Annex to Safety Data Sheet

Prepared in accordance with Annex II of the REACH Regulation EC 1907/2006 and Regulation (EC) 1272/2008.

APPENDIX: EXPOSURE SCENARIOS

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EXPOSURE ASSESSMENT (and related risk characterisation)

Introduction

Overview of uses and Exposure Scenarios

Sodium hypochlorite is used mainly in chemical synthesis, for cleaning, disinfection and sanitation in household, for municipal water and sewage disinfection and for bleaching. In Europe, mainly two concentrations are used: - 12 to 14% available chlorine as generally manufactured - 3 to 5% available chlorine after dilution but is possible to have a concentration up to 24% available chlorine. Sodium hypochlorite is increasingly used in a very wide range of formulations for house hold, institutional or industrial applications (concentrations 1 to 10% available chlorine). Sodium hypochlorite is used: - for household and laundry cleaning, sanitation, deodorizing and disinfection - for municipal water and sewage treatment, water cooling/heating systems - for medical environment disinfection - for textile industry and pulp and paper bleaching - for chemical synthesis - as multi-site fungicide in agriculture and horticulture - as an oxidant in a very wide range of activities Any biocidal use of sodium hypochlorite is covered by a dossier submitted under the Biocide Directive No 98/8/EC and Biocidal Product Regulation No 528/2012
Tonnage information:
1195.23 kt/y 24% active chlorine (286.85 kt/year Cl2 equivalent)

The following table list all the exposure scenarios (ES) assessed:

Identifiers	Titles of exposure scenarios and the related contributing scenarios
ES1 - M1	Manufacture - Manufacture - Manufacture (ERC 1) - General exposures (closed systems) (PROC 1) - General exposures (closed systems); with sample collection (PROC 2) - Use in batch processes (closed systems), with sample collection (PROC 3) - Use in batch processes, with sample collection (PROC 4) - Drum/batch transfers, non-dedicated facilities (PROC 8a) - Drum/batch transfer, dedicated facilities (PROC 8b) - Small containers transfers, dedicated facilities (PROC 9) - Laboratory activities (PROC 15)
ES2 - F1	Formulation - Formulation - Formulation (ERC 2) - General exposures (closed systems) (PROC 1) - General exposures (closed systems), with sample collection (PROC 2) - Use in batch process (closed systems), with sample collection (PROC 3) - Use in batch processes, with sample collection (PROC 4) - Mixing/blending in batch processes (PROC 5) - Drum/batch transfers, non-dedicated facilities (PROC 8a) - Drum/batch transfers, dedicated facilities (PROC 8b) - Small containers transfers, dedicated facilities (PROC 9) - Production of preparation/articles (PROC 14) - Laboratory activities (PROC 15)
ES3 - IW1	Use at industrial site - Use as an intermediate - Use as intermediate (ERC 6a) - General exposures (closed systems) (PROC 1) - General exposures (closed systems), with sample collection (PROC 2) - Use in batch processes (closed systems), with sample collection (PROC 3) - Use in batch processes, with sample collection (PROC 4) - Drum/batch transfers, non-dedicated facilities (PROC 8a) - Drum/batch transfers, dedicated facilities (PROC 8b)

	- Small containers transfers, dedicated facilities (PROC 9) - Laboratory activities (PROC 15)
ES4 - IW2	Use at industrial site - Use in textile industry - Use in textile industry (reactive processing aid) (ERC 6b) - General exposures (closed systems) (PROC 1) - General exposures (closed systems); with sample collection (PROC 2) - Use in batch processes (closed systems), with sample collection (PROC 3) - Use in batch processes, with sample collection (PROC 4) - Mixing/blending in batch processes (PROC 5) - Drum/batch transfers, non-dedicated facilities (PROC 8a) - Drum/batch processes, dedicated facilities (PROC 8b) - Small containers transfers, dedicated facilities (PROC 9) - Treatment by dipping/pouring (PROC 13) - Laboratory activities (PROC 15)
ES5 - IW3	Use at industrial site - Industrial use in sewage and cooling or heating water treatment - Use in sewage and cooling/heating water treatment (reactive processing aid) (ERC 6b) - General exposures (closed systems) (PROC 1) - General exposures (closed systems), with sample collection (PROC 2) - Use in batch processes (closed systems), with sample collection (PROC 3) - Use in batch processes, with sample collection (PROC 4) - Mixing/blending in batch processes (PROC 5) - Drum/batch transfers, non-dedicated facilities (PROC 8a) - Drum/batch transfers, dedicated facilities (PROC 8b) - Small containers transfers, dedicated facilities (PROC 9) - Laboratory activities (PROC 15)
ES6 - IW4	Use at industrial site - Industrial use in pulp and paper - Use in pulp and paper (reactive processing aid) (ERC 6b) - General exposures (closed systems) (PROC 1) - General exposures (closed systems), with sample collection (PROC 2) - Use in batch processes (closed systems), with sample collection (PROC 3) - Use in batch processes, with sample collection (PROC 4) - Mixing/blending in batch processes (PROC 5) - Drum/batch transfers, non-dedicated facilities (PROC 8a) - Drum/batch transfers, dedicated facilities (PROC 8b) - Small containers transfers, dedicated facilities (PROC 9) - Laboratory activities (PROC 15)
ES7 - IW5	Use at industrial site - Industrial cleaning use - Industrial cleaning use (ERC 6b) - Mixing/blending in batch processes (PROC 5) - Industrial spraying (PROC 7) - Drum/batch processes, non-dedicated facilities (PROC 8a) - Small containers transfers, dedicated facilities (PROC 9) - Roller application or brushing (PROC 10) - Treatment by dipping/pouring (PROC 13)
ES8 - PW1	Use by professional worker - Professional cleaning uses - Professional cleaning use (ERC 8a) - Mixing/blending in batch processes (PROC 5) - Small containers transfers, dedicated facilities (PROC 9) - Roller application or brushing (PROC 10) - Professional spraying (PROC 11)

	- Treatment by dipping/pouring (PROC 13) - Laboratory activities (PROC 15) - Drum/batch processes, non-dedicated facilities (PROC 8a) - Drum/batch processes, dedicated facilities (PROC 8b)
ES9 - C1	Consumer Use - Consumer Use - Consumer Use (ERC 8a) - Consumer use of products for textile treatment (dyes, bleaches,...) (PC 34) - Consumer use of products for water treatment (PC 37) - Consumer use of washing and cleaning products (PC 35) - Consumer use of cosmetic products (PC 39) - Consumer use of perfumes/fragrances (PC 28)

Introduction to the assessment

Scope and type of assessment - Workers

The scope of exposure assessment and type of risk characterization required for workers are described in the following table:

Route	Type of effect	Type of risk characterisation	Hazard conclusion (see section 5.11)
Inhalation	Systemic, long-term	Quantitative	DNEL (Derived No Effect Level) = 1.55 mg/m³
	Systemic, acute	Quantitative	DNEL (Derived No Effect Level) = 3.1 mg/m³
	Local, long-term	Quantitative	DNEL (Derived No Effect Level) = 1.55 mg/m³
	Local, acute	Quantitative	DNEL (Derived No Effect Level) = 3.1 mg/m³
Dermal	Systemic, long-term	Not needed	No hazard identified
	Systemic, acute	Qualitative	Low hazard (no threshold derived)
	Local, long-term	Quantitative	DNEL (Derived No Effect Level) = 0.5 % in mixture (weight basis)
	Local, acute	Qualitative	Low hazard (no threshold derived)
Eye	Local	Qualitative	Low hazard (no threshold derived)

Comments on assessment approach related to toxicological hazard:

A quantitative assessment was carried out for long term systemic hazards via skin and inhalation. The exposure of workers was estimated primarily using the ECETOC TRA (April 2012 version 3) modelling tool. Sodium hypochlorite solutions contain three species of chlorine in equilibrium: gaseous chlorine, hypochlorous acid (HOCl) and ClO-. Their concentration is a function of the pH of the solution. The pH of commercial solutions of sodium hypochlorite can range from pH 9 (diluted) to 13 (concentrated) and as such the dominant species are the hypochlorite anion and hypochlorous acid, with the former predominating. Being an anion, ClO- will not volatilize from aqueous solutions. The minute fraction of HOCl present in commercial solutions has a very low volatility. Gaseous chlorine can be released from a sodium hypochlorite solution only in accidental case by mixing with strong acids. Therefore, exposure to hypochlorite solutions does not comprise inhalation exposure, except in the cases in which an aerosol is formed. A qualitative assessment was carried out with respect to corrosion and respiratory irritation. Sodium hypochlorite is categorized in the "low hazard" band according to ECHA Guidance on information Requirements and Chemical Safety Assessment, Part E, Table E.3-1. Therefore, exposure should be minimized by appropriate general risk management measures below. When these risk management measures and operational conditions are applied, the risk for exposure to corrosive and respiratory irritant substance is controlled.

General information on risk management related to toxicological hazard:

General measures:

- Containment as appropriate
- Minimize number of staff exposed
- Segregation of the emitting process
- Effective contaminant extraction - Good standard of general ventilation
- Minimization of manual phases
- Avoidance of contact with contaminated tools and object - Regular cleaning of equipment and work area
- Management/supervision in place to check that the RMMs in place are being used correctly and OCs followed
- Training for staff on good practice
- Good standard of personal hygiene

Personal Protective Equipment:

- Substance/task appropriate gloves
- Skin coverage with appropriate barrier material based on potential for contact with the chemicals
- Substance/task appropriate respirator
- Chemical goggles
- Optional face shield

Scope and type of assessment - Consumers

The scope of exposure assessment and type of risk characterization required for consumers are described in the following table:

Route	**Type of effect**	**Type of risk characterisation**	**Hazard conclusion (see section 5.11)**
Inhalation	Systemic, long-term	Quantitative	DNEL (Derived No Effect Level) = 1.55 mg/m³
	Systemic, acute	Quantitative	DNEL (Derived No Effect Level) = 3.1 mg/m³
	Local, long-term	Quantitative	DNEL (Derived No Effect Level) = 1.55 mg/m³
	Local, acute	Quantitative	DNEL (Derived No Effect Level) = 3.1 mg/m³
Dermal	Systemic, long-term	Not needed	No hazard identified
	Systemic, acute	Qualitative	Low hazard (no threshold derived)
	Local, long-term	Quantitative	DNEL (Derived No Effect Level) = 0.5 % in mixture (weight basis)
	Local, acute	Qualitative	Low hazard (no threshold derived)
Eye	Local	Qualitative	Low hazard (no threshold derived)
Oral	Systemic, long-term	Quantitative	DNEL (Derived No Effect Level) = 0.26 mg/kg bw/day

Comments on assessment approach:

A quantitative assessment has been carried out for consumer uses.

1. Exposure scenario 1: Manufacture - Manufacture

Environment contributing scenario(s):	
Manufacture	ERC 1
Worker contributing scenario(s):	
General exposures (closed systems)	PROC 1
General exposures (closed systems); with sample collection	PROC 2
Use in batch processes (closed systems), with sample collection	PROC 3
Use in batch processes, with sample collection	PROC 4
Drum/batch transfers, non-dedicated facilities	PROC 8a
Drum/batch transfer, dedicated facilities	PROC 8b
Small containers transfers, dedicated facilities	PROC 9
Laboratory activities	PROC 15

1.1. Environmental contributing scenario 1: Manufacture

1.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Annual use at a site: <= 3.426E5 tonnes/year *Maximum regional tonnage for a 24% active chlorine solution. It corresponds to 82.22 kT/y Cl2 equivalent*
• Percentage of EU tonnage used at regional scale: = 100 %
• Emission Days (days/year): 360 days/year
Conditions and measures related to sewage treatment plant
• Municipal STP: Yes [Effectiveness Water: 100%]
• Discharge rate of STP: >= 2E3 m3/d
• Application of the STP sludge on agricultural soil: No
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low risk) (ERC based assessment demonstrating control of risk with default conditions. Low risk assumed for waste life stage. Waste disposal according to national/local legislation is sufficient.)
Other conditions affecting environmental exposure
• Receiving surface water flow rate: >= 1.8E4 m3/d

1.1.2. Releases

Product applied in aqueous process solution with negligible volatilization. Free available chlorine in effluent is measured as total residual chlorine (TRC) and should be below 1.0E-13 mg/L

No release in air from process expected because sodium hypochlorite solution is non-volatile.

No release in soil from process expected.

Technical conditions and measures at process level (source) to prevent release

Common practices vary across sites but releases expected are negligible to waste water and soil (sodium hypochlorite is destroyed rapidly in contact with organic as well as inorganic material).

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Risk from environmental exposure is driven by freshwater. Onsite wastewater treatment required. Prevent discharge of undissolved substance to or recover from onsite wastewater.

Conclusion on risk characterization

A qualitative approach is used to conclude safe use. The worst case exposure concentration used as PEC in waste water treatment plant is 1E-13 mg/l. The PECs for other compartments are not applicable, because sodium hypochlorite is destroyed rapidly in contact with organic as well as inorganic material and furthermore that is a non-volatile substance.

Hypochlorite will not reach the environment via the sewage treatment system, as the quick transformation of the applied hypochlorite (as free available chlorine, FAC) in the sewage system assures the absence of any human exposure to hypochlorite. Also in recreational zones located close to discharge points of chlorinated waste water, the potential for exposure to hypochlorite originating from waste water treatment is negligible as the emission of unreacted hypochlorite is non-existent. Due to physico-chemical properties of sodium hypochlorite, no indirect exposure is thought to occur via the human food chain. Thus no indirect exposure to sodium hypochlorite is thought to occur via the environment.

1.2. Worker contributing scenario

TRA Workers 3.0 method used.

1.2.1. Conditions of use

	PROC
Product (article) characteristics	
• Concentration of substance in mixture: 5-25%	1, 2, 3, 4, 8a, 8b, 9, 15
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: < 8 hours	1, 2, 3, 4, 8a, 8b, 9, 15
Technical and organisational conditions and measures	

	PROC
• General ventilation: Basic general ventilation (1-3 air changes per hour)	1, 2, 3, 4, 8a, 8b, 9, 15
• Local exhaust ventilation: no [Effectiveness Inhal: 0%]	1, 2, 3, 4, 8a, 8b, 9, 15
• Occupational Health and Safety Management System: Advanced	1, 2, 3, 4, 8a, 8b, 9, 15
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal Protection: Yes (chemically resistant gloves conforming to EN374 with basic employee training) [Effectiveness Dermal: 90%]	1, 2, 3, 4, 8a, 8b, 9, 15
• Respiratory Protection: No [Effectiveness Inhal: 0%]	1, 2, 3, 4, 8a, 8b, 9, 15
• Eye protection: Yes (chemically resistant face shield, goggles or safety glasses with side shields when there is potential for direct contact)	1, 2, 3, 4, 8a, 8b, 9, 15
Other conditions affecting workers exposure	
• Place of use: Indoor	1, 2, 3, 4, 8a, 8b, 9, 15
• Process temperature (for liquid): <= 40 °C	1, 2, 3, 4, 8a, 8b, 9, 15
• Skin surface potentially exposed: One hand face only (240 cm2)	1, 3, 15
• Skin surface potentially exposed: Two hands face (480 cm2)	2, 4, 9
• Skin surface potentially exposed: Two hands (960 cm2)	8a, 8b

1.2.2. Exposure and risks for workers

The exposure concentrations and risk characterization ratios (RCR) are reported in the following tables.

Table 1. Exposure concentrations and risks for workers: PROC 1

Route of exposure and type of effects	**Exposure concentration**	**Risk characterisation**
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, local, long-term	**5.95E-4 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Table 2. Exposure concentrations and risks for workers: PROC 2, 3

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.012 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 3. Exposure concentrations and risks for workers: PROC 4, 8a, 8b, 9

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Dermal, local, long-term	**0.06 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 4. Exposure concentrations and risks for workers: PROC 15

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.06 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Conclusion on risk characterisation

The risk management measures required based on the quantitative assessment provides sufficient protection against corrosion and respiratory irritation hazard. Details of the RMMs are given in the ES. Under these conditions, the risks are considered as controlled.

2. Exposure scenario 2: Formulation - Formulation

Environment contributing scenario(s):	
Formulation	ERC 2
Worker contributing scenario(s):	
General exposures (closed systems)	PROC 1
General exposures (closed systems), with sample collection	PROC 2
Use in batch process (closed systems), with sample collection	PROC 3
Use in batch processes, with sample collection	PROC 4
Mixing/blending in batch processes	PROC 5
Drum/batch transfers, non-dedicated facilities	PROC 8a
Drum/batch transfers, dedicated facilities	PROC 8b
Small containers transfers, dedicated facilities	PROC 9
Production of preparation/articles	PROC 14
Laboratory activities	PROC 15

2.1. Environmental contributing scenario 1: Formulation

2.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• Annual use at a site: <= 3.426E5 tonnes/year *Maximum regional tonnage for a 24% active chlorine solution. It corresponds to 82.22 kT/y Cl2 equivalent*
• Percentage of EU tonnage used at regional scale: = 100 %
• Emission Days (days/year):: 360 days/year
Conditions and measures related to sewage treatment plant
• Municipal STP: Yes [Effectiveness Water: 100%]
• Discharge rate of STP: >= 2E3 m3/d
• Application of the STP sludge on agricultural soil: No
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low risk) (ERC based assessment demonstrating control of risk with default conditions. Low risk assumed for waste life stage. Waste disposal according to national/local legislation is sufficient.)
Other conditions affecting environmental exposure

• Receiving surface water flow rate: >= 1.8E4 m3/d

2.1.2. Releases

Product applied in aqueous process solution with negligible volatilization. Free available chlorine in effluent is measured as total residual chlorine (TRC) and should be below 1.0E-13 mg/L

No release in air from process expected because sodium hypochlorite solution is non volatile.

No release in soil from process expected.

Technical conditions and measures at process level (source) to prevent release

Common practices vary across sites but releases expected are negligible to waste water and soil (sodium hypochlorite is destroyed rapidly in contact with organic as well as inorganic material).

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Risk from environmental exposure is driven by freshwater. Onsite wastewater treatment required. Prevent discharge of undissolved substance to or recover from onsite wastewater.

Conclusion on risk characterisation

A qualitative approach is used to conclude safe use. The worst case exposure concentration used as PEC in waste water treatment plant is 1E-13 mg/l. The PECs for other compartments are not applicable, because sodium hypochlorite is destroyed rapidly in contact with organic as well as inorganic material and further more that is a non volatile substance.

Hypochlorite will not reach the environment via the sewage treatment system, as the quick transformation of the applied hypochlorite (as free available chlorine, FAC) in the sewage system assures the absence of any human exposure to hypochlorite. Also in recreational zones loacted close to discharge points of chlorinated waste water, the potential for exposure to hypochlorite originating from waste water treatment is negligible as the emission of unreacted hypochlorite is non-existent. Due to physico-chemical properties of sodium hypochlorite, no indirect exposure is thought to occur via the human food chain. Thus no indirect exposure to sodium hypochlorite is thought to occur via the environment.

2.2. Worker contributing scenario

TRA Workers 3.0 method used.

2.2.1. Conditions of use

	PROC
Product (article) characteristics	
• Concentration of substance in mixture: 5-25%	1, 2, 4, 5, 8a, 8b, 9, 14, 15
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: < 8 hours	1, 2, 4, 5, 8a, 8b, 9, 14, 15
Technical and organisational conditions and measures	
• General ventilation: Basic general ventilation (1-3 air changes per hour)	1, 2, 4, 5, 8a, 8b, 9, 14, 15
• Local exhaust ventilation: no [Effectiveness Inhal: 0%]	1, 2, 4, 5, 8a, 8b, 9, 14, 15
• Occupational Health and Safety Management System: Advanced	1, 2, 4, 5, 8a, 8b, 9, 14, 15
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal Protection: Yes (chemically resistant gloves conforming to EN374 with basic employee training) [Effectiveness Dermal: 90%]	1, 2, 4, 5, 8a, 8b, 9, 14, 15
• Respiratory Protection: No [Effectiveness Inhal: 0%]	1, 2, 4, 5, 8a, 8b, 9, 14, 15
• Eye protection: Yes (chemically resistant face shield, goggles or safety glasses with side shields when there is potential for direct contact)	1, 2, 4, 5, 8a, 8b, 9, 14, 15
Other conditions affecting workers exposure	
• Place of use: Indoor	1, 2, 4, 5, 8a, 8b, 9, 14, 15
• Process temperature (for liquid): <= 40 °C	1, 2, 4, 5, 8a, 8b, 9, 14, 15
• Skin surface potentially exposed: One hand face only (240 cm2)	1, 3, 15
• Skin surface potentially exposed: Two hands face (480 cm2)	2, 4, 5, 9, 14
• Skin surface potentially exposed: Two hands (960 cm2)	8a, 8b,

2.2.2. Exposure and risks for workers

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

Table 5. Exposure concentrations and risks for workers: PROC 1

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**5.95E-4 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Table 6. Exposure concentrations and risks for workers: PROC 2, 3

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.012 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 7. Exposure concentrations and risks for workers: PROC 4, 8a, 8b, 9

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.06 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 8. Exposure concentrations and risks for workers: PROC 5

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.12 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 9. Exposure concentrations and risks for workers: PROC 14

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.03 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 10. Exposure concentrations and risks for workers: PROC 15

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.006 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Conclusion on risk characterisation

The risk management measures required based on the quantitative assessment provides sufficient protection against corrosion and respiratory irritation hazard. Details of the RMMs are given in the ES. Under these conditions, the risks are considered as controlled.

3. Exposure scenario 3: Use at industrial site - Use as an intermediate

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

Environment contributing scenario(s):	
Use as intermediate	ERC 6a
Worker contributing scenario(s):	
General exposures (closed systems)	PROC 1
General exposures (closed systems), with sample collection	PROC 2
Use in batch processes (closed systems), with sample collection	PROC 3
Use in batch processes, with sample collection	PROC 4
Drum/batch transfers, non-dedicated facilities	PROC 8a
Drum/batch transfers, dedicated facilities	PROC 8b
Small containers transfers, dedicated facilities	PROC 9
Laboratory activities	PROC 15

3.1. Environmental contributing scenario 1: Use as intermediate

3.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• European tonnage: 26 % of the total consumption was estimated to be used as a chemical intermediate (75.96 kt/year chlorine equivalent).
• Percentage of EU tonnage used at regional scale: = 100 %
Conditions and measures related to sewage treatment plant
• Municipal STP: Yes [Effectiveness Water: 100%]
• Discharge rate of STP: >= 2E3 m3/d
• Application of the STP sludge on agricultural soil: Yes
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low risk) (ERC based assessment demonstrating control of risk with default conditions. Low risk assumed for waste life stage. Waste disposal according to national/local legislation is sufficient.)
Other conditions affecting environmental exposure
• Receiving surface water flow rate: >= 1.8E4 m3/d

3.1.2. Releases

Reactions with organic intermediates in controlled closed systems. Sodium hypochlorite solution is filled into the reaction vessels through closed systems.

No release in environment is expected. In worst case the free available chlorine in effluent is measured as total residual chlorine (TRC) and is anticipated to be below 1.0E-13 mg/L

Technical conditions and measures at process level (source) to prevent release

Common release control mechanisms (all sites fall under IPPC BREF) and specific local regulations respected to minimize risk. Common practices vary across sites but no releases are expected. Off-gas from the reactor is usually treated in a thermal exhaust air decontaminator before release into the atmosphere.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

NaClO must be reduced completely to sodium chloride during the process avoiding critical releases in environment.

Chlorine formation should be avoided by maintening high alkalinity.

Waste water treatment is required to remove any residual organic compounds and at the same time remaining available chlorine.

Conclusion on risk characterisation

Emissions to the environment will not occur as NaClO either reacts or is reduced completely to sodium chloride during the process. The waste water is usually treated because of the organic compounds and at the same time any left available chlorine is destroyed.

A qualitative approach is used to conclude safe use. The worst case exposure concentration used as PEC in waste water treatment plant is 1E-13 mg/l. The PECs for other compartments are not applicable, because sodium hypochlorite is destroyed rapidly in contact with organic as well as inorganic material and further more that is a non volatile substance.

Hypochlorite will not reach the environment via the sewage treatment system, as the quick transformation of the applied hypochlorite (as free available chlorine, FAC) in the sewage system assures the absence of any human exposure to hypochlorite. Also in recreational zones loacted close to discharge points of chlorinated waste water, the potential for exposure to hypochlorite originating from waste water treatment is negligible as the emission of unreacted hypochlorite is non-existent. Due to physico-chemical properties of sodium hypochlorite, no indirect exposure is thought to occur via the human food chain. Thus no indirect exposure to sodium hypochlorite is thought to occur via the environment.

3.2. Worker contributing scenario

TRA Workers 3.0 method used.

3.2.1. Conditions of use

	PROC
Product (article) characteristics	
• Concentration of substance in mixture: 5-25%	1, 2, 3, 4, 8a, 8b, 9, 15
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: < 8 hours	1, 2, 3, 4, 8a, 8b, 9, 15
Technical and organisational conditions and measures	
• General ventilation: Basic general ventilation (1-3 air changes per hour)	1, 2, 3, 4, 8a, 8b, 9, 15
• Local exhaust ventilation: no [Effectiveness Inhal: 0%]	1, 2, 3, 4, 8a, 8b, 9, 15
• Occupational Health and Safety Management System: Advanced	1, 2, 3, 4, 8a, 8b, 9, 15
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal Protection: Yes (chemically resistant gloves conforming to EN374 with basic employee training) [Effectiveness Dermal: 90%]	1, 2, 3, 4, 8a, 8b, 9, 15
• Respiratory Protection: No [Effectiveness Inhal: 0%]	1, 2, 3, 4, 8a, 8b, 9, 15
• Eye protection: Yes (chemically resistant face shield, goggles or safety glasses with side shields when there is potential for direct contact)	1, 2, 3, 4, 8a, 8b, 9, 15
Other conditions affecting workers exposure	
• Place of use: Indoor	1, 2, 3, 4, 8a, 8b, 9, 15
• Process temperature (for liquid): <= 40 °C	1, 2, 3, 4, 8a, 8b, 9, 15
• Skin surface potentially exposed: One hand face only (240 cm2)	1, 3, 15
• Skin surface potentially exposed: Two hands face (480 cm2)	1, 2, 4, 9
• Skin surface potentially exposed: Two hands (960 cm2)	8a, 8b

3.2.2. Exposure and risks for workers

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

Table 11. Exposure concentrations and risks for workers: PROC 1

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**5.95E-4 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Table 12. Exposure concentrations and risks for workers: PROC 2, 3

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.012 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 13. Exposure concentrations and risks for workers: PROC 4, 8a, 8b, 9, 15

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.06 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Conclusion on risk characterisation

The risk management measures required based on the quantitative assessment provides sufficient protection against corrosion and respiratory irritation hazard. Details of the RMMs are given in the ES. Under these conditions, the risks are considered as controlled.

4. Exposure scenario 4: Use at industrial site - Use in textile industry

Sector of use: SU 5, Manufacture of textiles, leather, fur

Environment contributing scenario(s):	
Use in textile industry (reactive processing aid)	ERC 6b
Worker contributing scenario(s):	
General exposures (closed systems)	PROC 1
General exposures (closed systems); with sample collection	PROC 2
Use in batch processes (closed systems), with sample collection	PROC 3
Use in batch processes, with sample collection	PROC 4
Mixing/blending in batch processes	PROC 5
Drum/batch transfers, non-dedicated facilities	PROC 8a
Drum/batch processes, dedicated facilities	PROC 8b
Small containers transfers, dedicated facilities	PROC 9
Treatment by dipping/pouring	PROC 13
Laboratory activities	PROC 15

4.1. Environmental contributing scenario 1: Use in textile industry (reactive processing aid)

4.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• European tonnage: <= 1.205E4 tonnes/year of Cl_2 equivalent have been used in Europe in 1994 (300 t as chlorine gas and 11.75 kt as bleach).
• Percentage of EU tonnage used at regional scale: = 100 %
Conditions and measures related to sewage treatment plant
• Municipal STP: Yes [Effectiveness Water: 0.095%]
• Discharge rate of STP: >= 2E3 m3/d
• Application of the STP sludge on agricultural soil: Yes
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low risk) (ERC based assessment demonstrating control of risk with default conditions. Low risk assumed for waste life stage. Waste disposal according to national/local legislation is sufficient.)
Other conditions affecting environmental exposure
• Receiving surface water flow rate: >= 1.8E4 m3/d

4.1.2. Releases

Sulphite must be use in part of dechlorination process leading to negligible releases of NaClO in water.

No release in environment is expected. In worst case the free available chlorine in effluent is measured as total residual chlorine (TRC) and is anticipated to be below 1.0E-13 mg/L

Technical conditions and measures at process level (source) to prevent release

Common release control mechanisms (all sites fall under IPPC BREF) and specific local regulations respected to minimize risk. Common practices vary across sites but no releases are expected.

Off-gas from the reactor is usually treated in a thermal exhaust air decontaminator before release into the atmosphere.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

Wool chlorination performed in an acid environment, in which gaseous chlorine formation is unavoidable. This requires a high degree of enclosure of the plants, the presence of abatement system of gaseous emission, and a neutralisation stage

Waste water treatment is required to remove any residual organic compounds and remaining available chlorine.

Conclusion on risk characterisation

For use in textile industry, the releases of sodium hypochlorite are expected to be low due to the operational conditions put in place in the different process (for example, a dechlorination stage in wool treatment) and also, due to the rapid decay of hypochlorite.

A qualitative approach is used to conclude safe use. The worst case exposure concentration used as PEC in waste water treatment plant is 1E-13 mg/l. The PECs for other compartments are not applicable, because sodium hypochlorite is destroyed rapidly in contact with organic as well as inorganic material and further more that is a non volatile substance.

Hypochlorite will not reach the environment via the sewage treatment system, as the quick transformation of the applied hypochlorite (as free available chlorine, FAC) in the sewage system assures the absence of any human exposure to hypochlorite. Also in recreational zones located close to discharge points of chlorinated waste water, the potential for exposure to hypochlorite originating from waste water treatment is negligible as the emission of unreacted hypochlorite is non-existent. Due to physico-chemical properties of sodium hypochlorite, no indirect exposure is thought to occur via the human food chain. Thus no indirect exposure to sodium hypochlorite is thought to occur via the environment.

4.2. Worker contributing scenario 1:

TRA Workers 3.0 method used.

4.2.1. Conditions of use

	PROC
Product (article) characteristics	
• Concentration of substance in mixture: 5-25%	1, 2, 3, 4, 5, 8a, 8b, 9, 13, 15
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: < 8 hours	1, 2, 3, 4, 5, 8a, 8b, 9, 13, 15
Technical and organisational conditions and measures	
• General ventilation: Basic general ventilation (1-3 air changes per hour)	1, 2, 3, 4, 5, 8a, 8b, 9, 13, 15
• Local exhaust ventilation: no [Effectiveness Inhal: 0%]	1, 2, 3, 4, 5, 8a, 8b, 9, 13, 15
• Occupational Health and Safety Management System: Advanced	1, 2, 3, 4, 5, 8a, 8b, 9, 13, 15
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal Protection: Yes (chemically resistant gloves conforming to EN374 with basic employee training) [Effectiveness Dermal: 90%]	1, 2, 3, 4, 5, 8a, 8b, 9, 13, 15
• Respiratory Protection: No [Effectiveness Inhal: 0%]	1, 2, 3, 4, 5, 8a, 8b, 9, 13, 15
• Eye protection: Yes (chemically resistant face shield, goggles or safety glasses with side shields when there is potential for direct contact)	1, 2, 3, 4, 5, 8a, 8b, 9, 13, 15
Other conditions affecting workers exposure	
• Place of use: Indoor	1, 2, 3, 4, 5, 8a, 8b, 9, 13, 15
• Process temperature (for liquid): <= 40 °C	1, 2, 3, 4, 5, 8a, 8b, 9, 13, 15
• Skin surface potentially exposed: One hand face only (240 cm2)	1, 3, 15
• Skin surface potentially exposed: Two hands face (480 cm2)	2, 4, 5, 9, 13
• Skin surface potentially exposed: Two hands (960 cm2)	8a, 8b

4.2.2. Exposure and risks for workers

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

Table 14. Exposure concentrations and risks for workers: PROC 1

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**5.95E-4 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Table 15. Exposure concentrations and risks for workers: PROC 2, 3

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.012 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 16. Exposure concentrations and risks for workers: PROC 4, 8a, 8b, 9

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.06 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 17. Exposure concentrations and risks for workers: PROC 5, 13

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.12 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 18. Exposure concentrations and risks for workers: PROC 15

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.006 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Conclusion on risk characterisation

The risk management measures required based on the quantitative assessment provides sufficient protection against corrosion and respiratory irritation hazard. Details of the RMMs are given in the ES. Under these conditions, the risks are considered as controlled.

5. Exposure scenario 5: Use at industrial site - Industrial use in sewage and cooling or heating water treatment

Sector of use:

SU 23, Electricity, steam, gas water supply and sewage treatment

Environment contributing scenario(s):	
Use in sewage and cooling/heating water treatment (reactive processing aid)	ERC 6b
Worker contributing scenario(s):	
General exposures (closed systems)	PROC 1
General exposures (closed systems), with sample collection	PROC 2
Use in batch processes (closed systems), with sample collection	PROC 3
Use in batch processes, with sample collection	PROC 4
Mixing/blending in batch processes	PROC 5
Drum/batch transfers, non-dedicated facilities	PROC 8a
Drum/batch transfers, dedicated facilities	PROC 8b
Small containers transfers, dedicated facilities	PROC 9
Laboratory activities	PROC 15

5.1. Environmental contributing scenario 1: Use in sewage and cooling/heating water treatment (reactive processing aid)

5.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• European tonnage: Sewage treatment: 15.18 kt/year and 9.55 kt/year chlorine equivalent have been used in Europe in 1994 Cooling water: The consumption of hypochlorite produced by the chemical industry for cooling water applications is estimated at 5.58 kt/year chlorine equivalent. The use of gaseous chlorine is rather similar with 4.80 kt/year chlorine equivalent for the year 1994
• Percentage of EU tonnage used at regional scale: = 100 %
Conditions and measures related to sewage treatment plant
• Municipal STP: Yes [Effectiveness Water: 0.095%]
• Discharge rate of STP: >= 2E3 m3/d
• Application of the STP sludge on agricultural soil: Yes
Conditions and measures related to treatment of waste (including article waste)

• Particular considerations on the waste treatment operations: No (low risk) (ERC based assessment demonstrating control of risk with default conditions. Low risk assumed for waste life stage. Waste disposal according to national/local legislation is sufficient.)
Other conditions affecting environmental exposure
• Receiving surface water flow rate: >= 1.8E4 m3/d

5.1.2. Releases

Cooling water process must follow IPPC reference document on the application of best available techniques (BAT) to industrial cooling systems (European Commission, 2001). Site-specific operational conditions to be applied are determined for both chlorine and hypochlorite in the BAT document.

Chlorination processes used for disinfection of wastewater in sewage treatment require a chlorine dose of 5 – 40 mg Cl2/L. The chlorine dosages are designed in order to minimise the chlorine discharges to the environment.

Common practices vary across sites but no releases are expected.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

NaClO must be reduced completely to sodium chloride during the process avoiding critical releases in environment.

Waste water treatment is required to remove any residual organic compounds and remaining available chlorine.

Conclusion on risk characterisation

The releases of sodium hypochlorite to the aquatic compartment are generally low due to the rapid decay of hypochlorite. Indeed, due to immediate further reaction upon encountering oxidisable matter in the receiving water, any remaining free available chlorine will be eliminated upon discharge, with rates of decay increasing with discharged concentrations.

A qualitative approach is used to conclude safe use. The worst case exposure concentration used as PEC in waste water treatment plant is 1E-13 mg/l. The PECs for other compartments are not applicable, because sodium hypochlorite is destroyed rapidly in contact with organic as well as inorganic material and further more that is a non volatile substance.

Hypochlorite will not reach the environment via the sewage treatment system, as the quick transformation of the applied hypochlorite (as free available chlorine, FAC) in the sewage system assures the absence of any human exposure to hypochlorite. Also in recreational zones loacted close to discharge points of chlorinated waste water, the potential for exposure to hypochlorite originating from waste water treatment is negligible as the emission of unreacted hypochlorite is non-existent. Due to physico-chemical properties of sodium hypochlorite, no indirect exposure is thought to occur via the human food chain. Thus no indirect exposure to sodium hypochlorite is thought to occur via the environment.

5.2. Worker contributing scenario 1:

TRA Workers 3.0 method used.

5.2.1. Conditions of use

	PROC
Product (article) characteristics	
• Concentration of substance in mixture: 5-25%	1, 2, 3, 4, 5, 8a, 8b, 9, 15
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: < 8 hours	1, 2, 3, 4, 5, 8a, 8b, 9, 15
Technical and organisational conditions and measures	
• General ventilation: Basic general ventilation (1-3 air changes per hour)	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Local exhaust ventilation: no [Effectiveness Inhal: 0%]	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Occupational Health and Safety Management System: Advanced	1, 2, 3, 4, 5, 8a, 8b, 9, 15
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal Protection: Yes (chemically resistant gloves conforming to EN374 with basic employee training) [Effectiveness Dermal: 90%]	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Respiratory Protection: No [Effectiveness Inhal: 0%]	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Eye protection: Yes (chemically resistant face shield, goggles or safety glasses with side shields when there is potential for direct contact)	1, 2, 3, 4, 5, 8a, 8b, 9, 15
Other conditions affecting workers exposure	
• Place of use: Indoor	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Process temperature (for liquid): <= 40 °C	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Skin surface potentially exposed: One hand face only (240 cm2)	1, 3, 15
• Skin surface potentially exposed: Two hands face (480 cm2)	2, 4, 5, 9
• Skin surface potentially exposed: Two hands (960 cm2)	8a, 8b

5.2.2. Exposure and risks for workers

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

Table 19. Exposure concentrations and risks for workers: PROC 1

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**5.95E-4 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Table 20. Exposure concentrations and risks for workers: PROC 2, 3

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.012 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 21. Exposure concentrations and risks for workers: PROC 4

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.13 mg/m³**	RCR = 0.084
Inhalation, systemic, acute	**0.13 mg/m³**	RCR = 0.042
Inhalation, local, long-term	**0.13 mg/m³**	RCR = 0.084
Inhalation, local, acute	**0.13 mg/m³**	RCR = 0.042
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.06 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.084
Combined routes, systemic, acute		RCR = 0.042

Table 22. Exposure concentrations and risks for workers: PROC 5

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.12 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 23. Exposure concentrations and risks for workers: PROC 8a, 8b, 9

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.06 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 24. Exposure concentrations and risks for workers: PROC 15

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.006 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Conclusion on risk characterisation

The risk management measures required based on the quantitative assessment provides sufficient protection against corrosion and respiratory irritation hazard. Details of the RMMs are given in the ES. Under these conditions, the risks are considered as controlled.

6. Exposure scenario 6: Use at industrial site - Industrial use in pulp and paper

Sector of use:

SU 6b, Manufacture of pulp, paper and paper products

Environment contributing scenario(s):	
Use in pulp and paper (reactive processing aid)	ERC 6b
Worker contributing scenario(s):	
General exposures (closed systems)	PROC 1
General exposures (closed systems), with sample collection	PROC 2
Use in batch processes (closed systems), with sample collection	PROC 3
Use in batch processes, with sample collection	PROC 4
Mixing/blending in batch processes	PROC 5
Drum/batch transfers, non-dedicated facilities	PROC 8a
Drum/batch transfers, dedicated facilities	PROC 8b
Small containers transfers, dedicated facilities	PROC 9
Laboratory activities	PROC 15

6.1. Environmental contributing scenario 1: Use in pulp and paper (reactive processing aid)

6.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• European tonnage: Consumption for the year 1994 was 17.43 and 8.53 kt/year chlorine equivalent for chlorine and hypochlorite, respectively
• Percentage of EU tonnage used at regional scale: = 100 %
Conditions and measures related to sewage treatment plant
• Municipal STP: Yes [Effectiveness Water: 0.095%]
• Discharge rate of STP: >= 2E3 m3/d
• Application of the STP sludge on agricultural soil: Yes
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low risk) (ERC based assessment demonstrating control of risk with default conditions. Low risk assumed for waste life stage. Waste disposal according to national/local legislation is sufficient.)
Other conditions affecting environmental exposure

• Receiving surface water flow rate: >= 1.8E4 m3/d

6.1.2. Releases

The concentration of hypochlorite in the system is low, and quantities are determined so that there is negligible residual free hypochlorite at the end of the cleaning process.

No release in environment is expected. In worst case the free available chlorine in effluent is measured as total residual chlorine (TRC) and is anticipated to be below 1.0E-13 mg/L

Technical conditions and measures at process level (source) to prevent release

Only two specific applications are considered acceptable in pulp and paper industry:

- disinfection of the paper machine system
- breaking down of the wet strength resins

Common practices vary across sites but no releases are expected.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

NaClO must be reduced completely to sodium chloride during the process avoiding critical releases in environment.

Waste water treatment is required to remove any residual organic compounds and remaining available chlorine.

Conclusion on risk characterisation

A qualitative approach is used to conclude safe use. The worst case exposure concentration used as PEC in waste water treatment plant is 1E-13 mg/l. The PECs for other compartments are not applicable, because sodium hypochlorite is destroyed rapidly in contact with organic as well as inorganic material and further more that is a non volatile substance.

Hypochlorite will not reach the environment via the sewage treatment system, as the quick transformation of the applied hypochlorite (as free available chlorine, FAC) in the sewage system assures the absence of any human exposure to hypochlorite. Also in recreational zones loacted close to discharge points of chlorinated waste water, the potential for exposure to hypochlorite originating from waste water treatment is negligible as the emission of unreacted hypochlorite is non-existent. Due to physico-chemical properties of sodium hypochlorite, no indirect exposure is thought to occur via the human food chain. Thus no indirect exposure to sodium hypochlorite is thought to occur via the environment.

6.2. Worker contributing scenario 1:

TRA Workers 3.0 method used.

6.2.1. Conditions of use

	PROC
Product (article) characteristics	
• Concentration of substance in mixture: 5-25%	1, 2, 3, 4, 5, 8a, 8b, 9, 15
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: < 8 hours	1, 2, 3, 4, 5, 8a, 8b, 9, 15
Technical and organisational conditions and measures	
• General ventilation: Basic general ventilation (1-3 air changes per hour)	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Local exhaust ventilation: no [Effectiveness Inhal: 0%]	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Occupational Health and Safety Management System: Advanced	1, 2, 3, 4, 5, 8a, 8b, 9, 15
Conditions and measures related to personal protection, hygiene and health evaluation	
• Dermal Protection: Yes (chemically resistant gloves conforming to EN374 with basic employee training) [Effectiveness Dermal: 90%]	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Respiratory Protection: No [Effectiveness Inhal: 0%]	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Eye protection: Yes (chemically resistant face shield, goggles or safety glasses with side shields when there is potential for direct contact)	1, 2, 3, 4, 5, 8a, 8b, 9, 15
Other conditions affecting workers exposure	
• Place of use: Indoor	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Process temperature (for liquid): <= 40 °C	1, 2, 3, 4, 5, 8a, 8b, 9, 15
• Skin surface potentially exposed: One hand face only (240 cm2)	1, 3, 15
• Skin surface potentially exposed: Two hands face (480 cm2)	2, 4, 5, 9
• Skin surface potentially exposed: Two hands (960 cm2)	8a, 8b

6.2.2. Exposure and risks for workers

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

Table 25. Exposure concentrations and risks for workers: PROC 1

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**5.95E-4 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Table 26. Exposure concentrations and risks for workers: PROC 2, 3

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.012 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 27. Exposure concentrations and risks for workers: PROC 4, 8a, 8b, 9

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.06 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 28. Exposure concentrations and risks for workers: PROC 5

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.12 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 29. Exposure concentrations and risks for workers: PROC 15

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.019 mg/m³**	RCR = 0.012
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.006 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.012
Combined routes, systemic, acute		RCR < 0.01

Conclusion on risk characterisation

The risk management measures required based on the quantitative assessment provides sufficient protection against corrosion and respiratory irritation hazard. Details of the RMMs are given in the ES. Under these conditions, the risks are considered as controlled.

7. Exposure scenario 7: Use at industrial site - Industrial cleaning use

Sector of use:

SU 4, Manufacture of food products

Environment contributing scenario(s):	
Industrial cleaning use	ERC 6b
Worker contributing scenario(s):	
Mixing/blending in batch processes	PROC 5
Industrial spraying	PROC 7
Drum/batch processes, non-dedicated facilities	PROC 8a
Small containers transfers, dedicated facilities	PROC 9
Roller application or brushing	PROC 10
Treatment by dipping/pouring	PROC 13

7.1. Environmental contributing scenario 1: Industrial cleaning use

7.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• European tonnage: 250-450,000 tonnes per year of solution of sodium hypochlorite (5% solution).
• Percentage of EU tonnage used at regional scale: = 100 %
Conditions and measures related to sewage treatment plant
• Municipal STP: Yes [Effectiveness Water: 0.095%]
• Discharge rate of STP: >= 2E3 m3/d
• Application of the STP sludge on agricultural soil: Yes
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low risk) (ERC based assessment demonstrating control of risk with default conditions. Low risk assumed for waste life stage. Waste disposal according to national/local legislation is sufficient.)
Other conditions affecting environmental exposure
• Receiving surface water flow rate: >= 1.8E4 m3/d

7.1.2. Releases

Avoid releases to the environment (surface waters or soil) or to wastewaters. However sodium hypochlorite is shown to disappear rapidly from all use scenarios presented, by either rapid

reduction in factory effluent or in the sewer. Thus, no releases in environment are expected. In worst case the free available chlorine in effluent is measured as total residual chlorine (TRC) and is anticipated to be below 1.0E-13 mg/L.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

NaClO must be reduced completely to sodium chloride during the process avoiding critical releases in environment. Waste water treatment is required to remove any residual organic compounds and remaining available chlorine.

Conclusion on risk characterisation

A qualitative approach is used to conclude safe use. The worst case exposure concentration used as PEC in waste water treatment plant is 1E-13 mg/l. The PECs for other compartments are not applicable, because sodium hypochlorite is destroyed rapidly in contact with organic as well as inorganic material and further more that is a non volatile substance.

Hypochlorite will not reach the environment via the sewage treatment system, as the quick transformation of the applied hypochlorite (as free available chlorine, FAC) in the sewage system assures the absence of any human exposure to hypochlorite. Also in recreational zones loacted close to discharge points of chlorinated waste water, the potential for exposure to hypochlorite originating from waste water treatment is negligible as the emission of unreacted hypochlorite is non-existent. Due to physico-chemical properties of sodium hypochlorite, no indirect exposure is thought to occur via the human food chain. Thus no indirect exposure to sodium hypochlorite is thought to occur via the environment.

7.2. Worker contributing scenario 1:

TRA Workers 3.0 method used.

7.2.1. Conditions of use

	PROC
Product (article) characteristics	
• Concentration of substance in mixture: 5-25%	5
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: < 8 hours	5
Technical and organisational conditions and measures	
• General ventilation: Good general ventilation (3-5 air changes per hour)	5
• Local exhaust ventilation: no [Effectiveness Inhal: 0%]	5
• Occupational Health and Safety Management System: Advanced	5
Conditions and measures related to personal protection, hygiene and health evaluation	

	PROC
• Dermal Protection: Yes (chemically resistant gloves conforming to EN374 with basic employee training) [Effectiveness Dermal: 90%]	5, 7, 8a, 9, 10, 13
• Respiratory Protection: No [Effectiveness Inhal: 0%]	5, 7, 8a, 9, 10, 13
• Eye protection: Yes (chemically resistant face shield, goggles or safety glasses with side shields when there is potential for direct contact)	5, 7, 8a, 9, 10, 13
Other conditions affecting workers exposure	
• Place of use: Indoor	5, 7, 8a, 9, 10, 13
• Process temperature (for liquid): <= 40 °C	5, 7, 8a, 9, 10, 13
• Skin surface potentially exposed: Two hands face (480 cm2)	5, 9
• Skin surface potentially exposed: Two hands (960 cm2)	8a, 10, 13
• Skin surface potentially exposed: Two hands and upper wrists (1500 cm2)	7

7.2.2. Exposure and risks for workers

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

Table 30. Exposure concentrations and risks for workers: PROC 5

Route of exposure and type of effects	**Exposure concentration**	**Risk characterisation**
Inhalation, systemic, long-term	**0.13 mg/m³**	RCR = 0.084
Inhalation, systemic, acute	**0.13 mg/m³**	RCR = 0.042
Inhalation, local, long-term	**0.13 mg/m³**	RCR = 0.084
Inhalation, local, acute	**0.13 mg/m³**	RCR = 0.042
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.12 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.084
Combined routes, systemic, acute		RCR = 0.042

Table 31. Exposure concentrations and risks for workers: PROC 7

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.13 mg/m³**	RCR = 0.084
Inhalation, systemic, acute	**2.605 mg/m³**	RCR = 0.84
Inhalation, local, long-term	**0.13 mg/m³**	RCR = 0.084
Inhalation, local, acute	**2.605 mg/m³**	RCR = 0.84
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.12 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.084
Combined routes, systemic, acute		RCR = 0.84

Table 32. Exposure concentrations and risks for workers: PROC 8a, 9

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.06 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Table 33. Exposure concentrations and risks for workers: PROC 10

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.011 mg/m³**	RCR < 0.01
Inhalation, systemic, acute	**0.019 mg/m³**	RCR < 0.01
Inhalation, local, long-term	**0.011 mg/m³**	RCR < 0.01
Inhalation, local, acute	**0.019 mg/m³**	RCR < 0.01
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.12 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR < 0.01
Combined routes, systemic, acute		RCR < 0.01

Table 34. Exposure concentrations and risks for workers: PROC 13

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, systemic, acute	**0.186 mg/m³**	RCR = 0.06
Inhalation, local, long-term	**0.186 mg/m³**	RCR = 0.12
Inhalation, local, acute	**0.186 mg/m³**	RCR = 0.06
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.12 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.12
Combined routes, systemic, acute		RCR = 0.06

Conclusion on risk characterisation

The risk management measures required based on the quantitative assessment provides sufficient protection against corrosion and respiratory irritation hazard. Details of the RMMs are given in the ES. Under these conditions, the risks are considered as controlled.

8. Exposure scenario 8: Use by professional worker - Professional cleaning uses

Sector of use:

SU 0, Other

Environment contributing scenario(s):	
Professional cleaning use	ERC 8a
Worker contributing scenario(s):	
Mixing/blending in batch processes	PROC 5
Small containers transfers, dedicated facilities	PROC 9
Roller application or brushing	PROC 10
Professional spraying	PROC 11
Treatment by dipping/pouring	PROC 13
Laboratory activities	PROC 15
Drum/batch processes, non-dedicated facilities	PROC 8a
Drum/batch processes, dedicated facilities	PROC 8b

8.1. Environmental contributing scenario 1: Professional cleaning use

8.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• European tonnage: 250-450,000 tonnes per year of solution of sodium hypochlorite.
Conditions and measures related to sewage treatment plant
• Municipal STP: Yes [Effectiveness Water: 0.095%]
• Discharge rate of STP: >= 2E3 m3/d
• Application of the STP sludge on agricultural soil: Yes
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low risk) (ERC based assessment demonstrating control of risk with default conditions. Low risk assumed for waste life stage. Waste disposal according to national/local legislation is sufficient.)
Other conditions affecting environmental exposure
• Receiving surface water flow rate: >= 1.8E4 m3/d

8.1.2. Releases

Sodium hypochlorite is shown to disappear rapidly from all use scenarios presented, by either rapid reduction in factory effluent or in the sewer. Thus, no releases in environment are

expected. In worst case the free available chlorine in effluent is measured as total residual chlorine (TRC) and is anticipated to be below 1.0E-13 mg/L.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

NaClO must be reduced completely to sodium chloride during the process avoiding critical releases in environment. Waste water treatment is required to remove any residual organic compounds and remaining available chlorine.

Conclusion on risk characterisation

A qualitative approach is used to conclude safe use. The worst case exposure concentration used as PEC in waste water treatment plant is 1E-13 mg/l. The PECs for other compartments are not applicable, because sodium hypochlorite is destroyed rapidly in contact with organic as well as inorganic material and further more that is a non volatile substance.

Hypochlorite will not reach the environment via the sewage treatment system, as the quick transformation of the applied hypochlorite (as free available chlorine, FAC) in the sewage system assures the absence of any human exposure to hypochlorite. Also in recreational zones located close to discharge points of chlorinated waste water, the potential for exposure to hypochlorite originating from waste water treatment is negligible as the emission of unreacted hypochlorite is non-existent. Due to physico-chemical properties of sodium hypochlorite, no indirect exposure is thought to occur via the human food chain. Thus no indirect exposure to sodium hypochlorite is thought to occur via the environment.

8.2. Worker contributing scenario 1:

TRA Workers 3.0 method used.

8.2.1. Conditions of use

	PROC
Product (article) characteristics	
• Concentration of substance in mixture: 1-5%	5, 8a, 8b, 9, 10, 11, 13, 15
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: < 8 hours	5, 8a, 8b, 9, 10, 11, 13, 15
Technical and organisational conditions and measures	
• General ventilation: Basic general ventilation (1-3 air changes per hour)	5, 8a, 8b, 9, 10, 11, 13, 15
• Local exhaust ventilation: no [Effectiveness Inhal: 0%]	5, 8a, 8b, 9, 10, 11, 13, 15
• Occupational Health and Safety Management System: Basic	5, 8a, 8b, 9, 10, 11, 13, 15
Conditions and measures related to personal protection, hygiene and health evaluation	

	PROC
• Dermal Protection: Yes (chemically resistant gloves conforming to EN374 with basic employee training) [Effectiveness Dermal: 90%]	5, 8a, 8b, 9, 10, 11, 13, 15
• Respiratory Protection: No [Effectiveness Inhal: 0%]	5, 8a, 8b, 9, 10, 11, 13, 15
• Eye protection: Yes (chemically resistant face shield, goggles or safety glasses with side shields when there is potential for direct contact)	5, 8a, 8b, 9, 10, 11, 13, 15
Other conditions affecting workers exposure	
• Place of use: Indoor	5, 8a, 8b, 9, 10, 11, 13, 15
• Process temperature (for liquid): <= 40 °C	5, 8a, 8b, 9, 10, 11, 13, 15
• Skin surface potentially exposed: Two hands face (480 cm2)	5

8.2.2. Exposure and risks for workers

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

Table 35. Exposure concentrations and risks for workers: PROC 5

Route of exposure and type of effects	**Exposure concentration**	**Risk characterisation**
Inhalation, systemic, long-term	**0.062 mg/m³**	RCR = 0.04
Inhalation, systemic, acute	**0.062 mg/m³**	RCR = 0.02
Inhalation, local, long-term	**0.062 mg/m³**	RCR = 0.04
Inhalation, local, acute	**0.062 mg/m³**	RCR = 0.02
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.04 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.04
Combined routes, systemic, acute		RCR = 0.02

Table 36. Exposure concentrations and risks for workers: PROC 9, 15, 8a, 8b

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.062 mg/m³**	RCR = 0.04
Inhalation, systemic, acute	**0.062 mg/m³**	RCR = 0.02
Inhalation, local, long-term	**0.062 mg/m³**	RCR = 0.04
Inhalation, local, acute	**0.062 mg/m³**	RCR = 0.02
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.02 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.04
Combined routes, systemic, acute		RCR = 0.02

Table 37. Exposure concentrations and risks for workers: PROC 10

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.093 mg/m³**	RCR = 0.06
Inhalation, systemic, acute	**1.861 mg/m³**	RCR = 0.6
Inhalation, local, long-term	**0.093 mg/m³**	RCR = 0.06
Inhalation, local, acute	**1.861 mg/m³**	RCR = 0.6
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.04 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.06
Combined routes, systemic, acute		RCR = 0.6

Table 38. Exposure concentrations and risks for workers: PROC 11

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.26 mg/m³**	RCR = 0.168
Inhalation, systemic, acute	**1.737 mg/m³**	RCR = 0.56
Inhalation, local, long-term	**0.26 mg/m³**	RCR = 0.168
Inhalation, local, acute	**1.737 mg/m³**	RCR = 0.56
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.1 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.168
Combined routes, systemic, acute		RCR = 0.56

Table 39. Exposure concentrations and risks for workers: PROC 13

Route of exposure and type of effects	Exposure concentration	Risk characterisation
Inhalation, systemic, long-term	**0.062 mg/m³**	RCR = 0.04
Inhalation, systemic, acute	**0.062 mg/m³**	RCR = 0.02
Inhalation, local, long-term	**0.062 mg/m³**	RCR = 0.04
Inhalation, local, acute	**0.062 mg/m³**	RCR = 0.02
Dermal, systemic, acute		Qualitative (see below)
Dermal, local, long-term	**0.04 mg/cm²**	
Dermal, local, acute		Qualitative (see below)
Eye, local		Qualitative (see below)
Combined routes, systemic, long-term		RCR = 0.04
Combined routes, systemic, acute		RCR = 0.02

Conclusion on risk characterisation

The risk management measures required based on the quantitative assessment provides sufficient protection against corrosion and respiratory irritation hazard. Details of the RMMs are given in the ES. Under these conditions, the risks are considered as controlled.

9. Exposure scenario 9: Consumer Use - Consumer Use

Environment contributing scenario(s):	
Consumer Use	ERC 8a, 8b, 8d, 8e
Consumer contributing scenario(s):	
Consumer use of products for textile treatment (dyes, bleaches,...)	PC 34
Consumer use of products for water treatment	PC 37
Consumer use of washing and cleaning products	PC 35
Consumer use of cosmetic products	PC 39
Consumer use of perfumes/fragrances	PC 28

9.1. Environmental contributing scenario 1: Consumer Use

9.1.1. Conditions of use

Amount used, frequency and duration of use (or from service life)
• European tonnage: 118.57 kt per year in Cl_2 equivalent
Conditions and measures related to treatment of waste (including article waste)
• Particular considerations on the waste treatment operations: No (low risk) (ERC based assessment demonstrating control of risk with default conditions. Low risk assumed for waste life stage. Waste disposal according to national/local legislation is sufficient.)
Other conditions affecting environmental exposure
• Municipal STP: Yes [Effectiveness Water: 0.095%]
• Discharge rate of STP: >= 2E3 m3/d
• Application of the STP sludge on agricultural soil: Yes
• Receiving surface water flow rate: >= 1.8E4 m3/d

9.1.2. Releases

Sodium hypochlorite is shown to disappear rapidly from all use scenarios presented, by either rapid reduction in the sewer. Thus, no releases in environment are expected. In worst case the free available chlorine in effluent is measured as total residual chlorine (TRC) and is anticipated to be below 1.0E-13 mg/L.

Household waste water is treated in municipal sewage treatment because of the organic compounds and at the same time any left available chlorine is destroyed.

Conclusion on risk characterisation

A qualitative approach is used to conclude safe use. The worst case exposure concentration used as PEC in waste water treatment plant is 1E-13 mg/l. The PECs for other compartments are not applicable, because sodium hypochlorite is destroyed rapidly in contact with organic as

well as inorganic material and further more that is a non volatile substance.

Hypochlorite will not reach the environment via the sewage treatment system, as the quick transformation of the applied hypochlorite (as free available chlorine, FAC) in the sewage system assures the absence of any human exposure to hypochlorite. Also in recreational zones loacted close to discharge points of chlorinated waste water, the potential for exposure to hypochlorite originating from waste water treatment is negligible as the emission of unreacted hypochlorite is non-existent. Due to physico-chemical properties of sodium hypochlorite, no indirect exposure is thought to occur via the human food chain. Thus no indirect exposure to sodium hypochlorite is thought to occur via the environment.

9.2. Consumer contributing scenarios

9.2.1. Conditions of use

Contributing exposure scenario controlling consumer exposure for PC
Product characteristic
Concentration: <= 12.5 % (typically 3 – 5 %) Physical state: liquid Vapour pressure: 2.5 kPa at 20 °C
Amounts used
NA
Frequency and duration of use/exposure
Duration [for contact]: < 30 min. (cleaning and bleaching) to ca. 1 hour (swimming) Frequency [for one person cleaning]: 1 job/day, every day Frequency [for one person bleaching]: 2 jobs/week (laundry bleaching) and 4/day (spraying)
Human factors not influenced by risk management
Consumers may be exposed to the formulation when dosing the product into water and to the preparation (cleaning solution; inhalation, dermal, oral). Exposure to the solution predominantly occurs by misuse such, poor rinsing, spilling to skin or drinking of the cleaning solution.
Other given operational conditions affecting consumers exposure
Indoor air volume: min. 4 m^3, ventilation rate: min. 0.5/h
Conditions and measures related to information and behavioural advice to consumers
Safety and application notes on product label and/or package insert.
Conditions and measures related to personal protection and hygiene
None

9.2.2. Exposure and risks for consumers

For each scenario general public exposure is described. Exposure for general public is relevant in household and drinking water scenarios. The exposure assessment is based on the EU Risk Assessment Report on sodium hypochlorite (2007).

9.2.2.1. Household use

Use of sodium hypochlorite in household uses may represent a biocidal use. Biocidal applications are covered under the Biocide Dossier according to Directive No 98/8/EC. Exposures were included to represent worst-case scenarios.

Under the Dangerous Substances Directive (67/548/EEC) and the dangerous Preparations Directive (99/45/EEC) hypochlorite solutions are classified as "Corrosive" above 10 % and "Irritant" between 5-10 %. The final classification of the product will also depend on the levels of other materials present such as caustic soda and surfactants.

Dermal Exposure

Hypochlorite can be considered as a substance in a non-volatile medium (household bleach), which is diluted for normal use. Under normal use conditions, the key route of exposure to hypochlorite is via dermal contact when hands may be dipped into a diluted hypochlorite solution in a laundry bleaching or household cleaning task. Typical diluted concentrations range from 0.1-0.5 g/L (or 0.01-0.05 %) (AISE, 1997). Exposure to concentrated solutions (25-50 g/L, or 2.5 – 5.0 %) is less frequent and is due to undiluted use in toilet bowl cleaning for example (AISE, 1997). The concentrated solutions will rarely be in direct contact with skin for any appreciable time period, as a cleaning implement will be used and the skin will be wiped or rinsed after contact with the concentrated bleach product.

The potential dermal exposure was calculated considering the two typical usages of NaClO which could lead to exposure to the substance: hand washing/Laundry pre-treatment and hard surface cleaning. To this end, the habits and practice data collected by industry (AISE companies of HERA, http://www.heraproject.com/Index.cfm) and included in the updated version of the TGD (Appendix submitted to ECB in 2002) have been used.

The total dermal exposure was estimated assuming 2 laundry bleaching tasks/ week plus 1 hard surface cleaning task / day (both are maximum use data). The total amount of hypochlorite to which the skin may be exposed externally as well as the potential uptake via skin has been determined. In the absence of experimental data on skin penetration of hypochlorite, two routes could be followed to estimate the amount absorbed through the skin:

Estimate a fixed fraction of hypochlorite for absorption.

A fixed amount of sodium hypochlorite actually penetrating the skin can be estimated. Given the reactivity and polarity of the chemical as well as the known barrier functions of skin, this amount can be estimated to lie between 1 - 10 %, and the upper estimate 10 % is used here. Thus, a conservative approach has been used to estimate the dermal exposure to hypochlorite.

Assuming a "worst case" scenario using upper levels of ranges, the concentration (mg/cm^3) of hypochlorite in the end volume of the bleaching / cleaning solution is:

For laundry bleaching / pre-treatment:

C_{derm} = 0.5 mg/cm^3 (0.05 % hypochlorite)

(Data from AISE, 1997 cite 500 ppm which equals 0.05 % hypochlorite as maximum concentration for laundry bleaching.)

Habits & Practices data in the updated TGD consumer exposure section, 2002 report 1 % bleach solution as the high-end concentration used in laundry bleaching. Using a hypochlorite bleach product with 5 % hypochlorite content, this equals a 0.05 % hypochlorite concentration in the laundry bleaching solution).

For household cleaning:

In such uses, it is difficult to differentiate the cleaning from the disinfection and as a consequence they will not be differentiated. The information is kept as the level of exposure will be the same for either cleaning or disinfection. However for more details on the biocide use, please refer to the biocide dossier.

C_{derm} = 5.0 mg /cm^3 (0.5 % hypochlorite)

(Data from AISE, 1997 0.5 % hypochlorite reported as upper level of range in use for kitchen surface cleaning).

Model Parameters:

(Hypochlorite) in the product [mg.cm^{-3}]	C_{derm}
External exposure to skin [mg/day]	A_{derm}
Potential dermal uptake rate [mg.kg bw^{-1}day^{-1}]	U_{derm} pot
Thickness of the film layer on skin [default = 0.01cm] Tderm	
Surface area of skin exposed [cm^2]	$Area_{derm}$
Bioavailability for dermal exposure (default = 1)	Bio_{derm}
Number of events per period (usually, events.day^{-1})	N_{events}
Average female bodyweight [default = 60 kg]	bw
Default factor to quantify absorption [10 %]	F_{absorp}

Additional data:

- ☑ typical level of HYPOCHLORITE in household bleach products = 3 – 5 %
- ☑ upper hypochlorite concentration in laundry use = 0.05 %
- ☑ upper hypochlorite concentration in household applications = 0.5 %
- ☑ surface area of exposed skin (both hands) = 840 cm^2 (laundry pre-treatment)
- ☑ surface area of exposed skin (one hand) = 420 cm^2 (hard surface cleaning)
- ☑ number of laundry bleaching jobs per week = 2
- ☑ number of cleaning jobs per day = 1

1. Laundry Bleaching/Pre-treatment:

$A_{derm} = C_{derm}$ x T_{derm} x $Area_{derm}$ x N_{events} = 0.5 mg/cm^3 x 0.01 cm x 840 cm^2 x 2/7 days = 1.2 mg/day.

U_{derm} pot = A_{derm} / bw x F_{absorp} = 1.2 mg / 60 kg x 0.1 = 0.002 mg / kg bw/day.

2. Hard surface cleaning

$A_{derm} = C_{derm}$ x T_{derm} x $Area_{derm}$ x N_{events} = = 5.0 mg/cm^3 x 0.01 cm x 420 cm^2 x 7/7 = 21 mg/day.

U_{derm} pot = A_{derm} / bw x F_{absorp} = 21 mg/60 kg x 0.1 = 0.035 mg/kg bw/day.

The total dermal exposure in the household using the conservative dermal uptake assumption of 10 % is therefore:

0.002 + 0.035 = 0.037 mg Hypochlorite/kg bw/day corresponding to 0.035 mg/kg bw day as av. Cl_2.

This value described is conservative based on the fact that high end use concentration data were used and multiplied in the calculation with the following conservative assumptions:

- TGD exposure model considers a 0.01 cm film of substance solution is left to dry on skin, whereas is practice this film is likely to be wiped off at least or rinsed.
- A 10 % absorption value from this amount is very likely a conservative assumption for this polar, reactive chemical.

- 2 laundry bleaching tasks per week plus 1 household cleaning task per day were assumed
- The surface area of the entire hand was assumed to be wetted with cleaning solution in a household scenario, whereas realistically, often only the palm might be exposed.

Inhalation Exposure

The pH of solutions of sodium hypochlorite can range from as low as 9 (diluted) to 13 (concentrated) and as such the dominant species are the hypochlorite anion and hypochlorous acid with the former predominating and the latter giving the typical odour (AISE, 1997). No chlorine is predicted at these pHs. The only occasion when chlorine can be formed is through conditions of misuse by mixing with strong acids.

Some household products designed for hard surface cleaning are formulated as sprays. Such products typically contain 500 ml of a < 5 % sodium hypochlorite solution (Typical conc. 1 - 3 %). Based on industry data, an average product use of 20 g/day in a total of 30 min (0.5 h) spray cleaning time/day is used for this assessment (0.5 h is the total time assumed for this scenario/day, consisting of several tasks lasting few minutes each). The spray is generated using a purpose-designed trigger mechanism, which forms part of the product packaging.

Trigger spray bottles for household cleaners are designed to deliver essentially all their contents to the surface to be cleaned. Unlike spray containers that are under pressure, trigger sprayers do not have sophisticated delivery systems to deliver a fine, mist-like spray. They are designed to mostly deliver product in large particles (average > 75 μm) or as foam to the surfaces to be cleaned. Small amounts of product will become temporarily suspended in air, but only particles smaller than 30 μm will remain in the air for any appreciable time. The standard trigger spray apparatus is designed to minimize the numbers of particles ejected that may become airborne.

Industry has some knowledge about the amount of airborne particles discharged from trigger spray bottles of different manufacturers (data from repeated internal control measurements as well as product & packaging development). Based on that data, the consumer exposure to this airborne fraction of hypochlorite-containing spray products is calculated below.

A) Exposure concentration used for systemic uptake of hypochlorite through inhalation:

Derivation of average concentration of inhalable hypochlorite in air C_{air}:

Aerosol measurements were done on hypochlorite-based trigger spray cleaners typical of the EU market (see Annex I for details). Two test samples were tested in triplicates. The sprays were pumped, using 10 successive squeezes of the trigger, against the back wall of a 512 litre chamber (= 0.512 m^3, dimensions 0.8m x 0.8m x 0.8m) to simulate its use in a confined environment. The number and mass of airborne particles in the "breathing zone" (the chamber) were determined by sampling the atmosphere from the chamber at a rate of five litres a minute via a short tube connected to a TSI Model 3320 Aerodynamic Particle Sizer (APS) which samples particles in the size range 0.5 to 20 μm.

Data from the breathing zone measurements relating to particle number and particle mass were automatically calculated by the APS and associated software. Also the mean respirable and

inhalable mass concentrations were determined this way and the output obtained in µg/m³ of product sprayed.

The mean mass concentration determined was 56 µg/m^3 (range 26 – 92 µg/m^3). This concentration was measured in the chamber upon 10 trigger spray squeezes which released on average 1.18 g of product each. This experimental set-up conservatively mimics typical consumer product use in confined spaces.

Based on the high end hypochlorite concentration for household spray products of 3 %, the inhalable hypochlorite concentration from this measured mean mass concentration is:

$C_{air\ inhalable}$ = 56 x 0.03 µg/m^3= 1.68 µg/m^3

$C_{air\ inhalable}$ is determined via this experiment based on the entire aerosol fraction measured in the size range 0.5 – 20 µm. As typically only aerosols in the size range < 10 µm can actually reach the deep lung and be available for systemic uptake, the concentration used in the subsequent equation could be considered a conservative value.

Systemic exposure derived from this $C_{air\ inhalable}$:

$$I_{inh} = \frac{5g\ x1x1.68\mu g\ x0.8m^3\ x0.125h\ x4\ x0.75}{m^3\ x11.8\ g\ x\ h\ x70\ kg\ x1000}[mg/kg\ \ bw/day]$$

I_{Inh} = 0.00305 µg / kg BW / day

Model:

$$I_{inh} = \frac{q\ x\ w_f\ x\ f_{resp}\ \ x C_{air}\ x Q_{inh}\ x t\ x\ N_{events}\ x\ f_{bio}}{BW} = [g/kg\ bw/day]$$

Model Parameters:

Inhalatory Intake	I_{inh}
Amount of undiluted product used per task	q
Weight fraction of hypochlorite in product	w_f
Average conc. of hypochlorite in air, derived from	

experimental set-up and corrected per g product	C_{air}
Respirable or inhalable fraction of product: = 100 %, given that the experimentally determined value of C air refers to the fraction of likely respirable particles	f_{resp}
Ventilation rate of an adult (default = 0.8 m3/hour)	Q_{inh}
Duration of exposure	t
Number of events per period (usually, events.day-1)	Nevents
Average human bodyweight [default = 70kg]	bw
Weight fraction (percentage) absorbed or bioavailable: = 75 % (TGD, 1996).	f_{bio}
or bioavailable: = 75 % (TGD, 1996). fbio	

Other data used:

- ☑ 1) typical level of hypochlorite in household bleach sprays= 1 – 3 %
  (3 % is used in calculation)
- ☑ 2) assume the number of events or jobs per day = 4
- ☑ 3) assume the duration of a spray cleaning event to 7.5 minutes (0.125 h)
- ☑ 4) assume amount of bleach spray product used per event to 5 g
  (based on industry data / HERA)

B) Exposure concentration used to evaluate local irritation effects in the respiratory system:

Data obtained with the TSI Model 3320 Aerodynamic Particle Sizer from the same breathing zone measurement of aerosols generated by spraying hypochlorite-based spray products are used for this exposure assessment as well. As above, C_{air} inhalable based on particles collected in the 0.5 – 20 μm size range is determined to:

$C_{air\ inhalable} = 1.68\ \mu g/m^3 = 0.00168\ mg/m^3$

In addition, an attempt was also made using an Andersen Cascade Impactor to determine whether any particles greater than 20 μm would remain airborne long enough so that they could be inhaled and potentially cause effects in the upper respiratory tract. The amounts of material collected using the ACI was too small for analysis indicating that no significant amounts of

material remain suspended in the air, and thus inhalable, in particles greater than 20 μm. This confirms what would be expected because particles of 20 μm and above rapidly fall out of the air and are not available for breathing.

Hence, the concentration of inhalable hypochlorite determined to 1.68 μg/m^3 is a realistic estimate of a concentration which needs to be evaluated for local irritation effects in the respiratory system.

Accidents

An overview of reported accidents linked to the household use of hypochlorite is given here for information. The data show that incidence and severity are limited. This paragraph is based on a four-year survey (from 1989 to 1992) by Poison Control Centres across Europe (Racioppi et al., 1994). As data were available for all Poison Control Centres for 1992 and no significant effect variation was observed over years, only data from 1992 have been reported. On average, the products involved in these accidental exposures contained 6 % sodium hypochlorite, except for France were products containing 12.5 % were marketed. From the survey, it appears that the numbers of calls related to exposure to sodium hypochlorite is limited and vary from 1.7 to 5.4 % of the total number of calls and from 5 to 20 % of the calls related to domestic products. The data show that the main exposure route is oral ingestion, followed by inhalation. The authors noted that "exposure of humans to bleaches results in no or minor transient adverse health effects with no permanent sequelae".