

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

1,3-Butadiene

Version 16.0

Revision Date: 21.05.2024

Former date: 24.11.2023

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name : 1,3-Butadiene
REACH Registration Number : 01-2119471988-16-0002, 01-2119471988-16-XXXX
Substance name : 1,3-butadiene
EC-No. : 203-450-8

1.2 Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Raw material in chemical industry, Use in polymer production, Use in polymer processing, Use in rubber production and processing, Products such as pH-regulators, flocculants, precipitants, neutralization agents, Laboratory chemicals
Recommended restrictions on use : Consumer uses

1.3 Details of the supplier of the safety data sheet

Manufacturer : Borealis Polymers Oy
P.O.Box 330, FI-06101 Porvoo, Finland
Telephone: +358 9 394900
Supplier : Borealis AG
Trabrennstrasse 6-8, 1020 Vienna, Austria
Telephone: +43 1 22400 0
E-mail address : sds@borealisgroup.com

1.4 Emergency telephone number

+1 760 476 3962 (3E), Access code: 336296

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Flammable gases, Category 1A H220: Extremely flammable gas.

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Gases under pressure, Liquefied gas

H280: Contains gas under pressure; may explode if heated.

Germ cell mutagenicity, Category 1B
Carcinogenicity, Category 1A

H340: May cause genetic defects.
H350: May cause cancer.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms



Signal word : Danger

Hazard statements

: H220 Extremely flammable gas.
H280 Contains gas under pressure; may explode if heated.
H340 May cause genetic defects.
H350 May cause cancer.

Precautionary statements

: **Prevention:**
P202 Do not handle until all safety precautions have been read and understood.
P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P281 Use personal protective equipment as required.
Response:
P377 Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 In case of leakage, eliminate all ignition sources.
Storage:
P410 + P403 Protect from sunlight. Store in a well-ventilated place.

Additional Labelling

Restricted to professional users.

EUH208

Contains 4-tert-butylpyrocatechol. May produce an allergic reaction.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

Ecological information: The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

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Toxicological information: The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.1 Substances

Substance name : 1,3-butadiene

EC-No. : 203-450-8

Components

Chemical name	CAS-No. EC-No.	Concentration (% w/w)	M-Factor, SCL, ATE
1,3-butadiene	106-99-0 203-450-8	>= 90 - <= 100	
4-(1,1-dimethylethyl)-1,2-benzenediol	98-29-3 202-653-9	>= 0,1 - < 0,25	

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice : Move out of dangerous area.
In the case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

If inhaled : Move to fresh air.
Do not leave the victim unattended.
Causes asphyxiation in high concentrations. The victim will not realize that he/she is suffocating.
Keep patient warm and at rest.
Seek medical advice immediately.
If breathing is irregular or stopped, administer artificial respiration.

In case of skin contact : Contact with liquid or refrigerated gas can cause cold burns and frostbite.
Wash frost-bitten areas with plenty of water. Do not remove clothing.
Seek medical advice.

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- In case of eye contact : Remove contact lenses.
Rinse thoroughly with plenty of water for at least 15 minutes
and consult a physician.
Keep eye wide open while rinsing.
- If swallowed : Not probable:
The product evaporates readily.

4.2 Most important symptoms and effects, both acute and delayed

- Symptoms : Shortness of breath
Unconsciousness
Frostbite
- Risks : May cause effects on the central nervous system, resulting in
lowering of consciousness.
May cause genetic defects.
May cause cancer.

4.3 Indication of any immediate medical attention and special treatment needed

- Treatment : Artificial respiration and/or oxygen may be necessary.
There is no specific antidote available.
Treat frost-bitten areas as needed.

SECTION 5: Firefighting measures

5.1 Extinguishing media

- Suitable extinguishing media : Dry powder, carbon dioxide, foam and water mist.
- Unsuitable extinguishing media : Do NOT use water jet.

5.2 Special hazards arising from the substance or mixture

- Specific hazards during firefighting : Vapours are heavier than air and may spread along floors.
Flash back possible over considerable distance.
Do not allow run-off from fire fighting to enter drains or water courses.
Hazardous decomposition products formed under fire conditions.
See chapter 10.

5.3 Advice for firefighters

- Special protective equipment for firefighters : Wear self-contained breathing apparatus and protective suit.

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Further information : Attempt to stop leakage without personal risk.
If conditions permit, let fire burn itself out.
Cool containers/tanks with water spray.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment.
Do not breathe vapours.
Ensure adequate ventilation, especially in confined areas.
Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.
Avoid all contact with the product.
Keep people away from and upwind of spill/leak.
Attempt to stop leakage without personal risk.
For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so.
Prevent product from entering environment and drains.
If major spillage occurs, contact the proper local authorities.

6.3 Methods and material for containment and cleaning up

Attempt to stop leakage without personal risk.
Ventilate the area.
Allow to evaporate.

6.4 Reference to other sections

For personal protection see section 8.
For disposal considerations see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling : To be handled by trained personnel only.
Refill and handle product only in closed system.
Prevent leaks by checking valves, pipelines and joints regularly.
Ensure adequate ventilation.
In case of insufficient ventilation, wear suitable respiratory equipment.
Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.
When using do not eat, drink or smoke.

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Advice on protection against fire and explosion : Keep away from sources of ignition - No smoking. Take precautionary measures against static discharges. To avoid ignition of vapours by static electricity discharge, all metal parts of the equipment must be grounded. High risk of fire in case of leakage.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Keep only in the original container in a cool, well-ventilated place. Keep under dry nitrogen atmosphere. Keep product and empty container away from heat and sources of ignition. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Further information on storage conditions : Ensure adequate ventilation.

Advice on common storage : Keep away from incompatible materials. See chapter 10.

7.3 Specific end use(s)

Specific use(s) : Not applicable

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational Exposure Limits

Components	CAS-No.	Value type (Form of exposure)	Control parameters	Basis
1,3-butadiene	106-99-0	TWA	1 ppm 2,2 mg/m ³	2004/37/EC
Further information	Carcinogens or mutagens			

For national exposure limit (OEL) values, check country specific safety data sheets.

Derived No Effect Level (DNEL) according to Regulation (EC) No. 1907/2006:

Substance name	End Use	Exposure routes	Potential health effects	Value
1,3-Butadiene	Workers	Inhalation	Long-term systemic effects	2,21 mg/m ³ 1 ppm
Remarks:	Derived minimal effect level			
	Workers	Skin contact		
Remarks:	Not applicable, (gaseous)			

Predicted No Effect Concentration (PNEC) according to Regulation (EC) No. 1907/2006:

Substance name	Environmental Compartment	Value
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1,3-Butadiene		
Remarks:	Not applicable	

8.2 Exposure controls

Engineering measures

Application in a closed system
Prevent unauthorised persons entering the zone.

Personal protective equipment

Eye protection : Use eye protection according to EN 166.
If splashes are likely to occur, wear:
Face-shield

Hand protection

Material : Viton®
Break through time : > 8 h
Material : Trelchem HPS
Break through time : > 8 h
Material : Trelchem VPS
Break through time : > 8 h
Material : Silver Shield(R) gloves
Break through time : > 8 h

Remarks : The selected protective gloves have to satisfy the specifications of Regulation (EU) 2016/425 and the standard EN 374 derived from it. Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. Also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion, and the contact time.

Skin and body protection : Wear suitable protective clothing and rubber boots.
Respiratory protection : In case of insufficient ventilation: Respirator with AX filter or self-contained breathing apparatus.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
Protective measures : Avoid and prevent all spillage, contact and exposure.

Environmental exposure controls

General advice : Prevent further leakage or spillage if safe to do so. Prevent product from entering environment and drains. If major spillage occurs, contact the proper local authorities.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state : Liquefied gas

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Colour	:	clear
Odour	:	characteristic, mild, aromatic
Odour Threshold	:	1,6 ppm
Melting point	:	-109 °C
Boiling point	:	-4 °C
Flammability	:	Extremely flammable.
Upper explosion limit / Upper flammability limit	:	Upper flammability limit 12 %(V)
Lower explosion limit / Lower flammability limit	:	Lower flammability limit 2 %(V)
Flash point	:	-76 °C
Decomposition temperature	:	No data available
pH	:	Not applicable
Viscosity		
Viscosity, dynamic	:	Not applicable (gaseous)
Viscosity, kinematic	:	Not applicable (gaseous)
Solubility(ies)		
Water solubility	:	0,735 g/l (20 °C)
Partition coefficient: n-octanol/water	:	log Pow: 1,99
Vapour pressure	:	245 kPa (20 °C)
Relative density	:	0,6
Density	:	0,0023 g/cm ³ (15 °C)
Relative vapour density	:	1,9

9.2 Other information

Explosives	:	Not applicable
Oxidizing properties	:	Not applicable
Self-ignition	:	420 °C

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Evaporation rate : Not applicable

Surface tension : Not applicable

SECTION 10: Stability and reactivity

10.1 Reactivity

Stable under recommended storage conditions.
Vapours may form explosive mixture with air.
Risk of violent reaction.

10.2 Chemical stability

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions : Polymerises with risk of fire and explosion in contact with:
Air

10.4 Conditions to avoid

Conditions to avoid : Keep away from heat and sources of ignition.

10.5 Incompatible materials

Materials to avoid : air
Oxidizing agents
Ozone
Nitrogen oxides (NO_x)
Copper
Copper alloys
phenol
chlorine dioxide
crotonaldehyde
hydroquinone

10.6 Hazardous decomposition products

Under fire conditions:
Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).

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SECTION 11: Toxicological information

11.1 Information on hazard classes as defined in Regulation (EC) No 1272/2008

Acute toxicity

Based on available data, the classification criteria are not met.

Product:

Acute oral toxicity : Remarks: Not relevant
(gaseous)

Acute inhalation toxicity : LC50 (Mouse): 270 mg/l
Exposure time: 4 h
Test atmosphere: gas
Remarks: Not applicable
(gaseous)

Acute dermal toxicity : Remarks: Not relevant
(gaseous)

Assessment: Vapours can cause suffocation by reducing oxygen available for breathing.

Skin corrosion/irritation

Based on available data, the classification criteria are not met.

Product:

Remarks : Not applicable
(gaseous)
Contact with liquid or refrigerated gas can cause cold burns and frostbite.

Serious eye damage/eye irritation

Based on available data, the classification criteria are not met.

Product:

Species : Rabbit

Species : Dog

Result : No eye irritation

Remarks : Contact with liquid or refrigerated gas can cause cold burns and frostbite.

Respiratory or skin sensitisation

Skin sensitisation

Based on available data, the classification criteria are not met.

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Respiratory sensitisation

Based on available data, the classification criteria are not met.

Product:

Remarks : Not applicable
(gaseous)

Germ cell mutagenicity

May cause genetic defects.

Product:

Genotoxicity in vitro : Test Type: Ames test
Metabolic activation: with and without metabolic activation
Method: Mutagenicity (in vitro mammalian cytogenetic test)
Result: positive

Genotoxicity in vivo : Test Type: in vivo assay
Species: Mouse
Method: Mutagenicity (micronucleus test)
Result: positive

Carcinogenicity

May cause cancer.

Reproductive toxicity

Based on available data, the classification criteria are not met.

Product:

Effects on fertility : Species: Rat
Application Route: Inhalation
General Toxicity - Parent: No observed adverse effect level:
13.276 mg/m³

Effects on foetal development : Species: Mouse
Application Route: Inhalation
Developmental Toxicity: NOAEL: 88 mg/m³

STOT - single exposure

Based on available data, the classification criteria are not met.

Product:

Remarks : Not applicable
(gaseous)

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STOT - repeated exposure

Based on available data, the classification criteria are not met.

Repeated dose toxicity

Product:

Species : Rat
NOAEL : 2212 mg/m³
Application Route : Inhalation

Aspiration toxicity

Based on available data, the classification criteria are not met.

Product:

Not classified due to data which are conclusive although insufficient for classification.

11.2 Information on other hazards

Endocrine disrupting properties

Product:

Assessment : The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

Further information

Product:

Remarks : Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
High concentration of vapours may induce unconsciousness.

SECTION 12: Ecological information

12.1 Toxicity

Product:

Toxicity to fish : LL50 (Oncorhynchus mykiss (rainbow trout)): 34,55 mg/l
Exposure time: 72 h
Method: QSAR
Remarks: estimated

Toxicity to daphnia and other : LC50 (Daphnia magna (Water flea)): 64,642 mg/l

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aquatic invertebrates	Exposure time: 48 h Method: QSAR Remarks: estimated
Toxicity to algae/aquatic plants	: EC50 (Raphidocelis subcapitata (freshwater green alga)): 35,77 mg/l Exposure time: 72 h Method: QSAR Remarks: estimated
Toxicity to fish (Chronic toxicity)	: 6,62 mg/l Exposure time: 21 d Species: Oncorhynchus mykiss (rainbow trout) Method: QSAR
Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)	: NOEC: 12,384 mg/l Exposure time: 21 d Species: Daphnia magna (Water flea) Method: QSAR
Toxicity to microorganisms	: Remarks: Not applicable (gaseous)

Plant toxicity : EC50: 81,329 mg/kg

Ecotoxicology Assessment

Short-term (acute) aquatic hazard : Not classified due to data which are conclusive although insufficient for classification.

Long-term (chronic) aquatic hazard : Not classified due to data which are conclusive although insufficient for classification.

12.2 Persistence and degradability

Product:

Biodegradability : Water
Result: rapidly biodegradable

Photodegradation : Remarks: Prone to photochemical degradation, reacting with OH radicals and ozone.

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Bioconcentration factor (BCF): 9,8
Remarks: Bioaccumulation not expected: Partition coefficient

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(n-octanol/water) log Pow < 3.

12.4 Mobility in soil

Product:

Mobility : Remarks: Not expected to adsorb on soil., Partition coefficient (n-octanol/water) log Kow < 3.

Distribution among environmental compartments : Koc: 51,5 Method: QSAR
Remarks: The product evaporates readily.

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher..

12.6 Endocrine disrupting properties

Product:

Assessment : The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

12.7 Other adverse effects

Product:

Additional ecological information : Should not be released into the environment.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Dispose of as hazardous waste in compliance with local and national regulations.
Where possible recycling is preferred to disposal or incineration.
European waste code:
07 01 99 (wastes not otherwise specified (basic organic chemicals))

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Contaminated packaging : Handle with care.
Dispose of as hazardous waste in compliance with local and national regulations.

SECTION 14: Transport information

14.1 UN number or ID number

ADR : UN 1010
RID : UN 1010
IMDG : UN 1010

14.2 UN proper shipping name

ADR : BUTADIENES, STABILIZED
RID : BUTADIENES, STABILIZED
IMDG : BUTADIENES, STABILIZED

14.3 Transport hazard class(es)

ADR : 2
RID : 2
IMDG : 2.1

14.4 Packing group

ADR
Packing group : Not assigned by regulation
Classification Code : 2F
Hazard Identification Number : 239
Labels : 2.1
Tunnel restriction code : (B/D)

RID
Packing group : Not assigned by regulation
Classification Code : 2F
Hazard Identification Number : 239
Labels : 2.1 ((13))

IMDG
Packing group : Not assigned by regulation
Labels : 2.1
EmS Code : F-D, S-U

14.5 Environmental hazards

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ADR

Environmentally hazardous : no

RID

Environmentally hazardous : no

IMDG

Marine pollutant : no

14.6 Special precautions for user

Remarks : not required

The transport classification(s) provided herein are for informational purposes only, and solely based upon the properties of the unpackaged material as it is described within this Safety Data Sheet.

Transportation classifications may vary by mode of transportation, package sizes, and variations in regional or country regulations.

14.7 Maritime transport in bulk according to IMO instruments

Ship type : N/A

Pollution category : N/A

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

REACH - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles (Annex XVII) : Conditions of restriction for the following entries should be considered:
Number on list 40
1,3-butadiene (Number on list 29, 28)

Seveso III: Directive 2012/18/EU of the European Parliament and of the Council on the control of major-accident hazards involving dangerous substances.

Category		Quantity 1	Quantity 2
P2	FLAMMABLE GASES	10 t	50 t
P2	FLAMMABLE GASES	10 t	50 t

Other regulations:

Comply with below indicated regulations, relevant updates and amendments, as applicable:
Europe. Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work

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15.2 Chemical safety assessment

A Chemical Safety Assessment has been carried out for this substance.

SECTION 16: Other information

Full text of other abbreviations

- 2004/37/EC : Europe. Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work
- 2004/37/EC / TWA : Long term exposure limit

Further information

- Training advice : Provide adequate information, instruction and training for operators.
Regular trainings of all employees which are involved in the transport of dangerous goods (according to chapter 1.3 ADR).
- Other information : Issued according to Regulation (EC) No 1907/2006, Annex II, and its amendments.
Changes since the last version are highlighted in the margin.
This version replaces all previous versions.
- Issuer : Borealis, Group Product Stewardship
- Sources of key data used to compile the Safety Data Sheet : Chemical Safety Report, 1,3-butadiene, Lower Olefins and Aromatics REACH Consortium, 2023
International Chemical Safety Card, 1,3-Butadiene, April 2000 (<http://www.inchem.org/documents/icsc/icsc/eics0017.htm>)

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Disclaimer

To the best of our knowledge, the information contained herein is accurate and reliable as of the date of publication; however we do not assume any liability whatsoever for the accuracy and completeness of such information.

Borealis makes no warranties which extend beyond the description contained herein. Nothing herein shall constitute any warranty of merchantability or fitness for a particular purpose.

It is the customer's responsibility to inspect and test our products in order to satisfy itself as to the suitability of the products for the customer's particular purpose. The customer is responsible for the appropriate, safe and legal use, processing and handling of our products.

No liability can be accepted in respect of the use of Borealis' products in conjunction with other materials. The information contained herein relates exclusively to our products when not used in conjunction with any third party materials.

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Annex: Exposure Scenarios

Table of Contents

Number	Title
ES1	Manufacture, Manufacture of substance
ES2	Formulation or re-packing, Formulation & (re)packing of substances and mixtures
ES3	Use at industrial sites, Use in rubber production and processing
ES4	Use at industrial sites, Use in polymer production
ES5	Use at industrial sites, Use in polymer processing

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ES1: Manufacture of substance

1.1. Title section

Structured Short Title	: Manufacture, Manufacture of substance
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Environment		
CS1	Manufacture of substance, Environment	ERC1
Worker		
CS2	General measures applicable to all activities	PROC1, PROC2, PROC3, PROC8a, PROC8b, PROC9, PROC15
CS3	General exposures (closed systems)	PROC1
CS4	General exposures (closed systems), Product sampling	PROC2
CS5	General exposures (closed systems), Use in contained batch processes	PROC3
CS6	Process sampling	PROC9
CS7	Laboratory activities	PROC15
CS8	Laboratory activities, Local exhaust ventilation	PROC15
CS9	Bulk transfers, Closed systems	PROC8b
CS10	Equipment cleaning and maintenance	PROC8a
CS11	Storage, Product sampling	PROC2

1.2. Conditions of use affecting exposure

1.2.1. Control of environmental exposure: Manufacture of the substance (ERC1)

Amount used, frequency and duration of use (or from service life)	
Daily amount per site	: 833 t
Annual amount per site	: 230000 t

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Conditions and measures related to sewage treatment plant	
STP type	: Municipal sewage treatment plant
STP sludge treatment	: No application of sewage sludge to soil
STP effluent	: 2.000 m ³ /d

Other conditions affecting environmental exposure	
Receiving surface water flow	: 18.000 m ³ /d

1.2.2. Control of worker exposure: General measures applicable to all activities

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2) / Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3) / Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b) / Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9) / Use as laboratory reagent (PROC15)

Product (article) characteristics	
Covers percentage substance in the product up to 100 %.	
Physical form of product	: Liquid

Amount used, frequency and duration of use (or from service life)	
Duration	: Covers use up to 8 h

Conditions and measures related to personal protection, hygiene and health evaluation	
Use suitable eye protection and gloves. Low temperature resistant gloves Dermal - minimum efficiency of 80 %	

Other conditions affecting workers exposure	
Temperature	: Assumes process temperature up to 20 °C

1.2.3. Control of worker exposure: General exposures (closed systems)

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

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Technical and organisational conditions and measures

Closed systems
Occupational Health and Safety Management System: Advanced
Provide a basic standard of general ventilation (1 to 3 air changes per hour).

1.2.4. Control of worker exposure: General exposures (closed systems), Product sampling Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)

Use frequency : Covers use up to 1 h/day

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

Local exhaust ventilation
Handle substance within a predominantly closed system provided with extract ventilation.
Inhalation - minimum efficiency of 95 %

1.2.5. Control of worker exposure: General exposures (closed systems), Use in contained batch processes Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Amount used, frequency and duration of use (or from service life)

Use frequency : Covers use up to 0,25 h/day

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

Local exhaust ventilation
Handle substance within a predominantly closed system provided with extract ventilation.
Inhalation - minimum efficiency of 95 %

1.2.6. Control of worker exposure: Process sampling Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

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Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 0,25 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Local exhaust ventilation Sample via a closed loop or other system to avoid exposure.	

1.2.7. Control of worker exposure: Laboratory activities Use as laboratory reagent (PROC15)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).	
Handle in a fume cupboard or under extract ventilation. Inhalation - minimum efficiency of 95 %	

1.2.8. Control of worker exposure: Laboratory activities, Local exhaust ventilation Use as laboratory reagent (PROC15)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a basic standard of general ventilation (1 to 3 air changes per hour).	
Handle in a fume cupboard or under extract ventilation. Inhalation - minimum efficiency of > 95 %	

1.2.9. Control of worker exposure: Bulk transfers, Closed systems Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

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Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced	
Local exhaust ventilation Use dry break couplings for material transfer. Inhalation - minimum efficiency of > 95 %	

1.2.10. Control of worker exposure: Equipment cleaning and maintenance Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).	
Local exhaust ventilation Drain down and flush system prior to equipment break-in or maintenance. Inhalation - minimum efficiency of 95 %	

1.2.11. Control of worker exposure: Storage, Product sampling Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).	
Use in closed, continuous process with occasional controlled exposure	
Local exhaust ventilation Store substance within a closed system. Inhalation - minimum efficiency of 95 %	

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1.3. Exposure estimation and reference to its source

1.3.1. Environmental release and exposure: Manufacture of the substance (ERC1)

Release route	Release rate	Release estimation method
Water	389,8 kg/day	
Air	13,32 kg/day	

Compartment	Exposure level	RCR
Man via environment - Inhalation	0,077 mg/m ³	0,29

1.3.3. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m ³	0,01	

1.3.4. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

1.3.5. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

1.3.6. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,352 mg/m ³	0,612	

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1.3.7. Worker exposure: Use as laboratory reagent (PROC15)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,127 mg/m ³	0,51	

1.3.8. Worker exposure: Use as laboratory reagent (PROC15)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,127 mg/m ³	0,51	

1.3.9. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

1.3.10. Worker exposure: Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

1.3.11. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

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

The safety data sheet at hand provides the user with risk management measures and operational conditions which enables him to work safely with the substance / mixture. If other risk management measures / operational conditions are adopted, the user has to ensure, that the risks are managed to at least equivalent levels.

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ES2: Formulation & (re)packing of substances and mixtures

2.1. Title section

Structured Short Title	: Formulation or re-packing, Formulation & (re)packing of substances and mixtures
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Environment		
CS1	Formulation & (re)packing of substances and mixtures, Environment	ERC2
Worker		
CS2	General measures applicable to all activities	PROC1, PROC2, PROC3, PROC5, PROC8a, PROC8b, PROC9, PROC14, PROC15
CS3	General exposures (closed systems)	PROC1
CS4	General exposures (closed systems), With sample collection, Product sampling	PROC2
CS5	General exposures (closed systems), Use in contained batch processes	PROC3
CS6	Batch processes at elevated temperatures	PROC3
CS7	Process sampling	PROC9
CS8	Process sampling, Respiratory protection	PROC9
CS9	Laboratory activities	PROC15
CS10	Laboratory activities, Local exhaust ventilation	PROC15
CS11	Bulk transfers	PROC8b
CS12	Mixing operations (open systems), With potential for aerosol generation	PROC5
CS13	Manual, Transfer from/pouring from containers	PROC8a
CS14	Drum/batch transfers	PROC8b
CS15	Production or preparation or articles by tableting, compression, extrusion or pelletisation	PROC14
CS16	Drum and small package filling	PROC9

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CS17	Equipment cleaning and maintenance	PROC8a
CS18	Storage	PROC2

2.2. Conditions of use affecting exposure

2.2.1. Control of environmental exposure: Formulation into mixture (ERC2)

Amount used, frequency and duration of use (or from service life)	
Daily amount per site	: 125 t
Annual amount per site	: 37500 t
Conditions and measures related to sewage treatment plant	
STP type	: Municipal sewage treatment plant
STP sludge treatment	: No application of sewage sludge to soil
STP effluent	: 2.000 m ³ /d

2.2.2. Control of worker exposure: General measures applicable to all activities

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2) / Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3) / Mixing or blending in batch processes (PROC5) / Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b) / Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9) / Tableting, compression, extrusion, pelettisation, granulation (PROC14) / Use as laboratory reagent (PROC15)

Product (article) characteristics	
Covers percentage substance in the product up to 100 %.	
Physical form of product	: Liquid
Amount used, frequency and duration of use (or from service life)	
Duration	: Covers use up to 8 h
Conditions and measures related to personal protection, hygiene and health evaluation	

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Use suitable eye protection and gloves.

Low temperature resistant gloves

Dermal - minimum efficiency of 80 %

Other conditions affecting workers exposure

Temperature : Assumes process temperature up to 20 °C

2.2.3. Control of worker exposure: General exposures (closed systems)

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures

Closed systems

Occupational Health and Safety Management System: Advanced

Provide a basic standard of general ventilation (1 to 3 air changes per hour).

2.2.4. Control of worker exposure: General exposures (closed systems), With sample collection, Product sampling

Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)

Use frequency : Covers use up to 1 h/day

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced

Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

Use in closed, continuous process with occasional controlled exposure

Sample via a closed loop or other system to avoid exposure.

Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings.

Inhalation - minimum efficiency of 95 %

2.2.5. Control of worker exposure: General exposures (closed systems), Use in contained batch processes

Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Amount used, frequency and duration of use (or from service life)

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Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Closed batch process with occasional controlled exposure	
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %	

2.2.6. Control of worker exposure: Batch processes at elevated temperatures Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 4 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Closed batch process with occasional controlled exposure	
Handle substance within a predominantly closed system provided with extract ventilation. Inhalation - minimum efficiency of 95 %	
Other conditions affecting workers exposure	
Temperature	: Assumes process temperature up to 40 °C

2.2.7. Control of worker exposure: Process sampling Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 0,25 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	

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Sample via a closed loop or other system to avoid exposure.
Inhalation - minimum efficiency of 95 %

2.2.8. Control of worker exposure: Process sampling, Respiratory protection Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 0,25 h/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Sample via a closed loop or other system to avoid exposure. Inhalation - minimum efficiency of 95 %
Conditions and measures related to personal protection, hygiene and health evaluation
Respiratory protection Efficiency: APF 10

2.2.9. Control of worker exposure: Laboratory activities Use as laboratory reagent (PROC15)

Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 1 h/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Handle in a fume cupboard or under extract ventilation. Inhalation - minimum efficiency of 95 %
Other conditions affecting workers exposure
Indoor or outdoor use : Indoor use

2.2.10. Control of worker exposure: Laboratory activities, Local exhaust ventilation Use as laboratory reagent (PROC15)

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Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a basic standard of general ventilation (1 to 3 air changes per hour).	
Handle in a fume cupboard or under extract ventilation. Inhalation - minimum efficiency of > 95 %	

2.2.11. Control of worker exposure: Bulk transfers

Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Ensure material transfers are under containment or extract ventilation. Inhalation - minimum efficiency of > 95 %	

2.2.12. Control of worker exposure: Mixing operations (open systems), With potential for aerosol generation

Mixing or blending in batch processes (PROC5)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).	
Provide extract ventilation to points where emissions occur. Inhalation - minimum efficiency of 95 %	
Conditions and measures related to personal protection, hygiene and health evaluation	
Respiratory protection	

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Efficiency: APF 10

2.2.13. Control of worker exposure: Manual, Transfer from/pouring from containers Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).	
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %	
Conditions and measures related to personal protection, hygiene and health evaluation	
Respiratory protection Efficiency: APF 10	

2.2.14. Control of worker exposure: Drum/batch transfers Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %	

2.2.15. Control of worker exposure: Production or preparation or articles by tableting, compression, extrusion or pelletisation Tableting, compression, extrusion, pelettisation, granulation (PROC14)

Product (article) characteristics
Covers concentrations up to 1 %

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Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Handle substance within a predominantly closed system provided with extract ventilation. Inhalation - minimum efficiency of 95 %

2.2.16. Control of worker exposure: Drum and small package filling Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 8 h/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Fill containers/cans at dedicated fill points supplied with local extract ventilation. Transfer via enclosed lines. Inhalation - minimum efficiency of 95 %

2.2.17. Control of worker exposure: Equipment cleaning and maintenance Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 4 h/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Drain down and flush system prior to equipment break-in or maintenance. Inhalation - minimum efficiency of 95 %
Conditions and measures related to personal protection, hygiene and health evaluation
Respiratory protection Efficiency: APF 20

2.2.18. Control of worker exposure: Storage

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Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 4 h/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Store substance within a closed system.
Ensure material transfers are under containment or extract ventilation. Inhalation - minimum efficiency of 95 %

2.3. Exposure estimation and reference to its source

2.3.1. Environmental release and exposure: Formulation into mixture (ERC2)

Release route	Release rate	Release estimation method
Water	250 kg/day	
Air	0,034 kg/day	

Compartment	Exposure level	RCR
Man via environment - Inhalation	0,037 mg/m ³	0,202

2.3.3. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m ³	0,01	

2.3.4. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

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2.3.5. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,676 mg/m ³	0,306	

2.3.6. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	2,028 mg/m ³	0,918	

2.3.7. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,352 mg/m ³	0,612	

2.3.8. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,352 mg/m ³	0,612	

2.3.9. Worker exposure: Use as laboratory reagent (PROC15)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,127 mg/m ³	0,51	

2.3.10. Worker exposure: Use as laboratory reagent (PROC15)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,127 mg/m ³	0,51	

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2.3.11. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

2.3.12. Worker exposure: Mixing or blending in batch processes (PROC5)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

2.3.13. Worker exposure: Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

2.3.14. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

2.3.15. Worker exposure: Tableting, compression, extrusion, pelettisation, granulation (PROC14)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,69 mg/m ³	0,765	

2.3.16. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,352 mg/m ³	0,612	

2.3.17. Worker exposure: Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Exposure route	Health effect	Exposure	Exposure level	RCR	Remarks
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		indicator			
inhalative	systemic	long-term	1,183 mg/m ³	0,535	

2.3.18. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

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

The safety data sheet at hand provides the user with risk management measures and operational conditions which enables him to work safely with the substance / mixture. If other risk management measures / operational conditions are adopted, the user has to ensure, that the risks are managed to at least equivalent levels.

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ES3: Use in rubber production and processing

3.1. Title section

Structured Short Title : Use at industrial sites, Use in rubber production and processing

Environment		
CS1	Use in rubber production and processing, Environment	ERC4
Worker		
CS2	Use in rubber production and processing, General measures applicable to all activities	PROC1, PROC2, PROC3, PROC6, PROC8a, PROC8b, PROC9, PROC14, PROC15
CS3	Material transfers	PROC1
CS4	Material transfers, With occasional controlled exposure	PROC2
CS5	Material transfers, Dedicated facility	PROC8b
CS6	Bulk weighing, Closed systems	PROC1
CS7	Bulk weighing, With occasional controlled exposure	PROC2
CS8	Small scale weighing, Dedicated facility	PROC9
CS9	Additive premixing, Batch process, Closed systems	PROC3
CS10	Material transfers	PROC9
CS11	Calendering (including Banburys)	PROC6
CS12	Pressing uncured rubber blanks	PROC14
CS13	Laboratory activities	PROC15
CS14	Laboratory activities, Local exhaust ventilation	PROC15
CS15	Vulcanisation	PROC6
CS16	Cooling cured articles	PROC6
CS17	Equipment maintenance	PROC8a

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3.2. Conditions of use affecting exposure

3.2.1. Control of environmental exposure: Industrial use of processing aids in processes and products, not becoming part of articles (ERC4)

Amount used, frequency and duration of use (or from service life)	
Daily amount per site	: 500 t
Annual amount per site	: 150000 t
Technical and organisational conditions and measures	
User sites are assumed to be provided with oil/water separators and for waste water to be discharged via public sewer system.	
Conditions and measures related to sewage treatment plant	
STP type	: Municipal sewage treatment plant
STP effluent	: 2.000 m ³ /d
Other conditions affecting environmental exposure	
Receiving surface water flow	: 18.000 m ³ /d

3.2.2. Control of worker exposure: Use in rubber production and processing, General measures applicable to all activities

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2) / Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3) / Calendering operations (PROC6) / Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b) / Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9) / Tableting, compression, extrusion, pelettisation, granulation (PROC14) / Use as laboratory reagent (PROC15)

Product (article) characteristics	
Covers percentage substance in the product up to 100 %.	
Physical form of product	: Liquid
Amount used, frequency and duration of use (or from service life)	

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Duration	: Covers use up to 8 h
Conditions and measures related to personal protection, hygiene and health evaluation	
Use suitable eye protection and gloves. Low temperature resistant gloves	
Other conditions affecting workers exposure	
Temperature	: Assumes process temperature up to 20 °C

3.2.3. Control of worker exposure: Material transfers

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a basic standard of general ventilation (1 to 3 air changes per hour).

3.2.4. Control of worker exposure: Material transfers, With occasional controlled exposure

Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 4 hours/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Use in closed, continuous process with occasional controlled exposure	
Ensure material transfers are under containment or extract ventilation. Transfer via enclosed lines. Inhalation - minimum efficiency of 95 %	

3.2.5. Control of worker exposure: Material transfers, Dedicated facility

Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 hours/day

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Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of controlled ventilation (5 to 10 air changes per hour).

Ensure material transfers are under containment or extract ventilation.
Transfer via enclosed lines.
Inhalation - minimum efficiency of > 95 %

3.2.6. Control of worker exposure: Bulk weighing, Closed systems Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

3.2.7. Control of worker exposure: Bulk weighing, With occasional controlled exposure Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)

Use frequency : Covers use up to 4 hours/day

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of controlled ventilation (5 to 10 air changes per hour).

Use in closed, continuous process with occasional controlled exposure

Ensure material transfers are under containment or extract ventilation.
Inhalation - minimum efficiency of 95 %

3.2.8. Control of worker exposure: Small scale weighing, Dedicated facility Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Product (article) characteristics

Covers concentrations up to 5 %

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Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 4 hours/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Ensure material transfers are under containment or extract ventilation. Inhalation - minimum efficiency of 95 %	

3.2.9. Control of worker exposure: Additive premixing, Batch process, Closed systems Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 hours/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Closed batch process with occasional controlled exposure	
Ensure material transfers are under containment or extract ventilation. Inhalation - minimum efficiency of 95 %	

3.2.10. Control of worker exposure: Material transfers Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Product (article) characteristics	
Covers concentrations up to 1 %	
Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 4 hours/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	

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Ensure material transfers are under containment or extract ventilation.
Transfer via enclosed lines.
Inhalation - minimum efficiency of 95 %

3.2.11. Control of worker exposure: Calendering (including Banburys) Calendering operations (PROC6)

Product (article) characteristics
Covers concentrations up to 1 %
Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 4 hours/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %

3.2.12. Control of worker exposure: Pressing uncured rubber blanks Tabletting, compression, extrusion, pelettisation, granulation (PROC14)

Product (article) characteristics
Covers concentrations up to 1 %
Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 4 hours/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Ensure material transfers are under containment or extract ventilation. Inhalation - minimum efficiency of 95 %

3.2.13. Control of worker exposure: Laboratory activities Use as laboratory reagent (PROC15)

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Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 1 hours/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Handle in a fume cupboard or under extract ventilation. Inhalation - minimum efficiency of 95 %

3.2.14. Control of worker exposure: Laboratory activities, Local exhaust ventilation Use as laboratory reagent (PROC15)

Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 1 h/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a basic standard of general ventilation (1 to 3 air changes per hour).
Handle in a fume cupboard or under extract ventilation. Inhalation - minimum efficiency of > 95 %

3.2.15. Control of worker exposure: Vulcanisation Calendering operations (PROC6)

Product (article) characteristics
Covers concentrations up to 1 %
Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 4 hours/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %

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3.2.16. Control of worker exposure: Cooling cured articles Calendering operations (PROC6)

Product (article) characteristics
Covers concentrations up to 1 %
Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 4 hours/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %

3.2.17. Control of worker exposure: Equipment maintenance Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 4 hours/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Drain down and flush system prior to equipment break-in or maintenance. Inhalation - minimum efficiency of 95 %
Conditions and measures related to personal protection, hygiene and health evaluation
Respiratory protection Efficiency: APF 10

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3.3. Exposure estimation and reference to its source

3.3.1. Environmental release and exposure: Industrial use of processing aids in processes and products, not becoming part of articles (ERC4)

Release route	Release rate	Release estimation method
Water	1.500 kg/day	
Air	0,135 kg/day	

Compartment	Exposure level	RCR
Man via environment - Inhalation	0,22 mg/m ³	0,061

3.3.3. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m ³	0,01	

3.3.4. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

3.3.5. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

3.3.6. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,016 mg/m ³	< 0,01	

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3.3.7. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

3.3.8. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,623 mg/m ³	0,734	

3.3.9. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,676 mg/m ³	0,306	

3.3.10. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,811 mg/m ³	0,367	

3.3.11. Worker exposure: Calendering operations (PROC6)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

3.3.12. Worker exposure: Tableting, compression, extrusion, pelettisation, granulation (PROC14)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

3.3.13. Worker exposure: Use as laboratory reagent (PROC15)

Exposure route	Health effect	Exposure	Exposure level	RCR	Remarks
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		indicator			
inhalative	systemic	long-term	1,127 mg/m ³	0,51	

3.3.14. Worker exposure: Use as laboratory reagent (PROC15)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,127 mg/m ³	0,51	

3.3.15. Worker exposure: Calendering operations (PROC6)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

3.3.16. Worker exposure: Calendering operations (PROC6)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

3.3.17. Worker exposure: Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

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

The safety data sheet at hand provides the user with risk management measures and operational conditions which enables him to work safely with the substance / mixture. If other risk management measures / operational conditions are adopted, the user has to ensure, that the risks are managed to at least equivalent levels.

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ES4: Use in polymer production

4.1. Title section

Structured Short Title	: Use at industrial sites, Use in polymer production
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Environment		
CS1	Use in polymer production, Environment	ERC6c
Worker		
CS2	Use in polymer production, General measures applicable to all activities	PROC1, PROC2, PROC3, PROC6, PROC8a, PROC8b, PROC14
CS3	General exposures (closed systems), Continuous process, no sampling	PROC1
CS4	Bulk transfers, transport, With sample collection	PROC8b
CS5	Polymerisation, Continuous process, With sample collection	PROC2
CS6	Polymerisation, Batch process, With sample collection	PROC3
CS7	Polymerisation, Batch process, With sample collection, Elevated temperature	PROC3
CS8	Finishing operations, Batch process, With sample collection	PROC3
CS9	Additivation and stabilisation	PROC3
CS10	Pelletizing, Extrusion and masterbatching	PROC6
CS11	Pelletizing	PROC14
CS12	Pelletisation and pellet screening, Open systems	PROC8b
CS13	Bulk transfers, Continuous process, With sample collection	PROC3
CS14	transport, With sample collection	PROC8b
CS15	Equipment maintenance	PROC8a
CS16	Storage, With occasional controlled exposure	PROC2

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4.2. Conditions of use affecting exposure

4.2.1. Control of environmental exposure: Use of monomer in polymerisation processes at industrial site (inclusion or not into/onto article) (ERC6c)

Amount used, frequency and duration of use (or from service life)	
Daily amount per site	: 166,6 t
Annual amount per site	: 50000 t
Conditions and measures related to sewage treatment plant	
STP type	: Municipal sewage treatment plant
STP sludge treatment	: Controlled application of sewage sludge to agricultural soil
STP effluent	: 2.000 m ³ /d
Other conditions affecting environmental exposure	
Receiving surface water flow	: 18.000 m ³ /d

4.2.2. Control of worker exposure: Use in polymer production, General measures applicable to all activities

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2) / Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3) / Calendering operations (PROC6) / Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b) / Tableting, compression, extrusion, pelettisation, granulation (PROC14)

Product (article) characteristics	
Covers concentrations up to 100 %	
Physical form of product	: Liquid
Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 8 h/day
Conditions and measures related to personal protection, hygiene and health evaluation	

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Use suitable eye protection and gloves.
Low temperature resistant gloves

Other conditions affecting workers exposure

Temperature : Assumes process temperature up to 20 °C

4.2.3. Control of worker exposure: General exposures (closed systems), Continuous process, no sampling

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a basic standard of general ventilation (1 to 3 air changes per hour).

4.2.4. Control of worker exposure: Bulk transfers, transport, With sample collection

Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)

Use frequency : Covers use up to 1 hours/day

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of controlled ventilation (5 to 10 air changes per hour).

Sample via a closed loop or other system to avoid exposure.
Transfer via enclosed lines.
Inhalation - minimum efficiency of > 95 %

4.2.5. Control of worker exposure: Polymerisation, Continuous process, With sample collection

Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)

Use frequency : Covers use up to 1 hours/day

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

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Use in closed, continuous process with occasional controlled exposure

Sample via a closed loop or other system to avoid exposure.
Inhalation - minimum efficiency of 95 %

4.2.6. Control of worker exposure: Polymerisation, Batch process, With sample collection Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Amount used, frequency and duration of use (or from service life)

Use frequency : Covers use up to 1 h/day

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

Closed batch process with occasional controlled exposure

Sample via a closed loop or other system to avoid exposure.
Inhalation - minimum efficiency of 95 %

4.2.7. Control of worker exposure: Polymerisation, Batch process, With sample collection, Elevated temperature Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Product (article) characteristics

Covers concentrations up to 25 %

Amount used, frequency and duration of use (or from service life)

Use frequency : Covers use up to 1 hours/day

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

Closed batch process with occasional controlled exposure

Sample via a closed loop or other system to avoid exposure.
Inhalation - minimum efficiency of 95 %

Other conditions affecting workers exposure

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Temperature	: Assumes process temperature up to 40 °C
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4.2.8. Control of worker exposure: Finishing operations, Batch process, With sample collection Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Product (article) characteristics
Covers concentrations up to 5 %
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Closed batch process with occasional controlled exposure
Sample via a closed loop or other system to avoid exposure. Inhalation - minimum efficiency of 95 %

4.2.9. Control of worker exposure: Additivation and stabilisation Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Product (article) characteristics
Covers concentrations up to 5 %
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Closed batch process with occasional controlled exposure
Sample via a closed loop or other system to avoid exposure. Inhalation - minimum efficiency of 95 %

4.2.10. Control of worker exposure: Pelletizing, Extrusion and masterbatching Calendering operations (PROC6)

Product (article) characteristics
Covers concentrations up to 1 %

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Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %

4.2.11. Control of worker exposure: Pelletizing Tabletting, compression, extrusion, pelettisation, granulation (PROC14)

Product (article) characteristics
Covers concentrations up to 1 %
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %

4.2.12. Control of worker exposure: Pelletisation and pellet screening, Open systems Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Product (article) characteristics
Covers concentrations up to 1 %
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a basic standard of general ventilation (1 to 3 air changes per hour).
Ensure material transfers are under containment or extract ventilation. Inhalation - minimum efficiency of > 95 %

4.2.13. Control of worker exposure: Bulk transfers, Continuous process, With sample collection Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

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Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).	
Closed batch process with occasional controlled exposure	
Sample via a closed loop or other system to avoid exposure. Inhalation - minimum efficiency of 95 %	

4.2.14. Control of worker exposure: transport, With sample collection Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Ensure material transfers are under containment or extract ventilation. Inhalation - minimum efficiency of > 95 %	

4.2.15. Control of worker exposure: Equipment maintenance Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 4 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Drain down and flush system prior to equipment break-in or maintenance. Inhalation - minimum efficiency of 95 %	
Conditions and measures related to personal protection, hygiene and health evaluation	
Respiratory protection	

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Efficiency: APF 10

4.2.16. Control of worker exposure: Storage, With occasional controlled exposure Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 1 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).	
Use in closed, continuous process with occasional controlled exposure	
Ensure material transfers are under containment or extract ventilation. Inhalation - minimum efficiency of 95 %	
Store substance within a closed system.	

4.3. Exposure estimation and reference to its source

4.3.1. Environmental release and exposure: Use of monomer in polymerisation processes at industrial site (inclusion or not into/onto article) (ERC6c)

Release route	Release rate	Release estimation method
Water	25 kg/day	
Air	0,045 kg/day	

Compartment	Exposure level	RCR
Man via environment - Inhalation	0,004 mg/m ³	0,02

4.3.3. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m ³	0,01	

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4.3.4. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

4.3.5. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

4.3.6. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,578 mg/m ³	0,714	

4.3.7. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,947 mg/m ³	0,429	

4.3.8. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,578 mg/m ³	0,714	

4.3.9. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
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inhalative	systemic	long-term	1,578 mg/m ³	0,714	
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4.3.10. Worker exposure: Calendering operations (PROC6)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,69 mg/m ³	0,765	

4.3.11. Worker exposure: Tableting, compression, extrusion, pelettisation, granulation (PROC14)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,69 mg/m ³	0,765	

4.3.12. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,69 mg/m ³	0,765	

4.3.13. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,578 mg/m ³	0,714	

4.3.14. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

4.3.15. Worker exposure: Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

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4.3.16. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

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

The safety data sheet at hand provides the user with risk management measures and operational conditions which enables him to work safely with the substance / mixture. If other risk management measures / operational conditions are adopted, the user has to ensure, that the risks are managed to at least equivalent levels.

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ES5: Use in polymer processing

5.1. Title section

Structured Short Title	: Use at industrial sites, Use in polymer processing
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Environment		
CS1	Use in polymer processing, Environment	ERC6d
Worker		
CS2	Use in polymer processing, General measures applicable to all activities	PROC1, PROC2, PROC3, PROC6, PROC8a, PROC8b, PROC9, PROC13, PROC14
CS3	Bulk transfers, Closed systems	PROC1
CS4	Bulk transfers, Closed systems, With occasional controlled exposure	PROC2
CS5	Bulk transfers, Dedicated facility	PROC8b
CS6	Bulk weighing, Closed systems	PROC8b
CS7	Bulk weighing, With occasional controlled exposure	PROC2
CS8	Small scale weighing	PROC9
CS9	Additive premixing, Closed systems	PROC3
CS10	Bulk transfers, Drum/batch transfers	PROC8b
CS11	Bulk transfers, Small package filling	PROC9
CS12	Calendering (including Banburys)	PROC6
CS13	Production of articles by dipping and pouring	PROC13
CS14	Extrusion and masterbatching	PROC14
CS15	Injection moulding of articles	PROC14
CS16	Equipment maintenance	PROC8a
CS17	Storage, With occasional controlled exposure	PROC2

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5.2. Conditions of use affecting exposure

5.2.1. Control of environmental exposure: Use of reactive process regulators in polymerisation processes at industrial site (inclusion or not into/onto article) (ERC6d)

Amount used, frequency and duration of use (or from service life)	
Daily amount per site	: 41,67 t
Annual amount per site	: 12500 t
Conditions and measures related to sewage treatment plant	
STP type	: Municipal sewage treatment plant
STP sludge treatment	: Controlled application of sewage sludge to agricultural soil
STP effluent	: 2.000 m ³ /d
Other conditions affecting environmental exposure	
Receiving surface water flow	: 18.000 m ³ /d

5.2.2. Control of worker exposure: Use in polymer processing, General measures applicable to all activities

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2) / Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3) / Calendering operations (PROC6) / Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b) / Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9) / Treatment of articles by dipping and pouring (PROC13) / Tableting, compression, extrusion, pelettisation, granulation (PROC14)

Product (article) characteristics	
Covers concentrations up to 100 %	
Physical form of product	: Liquefied gas
Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 8 h/day

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Conditions and measures related to personal protection, hygiene and health evaluation	
Use suitable eye protection and gloves. Low temperature resistant gloves	
Other conditions affecting workers exposure	
Temperature	: Assumes process temperature up to 20 °C

5.2.3. Control of worker exposure: Bulk transfers, Closed systems Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a basic standard of general ventilation (1 to 3 air changes per hour).	

5.2.4. Control of worker exposure: Bulk transfers, Closed systems, With occasional controlled exposure Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Product (article) characteristics	
Covers concentrations up to 1 %	
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a basic standard of general ventilation (1 to 3 air changes per hour).	
Handle substance within a closed system. Inhalation - minimum efficiency of 95 %	

5.2.5. Control of worker exposure: Bulk transfers, Dedicated facility Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Product (article) characteristics	
Covers concentrations up to 1 %	
Technical and organisational conditions and measures	

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Occupational Health and Safety Management System: Advanced
Provide a basic standard of general ventilation (1 to 3 air changes per hour).

Ensure material transfers are under containment or extract ventilation.
Inhalation - minimum efficiency of > 95 %

5.2.6. Control of worker exposure: Bulk weighing, Closed systems Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a basic standard of general ventilation (1 to 3 air changes per hour).

Use in closed process

5.2.7. Control of worker exposure: Bulk weighing, With occasional controlled exposure Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Product (article) characteristics

Covers concentrations up to 1 %

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

Use in closed, continuous process with occasional controlled exposure

Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings.
Inhalation - minimum efficiency of 95 %

5.2.8. Control of worker exposure: Small scale weighing Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Product (article) characteristics

Covers concentrations up to 1 %

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced

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Provide a good standard of controlled ventilation (5 to 10 air changes per hour).

Ensure material transfers are under containment or extract ventilation.
Inhalation - minimum efficiency of 95 %

5.2.9. Control of worker exposure: Additive premixing, Closed systems Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Product (article) characteristics

Covers concentrations up to 1 %

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

Closed batch process with occasional controlled exposure

Ensure material transfers are under containment or extract ventilation.
Inhalation - minimum efficiency of 95 %

5.2.10. Control of worker exposure: Bulk transfers, Drum/batch transfers Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Product (article) characteristics

Covers concentrations up to 1 %

Technical and organisational conditions and measures

Occupational Health and Safety Management System: Advanced
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

Ensure material transfers are under containment or extract ventilation.
Inhalation - minimum efficiency of > 95 %

5.2.11. Control of worker exposure: Bulk transfers, Small package filling Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Product (article) characteristics

Covers concentrations up to 1 %

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Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 4 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).	
Ensure material transfers are under containment or extract ventilation. Inhalation - minimum efficiency of 95 %	

5.2.12. Control of worker exposure: Calendering (including Banburys) Calendering operations (PROC6)

Product (article) characteristics	
Covers concentrations up to 1 %	
Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 4 h/day
Technical and organisational conditions and measures	
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).	
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %	

5.2.13. Control of worker exposure: Production of articles by dipping and pouring Treatment of articles by dipping and pouring (PROC13)

Product (article) characteristics	
Covers concentrations up to 1 %	
Amount used, frequency and duration of use (or from service life)	
Use frequency	: Covers use up to 4 h/day
Technical and organisational conditions and measures	

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Occupational Health and Safety Management System: Advanced
Provide a good standard of controlled ventilation (5 to 10 air changes per hour).

Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings.
Inhalation - minimum efficiency of 95 %

5.2.14. Control of worker exposure: Extrusion and masterbatching Tabletting, compression, extrusion, pelettisation, granulation (PROC14)

Product (article) characteristics
Covers concentrations up to 1 %
Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 4 h/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %

5.2.15. Control of worker exposure: Injection moulding of articles Tabletting, compression, extrusion, pelettisation, granulation (PROC14)

Product (article) characteristics
Covers concentrations up to 1 %
Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 4 h/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Inhalation - minimum efficiency of 95 %

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5.2.16. Control of worker exposure: Equipment maintenance Transfer of substance or preparation (charging/ discharging) from/ to vessels/ large containers at non-dedicated facilities (PROC8a)

Product (article) characteristics
Covers concentrations up to 1 %
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Drain down and flush system prior to equipment break-in or maintenance. Inhalation - minimum efficiency of 95 %

5.2.17. Control of worker exposure: Storage, With occasional controlled exposure Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Product (article) characteristics
Covers concentrations up to 1 %
Amount used, frequency and duration of use (or from service life)
Use frequency : Covers use up to 1 h/day
Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Use in closed, continuous process with occasional controlled exposure Store substance within a closed system.

5.3. Exposure estimation and reference to its source

5.3.1. Environmental release and exposure: Use of reactive process regulators in polymerisation processes at industrial site (inclusion or not into/onto article) (ERC6d)

Release route	Release rate	Release estimation method
Water	0 kg/day	

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Air	0,011 kg/day	
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Compartment	Exposure level	RCR
Man via environment - Inhalation	0,000288 mg/m ³	0,000

5.3.3. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m ³	0,01	

5.3.4. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,563 mg/m ³	0,255	

5.3.5. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,69 mg/m ³	0,765	

5.3.6. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m ³	0,01	

5.3.7. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,394 mg/m ³	0,178	

5.3.8. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

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Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,352 mg/m ³	0,612	

5.3.9. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

5.3.10. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,183 mg/m ³	0,535	

5.3.11. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,893 mg/m ³	0,857	

5.3.12. Worker exposure: Calendering operations (PROC6)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

5.3.13. Worker exposure: Treatment of articles by dipping and pouring (PROC13)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

5.3.14. Worker exposure: Tableting, compression, extrusion, pelettisation, granulation (PROC14)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

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5.3.15. Worker exposure: Tableting, compression, extrusion, pelettisation, granulation (PROC14)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,014 mg/m ³	0,459	

5.3.16. Worker exposure: Transfer of substance or preparation (charging/ discharging) from/ to vessels/ large containers at non-dedicated facilities (PROC8a)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,69 mg/m ³	0,765	

5.3.17. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,789 mg/m ³	0,357	

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

The safety data sheet at hand provides the user with risk management measures and operational conditions which enables him to work safely with the substance / mixture. If other risk management measures / operational conditions are adopted, the user has to ensure, that the risks are managed to at least equivalent levels.