10 08 08*, 10 08 09, 10 08 15*, 10 08 16, 10 10 03, 10 10 05*, 10 10 07*, 10 10 09*, 10 10 10, 10 10 11*, 11 02 07*, 12 01 03*, 12 01 04, 15 01 04*, 15 01 10*, 16 01 04*, 16 01 06*, 16 01 08*, 16 06 02*, 16 06 05, 16 08 02*, 16 08 03*, 17 04 07*, 17 04 09*, 19 09 04*, 19 10 02*, 19 12 03*	
<b>Suitable disposal:</b> Keep separate and dispose of to either <ul style="list-style-type: none"> <li>- Hazardous waste incineration operated according to Council Directive 2008/98/EC on waste, Directive 2000/76/EC on the incineration of waste and the Reference Document on the Best Available Techniques for Waste Incineration of August 2006.</li> <li>- Hazardous landfill operated under Directive 1999/31/EC.</li> </ul>	
<b>Conditions and measures related to external recovery of waste</b>	
Shredders pre-treating metal wastes should have a maximum release factors to air of 0.0015 after RMM and no releases to water and soil. Q <sub>max, local</sub> (shredding)=26kg Ni/day (Note: This Q <sub>max, local</sub> for shredders is based on the existing information at the moment of the update. It will be reviewed when new information is available from the BREF for shredding)	
<b>2.2 Control of workers exposure for contributing exposure scenario 39.1</b>	
Ni-derived micronutrient reception	
<b>Workers related free short title</b>	Use of Ni-derived micronutrients for biogas production
<b>Use descriptor covered</b>	PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

<b>Processes, tasks, activities covered</b>	Sealed biodegradable bags of Ni-derived micronutrient are warehoused for manual charging of the bioreactor
<b>Assessment Method</b>	Estimation of dermal & inhalation exposure using a Tier 1 model (MEASE)
<b>Product characteristic</b>	
Ni-derived micronutrient powder	
<b>Amounts used</b>	
Not relevant	
<b>Frequency and duration of use/exposure</b>	
Duration of exposure is up to one hour per day for this activity to maintain the operation of the bioreactor	
<b>Human factors not influenced by risk management</b>	
Respiration volume under conditions of use	Light to medium level work is routinely undertaken ~10 m <sup>3</sup> /d
Room size and ventilation rate	Not relevant
Area of skin contact with the substance under conditions of use	480 cm <sup>2</sup>
Body weight	70 kg
<b>Other given operational conditions affecting workers exposure</b>	
The reception of micronutrient additives for the manufacture of biogas is a non-continuous operation and takes place for no more than 1 hour per day. All activities are carried out manually by the worker and the reactor is charged with sealed biodegradable bags of Ni-derived micronutrient additive. Oral: Good workplace hygiene practice.	
<b>Technical conditions and measures at process level (source) to prevent release</b>	
Transfer of Ni-derived micronutrient powder should be automated and enclosed where exposure to Ni-containing powder and dust is likely.	
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	
LEV is required to extract dust and aerosols from processes that are not fully enclosed and are likely to give rise to Ni-containing aerosols.	
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>	
Training to reinforce good workplace hygiene practice and hygiene issues are performed.	
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
<u>Inhalation</u> : Air-assisted filtering visor, masks or hood with P3 filter element (Assigned Protection Factor ~20 based on use of powered respirator meeting EN12492 requirement or FFP3 (EN149) or equivalent suitable respirator) is required for emergencies and non-routine tasks where exposure to Ni-containing dust or aerosol is possible or for operations that are not fully enclosed and are likely to give rise to Ni-containing dust or aerosol and where there is contamination with Ni-containing dusts. It is important to note that the disposable mask FFP1 (with APF = 4) is not recommended for use with Ni-containing aerosols. <u>Dermal</u> : Suitable gloves (EN 374, protection level 6, PVC or equivalent), and goggles. Other protective equipment e.g. special safety clothing should be chosen based on activities being undertaken, potential for exposure to airborne nickel-containing aerosols and other relevant workplace hazards may include protective suit with hood (conforming to EN13982-1 Type 5) and safety shoes (e.g. according to EN 20346).	
<b>2.3 Control of workers exposure for contributing exposure scenario 39.2</b>	
Charging the bioreactor with powdered Ni-derived micronutrient additives	
<b>Workers related free short title</b>	Use of Ni-derived micronutrients for biogas production
<b>Use descriptor covered</b>	PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
<b>Processes, tasks, activities covered</b>	Dosing (measuring out and dispensing) the bioreactor, containing feedstock and bacteria, with the powdered micronutrient additive (loading sealed biodegradable bags) If the product is in liquid form it is pumped into the bioreactor.
<b>Assessment Method</b>	Estimation of dermal & inhalation exposure using a Tier 1 model (MEASE)
<b>Product characteristic</b>	
Ni-derived micronutrient powder	

<b>Amounts used</b>	
Not relevant	
<b>Frequency and duration of use/exposure</b>	
Duration of exposure is considered to be less than 4 hours per day for Ni-derived nutrient dosing of the (continuously running) bioreactor and this carried out frequently (about 30 times per day).	
<b>Human factors not influenced by risk management</b>	
Respiration volume under conditions of use	Light to medium level work is routinely undertaken ~10 m <sup>3</sup> /d
Room size and ventilation rate	Not relevant
Area of skin contact with the substance under conditions of use	480 cm <sup>2</sup>
Body weight	70 kg
<b>Other given operational conditions affecting workers exposure</b>	
All activities are largely run from a control room and the worker enters the grounds of the plant to inspect, monitor or intervene in the process such as charging the reactor and clearing blockages or spills. Oral: Good workplace hygiene practice.	
<b>Technical conditions and measures at process level (source) to prevent release</b>	
Transfer and mixing systems shall employ a high level of containment.	
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	
LEV shall be used to extract the particulate during transferring operations where there is risk of exposure to dusts e.g. from leaking bags.	
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>	
Training to reinforce good workplace hygiene practice and hygiene issues.	
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
<u>Inhalation:</u> Air-assisted filtering visor, masks or hood with P3 filter element (Assigned Protection Factor ~20 based on use of powered respirator meeting EN12492 requirement or equivalent suitable P3 level protection) is required for entry into the production area for inspections/emergency situations where exposure to Ni-containing mist or dust is possible. It is important to note that the disposable mask FFP1 (with APF = 4) is not recommended for use with Ni-containing aerosols. <u>Dermal:</u> Suitable gloves (EN 374, protection level 6, PVC or equivalent), and goggles. Other protective equipment e.g. special safety clothing should be chosen based on activities being undertaken, potential for exposure to airborne nickel-containing aerosols and other relevant workplace hazards may include protective suit with hood (conforming to EN13982-1 Type 5) and safety shoes (e.g. according to EN 20346).	
<b>2.4 Control of workers exposure for contributing exposure scenario 39.3</b>	
Discharging the reactor	
<b>Workers related free short title</b>	Use of Ni-derived micronutrients for biogas production
<b>Use descriptor covered</b>	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
<b>Processes, tasks, activities covered</b>	Biogas is piped and digestate is pumped out of the bioreactor.
<b>Assessment Method</b>	Not relevant
<b>Product characteristic</b>	
Non-Ni containing	
<b>Amounts used</b>	
Not relevant	
<b>Frequency and duration of use/exposure</b>	
Not relevant	
<b>Human factors not influenced by risk management</b>	
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	Not relevant

use	
Body weight	Not relevant
<b>Other given operational conditions affecting workers exposure</b>	
Not relevant	
<b>Technical conditions and measures at process level (source) to prevent release</b>	
Not relevant	
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	
Not relevant	
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>	
Not relevant	
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
Not relevant	
<b>2.5 Control of workers exposure for contributing exposure scenario 39.4</b>	
Cleaning and Maintenance	
<b>Workers related free short title</b>	Use of Ni-derived micronutrients for biogas production
<b>Use descriptor covered</b>	PROC 0 – Cleaning and maintenance
<b>Processes, tasks, activities covered</b>	Cleaning and Maintenance
<b>Assessment Method</b>	Estimation of dermal & inhalation exposure using a Tier 1 model (MEASE)
<b>Product characteristic</b>	
Ni-containing powder, solution and dust	
<b>Amounts used</b>	
Not relevant	
<b>Frequency and duration of use/exposure</b>	
Duration is considered to be less than 1 hour per day for biogas manufacture	
<b>Human factors not influenced by risk management</b>	
Respiration volume under conditions of use	Light to medium level work is routinely undertaken ~10 m <sup>3</sup> /d
Room size and ventilation rate	Not relevant
Area of skin contact with the substance under conditions of use	960 cm <sup>2</sup>
Body weight	70 kg
<b>Other given operational conditions affecting workers exposure</b>	
Bioreactors are generally not cleaned out and this is likely to be the case for the gas holder and the digestate storage tank. Maintenance of the plant and the grounds will be carried out as needed e.g. remove blockages. Oral: Good workplace hygiene practice.	
<b>Technical conditions and measures at process level (source) to prevent release</b>	
None	
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	
None	
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>	
Training to reinforce good workplace hygiene practice and hygiene issues	
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
Inhalation to mists and particulates and skin exposure to mists, liquids splashes and particulates shall be controlled by RPE and gloves when undertaking maintenance and cleaning work. <u>Inhalation:</u> Use of air-assisted filtering visor, masks or hood with P3 filter element for plant or premises heavily contaminated with nickel-containing dust or spills {APF 20 or 40 based on use of powered respirator meeting EN12492 or EN12941 requirement or FFP3 (EN136) or equivalent suitable respirator}. RPE with a lower APF of 10 {air-assisted filtering visor, masks or hood with P2 filter element including powered respirators meeting the EN12492 TM1 or EN 12941 TH1 requirement or the FFP2 (EN149) or equivalent suitable respirator} may be used for cleaning and maintenance work where the plant or premises is less heavily contaminated with nickel-containing dust or spills. It is important to note that the disposable mask FFP1 (with APF = 4) is not recommended for use with Ni-containing dust. Dermal: Suitable gloves (EN 374, protection level 6, PVC or equivalent), and goggles. Other protective equipment e.g.	

special safety clothing should be chosen based on activities being undertaken, potential for exposure to airborne nickel-containing aerosols and other relevant workplace hazards may include protective suit with hood (conforming to EN13982-1 Type 5) and safety shoes (e.g. according to EN 20346).

### 3. Exposure and risk estimation

#### Environment

ERC 2							
compartment	Unit	PNEC	PEC <sub>Regional</sub>	C <sub>local</sub>	PEC	RCR	Methods for calculation of environmental concentration
Freshwater	µg/L	3.6	-	-	-	-	Not relevant
Marine	µg/L	8.6	-	-	-	-	
Sediment	Mg/kg	136	33.5	-	-	-	
Terrestrial	mg/kg	29.9	-	-	-	-	
STP	Mg/kg	0.33	-	-	-	-	

#### Workers

##### ES 39.1

PROC 4 and PROC 8b: Ni-derived micronutrient reception

	Unit	DNEL	Exposure concentration	RCR	Methods for calculation of exposure
Dermal					
Acute systemic	mg Ni/kg/day	-	NR		
Acute local	mg Ni/cm <sup>2</sup> /day	-	NR		
Long-term systemic	mg Ni/kg/day	-	NR		
Long-term local	mg Ni/cm <sup>2</sup> /day	0.035	0.000001	2.86 x 10 <sup>-5</sup>	90 <sup>th</sup> percentile exposure estimate using MEASE for PROC 8b {Ni <1%, ind, NDU, NDH, inc, GV, duration 15 -60mins, gloves}
Inhalation					
Acute local	mg Ni/m <sup>3</sup>	4	0.003	7.5 x 10 <sup>-4</sup>	3 x long-term modeled estimate
Long-term systemic and local	mg Ni/m <sup>3</sup>	0.05	0.001	0.02	90 <sup>th</sup> percentile exposure estimate using MEASE for PROC 8b {Ni <1%, ind, NDU, NDH, inc, GV, duration 15 -60mins, gloves}

##### ES 39.2

PROC 8b: Charging the bioreactor with powdered Ni-derived micronutrient additives

	Unit	DNEL	Exposure concentration	RCR	Methods for calculation of exposure
Dermal					
Acute systemic	mg Ni/kg/day	-	NR		
Acute local	mg Ni/cm <sup>2</sup> /day	-	NR		
Long-term systemic	mg Ni/kg/day	-	NR		
Long-term	mg	0.035	0.000003	8.6 x 10 <sup>-5</sup>	90 <sup>th</sup> percentile exposure estimate using

local	Ni/cm <sup>2</sup> /day				MEASE for PROC 3 {Ni <1%, ind, NDU, NDH, incidental exposure, enc, GV, duration 60-240 mins, gloves}
Inhalation					
Acute local	mg Ni/m <sup>3</sup>	4	0.009	2.25 x 10 <sup>-3</sup>	3 x long-term inhalable modeled estimate
Long-term systemic and local	mg Ni/m <sup>3</sup>	0.05	0.003	0.06	90 <sup>th</sup> percentile exposure estimate using MEASE for PROC 3 {Ni <1%, ind, NDU, NDH, incidental exposure, enc, GV, duration 60-240 mins, gloves}
<b>ES 39.4</b>					
PROC 0: Cleaning and Maintenance					
	Unit	DNEL	Exposure concentration	RCR	Methods for calculation of exposure
Dermal					
Acute systemic	mg Ni/kg/day	-	NR		
Acute local	mg Ni/cm <sup>2</sup> /day	-	NR		
Long-term systemic	mg Ni/kg/day	-	NR		
Long-term local	mg Ni/cm <sup>2</sup> /day	0.035	0.000006	1.7 x 10 <sup>-4</sup>	90 <sup>th</sup> percentile exposure estimate using MEASE for PROC 10 {Ni > 25%, ind, incidental exposure, NDU, NDH, duration 15-60 mins, GV, RPE, gloves}
Inhalation					
Acute local	mg Ni/m <sup>3</sup>	4	1.71	0.428	3 x long-term inhalable modeled estimate
Long-term systemic and local	mg Ni/m <sup>3</sup>	0.05	0.57 0.029	11.4 (excluding RPE) By use of RPE (APF 20) 0.58	90 <sup>th</sup> percentile exposure estimate using MEASE for PROC 10 {Ni > 25%, ind, incidental exposure, NDU, NDH, duration 15-60 mins, GV, RPE, gloves}
NR: Not Relevant					
<u>Acute local inhalation</u> DNEL based on respirable size aerosols. Equivalent inhalable fraction levels expected to be at least 3-fold higher					

#### 4. Guidance to evaluate whether a site 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<sub>local</sub> approach).

Scaling of the PNEC for soil compartment by using a tiered approach for correction for bioavailability and background concentration (C<sub>local</sub> approach).

##### Workers

Scaling considering duration and frequency of use

Collect process monitoring data with an inhalable sampler. The simultaneous use of a respirable sampler is encouraged. Use aerosol particle size information, when available, to confirm the appropriate use of the inhalable DNEL of 0.05 mg Ni/m<sup>3</sup>. Respirable fraction exposure levels should be kept below 0.01 mg Ni/m<sup>3</sup>.

For further information and guidance on exposure scenarios, available tools, and scaling options, please visit the Nickel Consortia exposure scenario library at the following link: <http://www.nickelconsortia.eu/exposure-scenario-library.html>

### **Man via Environment exposure and risk characterisation assessments for the manufacturing of micronutrient additions for biogas production**

Environmental exposure is not relevant for this exposure scenario.