



CHEMICAL SAFETY REPORT – CHESAR

**Applicable for locations
Heiligerlee and Zuidwending**



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9. EXPOSURE ASSESSMENT (and related risk characterisation)

The sections 9 and 10 of this CSR have been generated with Chesar 3.4.

9.0. Introduction

9.0.1. Overview on uses

See the description of the various uses in section 9.1.

9.0.2. Assessment entity groups

Not applicable

9.0.3. Introduction to the assessment for the environment

9.0.3.1. Tonnage

Assessed tonnage: 252 tonnes/year based on:

On a yearly basis there are 5 workovers with max 50 m3 of diesel each = 250 m3/a or 225 t/. This covers all caverns on the site Delfzijl.

The following table provides the tonnage per use and the local tonnages used in the assessment for each environmental contributing activity.

Table 9.1. Tonnage for assessment

ES#	Exposure scenario (ES) name and related environmental contributing scenarios	Tonnage per use (t/year)	Daily local tonnage (t/day)	Annual local tonnage (t/year)
ES1 (IS)	Industrial use; Use of functional fluid at industrial site	225		
	- Industrial use; Use of functional fluid at industrial site (ERC 7)		25	225

9.0.3.2. Scope and type of assessment for the environment

The scope of exposure assessment and type of risk characterisation required for the environment are described in the following table based on the hazard conclusions presented in the e-SDS from the supplier.

Table 9.2. Type of risk characterisation required for the environment

Protection target	Risk characterisation type	Hazard conclusion
Fresh water	Undefined*	
Sediment (freshwater)	Undefined*	
Marine water	Undefined*	
Sediment (marine water)	Undefined*	
Sewage Treatment Plant	Undefined*	
Air	Undefined*	
Agricultural soil	Undefined*	
Predator's prey (freshwater)	Undefined*	



Protection target	Risk characterisation type	Hazard conclusion
Predator's prey (marine water)	Undefined*	
Top predator's prey (marine water)	Undefined*	
Predator's prey (terrestrial)	Undefined*	

* In the supplier eSDS the following is explained:

"Fuels, Diesel is a hydrocarbon UVCB. The hydrocarbon block method is used in PETRORISK to calculate the environmental toxicity (HC5) of each group of components in the substance. These are used to estimate the environmental risk for the substance. As a down-stream user we do not have this information. Therefore a PNEC is not available for Fuels, Diesel for individual environmental compartments."

9.0.3.3. Fate and distribution parameters

Physicochemical properties used for exposure estimation

The following substance properties are used in the fate estimation done by EUSES. They correspond to the values in the e-SDS from supplier.

Table 9.3. Substance key phys-chem and fate properties

Substance property	Value
Molecular weight	128 - 282
Molecular weight used for the assessment	282
Melting point at 101 325 Pa	-40 °C
Vapour pressure	400 Pa at 20 °C
Partition coefficient (Log Kow)	3 at 20 °C
Water solubility	0.1 mg/L at 20 °C

Fate (release percentage) in the modelled biological sewage treatment plant

In a standard (modelled) biological STP, the emissions are distributed in the following way:

Release to water	4.837%
Release to air	91.87%
Release to sludge	3.284%
Release degraded	0%

The above fractions are calculated by the SIMPLETREAT model integrated in EUSES.

9.0.3.4. Comments on assessment approach for the environment

The regional concentrations are reported in section 10.2.1.1. The local Predicted Exposure Concentrations (PECs) reported for each contributing scenario correspond to the sum of the local concentrations (Clocal) and the regional concentrations (PEC regional).

9.0.3.5. Scope and type of assessment for man via environment

The scope of exposure assessment and type of risk characterisation required for man via the environment are described in the following table based on the hazard conclusions presented in the e-SDS from supplier.

Table 9.4. Type of risk characterisation required for man via the environment



Route of exposure and type of effects	Risk characterisation type	Hazard conclusion
Inhalation: Long term, Systemic	Undefined*	
Oral: Long term, Systemic	Undefined*	

*These values are not available in the e-SDS

9.0.4. Introduction to the assessment for workers

9.0.4.1. Scope and type of assessment for workers

The scope of exposure assessment and type of risk characterisation required for workers are described in the following table based on the hazard conclusions presented in the supplier eSDS.

Table 9.5. Type of risk characterisation required for workers

Route	Type of effect	Risk characterisation type	Hazard conclusion
Inhalation	Systemic effects - long term	Quantitative	DNEL (Derived No Effect Level) = 68 mg/m ³
	Systemic effects - acute	Qualitative	Low hazard (no threshold derived)
	Local effects - long term	Quantitative	DNEL (Derived No Effect Level) = 4.3E3 mg/m ³
	Local effects - acute	Qualitative	Medium hazard (no threshold derived)
Dermal	Systemic effects - long term	Quantitative	DNEL (Derived No Effect Level) = 2.9 mg/kg bw/day
	Systemic effects - acute	Not needed	No hazard identified
	Local effects - long term	Qualitative	Medium hazard (no threshold derived)
	Local effects - acute	Qualitative	Medium hazard (no threshold derived)
Eye	Local effects	Not needed	No hazard identified

9.0.5. Introduction to the assessment for consumers

Exposure assessment is not applicable as there are no consumer-related uses for the substance.



9.1. Exposure scenario 1: Use at industrial sites - Industrial use; Use of functional fluid at industrial site

Product category used: PC 0: Other

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

Environment contributing scenario(s):		
CS 1	Industrial use; Use of functional fluid at industrial site	ERC 7
Worker contributing scenario(s):		
CS 2	Closed systems	PROC 1
CS 3	Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions	PROC 2
CS 4	Chemical production where opportunity for exposure arises	PROC 4
CS 5	Transfer of substance or mixture (charging/discharging) at dedicated facilities	PROC 8b

Further description of the use:

Diesel oil is used as blanketing fluid in the salt caverns of site Delfzijl (The Netherlands), in which it floats on the brine.

The diesel oil is pumped from the storage tank of the supplier into a transport truck, from which it is pumped on the site into the drilling well / cavern. The loading and unloading is done in a closed system – i.e. there is a direct link from truck to the cavern. In between the several development phases and after ending the production, blanketing oil is removed, and pumped back to storage. For some wells an open container is used between the well and the transport truck.

There are 5 workovers per year with max 50 m³ of diesel, which makes a total of 250 m³/year equal to 225 tons/year.

9.1.1. Env CS 1: Industrial use; Use of functional fluid at industrial site (ERC 7)

In our supplier eSDS the following is explained:

“Fuels, Diesel is a hydrocarbon UVCB. The hydrocarbon block method is used in PETRORISK to calculate the environmental toxicity (HC5) of each group of components in the substance. These are used to estimate the environmental risk for the substance. Therefore a PNEC is not available for Fuels, Diesel for individual environmental compartments.”

The release to environment in this closed use is expected to be similar to the scenario for distribution of fuels, since the only emission points will be at charging/discharging. Therefore the same spERC has been used

9.1.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Daily use amount at site: <= 25 tonnes/day <i>10 days of use</i>
• Annual use amount at site: <= 225 tonnes/year
Conditions and measures related to biological sewage treatment plant
• Biological STP: None [Effectiveness Water: 0%]
Conditions and measures related to external treatment of waste (including article waste)
• Particular considerations on the waste treatment operations
Other conditions affecting environmental exposure
• Receiving surface water flow rate: >= 1.8E4 m ³ /day
• Discharge rate of effluent: >= 2E3 m ³ /day



9.1.1.2. Releases

The local releases to the environment are reported in the following table. Note that the releases reported do not account for the removal in the modelled biological STP.

Table 9.6. Local releases to the environment

Release	Release estimation method	Explanations
Water	Estimated release factor (ESVOC SpERC 1.1b.v1)	Release factor before on site RMM: 1E-4% Release factor after on site RMM: 1E-4% Local release rate: 0.025 kg/day Explanation: From supplier eSDS: Msafe is 2.9E6 kg/day at site. Waste water emission factor 1E-6, RMM efficiency 94.1%. Safe release rate to water compartment: $(1-94.1) \times 2.9 \text{ kg/day} = 0.1711 \text{ kg/day}$. Release rate to water in this scenario is 0.025 kg/day is 7 times lower.
Air	Estimated release factor (ESVOC SpERC 1.1b.v1)	Release factor before on site RMM: 0.1% Release factor after on site RMM: 0.1% Local release rate: 25 kg/day Explanation: In supplier e-SDS Msafe is 2.9E6 kg/day at site. Emission to air is 1E-3, RMM efficiency 90% Safe release to air is $(1-0.9) \times 2.9E6 \times 1E-3 = 290 \text{ kg/day}$ In this scenario release is ~10 times lower.
Non agricultural soil	Estimated release factor (ESVOC SpERC 1.1b.v1)	Release factor after on site RMM: 1E-3% Explanation: In supplier e-SDS Msafe is 2.9E6 kg/day at site Soil emission factor in eSDS is 1E-5, no RMM. Safe release to soil is $2.9E6 \times 1E-5 = 29 \text{ kg/day}$ In this scenario soil release is 0.25 kg/day, so much lower.

9.1.1.3. Exposure and risks for the environment and man via the environment

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table. The exposure estimates have been obtained with EUSES 2.1.2 unless stated otherwise.

Table 9.7. Exposure concentrations and risks for the environment and man via the environment

Protection target	Exposure concentration	Risk quantification
Fresh water	Local PEC: 1.25E-3 mg/L	
Sediment (freshwater)	Local PEC: 0.052 mg/kg dw	
Marine water	Local PEC: 1.25E-4 mg/L	
Sediment (marine water)	Local PEC: 5.2E-3 mg/kg dw	
Sewage Treatment Plant	Local PEC: 0 mg/L	
Air	Local PEC: 4.85E-4 mg/m ³	
Agricultural soil	Local PEC: 3.14E-4 mg/kg dw	
Predator's prey (freshwater)	Local PEC: 1.09E-3 mg/kg ww	
Predator's prey (marine water)	Local PEC: 1.09E-4 mg/kg ww	
Top predator's prey (marine water)	Local PEC: 2.19E-5 mg/kg ww	
Predator's prey (terrestrial)	Local PEC: 5.21E-5 mg/kg ww	
Man via environment -	Concentration in air: 4.85E-4 mg/m ³	



Protection target	Exposure concentration	Risk quantification
Inhalation		
Man via environment - Oral	Exposure via food consumption: 4.44E-6 mg/kg bw/day	

Risk characterisation

Based on comparison of released amount to supplier e-SDS this is a safe environmental use.

Therefore also exposure to man via environment is safe in this use.

9.1.2. Worker CS 2: Closed systems (PROC 1)

Use as a blanketing fluid. Storage in closed systems.

9.1.2.1. Conditions of use

	Method
Product (article) characteristics	
• Percentage (w/w) of substance in mixture/article: ≤ 100 %	TRA Workers 3.0
• Physical form of the used product: Liquid	TRA Workers 3.0
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: ≤ 8 h/day	TRA Workers 3.0
Technical and organisational conditions and measures	
• General ventilation: Basic general ventilation (1-3 air changes per hour) [Effectiveness Inhalation: 0%]	TRA Workers 3.0
• Occupational Health and Safety Management System: Advanced	TRA Workers 3.0
• Local exhaust ventilation: No [Effectiveness Inhalation: 0%, Dermal: 0%]	TRA Workers 3.0
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protection: No [Effectiveness Inhalation: 0%]	TRA Workers 3.0
• Dermal protection: No [Effectiveness Dermal: 0%]	TRA Workers 3.0
Other conditions affecting workers exposure	
• Place of use: Indoor	TRA Workers 3.0
• Operating temperature: ≤ 40 °C	TRA Workers 3.0

9.1.2.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.8. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	0.117 mg/m ³ (TRA Workers)	RCR < 0.01
Inhalation, local, long term	0.117 mg/m ³ (TRA Workers)	RCR < 0.01
Dermal, systemic, long term	0.034 mg/kg bw/day (TRA Workers)	RCR = 0.012
Combined routes, systemic, long-term		RCR = 0.013

Remarks on exposure dataset obtained with ECETOC TRA

The vapour pressure at operating temperature (40°C) used for the calculation is 1.48E3 Pa.

Risk characterisation

Qualitative risk characterisation (Inhalation, systemic, acute, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute):



Short term and local assessment is covered by assessment for systemic long-term effects.

9.1.3. Worker CS 3: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC 2)

Use as a blanketing fluid. Storage in closed systems.

9.1.3.1. Conditions of use

	Method
Product (article) characteristics	
• Percentage (w/w) of substance in mixture/article: $\leq 100\%$	TRA Workers 3.0
• Physical form of the used product: Liquid	TRA Workers 3.0
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: ≤ 8 h/day	TRA Workers 3.0
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Advanced	TRA Workers 3.0
• Local exhaust ventilation: No [Effectiveness Inhalation: 0%, Dermal: 0%]	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protection: No [Effectiveness Inhalation: 0%]	TRA Workers 3.0
• Dermal protection: Yes (Chemically resistant gloves conforming to EN374) and (other) appropriate dermal protection [Effectiveness Dermal: 80%]	TRA Workers 3.0
Other conditions affecting workers exposure	
• Place of use: Outdoor	TRA Workers 3.0
• Operating temperature: $\leq 40^\circ\text{C}$	TRA Workers 3.0

9.1.3.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.9. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	41.12 mg/m ³ (TRA Workers)	RCR = 0.605
Inhalation, local, long term	41.12 mg/m ³ (TRA Workers)	RCR < 0.01
Dermal, systemic, long term	0.274 mg/kg bw/day (TRA Workers)	RCR = 0.094
Combined routes, systemic, long-term		RCR = 0.699

Remarks on exposure dataset obtained with ECETOC TRA

The vapour pressure at operating temperature (40°C) used for the calculation is 1.48E3 Pa.

Risk characterisation

Qualitative risk characterisation (Inhalation, systemic, acute, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute):

Short term and local assessment is covered by assessment for systemic long-term effects.

9.1.4. Worker CS 4: Chemical production where opportunity for exposure arises (PROC 4)

Use as a blanketing fluid, open container between truck and cavern.

**9.1.4.1. Conditions of use**

	Method
Product (article) characteristics	
• Percentage (w/w) of substance in mixture/article: $\leq 100\%$	TRA Workers 3.0
• Physical form of the used product: Liquid	TRA Workers 3.0
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: ≤ 8 h/day	TRA Workers 3.0
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Advanced	TRA Workers 3.0
• Local exhaust ventilation: No [Effectiveness Inhalation: 0%, Dermal: 0%]	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protection: Yes (Respirator with APF of 10) [Effectiveness Inhalation: 90%]	TRA Workers 3.0
• Dermal protection: Yes (Chemically resistant gloves conforming to EN374) and (other) appropriate dermal protection [Effectiveness Dermal: 80%]	TRA Workers 3.0
Other conditions affecting workers exposure	
• Place of use: Outdoor	TRA Workers 3.0
• Operating temperature: $\leq 40^\circ\text{C}$	TRA Workers 3.0

9.1.4.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.10. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	16.45 mg/m ³ (TRA Workers)	RCR = 0.242
Inhalation, local, long term	16.45 mg/m ³ (TRA Workers)	RCR < 0.01
Dermal, systemic, long term	1.372 mg/kg bw/day (TRA Workers)	RCR = 0.473
Combined routes, systemic, long-term		RCR = 0.715

Remarks on exposure dataset obtained with ECETOC TRA

The vapour pressure at operating temperature (40°C) used for the calculation is 1.48E3 Pa.

Risk characterisation

Qualitative risk characterisation (Inhalation, systemic, acute, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute):

Short term and local assessment is covered by assessment for systemic long-term effects.

9.1.5. Worker CS 5: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC 8b)

Connecting or disconnecting transfer lines during charging/discharging operations.

9.1.5.1. Conditions of use

	Method
Product (article) characteristics	
• Percentage (w/w) of substance in mixture/article: $\leq 100\%$	TRA Workers 3.0
• Physical form of the used product: Liquid	TRA Workers 3.0



	Method
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: ≤ 0.25 h/day <i>Exposure only during connecting/disconnecting pipes/hoses</i>	TRA Workers 3.0
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Advanced	TRA Workers 3.0
• Local exhaust ventilation: No [Effectiveness Inhalation: 0%, Dermal: 0%]	
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protection: No [Effectiveness Inhalation: 0%]	TRA Workers 3.0
• Dermal protection: Yes (Chemically resistant gloves conforming to EN374) and (other) appropriate dermal protection [Effectiveness Dermal: 80%]	TRA Workers 3.0
Other conditions affecting workers exposure	
• Place of use: Outdoor	TRA Workers 3.0
• Operating temperature: ≤ 40 °C	TRA Workers 3.0

9.1.5.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.11. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	20.56 mg/m ³ (TRA Workers)	RCR = 0.302
Inhalation, local, long term	20.56 mg/m ³ (TRA Workers)	RCR < 0.01
Dermal, systemic, long term	0.274 mg/kg bw/day (TRA Workers)	RCR = 0.095
Combined routes, systemic, long-term		RCR = 0.397

Remarks on exposure dataset obtained with ECETOC TRA

The vapour pressure at operating temperature (40°C) used for the calculation is 1.48E3 Pa.

Risk characterisation

Qualitative risk characterisation (Inhalation, systemic, acute, Inhalation, local, acute, Dermal, local, long term, Dermal, local, acute):

Short term and local assessment is covered by assessment for systemic long-term effects.



10. RISK CHARACTERISATION RELATED TO COMBINED EXPOSURE

10.1. Human health

10.1.1. Workers

10.1.2. Consumer

10.2. Environment (combined for all emission sources)

10.2.1. All uses (regional scale)

10.2.1.1. Total releases

The total releases to the environment from all the exposure scenarios covered are presented in the table below. This is the sum of the releases to the environments from all exposure scenarios addressed.

Table 10.1. Total releases to the environment per year from all life cycle stages

Release route	Total releases per year
Water	0.225 kg/year
Air	225 kg/year
Soil	2.25 kg/year

10.2.2. Regional assessment

The regional predicted environmental concentration (PEC regional) and the related risk characterisation ratios when a PNEC is available are presented in the table below. The exposure to man via the environment from regional exposure and the related risk characterisation ratios are also provided (when relevant). The exposure concentration for human via inhalation is equal to the PEC air.

The exposure estimates have been obtained with EUSES 2.1.2 unless stated otherwise.

Table 10.2. Predicted regional exposure concentrations (Regional PEC) and risks for the environment

Protection target	Regional PEC	Risk characterisation
Fresh water	Regional PEC: 1.77E-9 mg/L	
Sediment (freshwater)	Regional PEC: 8.78E-8 mg/kg dw	
Marine water	Regional PEC: 1.37E-9 mg/L	
Sediment (marine water)	Regional PEC: 6.11E-8 mg/kg dw	
Air	Regional PEC: 3.14E-4 mg/m ³	
Agricultural soil	Regional PEC: 1.61E-7 mg/kg dw	
Man via environment - Inhalation	Concentration in air: 3.14E-4 mg/m ³	
Man via environment - Oral	Exposure via food consumption: 9.58E-9 mg/kg bw/day	

10.2.3. Local exposure due to all widespread uses

Not relevant as there are not several widespread uses covered in this CSR.