Extended Safety Data Sheet

According to Regulation (EC) No 1907/2006, Annex II,

Amended by COMMISSION REGULATION (EU) 2020/878,

According to REGULATION (EC) No 1272/2008

3a,4,7,7a-tetrahydro-4,7-methanoindene

Version 1.0

Issue date: 09-08-2023

Revision date: 09-08-2023 **eSDS Record Number: CSSS-TCO-010-130163**

Section 1 Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier:

Identification on the label/Trade name:	3a,4,7,7a-tetrahydro-4,7-methanoindene
Additional identification:	DCPD; DICYCLOPENTADIENE
Identification of the product:	CAS# 77-73-6 EC# 201-052-9
Index Number:	601-044-00-9
REACH registration No.:	01-2119463601-44-0021

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

1.2.1 Identified uses:

Distribution

Use as an intermediate

Polymer Production

Polymer Processing

1.2.2 Uses advised against:

No uses advised against are identified.

1.3 Details of the supplier of the safety data sheet:

Supplier(Only representative):	Chemical Inspection & Regulation Service Limited
Supplier(Manufacturer):	HENGHE MATERIALS AND SCIENCE TECHNOLOGY CO., LTD .
Address:	No.3511 Yuejingtang Road, Ningbo Petrochemical park, Ningbo, China,315200 .
Contact person(E-mail):	Amy Ding (amy@hh-sh.com)
Telephone:	+86-574 -86680024
Fax:	+86-574 -86680088

1.4 Emergency telephone Number:

+353 (1) 477 3710 (Only available during office hours (9:00a.m.-17:30p.m. Beijing Time Zone)

Available outside office hours? YES [ ] NO [X]

Section 2 Hazards Identification

2.1 Classification of the substance or mixture:

2.1.1 Classification:

The substance is classified as following according to REGULATION (EC) No 1272/2008:

REGULATION (EC) No 1272/2008	
Hazard classes/Hazard categories	Hazard statement
Flam. Liquid. 2	H225
Acute Tox. 4	H302
Skin Irrit. 2	H315
Eye Irrit. 2	H319

Acute Tox. 2	H330
STOT SE 3	H335
Aquatic Acute 1	H400
Aquatic Chronic 2	H411

For full text of H- phrases: see section 2.2.

2.2 label elements:

Hazard Pictograms:

Signal Word(S): Danger

Hazard Statement:

H225: Highly flammable liquid and vapour.
H302: Harmful if swallowed.
H315: Causes skin irritation.
H319: Causes serious eye irritation.
H330: Fatal if inhaled.
H335: May cause respiratory irritation (Affected Organs: respiratory tract) (Route of exposure: Inhalation).
H400: Very toxic to aquatic life.
H411: Toxic to aquatic life with long lasting effects.

Precautionary statement:

P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P233: Keep container tightly closed.
P240: Ground/bond container and receiving equipment.
P241: Use explosion-proof electrical/ventilating/lighting equipment.
P242: Use only non-sparking tools.
P243: Take precautionary measures against static discharge.
P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
P264: Wash hands thoroughly after handling.
P270: Do not eat, drink or smoke when using this product.
P271: Use only outdoors or in a well-ventilated area.
P273: Avoid release to the environment.
P280: Wear protective gloves/protective clothing/eye protection/face protection.
P284: [In case of inadequate ventilation] wear respiratory protection.
P301 + P312: IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell.
P302 + P352: IF ON SKIN: Wash with plenty of water.
P303 + P361 + P353: IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340: IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310: Immediately call a POISON CENTER/doctor.
P332 + P313: If skin irritation occurs: Get medical advice/attention.
P337 + P313: If eye irritation persists: Get medical advice/attention.
P362 + P364: Take off contaminated clothing and wash it before reuse.
P370 + P378: In case of fire: Use water spray, water fog or foam, dry powder or carbon dioxide (CO2) extinguisher, dry sand or fire fighting foam to extinguish.
P391: Collect spillage.
P403 + P233: Store in a well-ventilated place. Keep container tightly closed.

P403 + P235: Store in a well-ventilated place. Keep cool.

P405: Store locked up.

P501: Dispose of contents/container in accordance with local regulations.

2.3 Other hazards:

The substance is not considered a PBT/vPvB.

Section 3 Composition/information on ingredients

Substance/Mixture: Substance

Ingredient(s):

Chemical Name	Registration No.	CAS No.	EC No.	Concentration
Dicyclopentadiene	01-2119463601-44-0021	77-73-6	201-052-9	95.0-98.5%
Cyclopentene/cyclopentadiene dimer	N/A	142-29-0	N/A	0-0.5%
Cyclopentadiene	N/A	542-92-7	208-835-4	0-0.5%

Section 4 First aid measures

4.1 Description of first aid measures:

In all cases of doubt, or when symptoms persist, seek medical attention.

4.1.1 In case of inhalation:

Move to fresh air.

Do not leave the victim unattended.

Keep patient warm and at rest.

Seek immediate medical attention.

If breathing is difficult, give oxygen if possible or assisted ventilation, (do not use mouth to mouth).

If unconscious, place in recovery position.

In the event of cardiac arrest (no pulse), apply cardiopulmonary resuscitation.

4.1.2 In case of skin contact:

Take off all contaminated clothing and shoes.

Immediately flush affected area with plenty of soap and water – continue for at least 15 minutes.

If there are signs of irritation or other symptoms seek medical attention.

4.1.3 In case of eyes contact:

Remove any contact lenses.

Flush eyes with water thoroughly and continuously for at least 15 minutes.

Keep eye wide open while rinsing.

Protect unharmed eye.

If there are signs of irritation or other symptoms seek medical attention.

If eye irritation, pain, swelling, lachrymation or photophobia persists, patient should be referred to a specialist health care facility.

4.1.4 In case of ingestion:

Get medical attention immediately.

Clean mouth with water and drink afterwards plenty of water.

Do not give milk or alcoholic beverages.

Never give anything by mouth to an unconscious person.

4.2 Most important symptoms and effects, both acute and delayed:

Symptoms: The most important known symptoms and effects are described in the labelling (see section 2) and/or in section 11, Further symptoms are possible.

4.3 Indication of any immediate medical attention and special treatment needed:

Causes eye irritation. This irritation can result in redness and swelling of the eyes.

Causes irritation to the skin. This irritation can result in redness and swelling of the skin. Repeat contact with the skin may cause it to become dry and cracked.

May cause respiratory irritation. If inhalation occurs, signs and symptoms may include sore throat, headache, nausea, and coughing, choking, wheezing, difficulty in breathing, chest congestion, and shortness of breath and may cause transient central nervous system (CNS) depression.

In case of ingestion, Ipecac-induced emesis is not recommended. Consider use of charcoal as a slurry (240mL water/30 g charcoal). Usual dose: 25 to 100 g in adults.				
If determined necessary (and under qualified medical supervision), the stomach should be emptied by gastric lavage with the airway protected by endotracheal intubation.				

Section 5 Firefighting measures

5.1 Extinguishing media:

Suitable extinguishing media: LARGE FIRE: Use water spray, water fog or foam. DO NOT use direct water jet.
SMALL FIRE: Dry powder or carbon dioxide (CO_2) extinguisher, dry sand or firefighting foam.

Unsuitable extinguishing media: Do NOT use water jet.
Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

5.2 Special hazards arising from the substance or mixture

In case of fire, the following can be released: Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).
Vapour is denser than air – flashback may be possible over considerable distances.
Containers may explode under fire conditions - use water spray to cool unopened containers.
Do not allow run-off from fire-fighting to enter drains or water courses – may cause explosion hazard in drains and may reignite on surface water.

5.3 Advice for firefighters:

Self-contained breathing apparatus with full-face mask and full protective clothing (standard wear).

Section 6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

6.1.1 For non-emergency personnel: Wear personal protective equipment. Avoid breathing vapours or mist. Ensure adequate ventilation and absence of sources of ignition. Beware of accumulation of vapours in low areas or contained areas, where explosive concentrations may occur.

6.1.2 For emergency responders: Wear an appropriate NIOSH/MSHA approved respirator if vapor is generated.

6.2 Environmental Precautions:

Try to prevent the material from entering drains or water courses. Advise Authorities if spillage has entered water course or sewer or has contaminated soil or vegetation.

6.3 Methods and material for Containment and Cleaning up:

Land spillage: Contain spillage. Small spillages can be taken up by collection with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and placed in container for disposal according to local / national regulations.
Water spillage:

If the Flash Point exceeds the Ambient Temperature by 10°C or more, use containment booms and remove from the surface by skimming or with suitable absorbents when conditions permit. If the Flash Point does not exceed the Ambient Air Temperature by at least 10°C, use booms as a barrier to protect shorelines and allow material to evaporate. Seek the advice of a specialist before using dispersants.

6.4 Reference to other sections: See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for information on disposal.

Section 7 Handling and storage

7.1 Precautions for safe handling:

7.1.1 Protective measures: Store in tightly closed containers in cool, dry, isolated, well-ventilated area. Avoid inhaling vapor. Avoid contact with eyes, skin and clothing. Suitable equipment for dealing with fires, spills and leaks must be readily available. Earth all equipment. Use explosion protected electrical equipment and lighting. Do not smoke eat or drink in areas of use and storage. Use closed-system transfers wherever possible. Earth (ground) lines and equipment used during transfer to reduce possibility of static spark initiated fire or explosion

7.1.2 Advice on general occupational hygiene: Do not eat, drink and smoke in work areas. Wash hands after use. Remove contaminated clothing and protective equipment before entering eating areas.

7.2 Conditions for safe storage, including any incompatibilities: Store in either mild steel or stainless steel containers or vessels. Store in a designated cool and well-ventilated place. Store in the original, tightly closed, container. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Keep container tightly closed and properly labelled. Vapor space above stored liquid may be flammable/explosive unless blanketed with inert gas. Storage installations should be designed with adequate bunds so as to prevent ground and water pollution in case of leaks or spills. Fixed storage containers, transfer containers and associated equipment should be earthed and bonded to prevent accumulation of static charge.

7.3 Specific end use(s): Not applicable.

Section 8 Exposure Controls/Personal Protection

8.1 Control parameters:

8.1.1 Occupational exposure limits: Not available.

				Occupational Exposure Limit Value (8-hour reference period)		Occupational Exposure Limit Value (15-minute reference period)		
Country	Substance	EINECS No.	CAS No.	ppm	mg/ m3	ppm	mg/ m3	Note
Ireland	Dicyclopentadiene	201-052-9	77-73-6	5	30	-	-	-

8.1.2 Additional exposure limits under the conditions of use: Not available.

8.1.3 DNEL/DMEL and PNEC-Values:

Workers - Hazard via inhalation route	Systemic effects-Long term exposure	DNEL= 2.31 mg/m³
Workers - Hazard via inhalation route	Local effects-Long term exposure	DNEL= 2.31 mg/m³
Workers - Hazard via inhalation route	Local effects-Acute exposure	DNEL= 160.23 mg/m³
Workers - Hazard via dermal route	Systemic effects-Long term exposure	DNEL= 0.95 mg/kg bw/day
General Population - Hazard via inhalation route	Systemic effects-Long term exposure	DNEL= 0.69 mg/m³
General Population - Hazard via inhalation route	Local effects-Long term exposure	DNEL= 0.69 mg/m³
General Population - Hazard via inhalation route	Local effects-Acute exposure	DNEL= 143.5 mg/m³

General Population - Hazard via dermal route	Systemic effects-Long term exposure	DNEL= 0.28 mg/kg bw/day
General Population - Hazard via oral route	Systemic effects-Long term exposure	DNEL= 0.03 mg/kg bw/day
General Population - Hazard via oral route	Systemic effects-Acute exposure	DNEL= 25.6 mg/kg bw/day
Hazard for aquatic organisms	Freshwater	PNEC= 0.057 mg/L
Hazard for aquatic organisms	Marine water	PNEC= 0.006 mg/L
Hazard for aquatic organisms	Intermittent releases	PNEC= 0.008 mg/L
Hazard for aquatic organisms	STP	PNEC= 2.2 mg/L
Hazard for aquatic organisms	Sediment (freshwater)	PNEC= 8.89 mg/kg sediment dw
Hazard for aquatic organisms	Sediment (marine water)	PNEC= 0.889 mg/kg sediment dw
Hazard for terrestrial organisms	Soil	PNEC= 2.5 mg/kg soil dw
Hazard for predators	Secondary poisoning	no potential for bioaccumulation

8.2 Exposure controls:

8.2.1Appropriate engineering controls: Explosion proof exhaust ventilation should be used. Observe Occupational Exposure Limits and minimize the risk of inhalation of vapors.

8.2.2 Individual protection measures, such as personal protective equipment:

Eye/face protection: Wear eye protection (chemical goggles or goggles and an 8-inch (minimum) full face shield where spilling or splashing may occur).

Hand protection: Wear chemical resistant (impervious) gloves.

Body protection: Wear chemical resistant protective clothing.

Respiratory protection: Wear a respirator approved by NIOSH/MSHA (e.g., an organic vapor respirator, a full face air purifying respirator for organic vapors, or a self-contained breathing apparatus) whenever exposure to aerosol, mist, spray, fume or vapor exceed the exposure limit(s) of any chemical substance listed in this SDS.

Thermal hazards: Wear suitable protective clothing to prevent heat.

8.2.3 Environmental exposure controls: Avoid discharge into the environment. According to local regulations, Federal and official regulations.

Section 9 Physical and chemical properties

9.1 Information on basic physical and chemical properties:

Appearance: Liquid

Colour: Colorless or light yellow

Odour: Sweet, sharp, disagreeable and camphor-like

Odour threshold: Not available

pH: Not available

Melting point/range (°C): 32.2 °C at 101.3 kPa

Boiling point/range (°C): 172.2 °C at 101.3 kPa

Flash point (°C): 32.2 °C at 101.3 kPa

Evaporation rate: Not available

Flammability limit - lower (%): Not available

Flammability: Data are available for the explosion limits in air so they have been included here for completeness. DCPD has an LEL of 0.8% and a UEL of 6.3% volume in air. However, DCPD is a liquid (commercial DCPD) or a low melting point solid (high purity DCPD) and therefore the flammability is determined on the basis of the flash point, the ability to emit flammable gases upon contact with water and the pyrophoricity.

Ignition temperature (°C): Not available

Upper/lower explosive limits:	UEL: 6.3% volume in air, LEL: 0.8% volume in air
Vapour pressure:	186 Pa at 20 °C
Vapour density:	Not available
Relative Density:	0.9302 g/cm3 at 35 °C (high purity DCPD) 975-989 kg/m3 at 20 °C (commercial DCPD)
Bulk density (kg/m^3):	Not available
Water solubility (g/l):	0.02 g/L at 25 °C
n-Octanol/Water (log Po/w):	Log Kow (Pow): 2.78 at 20 °C
Auto-ignition temperature:	503 °C at 101.3 kPa
Decomposition temperature:	Not available
Viscosity, dynamic (mPa.s):	Commercial DCPD (>80%) is a liquid at ambient temperature, with a viscosity of 1-5 mPa.s at 20°C. Commercial DCPD with a purity of 94% has been shown to have a viscosity of 4.384 mm^2/s at 20 °C and 2.811 mm^2/s at 40 °C.
Explosive properties:	non explosive
Oxidising properties:	no oxidising properties
Molecular Formula:	C10H12
Molecular Weight:	132.204

9.2. Other information:

Fat solubility(solvent-oil to be specified) etc:	Not available
Surface tension:	Not available
Dissociation constant in water(pKa):	Not available
Oxidation-reduction Potential:	Not available

Section 10 Stability and reactivity

10.1 Reactivity:	Stable at room temperature under normal storage and handling conditions.
10.2 Chemical stability:	Stable at room temperature in closed containers under normal storage and handling conditions.
10.3 Possibility of hazardous reactions:	Hazardous polymerization will not occur if stored below 122°F (50°C).
10.4 Conditions to avoid:	Incompatible materials. Lack or depletion of polymerization inhibitor. Do not expose to excessive heat or ignition sources. Overheating at temperatures over the flash point for a prolonged period of time may result in lowering of flash point due to formation of monomeric cyclopentadiene species and possible polymerization hen heated at temperatures over 122°F).
10.5 Incompatible materials:	Avoid contact with strong oxidizing agents. Metal chloride salts or heat can catalyze polymerization.
10.6 Hazardous decomposition products:	Carbon monoxide, carbon dioxide, aliphatic and aromatic hydrocarbons. Distillation to dryness may produce peroxides. Peroxides may catalyze polymerization of DCPD at elevated temperatures. Dicyclopentadiene will decompose to cyclopentadiene at > 280°F (> 138°C).

Section 11 Toxicological information

11.1 Information on toxicological effects:

Acute toxicity:	
LD50(Oral, Rat):	590 mg/kg bw
LD50(Dermal, Rabbit):	> 2000 mg/kg bw

LC50(Inhalation, Rat):	1723 mg/m³ air (analytical) (6h)
Skin corrosion/Irritation:	Causes skin irritation
Serious eye damage/irritation:	Causes serious eye irritation
Respiratory or skin sensitization:	Not classified
Germ cell mutagenicity:	Not classified
Carcinogenicity:	Not classified
Reproductive toxicity:	Not classified
STOT- single exposure:	May cause respiratory irritation (Affected Organs: respiratory tract) (Route of exposure: Inhalation)
STOT-repeated exposure:	Not classified
Aspiration hazard:	Not classified

Section 12 Ecological information

12.1 Toxicity:

Acute (short-term) toxicity:	
LC50(96h, Fish):	15.7 mg/L
EC50(48h, Daphnia magna):	0.823 mg/L
EC50(96h, Algae/aquatic plants):	22 mg/L
Chronic (long-term) toxicity:	
NOEC(Fish):	0.98 mg/L
NOEC(Daphnia magna):	3.2 mg/L
NOEC(Algae/aquatic plants):	Not available
12.2 Persistence and degradability:	Not readily biodegradable.
12.3 Bioaccumulative potential:	A BCF of 53 was reported in Bluegill for DCPD.
12.4 Mobility in soil:	Low potential for adsorption, Koc at 20°C: 1514 (QSAR).
12.5 Results of PBT and vPvB assessment:	The substance is not considered a PBT/vPvB.
12.6 Other adverse effects:	Very toxic to aquatic life. Toxic to aquatic life with long lasting effects.

Section 13 Disposal considerations

13.1 Waste treatment methods: Dispose of in accordance with all applicable local and national regulations. Use recovery/recycling where feasible, otherwise incineration is the recommended method of disposal. Empty containers may contain hazardous residues. Do not cut, puncture or weld on or near to the container. Labels should not be removed from containers until they have been cleaned. Contaminated containers must not be treated as household waste. Containers should be cleaned by appropriate methods and then re-used or disposed of by landfill or incineration as appropriate. Do not incinerate closed containers.

Section 14 Transport information

	Land transport (ADR/RID)	**Inland waterways (ADN)**	**Sea transport (IMDG)**	**Air transport (ICAO/IATA)**
UN number	2048	2048	2048	2048

UN Proper shipping name	Dicyclopentadiene	Dicyclopentadiene	Dicyclopentadiene	Dicyclopentadiene
Transport hazard Class(es)	3	3	3	3
Packing group	III	III	III	III
Environmental hazards	Yes	Yes	Yes	Yes
Special precautions for user	See section 2.2	See section 2.2	See section 2.2	See section 2.2
Transport in bulk according to Annex II of Marpol and the IBC Code	IBC03	IBC03	IBC03	IBC03

Section 15 Regulatory information

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

Relevant information regarding authorization: Not applicable.

Relevant information regarding restriction: Not applicable.

Other EU regulations: Employment restrictions concerning young person must be observed.
For use only by technically qualified individuals.

Other National regulations: Not applicable

15.2 Chemical safety assessment YES [X] NO [ ]

Section 16 Other information

16.1 Indication of changes:

Version 1.0 Amended by (EU) 2020/878

Version 2.0 Exposure scenarios are placed after section 16.

16.2 Abbreviations and acronyms:

ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road

RID: Regulation for rail International transportation of Dangerous goods

ADN: European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways

IMDG: Code international maritime dangerous goods code

ICAO: International Civil Aviation Organization

IATA: International Air Transport Association

LC50: median lethal concentration

EC50: The effective concentration of substance that causes 50% of the maximum response.

NOEC: No Observed Effect Concentration

DNEL: derived no-effect level

PNEC: predicted no-effect concentration

16.3 Key literature references and sources for data

ECHA Registered substances data

16.4 Classification and procedure used to derive the classification for mixtures according to Regulation (EC) 1272/2008 [CLP]

Classification according to Regulation (EC) No. 1272/2008		Classification procedure
Flam. Sol. 1	H225	On basis of test data
Acute Tox. 4	H302	On basis of test data
Skin Irrit. 2	H315	On basis of test data
Eye Irrit. 2	H319	On basis of test data
Acute Tox. 2	H330	On basis of test data
STOT SE 3	H335	On basis of test data
Aquatic Acute 1	H400	On basis of test data

Aquatic Chronic 2	H411	On basis of test data

16.5 Relevant H-statements (number and full text):

H225: Highly flammable liquid and vapour.

H302: Harmful if swallowed.

H315: Causes skin irritation.

H319: Causes serious eye irritation.

H330: Fatal if inhaled.

H335: May cause respiratory irritation (Affected Organs: respiratory tract) (Route of exposure: Inhalation).

H400: Very toxic to aquatic life.

H411: Toxic to aquatic life with long lasting effects.

16.6 Training instructions:

Not applicable.

16.7 Further information:

This information is based upon the present state of our knowledge. This SDS has been compiled and is solely intended for this product.

16.8 Notice to reader:

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgment of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

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The exposure scenario section is extracted from the CSR.

9. EXPOSURE ASSESSMENT

The following generic uses were evaluated in the exposure assessment of 3a,4,7,7a-tetrahydro-4,7-methanoindene.

Identified use	Process category (PROC)	Product Category (PC)	Sector of Use (SU)	Environmental Release Category (ERC)	Article category (AC)	EU tonnage (ktonnes)	Regional fraction
Manufacture (Industrial)	PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC15	NA	3, 8, 9	1, 4	NA	50	0.2
Distribution (Industrial)	PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC9, PROC15	NA	3, 8, 9	1 - 7	NA	50	0.2
Use as Intermediate (Industrial)	PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC 15	NA	3, 8, 9	6a	NA	10	0.1
Polymer Production (Industrial)	PROC1, PROC2, PROC3, PROC4, PROC5, PROC6, PROC8a, PROC8b, PROC14, PROC21	NA	3, 10	6c	NA	40	0.1
Polymer Processing (Industrial)	PROC1, PROC2, PROC3, PROC4, PROC5, PROC6, PROC8a, PROC8b, PROC9, PROC13, PROC14 PROC 21	NA	3, 10	4	NA	2	0.1
Polymer Processing (Professional)	PROC1, PROC2, PROC6, PROC8a, PROC8b, PROC14 PROC 21	NA	22	8a, 8d	NA	2	0.1

For some exposure scenarios multiple ERCs are listed. In such cases the most conservative ERC was used for each environmental compartment in the modelling. If a SPERC was used in the environmental modelling then this is listed in the Section 9 narratives and in Appendix B.

The following information was used for the exposure assessments:

Substance specific information				Reference Values (using SPARC generated log Kow of 4.35)	
Substance	3a,4,7,7a-tetrahydro-4,7-methanoindene	**MOLW**	132.21g $mole^{-1}$	**HC5 $PNEC_{aqua}$ $mg.l^{-1}$**	0.029
CAS RN	77-73-6	**MP**	32.2°C.	**HC5 $PNEC_{marine}$ $mg.l^{-1}$**	0.029
Vapour pressure	187 Pa at 20 C	**BP**	172.2°C	**HC5 $PNEC_{STP}$ $mg.l^{-1}$**	0.85
TRA volatility range	Low	**SOL**	20$mg.l^{-1}$ at 25°C	**HC5 $PNEC_{sediment}$ $mg.kg^{-1}$**	5.49
Physical property	not readily biodegradable solid, liquid above 32.2 C	**Log KOW**	2.78	**HC5 $PNEC_{soil}$ $mg.kg^{-1}$**	0.86
Henry's Law Constant	634 Pa m^3mol^{-1}	**Rate constant for degradation in air**	5.15 d^{-1}		

9.1. Exposure scenario 1: Manufacture of 3a,4,7,7a-tetrahydro-4,7-methanoindene

9.1.1. Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Manufacture of DCPD;CAS RN 77-73-6**
Use Descriptor	Sector of Use: Industrial (SU3, SU8, SU9)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC15
	Environmental Release Categories: ERC1; ERC4
Processes, tasks, activities covered	Manufacture of the substance or use as an intermediate or process chemical or extraction agent. Includes recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure < 0.5 kPa [OC3].
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures**
General exposures (closed systems) [CS15].	No other specific measures identified [EI20]. Wear suitable gloves tested to EN374 [PPE15].
General exposures (closed systems) [CS15]. With sample collection [CS56]. With occasional controlled exposure [CS137]	Ensure material transfers are under containment or extract ventilation [E66].
General exposures (closed systems) [CS15]. Use in contained batch processes [CS37].	Ensure material transfers are under containment or extract ventilation [E66].
General exposures (open systems) [CS16]. Batch process [CS55]. With sample collection [CS56].	Handle substance within a predominantly closed system provided with extract ventilation [E49]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Wear suitable gloves tested to EN374 [PPE15].
Process sampling [CS2].	Ensure material transfers are under containment or extract ventilation [E66]. Wear suitable gloves tested to EN374 [PPE15].
Laboratory activities [CS36].	Handle in a fume cupboard or under extract ventilation [E83]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Bulk transfers [CS14]. (open systems) [CS108]. With potential for aerosol generation [CS138].	Handle substance within a closed system [E47]. Provide extract ventilation to points where emissions occur [E54]. Wear suitable gloves tested to EN374 [PPE15].
Bulk transfers [CS14]. (closed systems) [CS107].	Ensure material transfers are under containment or extract ventilation [E66]. Wear suitable gloves tested to EN374 [PPE15].
Equipment cleaning and maintenance [CS39].	Drain down system prior to equipment break-in or maintenance [E65]. Provide extract ventilation to points where emissions occur [E54]. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].
Storage [CS67]. With occasional controlled exposure [CS137]	Provide extract ventilation to material transfer points and other openings [E82]. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].

Section 2.2	Control of Environmental Exposure	
Assessment method	EUSES 2.1.1 using default release fractions from ESVOC SpERC 1.1. V.1	
Product characteristics	DCPD is a liquid of low volatility. The water solubility is 20 mg/l; the vapour pressure is 187 Pa; and the log Kow is 2.78. DCPD is not readily biodegradable.	
Amounts Used	EU tonnage	50 ktonnes per year
	Regional tonnage	10 ktonnes per year
	Fraction of main local source	1
Frequency and duration of use	Emission days per year	300
Environmental Factors not influenced by risk management	Local Freshwater dilution factor	40
	Local marine water dilution factor	100
Conditions given in SPERC fact sheet (ESVOC SpERC 1.1.v1) give rise to following releases fractions		
Other Operational Conditions of use affecting environmental exposure	Release fraction to air from process before RMMs	0.01
	Release fraction to waste water from process before RMMs	0.0003
	Release fraction to soil from process before RMMs	0.0001
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	Treat air emissions to provide a typical removal efficiency of >90%. [TCR 7]	
	Typical onsite wastewater treatment technology provides removal efficiency of 90.9%. [TCR 11]	
	Soil emission controls are not applicable as there is no direct release to soil. [TCR 4]	
	Prevent discharge of undissolved substance to or recover from wastewater [TCR14].	
Organisation measures to prevent/limit release from site	Do not apply industrial sludge to natural soils [OMS2].	
	Sludge should be incinerated, contained or reclaimed [OMS3].	
Conditions and measures related to municipal sewage treatment plant	Not applicable	
Conditions and measures related to external treatment of waste for disposal	During manufacturing no waste of the substance is generated. [ETW 4]	
Conditions and measures related to external recovery of waste	During manufacturing no waste of the substance is generated. [EWR 2]	
Other environmental control measures additional to above	None	

Section 3	Exposure Estimation
3.1. Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2. Environment	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are*

	not expected to exceed the predicted PNECs and the resulting risk characterisation ratios are expected to be less than 1. See Appendix B for details.	
Section 4	**Guidance to check compliance with the Exposure Scenario**	
4.1. Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A for details of efficiencies and OC.*	
4.2. Environment	*Confirm that RMMs and OCs are as described or of equivalent efficiency. The required efficiency removal from water is 90.9% which would be typically found in waste-water treatment plant.*	
Values for Scaling Purposes DSU 4 : Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).		
Basis for scaling	Environment	
	Risk-driving Compartment – STP	
	Msafe 62189 kg/day after RMM	
Site Use	10 ktonnes/year	
RMM Removal Efficiencies	90.9 % efficiency water, 90 % efficiency air	
Dilution factors	Freshwater	40
	Marine water	100
Initial release percent at site to water (before RMM)	0.03	
Typical release to water after RMM	0.0114 mg/l	
See Appendix C for further details		
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**	
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.		
Control of Worker Exposure		
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*	
Control of environmental exposure		
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*	

9.1.2. Exposure estimation

9.1.2.1. Workers exposure

The worker exposure estimates for the activities associated with the manufacturing of 3a,4,7,7a-tetrahydro-4,7-methanoindene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.1.2.2. Consumer exposure

Not applicable.

9.1.2.3. Indirect exposure of humans via the environment (oral)

The estimation of indirect human exposure via the environment was conducted using EUSES v2.1.1. The total daily intakes from exposure via the local environmental are presented in Appendix B.

9.1.2.4. Environmental exposure

The PECs are based on the factors shown in Section 2.2 of 9.1.1 Exposure Scenario: See Appendix B for local PECs and local environmental releases.

For regional PECs see section 9.7.

9.2. Exposure scenario 2: Distribution of 3a,4,7,7a-tetrahydro-4,7-methanoindene

9.2.1. Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Distribution of DCPD;CAS RN 77-76-3**
Use Descriptor	Sector of Use: Industrial (SU3, SU8, SU9)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC9, PROC15
	Environmental Release Categories: ERC1 - 7
Processes, tasks, activities covered	Loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance, including its distribution and associated laboratory activities
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure < 0.5 kPa [OC3].
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]; Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures**
General exposures (closed systems) [CS15].	No other specific measures identified [EI20]. Wear suitable gloves tested to EN374 [PPE15].
General exposures (closed systems) [CS15]. With sample collection [CS56]. With occasional controlled exposure [CS137].	Ensure material transfers are under containment or extract ventilation [E66].
General exposures (closed systems) [CS15]. Use in contained batch processes [CS37].	Ensure material transfers are under containment or extract ventilation [E66].
General exposures (open systems) [CS16]. Batch process [CS55]. With sample collection [CS56].	Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].
Process sampling [CS2].	Ensure material transfers are under containment or extract ventilation [E66].
Laboratory activities [CS36].	Handle in a fume cupboard or under extract ventilation [E83].
Bulk transfers [CS14]. (closed systems) [CS107]	Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].

Bulk transfers [CS14]. (open systems) [CS108]	Ensure material transfers are under containment or extract ventilation [E66]. Ensure operation is undertaken outdoors [E69]. Or Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan. [E1]. Wear chemically resistant gloves (tested to EN374) in combination with specific activity training [PPE17].	
Drum and small package filling [CS6].	Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Ensure operation is undertaken outdoors [E69]. Or Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan. [E1]. Wear chemically resistant gloves (tested to EN374) in combination with specific activity training [PPE17].	
Equipment cleaning and maintenance [CS39].	Drain down and flush system prior to equipment break-in or maintenance [E55].Provide extract ventilation to points where emissions occur [E54].	
Storage [CS67]. With occasional controlled exposure [CS137]	Transfer via enclosed lines [E52]. Ensure operation is undertaken outdoors [E69]. Provide extract ventilation to material transfer points and other openings [E82]. Locate bulk storage outdoors [E88]. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].	
Section 2.2	**Control of Environmental Exposure**	
Assessment method	EUSES 2.1.1 using default release fractions from ESVOC SpERC 1.1 b V.1	
Product characteristics	DCPD is a liquid of low volatility. The water solubility is 20 mg/l; the vapour pressure is 187 Pa; and the log Kow is 2.78. DCPD is not readily biodegradable.	
Amounts used	EU tonnage	50 ktonnes per year
	Regional tonnage	10 ktonnes per year
	Fraction of the main local source	1
Frequency and duration of use	Emission days per year	300
Environmental Factors not influenced by risk management	Local Freshwater dilution factor	10
	Local marine water dilution factor	100
Conditions given in SPERC fact sheet (ESVOC SpERC 1.1b.v1) give rise to following releases fractions		
Other Operational Conditions of use affecting environmental exposure	Release fraction to air from process before RMMs	0.001
	Release fraction to waste water from process before RMMs	0.00001
	Release fraction to soil from process before RMMs	0.00001
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	Treat air emissions to provide a typical removal efficiency of >90%. [TCR 7]	
	Typical onsite wastewater treatment technology provides removal efficiency of 90.9%. [TCR 11]	
	Soil emission controls are not applicable as there is no direct release to soil. [TCR4]	
	Prevent discharge of undissolved substance to or recover from wastewater [TCR14].	

Organisation measures to prevent/limit release from site	Do not apply industrial sludge to natural soils [OMS2].
	Sludge should be incinerated, contained or reclaimed [OMS3].
Conditions and measures related to municipal sewage treatment plant	Not applicable
Conditions and measures related to external treatment of waste for disposal	External treatment and disposal of waste should comply with applicable local and/or national regulations. [ETW 3]
Conditions and measures related to external recovery of waste	External recovery and recycling of waste should comply with applicable local and/or national regulations.[EWR 1]
Other environmental control measures additional to above	None

Section 3	**Exposure Estimation**
3.1. Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2. Environment	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted PNECs and the resulting risk characterisation ratios are expected to be less than 1. This is only applicable to the intermediate exposure scenario.*
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1. Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A.2 for details of efficiencies and OC.*
4.2. Environment	*Confirm that RMMs and OCs are as described or of equivalent efficiency. The required efficiency removal from water is 90.9% which would be typically found in waste-water treatment plant.*

Values for Scaling Purposes

DSU 4 : Further details on scaling and control technologies are provided in SpERC factsheet

(http://cefic.org/en/reach-for-industries-libraries.html).

Basis for scaling	Environment	
	Risk-driving Compartment – soil	
	Msafe 520833 kg/day after RMM	
Site Use	10 ktonnes/year	
RMM Removal Efficiencies	90.9 % efficiency water, 90 % efficiency air	
Dilution factors	Freshwater	10
	Marine water	100
Initial release percent at site to water		0.001

Typical release to water after RMM	1.53E-03 mg/l
See Appendix B for further details	
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.2.2. Exposure estimation

9.2.2.1. Workers exposure

The worker exposure estimates for the activities associated with the manufacturing of 3a,4,7,7a-tetrahydro-4,7-methanoindene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.2.2.2. Consumer exposure

Not applicable.

9.2.2.3. Indirect exposure of humans via the environment (oral)

The estimation of indirect human exposure via the environment was conducted using EUSES v2.1.1. The total daily intakes from exposure via the local environmental are presented in Appendix B.

9.2.2.4. Environmental exposure

The PECs are based on the factors shown in Section 2.2 of 9.2.1 Exposure Scenario: See Appendix B for local PECs and local environmental releases.

For regional PECs see section 9.7.

9.3. Exposure scenario 3: Use of 3a,4,7,7a-tetrahydro-4,7-methanoindene as an Intermediate

Use as an intermediate is only applicable to the environment and not to the worker or consumer exposure scenarios.

9.3.1. Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Manufacture of DCPD;CAS RN77-73-6**
Use Descriptor	Sector of Use: Industrial (SU3, SU8, SU9)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC15
	Environmental Release Categories: ERC6A
Processes, tasks, activities covered	Use of the substance as an intermediate (not related to Strictly Controlled Conditions). Includes recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure < 0.5 kPa [OC3].
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20oC above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures**
General exposures (closed systems) [CS15].	No other specific measures identified [EI20]. Wear suitable gloves tested to EN374 [PPE15].
General exposures (closed systems) [CS15]. With sample collection [CS56]. With occasional controlled exposure [CS137]	Ensure material transfers are under containment or extract ventilation [E66].
General exposures (closed systems) [CS15]. Use in contained batch processes [CS37].	Ensure material transfers are under containment or extract ventilation [E66].
General exposures (open systems) [CS16]. Batch process [CS55]. With sample collection [CS56].	Handle substance within a predominantly closed system provided with extract ventilation [E49].Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].Wear suitable gloves tested to EN374 [PPE15].

Process sampling [CS2].	Ensure material transfers are under containment or extract ventilation [E66]. Wear suitable gloves tested to EN374 [PPE15].
Laboratory activities [CS36].	Handle in a fume cupboard or under extract ventilation [E83]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40
Bulk transfers [CS14]. (open systems) [CS108]With potential for aerosol generation [CS138].	Handle substance within a closed system [E47]. Provide extract ventilation to points where emissions occur [E54]. Wear suitable gloves tested to EN374 [PPE15].
Bulk transfers [CS14]. (closed systems) [CS107];	Ensure material transfers are under containment or extract ventilation [E66]. Wear suitable gloves tested to EN374 [PPE15].
Equipment cleaning and maintenance [CS39].	Drain down system prior to equipment break-in or maintenance [E65].Provide extract ventilation to points where emissions occur [E54]. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].
Storage [CS67]. With occasional controlled exposure [CS137]	Provide extract ventilation to material transfer points and other openings [E82]. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].

Section 2.2	**Control of Environmental Exposure (This is only applicable to the intermediate exposure scenario.**	
Assessment method	EUSES 2.1.1 using default release fractions from ESVOC SpERC 6.1 a V.1	
Product characteristics	DCPD is a liquid of low volatility. The water solubility is 20 mg/l; the vapour pressure is 187 Pa; and the log Kow is 2.78. DCPD is not readily biodegradable.	
Amounts used	EU tonnage	10 ktonnes per year
	Regional tonnage	1 ktonnes per year
	Fraction of the main local source	1
Frequency and duration of use	Emission days per year	300
Environmental Factors not influenced by risk management	Local Freshwater dilution factor	10
	Local marine water dilution factor	100
Conditions given in SPERC fact sheet (ESVOC SpERC 6.1a.v1) give rise to following releases fractions		
Other Operational Conditions of use affecting environmental exposure	Release fraction to air from process before RMMs	0.001
	Release fraction to waste water from process before RMMs	0.0003
	Release fraction to soil from process before RMMs	0.001
Technical onsite conditions and measures to reduce or limit	Treat air emissions to provide a typical removal efficiency of >80%.[TCR 7]	

discharges, air emissions and releases to soil	Typical onsite wastewater treatment technology provides removal efficiency of 90.9%. [TCR 11]
	Soil emission controls are not applicable as there is no direct release to soil. [TCR4]
	Prevent discharge of undissolved substance to or recover from wastewater [TCR14].
Organisation measures to prevent/limit release from site	Do not apply industrial sludge to natural soils [OMS2].
	Sludge should be incinerated, contained or reclaimed [OMS3].
Conditions and measures related to municipal sewage treatment plant	Not applicable
Conditions and measures related to external treatment of waste for disposal	This substance is consumed during use and no waste of the substance is generated. [ETW 5]
Conditions and measures related to external recovery of waste	This substance is consumed during use and no waste of the substance is generated. [EWR 3]
Other environmental control measures additional to above	None

Section 3	**Exposure Estimation**
3.1. Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2. Environment	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted PNECs and the resulting risk characterisation ratios are expected to be less than 1. This is only applicable to the intermediate exposure scenario.*
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1. Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A.2 for details of efficiencies and OC.*
4.2. Environment	*Confirm that RMMs and OCs are as described or of equivalent efficiency. The required efficiency removal from water is 90.9% which would be typically found in waste-water treatment plant.*

Values for Scaling Purposes

DSU 4 : Further details on scaling and control technologies are provided in SpERC factsheet

(http://cefic.org/en/reach-for-industries-libraries.html).

Basis for scaling	Environment
	Risk-driving Compartment – soil
	Msafe 18315 kg/day after RMM
Site Use	1 ktonnes/year

RMM Removal Efficiencies	90.9 % efficiency water, 80 % efficiency air	
Dilution factors	Freshwater	10
	Marine water	100
Initial release percent at site to water		0.03
Typical release to water after RMM		4.56E-03 mg/l
See Appendix B for further details		
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**	
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.		
Control of Worker Exposure		
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*	
Control of environmental exposure		
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*	

9.4.2. Exposure estimation

9.3.2.1. Workers exposure

The worker exposure estimates for the activities associated with the manufacturing of 3a,4,7,7a-tetrahydro-4,7-methanoindene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.3.2.2. Consumer exposure

Not applicable.

9.3.2.3. Indirect exposure of humans via the environment (oral)

The estimation of indirect human exposure via the environment was conducted using EUSES v2.1.1. The total daily intakes from exposure via the local environmental are presented in Appendix B.

9.3.2.4. Environmental exposure

The PECs are based on the factors shown in Section 2.2 of 9.3.1 Exposure Scenario: See Appendix B for local PECs and local environmental releases.

For regional PECs see section 9.7.

9.4. Exposure scenario 4: Use of 3a,4,7,7a-tetrahydro-4,7-methanoindene in polymer production

9.4.1. Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Use in polymer production of DCPD;CAS RN77-76-3**
Use Descriptor	Sector of Use: Industrial (SU3, SU10)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC5, PROC6, PROC8a, PROC8b, PROC14, PROC21
	Environmental Release Categories: ERC4, ERC6C
Processes, tasks, activities covered	Manufacture of polymers from monomers in continuous and batch processes, include sparging, discharging, and reactor maintenance and immediate polymer product formation (i.e. compounding, pelletisation, product off-gassing).
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure < 0.5 kPa [OC3].
Concentration of substance in product	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20oC above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures**
General exposures (closed systems) [CS15]. Continuous process [CS54]. No sampling [CS57].	No other specific measures identified [EI20]. Wear suitable gloves tested to EN374 [PPE15].
Bulk transfers [CS14]. Transport [CS58]. With sample collection [CS56].	Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Wear suitable gloves tested to EN374 [PPE15].
Polymerisation (bulk and batch) [CS65]Continuous process [CS54]. With sample collection [CS56].	Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Provide extract ventilation to points where emissions occur [E54]. Wear suitable gloves tested to EN374 [PPE15].
Polymerisation (bulk and batch) [CS65]. Batch process [CS55]. With sample collection [CS56].	Provide extract ventilation to points where emissions occur [E54].
Finishing operations [CS102]. Batch process [CS55]. With sample collection [CS56].	Provide extract ventilation to points where emissions occur [E54].
Intermediate polymer storage [CS66]	Limit the substance content in the product to 5% [OC17]. Provide extract ventilation to points where emissions occur [E54]. Wear suitable gloves tested to EN374 [PPE15].

Additivation and stabilisation [CS69]	Provide extract ventilation to points where emissions occur [E54].
Mixing in containers [CS23]. Batch process [CS55].	Limit the substance content in the product to 5% [OC17]. Provide extract ventilation to points where emissions occur [E54].
Pelletizing [CS53]. Extrusion and masterbatching [CS88]	Limit the substance content in the product to 5% [OC17]. Handle substance within a predominantly closed system provided with extract ventilation [E49]. Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan. [E1]. Wear suitable gloves tested to EN374 [PPE15].
Pelletizing [CS53].	Limit the substance content in the product to 5% [OC17]. Handle substance within a predominantly closed system provided with extract ventilation [E49]. Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan. [E1]. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].
Pelletisation and pellet screening [CS68]. (open systems) [CS108]	Ensure material transfers are under containment or extract ventilation [E66]. Wear suitable gloves tested to EN374 [PPE15].
Bulk transfers [CS14]. Continuous process [CS54]. With sample collection [CS56]. With occasional controlled exposure [CS137]	Provide extract ventilation to points where emissions occur [E54]. Wear suitable gloves tested to EN374 [PPE15].
Bulk transfers [CS14]. Continuous process [CS54]. With sample collection [CS56].	Provide extract ventilation to points where emissions occur [E54].
Transport [CS58]. With sample collection [CS56].	Ensure material transfers are under containment or extract ventilation [E66]. Wear suitable gloves tested to EN374 [PPE15].
Equipment maintenance [CS5].	Drain down and flush system prior to equipment break-in or maintenance [E55]. Avoid carrying out operation for more than 1 hour [OC11]. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].
Rework of articles [CS86].	Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].
Storage [CS67]. With occasional controlled exposure [CS137]	Avoid carrying out operation for more than 1 hour [OC11]. Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16].

Section 2.2	**Control of Environmental Exposure**	
Assessment method	EUSES 2.1.1 using default release fractions from ESVOC SpERC 4.20.v1	
Product characteristics	DCPD is a liquid of low volatility. The water solubility is 20 mg/l; the vapour pressure is 187 Pa; and the log Kow is 2.78. DCPD is not readily biodegradable.	
Amounts used	EU tonnage	40 ktonnes per year
	Regional tonnage	4 ktonnes per year

	Fraction of the main local source	1
Frequency and duration of use	Emission days per year	300
Environmental Factors not influenced by risk management	Local Freshwater dilution factor	10
	Local marine water dilution factor	100
Conditions given in SPERC fact sheet (ESVOC SpERC 4.20.v1) give rise to following releases fractions		
Other Operational Conditions of use affecting environmental exposure	Release fraction to air from process before RMMs	0.01
	Release fraction to waste water from process before RMMs	0.0003
	Release fraction to soil from process before RMMs	0.0001
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	Treat air emissions to provide a typical removal efficiency of >80%.[TCR 7]	
	Typical onsite wastewater treatment technology provides removal efficiency of 90.9%. [TCR 11]	
	Soil emission controls are not applicable as there is no direct release to soil. [TCR4]	
	Prevent discharge of undissolved substance to or recover from wastewater [TCR14].	
Organisation measures to prevent/limit release from site	Do not apply industrial sludge to natural soils [OMS2].	
	Sludge should be incinerated, contained or reclaimed [OMS3].	
Conditions and measures related to municipal sewage treatment plant	Not applicable	
Conditions and measures related to external treatment of waste for disposal	This substance is consumed during use and no waste of the substance is generated.. [ETW 5]	
Conditions and measures related to external recovery of waste	This substance is consumed during use and no waste of the substance is generated. [EWR 3]	
Other environmental control measures additional to above	None	
See Appendix B for further details		

Section 3	**Exposure Estimation**
3.1. Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2. Environment	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted PNECs and the resulting risk characterisation ratios are expected to be less than 1. This is only*

	applicable to the intermediate exposure scenario.
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1. Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A.2 for details of efficiencies and OC.*
4.2. Environment	*Confirm that RMMs and OCs are as described or of equivalent efficiency. The required efficiency removal from water is 90.9% which would be typically found in waste-water treatment plant.*

Values for Scaling Purposes

DSU 4 : Further details on scaling and control technologies are provided in SpERC factsheet

(http://cefic.org/en/reach-for-industries-libraries.html).

Basis for scaling	Environment	
	Risk-driving Compartment – soil	
	Msafe 17707 kg/day after RMM	
Site Use	4 ktonnes/year	
RMM Removal Efficiencies	90.9 % efficiency water, 80 % efficiency air	
Dilution factors	Freshwater	10
	Marine water	100
Initial release percent at site to water		0.03
Typical release to water after RMM		1.82E-02 mg/l
See Appendix B for further details		

Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.4.2. Exposure estimation

9.4.2.1. Workers exposure

The worker exposure estimates for the activities associated with the manufacturing of 3a,4,7,7a-tetrahydro-4,7-methanoindene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A

contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.4.2.2. Consumer exposure

Not applicable.

9.4.2.3. Indirect exposure of humans via the environment (oral)

The estimation of indirect human exposure via the environment was conducted using EUSES v2.1.1. The total daily intakes from exposure via the local environmental are presented in Appendix B.

9.4.2.4. Environmental exposure

The PECs are based on the factors shown in Section 2.2 of 9.4.1 Exposure Scenario: See Appendix B for local PECs and local environmental releases.

For regional PECs see section 9.7.

9.5. Exposure scenario 5: Use of 3a,4,7,7a-tetrahydro-4,7-methanoindene in polymer processing – Industrial

9.5.1. Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Use in polymer processing of DCPD;CAS RN 77-73-6**
Use Descriptor	Sector of Use: Industrial (SU3, SU10)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC5, PROC6, PROC8a, PROC8b, PROC9, PROC13, PROC14, PROC21
	Environmental Release Categories: ERC 4
Processes, tasks, activities covered	Processing of formulated polymers including material transfers, additives handling (e.g. pigments, stabilisers, fillers, plasticisers, etc.), moulding, curing and forming activities, material re-works, storage and associated maintenance.
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure < 0.5 kPa [OC3].
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures**
Bulk transfers [CS14]. (closed systems) [CS107]	No other specific measures identified [EI20]. Wear suitable gloves tested to EN374 [PPE15].
Bulk transfers [CS14]. (closed systems) [CS107]With occasional controlled exposure [CS137]	Ensure material transfers are under containment or extract ventilation [E66].
Bulk transfers [CS14]. Dedicated facility [CS81].	Ensure material transfers are under containment or extract ventilation [E66]. Wear suitable gloves tested to EN374 [PPE15].
Bulk weighing [CS91]. (closed systems) [CS107].	No other specific measures identified [EI20]. Wear suitable gloves tested to EN374 [PPE15].
Bulk weighing [CS91]. With occasional controlled exposure [CS137]	Limit the substance content in the product to 5% [OC17]. Wear suitable gloves tested to EN374 [PPE15].
Small scale weighing [CS90]	Limit the substance content in the product to 5% [OC17]. Ensure material transfers are under containment or extract ventilation [E66].
Additive premixing [CS92](closed systems) [CS107]	Ensure material transfers are under containment or extract ventilation [E66].
Additive premixing [CS92]. (open systems) [CS108]. With sample collection [CS56].	Limit the substance content in the product to 5% [OC17]. Ensure material transfers are under containment or extract ventilation [E66].
Additive premixing [CS92]. General exposures (open systems) [CS16].	Limit the substance content in the product to 5% [OC17]. Ensure material transfers are under containment or extract ventilation [E66].

Bulk transfers [CS14]. Drum/batch transfers [CS8].	Limit the substance content in the product to 5% [OC17]. Ensure material transfers are under containment or extract ventilation [E66].
Bulk transfers [CS14]. Small package filling [CS7].	Limit the substance content in the product to 5% [OC17]. Ensure material transfers are under containment or extract ventilation [E66].
Calendering (including Banburys) [CS64]	Limit the substance content in the product to 5% [OC17]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Wear suitable gloves tested to EN374 [PPE15].
Production of articles by dipping and pouring [CS113].	Limit the substance content in the product to 5% [OC17]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60].
Extrusion and masterbatching [CS88]	Limit the substance content in the product to 5% [OC17]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Wear suitable gloves tested to EN374 [PPE15].
Injection moulding of articles [CS89]	Limit the substance content in the product to 5% [OC17]. Provide extract ventilation to material transfer points and other openings [E82].
Equipment maintenance [CS5].	Limit the substance content in the product to 5% [OC17]. Drain down and flush system prior to equipment break-in or maintenance [E55]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Storage [CS67]. With occasional controlled exposure [CS137]	Provide extract ventilation to points where emissions occur [E54].

Section 2.2	**Control of Environmental Exposure**	
Assessment method	EUSES 2.1.1 using default release fractions from ESVOC SpERC 4.21a V.1	
Product characteristics	DCPD is a liquid of low volatility. The water solubility is 20 mg/l; the vapour pressure is 187 Pa; and the log Kow is 2.78. DCPD is not readily biodegradable.	
Amounts used	EU tonnage	2 ktonnes per year
	Regional tonnage	0.2 ktonnes per year
	Fraction of main local source	1
Frequency and duration of use	Emission days per year	300
Environmental Factors not influenced by risk management	Local Freshwater dilution factor	10
	Local marine water dilution factor	100
Conditions given in SPERC fact sheet (ESVOC SpERC 4.21a. v1) give rise to following releases fractions		
Other Operational Conditions of use affecting environmental exposure	Release fraction to air from process before RMMs	0.25
	Release fraction to waste water from process before RMMs	0
	Release fraction to soil from process before RMMs	0.00001

Section 2.2	Control of Environmental Exposure
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	Treat air emissions to provide a typical removal efficiency of >80%.[TCR 7]
	Typical onsite wastewater treatment technology provides removal efficiency of 90.9%. [TCR 11]
	Soil emission controls are not applicable as there is no direct release to soil. [TCR4]
	Prevent discharge of undissolved substance to or recover from wastewater [TCR14].
Organisation measures to prevent/limit release from site	Do not apply industrial sludge to natural soils [OMS2].
	Sludge should be incinerated, contained or reclaimed [OMS3].
Conditions and measures related to municipal sewage treatment plant	Not applicable
Conditions and measures related to external treatment of waste for disposal	This substance is consumed during use and no waste of the substance is generated.. [ETW 5]
Conditions and measures related to external recovery of waste	This substance is consumed during use and no waste of the substance is generated. [EWR 3]
Other environmental control measures additional to above	None

Section 3	Exposure Estimation
3.1. Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2. Environment	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted PNECs and the resulting risk characterisation ratios are expected to be less than 1. This is only applicable to the intermediate exposure scenario.*
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1. Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A.2 for details of efficiencies and OC.*
4.2. Environment	*Confirm that RMMs and OCs are as described or of equivalent efficiency. The required efficiency removal from water is 90.9% which would be typically found in waste-water treatment plant.*
Values for Scaling Purposes DSU 4 : Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).	
Basis for scaling	Environment
	Risk-driving Compartment – soil
	Msafe 18067 kg/day after RMM

Site Use	0.2 ktonnes/year	
RMM Removal Efficiencies	90.9 % efficiency water, 80 % efficiency air	
Dilution factors	Freshwater	10
	Marine water	100
Initial release percent at site to water		0
Typical release to water after RMM		1.37E-05 mg/l
See Appendix B for further details		

Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.5.2. Exposure estimation

9.5.2.1. Workers exposure

The worker exposure estimates for the activities associated with the manufacturing of 3a,4,7,7a-tetrahydro-4,7-methanoindene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.5.2.2. Consumer exposure

Not applicable.

9.5.2.3. Indirect exposure of humans via the environment (oral)

The estimation of indirect human exposure via the environment was conducted using EUSES v2.1.1. The total daily intakes from exposure via the local environmental are presented in Appendix B.

9.5.2.4. Environmental exposure

The PECs are based on the factors shown in Section 2.2 of 9.5.1 Exposure Scenario: See Appendix B for local PECs and local environmental releases.

For regional PECs see section 9.7.

9.6. Exposure scenario 6: Use of 3a,4,7,7a-tetrahydro-4,7-methanoindene in polymer processing – Professional

9.6.1. Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Use in polymer processing of DCPD;CAS RN 77-73-6**
Use Descriptor	Sector of Use: Professional (SU22)
	Process Categories: PROC1, PROC2, PROC6, PROC8a, PROC8b, PROC14, PROC21
	Environmental Release Categories: ERC8A, ERC8D
Processes, tasks, activities covered	Processing of formulated polymers including material transfers, moulding and forming activities, material re-works and associated maintenance.
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure < 0.5 kPa [OC3].
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20oC above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures**
Bulk transfers [CS14]. (closed systems) [CS107]	No other specific measures identified [EI20]. Wear suitable gloves tested to EN374 [PPE15].
Bulk transfers [CS14]. (closed systems) [CS107]. With occasional controlled exposure [CS137]	Limit the substance content in the product to 5% [OC17]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Material transfers [CS3].	Limit the substance content in the product to 5% [OC17]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Ensure material transfers are under containment or extract ventilation [E66].
Injection moulding of articles [CS89]	Limit the substance content in the product to 5% [OC17].Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].Wear suitable gloves tested to EN374 [PPE15].
Rework of articles [CS86]	No specific measures identified [EI18].
Equipment maintenance [CS5].	Drain down system prior to equipment break-in or maintenance [E65]. Limit the substance content in the product to 5% [OC17]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Injection moulding of articles [CS89].	Limit the substance content in the product to 5% [OC17]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out operation for more than 1 hour [OC11]. Wear suitable gloves tested to EN374 [PPE15].

Rework of articles [CS86].	Limit the substance content in the product to 5% [OC17]. Wear suitable gloves tested to EN374 [PPE15].
Storage [CS67]	No other specific measures identified [EI20]. Wear suitable gloves tested to EN374 [PPE15].
Storage [CS67]With occasional controlled exposure [CS137]	Limit the substance content in the product to 5% [OC17]. Provide extract ventilation to points where emissions occur [E54]. Wear suitable gloves tested to EN374 [PPE15].

Section 2.2	**Control of Environmental Exposure**	
Assessment method	EUSES 2.1.1 using default release fractions from ESVOC SpERC 8.21b V.1	
Product characteristics	DCPD is a liquid of low volatility. The water solubility is 20 mg/l; the vapour pressure is 187 Pa; and the log Kow is 2.78. DCPD is not readily biodegradable.	
Amounts used	EU tonnage	2 ktonnes per year
	Regional tonnage	0.2 ktonnes per year
	Faction of main local source	0.002
Frequency and duration of use	Emission days per year	365
Environmental Factors not influenced by risk management	Local Freshwater dilution factor	10
	Local marine water dilution factor	100
Conditions given in SPERC fact sheet (ESVOC SpERC 8.21b. v1) give rise to following releases fractions		
Other Operational Conditions of use affecting environmental exposure	Release fraction to air from process before RMMs	0.98
	Release fraction to waste water from process before RMMs	0.01
	Release fraction to soil from process before RMMs	0.01
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	Negligible air emissions as process operates in a contained system.	
	Typical onsite wastewater treatment technology provides removal efficiency of 90.9%. [TCR 11]	
	Soil emission controls are not applicable as there is no direct release to soil. [TCR4]	
Organisation measures to prevent/limit release from site	Prevent environmental discharge consistent with regulatory requirements. [OMS 4]	
Conditions and measures related to municipal sewage treatment plant	Typical onsite wastewater treatment technology provides removal efficiency of 90.9%. [TCR 11]	
Conditions and measures related to external treatment of waste for disposal	External treatment and disposal of waste should comply with applicable local and/or national regulations. [ETW 3]	
Conditions and measures related to external recovery of waste	External recovery and recycling of waste should comply with applicable local and/or national regulations.[ERW 1]	
Other environmental control measures additional to above	Not applicable	

Section 3	**Exposure Estimation**

3.1. Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2. Environment	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted PNECs and the resulting risk characterisation ratios are expected to be less than 1. This is only applicable to the intermediate exposure scenario.*
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1. Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A.2 for details of efficiencies and OC.*
4.2. Environment	*Confirm that RMMs and OCs are as described or of equivalent efficiency. The required efficiency removal from water is 90.9% which would be typically found in waste-water treatment plant.*

Values for Scaling Purposes

DSU 4 : Further details on scaling and control technologies are provided in SpERC factsheet

(http://cefic.org/en/reach-for-industries-libraries.html).

Basis for scaling	Environment	
	Risk-driving Compartment – soil	
	Msafe 320 kg/day after RMM	
Site Use	0.4 tonnes/year	
RMM Removal Efficiencies	90.9 % efficiency water, 0 % efficiency air	
Dilution factors	Freshwater	10
	Marine water	100
Initial release percent at site to water		1
Typical release to water after RMM		6.35E-05 mg/l
See Appendix B for further details		

Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.6.2. Exposure estimation

9.6.2.1. Workers exposure

The worker exposure estimates for the activities associated with the manufacturing of 3a,4,7,7a-tetrahydro-4,7-methanoindene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.6.2.2. Consumer exposure

Not applicable.

9.6.2.3. Indirect exposure of humans via the environment (oral)

The estimation of indirect human exposure via the environment was conducted using EUSES v2.1.1. The total daily intakes from exposure via the local environmental are presented in Appendix B.

9.6.2.4. Environmental exposure

The PECs are based on the factors shown in Section 2.2 of 9.6.1 Exposure Scenario: See Appendix B for local PECs and local environmental releases.

For regional PECs see section 9.7.

9.7 Regional Exposure Concentrations

Compartments					
Air (mg m^{-3})	**Fresh water (mg l^{-1})**	**Marine water (mg l^{-1})**	**Fresh water Sediment (mg kg^{-1} wwt)**	**Marine water Sediment (mg kg^{-1} wwt)**	**Soil (mg kg^{-1} wwt) (agricultural)**
2.41E-06	1.37E-05	1.13E-06	8.64E-05	6.6E-06	3.09E-05

10. RISK CHARACTERISATION

Table 10.1 PNECs used in environmental modelling

Reference Values (using SPARC generated log Kow of 4.35)			
HC5 $PNEC_{aqua}$ ($mg.l^{-1}$)	0.029		
HC5 $PNEC_{marine}$ ($mg.l^{-1}$)	0.029		
HC5 $PNEC_{STP}$ ($mg.l^{-1}$)	0.85		
HC5 $PNEC_{sediment}$ ($mg.kg^{-1}$ dwt)	5.49	HC5 $PNEC_{sediment}$ ($mg.kg^{-1}$ wwt)	1.19
HC5 $PNEC_{soil}$ ($mg.kg^{-1}$ dwt)	0.86	HC5 $PNEC_{soil}$ ($mg.kg^{-1}$ wwt)	0.759

Table 10.2 DN(M)ELs for workers

Acute - systemic effects		Acute - local effects		Long-term - systemic effects		Long-term – local effects	
dermal ($mg\ kg^{-1}\ bw\ day^{-1}$)	Inhalation ($mg\ m^{-3}$)	Dermal ($mg\ cm^{-2}$)	Inhalation ($mg\ m^{-3}$)	Dermal ($mg\ kg^{-1}\ bw\ day^{-1}$)	Inhalation ($mg\ m^{-3}$)	Dermal ($mg\ cm^{-2}$)	Inhalation ($mg\ m^{-3}$)
NA	NA	NA	(160)	0.34	(2.30)	NA	2.30

Table 10.3 DN(M)ELs for General Population

Acute – systemic effects			Acute - local effects		Long-term - systemic effects			Long-term – local effects	
Dermal ($mg\ kg^{-1}\ bw\ day^{-1}$)	Inhalation ($mg\ m^{-3}$)	Oral ($mg\ kg^{-1}\ bw\ day^{-1}$)	Dermal ($mg\ cm^{-2}$)	Inhalation ($mg\ m^{-3}$)	Dermal ($mg\ kg^{-1}\ bw\ day^{-1}$)	Inhalation ($mg\ m^{-3}$)	Oral ($mg\ kg^{-1}\ bw\ day^{-1}$)	Dermal ($mg\ cm^{-2}$)	Inhalation ($mg\ m^{-3}$)
NA	143	NA	NA	(143)	0.14	0.49	0.10	NA	(0.49)

10.1 Human Health

10.1.1. Exposure Scenario 1: Manufacture of 3a,4,7,7a-tetrahydro-4,7-methanoindene

Contributing Scenarios	Substance specific RCR (inhalation)	Substance specific RCR (dermal)	Substance specific RCR (all routes)
General exposures (closed systems) [CS15].	0.02	0.20	0.22
General exposures (closed systems) [CS15]. With sample collection [CS56].	0.23	0.40	0.64
General exposures (closed systems) [CS15].	0.70	0.10	0.80
General exposures (open systems) [CS16].	0.35	0.40	0.75
Process sampling [CS2].	0.35	0.40	0.75
Laboratory activities [CS36].	0.35	0.10	0.45
Bulk transfers [CS14]. (open systems) [CS108]	0.35	0.40	0.75
Bulk transfers [CS14]. (closed systems) [CS107];	0.35	0.40	0.75
Equipment cleaning and maintenance [CS39].	0.47	0.40	0.87
Storage [CS67]	0.23	0.40	0.64

10.1.1.1. Consumers

Not relevant for this ES

10.1.2 Exposure Scenario 2: Distribution of 3a,4,7,7a-tetrahydro-4,7-methanoindene

Contributing Scenarios	RCR (inhalation)	RCR (dermal)	RCR (all routes)
General exposures (closed systems) [CS15].	0.02	0.20	0.22
General exposures (closed systems) [CS15]. With sample collection [CS56].	0.23	0.40	0.64
General exposures (closed systems) [CS15].	0.70	0.10	0.80
General exposures (open systems) [CS16].	0.35	0.20	0.55
Process sampling [CS2].	0.70	0.10	0.80
Laboratory activities [CS36].	0.35	0.10	0.45
Bulk transfers [CS14]. (closed systems) [CS107]	0.35	0.20	0.55
Bulk transfers [CS14]. (open systems) [CS108]	0.81	0.10	0.91
Drum and small package filling [CS6].	0.81	0.10	0.91
Equipment cleaning and maintenance [CS39].	0.23	0.40	0.64
Storage [CS67]	0.23	0.40	0.64

10.1.2.1. Consumers

Not relevant for this ES

10.1.3 Exposure Scenario 3: Use of 3a,4,7,7a-tetrahydro-4,7-methanoindene as an intermediate

Contributing Scenario	Process Category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
General exposures (closed systems) [CS15].	1 - Use in closed process, no likelihood of exposure	0.02	0.20	0.22
General exposures (closed systems) [CS15]. With sample collection [CS56].	2 - Use in closed, continuous process with occasional controlled exposure	0.23	0.40	0.64
General exposures (closed systems) [CS15].	3 - Use in closed batch process (synthesis or formulation)	0.70	0.10	0.80
General exposures (open systems) [CS16].	4 - Use in batch and other process (synthesis) where opportunity for exposure arises	0.35	0.40	0.75
Process sampling [CS2].	8b -Transfer of chemicals from/to vessels/ large containers at dedicated facilities	0.35	0.40	0.75
Laboratory activities [CS36].	15 - Use of laboratory reagents in small scale laboratories	0.35	0.10	0.45
Bulk transfers [CS14]. (open systems) [CS108]	8b -Transfer of chemicals from/to vessels/ large containers at dedicated facilities	0.35	0.40	0.75
Bulk transfers [CS14]. (closed systems) [CS107];	8b -Transfer of chemicals from/to vessels/ large containers at dedicated facilities	0.35	0.40	0.75

Contributing Scenario	Process Category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
Equipment cleaning and maintenance [CS39].	8a -Transfer of chemicals from/to vessels/ large containers at non dedicated facilities	0.47	0.40	0.87
Storage [CS67]	2 - Use in closed, continuous process with occasional controlled exposure	0.23	0.40	0.64

10.1.3.1. Consumers

Not relevant for this ES

10.1.4 Exposure Scenario 4: Polymer production of 3a,4,7,7a-tetrahydro-4,7-methanoindene

Contributing Scenario	Process Category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
General exposures (closed systems) [CS15].	1 - Use in closed process, no likelihood of exposure	0.02	0.20	0.22
Bulk transfers [CS14].	8b -Transfer of chemicals from/to vessels/ large containers at dedicated facilities	0.35	0.40	0.75
Polymerisation (bulk and batch) [CS65]	2 - Use in closed, continuous process with occasional controlled exposure	0.07	0.08	0.15
Polymerisation (bulk and batch) [CS65]	3 - Use in closed batch process (synthesis or formulation)	0.70	0.10	0.80
Finishing operations [CS102]	3 - Use in closed batch process (synthesis or formulation)	0.70	0.10	0.80
Intermediate polymer storage [CS66]	4 - Use in batch and other process (synthesis) where opportunity for exposure arises	0.23	0.40	0.64
Additivation and stabilisation [CS69]	3 - Use in closed batch process (synthesis or formulation)	0.70	0.10	0.80

Contributing Scenario	Process Category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
Mixing in containers [CS23].	5 -Mixing or blending in batch processes (multistage and/or significant contact)	0.23	0.20	0.43
Pelletizing [CS53].	6 -Calendering operations	0.16	0.81	0.97
Pelletizing [CS53].	14 - Production of preparations or articles by tabletting, compression, extrusion, pelletisation	0.16	0.20	0.36
Pelletisation and pellet screening [CS68]	8b -Transfer of chemicals from/to vessels/ large containers at dedicated facilities	0.35	0.40	0.75
Bulk transfers [CS14].	2 - Use in closed, continuous process with occasional controlled exposure	0.23	0.08	0.31
Bulk transfers [CS14].	3 - Use in closed batch process (synthesis or formulation)	0.70	0.10	0.80
Transport [CS58].	8b -Transfer of chemicals from/to vessels/ large containers at dedicated facilities	0.35	0.40	0.75

Contributing Scenario	Process Category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
Equipment maintenance [CS5].	8a -Transfer of chemicals from/to vessels/ large containers at non dedicated facilities	0.47	0.40	0.87
Rework of articles [CS86].	21 - Low energy manipulation of substances bound in materials and/or articles	0.00	0.83	0.83
Storage [CS67]	2 - Use in closed, continuous process with occasional controlled exposure	0.47	0.40	0.87

10.1.4.1. Consumers

Not relevant for this ES

10.1.48 Exposure Scenario 48: Use of 3a,4,7,7a-tetrahydro-4,7-methanoindene polymer processing (industrial)

Contributing Scenarios	RCR (inhalation)	RCR (dermal)	RCR (all routes)
Bulk transfers [CS14]. (closed systems) [CS107]	0.02	0.20	0.22
Bulk transfers [CS14]. (closed systems) [CS107]	0.23	0.40	0.64
Bulk transfers [CS14].	0.35	0.40	0.75
Bulk weighing [CS91]	0.02	0.20	0.22
Bulk weighing [CS91]	0.47	0.16	0.63
Small scale weighing [CS90]	0.23	0.40	0.64
Additive premixing [CS92]	0.70	0.10	0.80
Additive premixing [CS92]	0.23	0.40	0.64
Additive premixing [CS92]	0.23	0.04	0.27
Bulk transfers [CS14].	0.23	0.40	0.64
Bulk transfers [CS14].	0.23	0.40	0.64
Calendering (including Banburys) [CS64]	0.70	0.16	0.86
Production of articles by dipping and pouring [CS113].	0.47	0.20	0.67
Extrusion and masterbatching [CS88]	0.23	0.40	0.64
Injection moulding of articles [CS89]	0.47	0.20	0.67
Equipment maintenance [CS5].	0.14	0.81	0.95
Storage [CS67]	0.47	0.40	0.87

10.1.5.1. Consumers

Not relevant for this ES

10.1.49 Exposure Scenario 49: Use of 3a,4,7,7a-tetrahydro-4,7-methanoindene polymer processing (professional)

Contributing Scenario	Process Category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
Bulk transfers [CS14]. (closed systems) [CS107]	1 - Use in closed process, no likelihood of exposure	0.02	0.20	0.22
Bulk transfers [CS14]. (closed systems) [CS107]	2 - Use in closed, continuous process with occasional controlled exposure	0.70	0.01	0.71
Material transfers [CS3].	8b -Transfer of chemicals from/to vessels/ large containers at dedicated facilities	0.28	0.40	0.68
Injection moulding of articles [CS89]	6 -Calendering operations	0.28	0.16	0.44
Equipment maintenance [CS5].	8a -Transfer of chemicals from/to vessels/ large containers at non dedicated facilities	0.70	0.08	0.78
Injection moulding of articles [CS89].	14 - Production of preparations or articles by tabletting, compression, extrusion, pelletisation	0.28	0.40	0.68
Rework of articles [CS86].	21 - Low energy manipulation of substances bound in materials and/or articles	0.00	0.33	0.33
Storage [CS67]	1 - Use in closed process, no likelihood of exposure	0.02	0.20	0.22

Contributing Scenario	Process Category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
Storage [CS67]	2 - Use in closed, continuous process with occasional controlled exposure	0.47	0.16	0.63

10.1.6.1. Consumers

Not relevant for this ES

10.2 Environment

10.2.1. Exposure Scenario 1: Manufacture of 3a,4,7,7a-tetrahydro-4,7-methanoindene

10.2.1.1 Risk characterisation for the soil, sediment and water compartments

Compartment	Local PEC	PNEC	PEC/PNEC (RCR)
Freshwater aquatic (mg.l^{-1})	1.14E-02	0.029	3.93E-01
Marine aquatic (mg.l^{-1})	4.55E-03	0.029	1.57E-01
Freshwater sediment (mg.kg^{-1} wwt)	6.46E-02	1.19	5.41E-02
Marine sediment (mg.kg^{-1} wwt)	2.58E-02	1.19	2.16E-02
Terrestrial (mg.kg^{-1} wwt)	3.56E-02	0.759	4.67E-02
Sewage treatment plant (mg.l^{-1})	4.55E-01	0.85	5.36E-01

10.2.1.2 Risk characterisation for the secondary poisoning compartment

3a,4,7,7a-tetrahydro-4,7-methanoindene does not bioaccumulate and therefore this evaluation is not required.

10.2.1.3 Risk characterisation for indirect human exposures

Compartment	Daily dose (local)	DNEL (mg.kg bw^{-1}.day^{-1})	Daily dose/DNEL
Daily dose through intake of drinking water (mg.kg^{-1}.d^{-1})	2.46E-04	0.1	2.46E-03
Daily dose through intake of fish (mg.kg^{-1}.d^{-1})	7.08E-04	0.1	7.08E-03
Daily dose through intake of leaf crops (mg.kg^{-1}.d^{-1})	2.72E-06	0.1	2.72E-05
Daily dose through intake of root crops (mg.kg^{-1}.d^{-1})	3.39E-04	0.1	3.39E-03
Daily dose through intake of meat (mg.kg^{-1}.d^{-1})	9.31E-08	0.1	9.31E-07
Daily dose through intake of milk (mg.kg^{-1}.d^{-1})	9.11E-08	0.1	9.11E-07
Daily dose through intake of air (mg.kg^{-1}.d^{-1})	2.18E-03	0.14	1.56E-02

10.2.2 Exposure Scenario 2: Distribution of 3a,4,7,7a-tetrahydro-4,7-methanoindene

10.2.2.1 Risk characterisation for the soil, sediment and water compartments

Compartment	Local PEC	PNEC	PEC/PNEC (RCR)
Freshwater aquatic (mg.l^{-1})	1.53E-03	0.029	5.28E-02
Marine aquatic (mg.l^{-1})	1.53E-04	0.029	5.27E-03
Freshwater sediment (mg.kg^{-1} wwt)	8.68E-03	1.19	7.28E-03
Marine sediment (mg.kg^{-1} wwt)	8.67E-04	1.19	7.26E-04
Terrestrial (mg.kg^{-1} wwt)	4.85E-02	0.759	6.40E-02
Sewage treatment plant (mg.l^{-1})	1.52E-02	0.85	1.79E-02

10.2.2.2 Risk characterisation for the secondary poisoning compartment

3a,4,7,7a-tetrahydro-4,7-methanoindene does not bioaccumulate and therefore this evaluation is not required.

10.2.2.3 Risk characterisation for indirect human exposures

Compartment	Daily dose (local)	DNEL (mg.kg bw^{-1}.day^{-1})	Daily dose/DNEL
Daily dose through intake of drinking water (mg.kg^{-1}.d^{-1})	3.17E-04	0.1	3.17E-03
Daily dose through intake of fish (mg.kg^{-1}.d^{-1})	9.53E-05	0.1	9.53E-04
Daily dose through intake of leaf crops (mg.kg^{-1}.d^{-1})	2.78E-07	0.1	2.78E-06
Daily dose through intake of root crops (mg.kg^{-1}.d^{-1})	4.37E-04	0.1	4.37E-03
Daily dose through intake of meat (mg.kg^{-1}.d^{-1})	4.63E-08	0.1	4.63E-07
Daily dose through intake of milk (mg.kg^{-1}.d^{-1})	4.53E-08	0.1	4.53E-07
Daily dose through intake of air (mg.kg^{-1}.d^{-1})	2.18E-04	0.14	1.56E-03

10.2.3 Exposure Scenario 3: Use as an Intermediate of 3a,4,7,7a-tetrahydro-4,7-methanoindene

10.2.3.1 Risk characterisation for the soil, sediment and water compartments

Compartment	Local PEC	PNEC	PEC/PNEC (RCR)
Freshwater aquatic (mg.l^{-1})	4.56E-03	0.029	1.57E-01
Marine aquatic (mg.l^{-1})	4.56E-04	0.029	1.57E-02
Freshwater sediment (mg.kg^{-1} wwt)	2.59E-02	1.19	2.17E-02
Marine sediment (mg.kg^{-1} wwt)	2.59E-03	1.19	2.17E-03
Terrestrial (mg.kg^{-1} wwt)	1.38E-01	0.759	1.82E-01
Sewage treatment plant (mg.l^{-1})	4.55E-02	0.85	5.36E-02

10.2.3.2 Risk characterisation for the secondary poisoning compartment

3a,4,7,7a-tetrahydro-4,7-methanoindene does not bioaccumulate and therefore this evaluation is not required.

10.2.3.3 Risk characterisation for indirect human exposures

Compartment	Daily dose (local)	DNEL (mg.kg bw^{-1}.day^{-1})	Daily dose/DNEL
Daily dose through intake of drinking water (mg.kg^{-1}.d^{-1})	8.98E-04	0.1	8.98E-03
Daily dose through intake of fish (mg.kg^{-1}.d^{-1})	2.84E-04	0.1	2.84E-03
Daily dose through intake of leaf crops (mg.kg^{-1}.d^{-1})	8.69E-08	0.1	8.69E-07
Daily dose through intake of root crops (mg.kg^{-1}.d^{-1})	1.24E-03	0.1	1.24E-02
Daily dose through intake of meat (mg.kg^{-1}.d^{-1})	1.15E-07	0.1	1.15E-06
Daily dose through intake of milk (mg.kg^{-1}.d^{-1})	1.13E-07	0.1	1.13E-06
Daily dose through intake of air (mg.kg^{-1}.d^{-1})	5.87E-05	0.14	4.19E-04

10.2.4 Exposure Scenario 4: Use in Polymer production of 3a,4,7,7a-tetrahydro-4,7-methanoindene (industrial)

10.2.4.1 Risk characterisation for the soil, sediment and water compartments

Compartment	Local PEC	PNEC	PEC/PNEC (RCR)
Freshwater aquatic (mg.l^{-1})	1.82E-02	0.029	6.28E-01
Marine aquatic (mg.l^{-1})	1.82E-03	0.029	6.28E-02
Freshwater sediment (mg.kg^{-1} wwt)	1.03E-01	1.19	8.66E-02
Marine sediment (mg.kg^{-1} wwt)	1.03E-02	1.19	8.66E-03
Terrestrial (mg.kg^{-1} wwt)	5.71E-01	0.759	7.53E-01
Sewage treatment plant (mg.l^{-1})	1.82E-01	0.85	2.14E-01

10.2.4.2 Risk characterisation for the secondary poisoning compartment

3a,4,7,7a-tetrahydro-4,7-methanoindene does not bioaccumulate and therefore this evaluation is not required.

10.2.4.3 Risk characterisation for indirect human exposures

Compartment	Daily dose (local)	DNEL (mg.kg bw^{-1}.day^{-1})	Daily dose/DNEL
Daily dose through intake of drinking water (mg.kg^{-1}.d^{-1})	3.73E-03	0.1	3.73E-02
Daily dose through intake of fish (mg.kg^{-1}.d^{-1})	1.13E-03	0.1	1.13E-02
Daily dose through intake of leaf crops (mg.kg^{-1}.d^{-1})	2.23E-06	0.1	2.23E-05
Daily dose through intake of root crops (mg.kg^{-1}.d^{-1})	5.14E-03	0.1	5.14E-02
Daily dose through intake of meat (mg.kg^{-1}.d^{-1})	5.21E-07	0.1	5.21E-06
Daily dose through intake of milk (mg.kg^{-1}.d^{-1})	5.09E-07	0.1	5.09E-06
Daily dose through intake of air (mg.kg^{-1}.d^{-1})	1.74E-03	0.14	1.24E-02

10.2.5 Exposure Scenario 5: Use in Polymer processing of 3a,4,7,7a-tetrahydro-4,7-methanoindene (industrial)

10.2.5.1 Risk characterisation for the soil, sediment and water compartments

Compartment	Local PEC	PNEC	PEC/PNEC (RCR)
Freshwater aquatic (mg.l^{-1})	1.37E-05	0.029	4.74E-04
Marine aquatic (mg.l^{-1})	1.13E-06	0.029	3.89E-05
Freshwater sediment (mg.kg^{-1} wwt)	7.79E-05	1.19	6.53E-05
Marine sediment (mg.kg^{-1} wwt)	6.40E-06	1.19	5.36E-06
Terrestrial (mg.kg^{-1} wwt)	2.81E-02	0.759	3.69E-02
Sewage treatment plant (mg.l^{-1})	0.00E+00	0.85	0.00E+00

10.2.5.2 Risk characterisation for the secondary poisoning compartment

3a,4,7,7a-tetrahydro-4,7-methanoindene does not bioaccumulate and therefore this evaluation is not required.

10.2.5.3 Risk characterisation for indirect human exposures

Compartment	Daily dose (local)	DNEL (mg.kg bw^{-1}.day^{-1})	Daily dose/DNEL
Daily dose through intake of drinking water (mg.kg^{-1}.d^{-1})	1.94E-04	0.1	1.94E-03
Daily dose through intake of fish (mg.kg^{-1}.d^{-1})	1.04E-06	0.1	1.04E-05
Daily dose through intake of leaf crops (mg.kg^{-1}.d^{-1})	2.72E-06	0.1	2.72E-05
Daily dose through intake of root crops (mg.kg^{-1}.d^{-1})	2.68E-04	0.1	2.68E-03
Daily dose through intake of meat (mg.kg^{-1}.d^{-1})	8.64E-08	0.1	8.64E-07
Daily dose through intake of milk (mg.kg^{-1}.d^{-1})	8.45E-08	0.1	8.45E-07
Daily dose through intake of air (mg.kg^{-1}.d^{-1})	2.18E-03	0.14	1.56E-02

10.2.6 Exposure Scenario 6: Use in Polymer processing of 3a,4,7,7a-tetrahydro-4,7-methanoindene (professional)

10.2.6.1 Risk characterisation for the soil, sediment and water compartments

Compartment	Local PEC	PNEC	PEC/PNEC (RCR)
Freshwater aquatic (mg.l^{-1})	6.36E-05	0.029	2.19E-03
Marine aquatic (mg.l^{-1})	6.12E-06	0.029	2.11E-04
Freshwater sediment (mg.kg^{-1} wwt)	3.61E-04	1.19	3.02E-04
Marine sediment (mg.kg^{-1} wwt)	3.47E-05	1.19	2.91E-05
Terrestrial (mg.kg^{-1} wwt)	2.60E-03	0.759	3.43E-03
Sewage treatment plant (mg.l^{-1})	4.99E-04	0.85	5.87E-04

10.2.6.2 Risk characterisation for the secondary poisoning compartment

3a,4,7,7a-tetrahydro-4,7-methanoindene does not bioaccumulate and therefore this evaluation is not required.

10.2.6.3 Risk characterisation for indirect human exposures

Compartment	Daily dose (local)	DNEL (mg.kg bw^{-1}.day^{-1})	Daily dose/DNEL
Daily dose through intake of drinking water (mg.kg^{-1}.d^{-1})	1.74E-05	0.1	1.74E-04
Daily dose through intake of fish (mg.kg^{-1}.d^{-1})	4.81E-06	0.1	4.81E-05
Daily dose through intake of leaf crops (mg.kg^{-1}.d^{-1})	1.08E-07	0.1	1.08E-06
Daily dose through intake of root crops (mg.kg^{-1}.d^{-1})	2.40E-05	0.1	2.40E-04
Daily dose through intake of meat (mg.kg^{-1}.d^{-1})	4.64E-09	0.1	4.64E-08
Daily dose through intake of milk (mg.kg^{-1}.d^{-1})	4.54E-09	0.1	4.54E-08
Daily dose through intake of air (mg.kg^{-1}.d^{-1})	8.60E-05	0.14	6.14E-04

10.2.7 Regional RCRs

Compartments				
Fresh water	**Marine water**	**Fresh water Sediment**	**Marine water Sediment**	**Soil**
4.74E-04	3.89E-05	7.24E-05	5.53E-06	4.07E-05

10.3. Overall exposure (combined for all relevant emission/release sources)

10.3.1. Human health (combined for all exposure routes)

See Appendix A for details.

10.3.2. Indirect exposure of humans via the environment (combined for all emission sources)

ES	Regional and local total daily intake for humans ($mg.kg^{-1}.d^{-1}$)	DNEL	Daily dose/DNEL
Manufacture	3.48E-03	0.1	3.48E-02
Distribution	1.07E-03	0.1	1.07E-02
Intermediates	2.48E-03	0.1	2.48E-02
Polymer production - Industrial	1.17E-02	0.1	1.17E-01
Polymer processing - Industrial	2.65E-03	0.1	2.65E-02
Polymer processing - Professional	1.35E-04	0.1	1.35E-03

10.21.3 Environment (combined for all emission sources)

See Appendix B for details.