NOVA MOLECULAR TECHNOLOGIES, INC.
A Responsible Care® Company

RESPONSIBLE CARE®
OUR COMMITMENT TO SUSTAINABILITY

SAFETY DATA SHEET

In accordance with Regulation (EC) 1907/2006 (REACH), Annex II

SDS Number: 0127 – Effective Date: February, 2014

TETRAHYDROFURFURYL ALCOHOL

Section 1 – Identification of the Substance and of the company/undertaking

1.1 Product Identifier
EC Number (Annex VI to Regulation (EC) No 1272/2008)
202-625-6
Product Name:
Tetrahydrofurfuryl Alcohol
Synonyms:
Tetrahydro-2-furanmethanol; tetrahydro-2-furylmethanol
Product Appearance:
Clear, colorless liquid
Registration Number: 01-2119968921-26-0002

1.2 Relevant identified uses of the substance or mixture and uses advised against
Identified use(s): co-formulant in plant protection products

1.3 Details of the Supplier:
Manufacturer:
Nova Molecular Technologies, Inc.,
1 Parker Place, Suite 725, Janesville, WI 53545, USA
Ph: 800-445-6682 or 608-754-6682

1.4 Emergency Telephone Number:
CHEMTREC (24 hours): 703-527-3887 (Global Chemtrec Number)

Questions regarding this MSDS should be addressed to Customer Service: sdsinfo@novamolecular.com
Phone: 608-754-6682 x 1

Section 2 – Hazards Identification

2.1 Classification of the Substance:
2.1.1 Classification in accordance with Regulation (EC) No 1272/2008 :

Eye irritation, category 2, H319
Reproductive toxicity, category 2, H361

2.1.2 Classification in accordance with Directive 67/548/EEC:

Xi Irritant Xn Harmful
R36: Irritating to the eyes

R62: Possible risk of impaired fertility
R63: Possible risk of harm to the unborn child

2.2 Label Elements

Labelling:  Regulation (EC) No. 1272/2008Hazard pictogram:

Signal Word: Warning
Hazard Statements:
H319: Causes serious eye irritation

H361: Suspected of damaging fertility or the unborn child. Specific effect: Males: lower prostate, epididymal and testes weights, necrosis of the seminiferous tubular epithelium and lower sperm production. Females: prolonged oestrus cycle and gestation length. Foetal resorption or mummification and dead pups on PND 1. Route of exposure: Oral
Precautionary statements:
P201: Obtain special instructions before use.
P280: Wear protective gloves / protective clothing / eye protection / face protection

P305+P351+P388: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rising.
P337+P313: If eye irritation persist: Get medical advice/attention.
P308+P313: IF exposed or concerned: Get medical advice/attention.
P405: Store locked up.

2.3 Other Hazards

None identified.

Section 3 – Composition/Information on Ingredients

3.1 Substances
CAS Number: 97-99-4
Description: Tetrahydrofurfuryl Alcohol
EC#: 202-625-6
Index Number Annex VI CLP: 603-061-00-7
Weight % content Range: 98 -100%

There are no additional ingredients present which, within the current knowledge of the supplier, are classified and contribute to the classification of the substance and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4 – First Aid Measures

FIRST AID MEASURES

4.1 Description of First aid measures

Eye Contact:
Prompt action is essential is case of contact. Flush immediately under running water for at least 15 minutes while holding eyelids open and seek immediate medical attention.
Skin Contact:
Immediately wash skin with soap and water. Continue flushing with plenty of water for at least 15 minutes. Remove contaminated clothing, shoes, and leather goods immediately, and launder before reuse. If irritation develops, see a physician.
Inhalation:
Breathe fresh air. Give artificial respiration if required. Give oxygen and see a physician if breathing is difficult.
Ingestion:
Consult a doctor / medical service if unwell. Do not induce vomiting.
NOTE TO PHYSICIAN:
Show this Material Safety Data Sheet to your physician

4.2 Most important symptoms and effects, both acute and delayed
Eye contact: Causes serious eye irritation. Adverse symptoms may include the following: pain or irritation, watering, redness
Inhalation: No known significant effects
Skin contact: No known significant effects

4.3 Indication of any immediate medical attention and special treatment needed
Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

5 – Fire Fighting Measures

5.1 Extinguishing Media
Alcohol foam, carbon dioxide, dry chemical, water spray for dilution to nonflammable mixture.

5.2 Special hazards arising from the substance or mixture
DECOMPOSITION PRODUCTS UNDER FIRE CONDITIONS: Combustion produces carbon dioxide and carbon monoxide.

5.3 Advice for fire fighters:
FIRE FIGHTING: If material on fire or involved in fire: Do not extinguish fire unless flow can be stopped. Use water in flooding quantities as fog. Solid streams of water may be ineffective. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible. Use "alcohol" foam, dry chemical or carbon dioxide.

Section 6 – Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures:
Restrict access to area as appropriate until cleanup operations are complete. Only trained personnel should conduct cleanup. Remove sources of ignition. Ventilate spill area if possible. Do not touch spilled material. Stop or reduce leaks if safe to do so. Dispose of spent material in accordance with all applicable local, state, and federal requirements.

6.2 Environmental Precautions
Do not contaminate surface water.

6.3 Methods and material for containment and cleaning up
LAND OR WATER SPILL
Small Spills:

Soak up spill with absorbent material. Place residues in a suitable, covered, properly labeled container. Wash affected area thoroughly. Notify appropriate government, occupational health and safety, and environmental authorities. Dispose of spent material in accordance with all applicable local, state, and federal requirements.

Large Spills:

Contain liquid using absorbent material, by digging trenches or by diking. Reclaim into recovery or salvage drums or tank truck for proper disposal. Wash site of spillage thoroughly with water. Dispose of spent material in accordance with all applicable local, state, or federal requirements.

6.4 Reference to other sections

Use personal protective equipment recommended in Section 8.

Section 7 – Handling and Storage

7.1 Precautions for safe handling

Do not get in eyes, on skin, or on clothing. Do not take internally. Do not breathe vapors, gases, or dust. Avoid generating aerosols and mists. Keep away from acids and oxidizing agents. Keep containers closed when not in use. Have emergency equipment for fires, spills, leaks, etc. readily available. Laboratory samples should be stored and handled in a lab hood. Provide mechanical ventilation of combined spaces.

Advice on general occupational hygiene

Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

7.2 Conditions for Safe Storage, including any incompatibilities

Store in a cool well-ventilated area away from direct sunlight. Store away from heat and sources of ignition. Use proper grounding procedures. Store the containers tightly closed. Store separately from acids and oxidizing agents.

7.3 Specific end use(s) Recommendations:

See information supplied by the manufacturer.

Industrial sector specific solutions

See information supplied by the manufacturer.

Section 8 – Exposure Controls/Personal Protection

8.1 Control parameters

OCCUPATIONAL EXPOSURE LIMITS

Not Listed / Not available

Recommended occupational and consumer exposure limit values (following from the performed CSA):

Exposure pattern	**Derived No Effect Level (DNEL)**	
	Workers	**General population**
Inhalation – Systemic, long term	1.4 mg/m^3	0.25 mg/m^3
Inhalation – Systemic, acute	1.4 mg/m^3	0.25 mg/m^3
Dermal – Systemic, long term	**0.35 mg/kg bw/day**	**0.175 mg/kg bw/day**
Dermal – Systemic, acute	0.35 mg/kg bw/day	**0.175 mg/kg bw/day**
Oral – Systemic, long term		0.175 mg/kg bw/day
Oral – Systemic, acute		0.175 mg/kg bw/day

PNECs

Environmental protection target	**PNEC**
Fresh water	1.9 mg/L
Sediments (freshwater)	8.6 mg/kg sediment dw
Marine water	0.19 mg/L

Sediments (marine water)	0.86 mg/kg sediment dw
Microorganisms in sewage treatment	10 mg/L
Soil (agricultural)	0.6 mg/kg soil dw
Intermittent releases to water	0.917 mg/L

Personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

8.2 Exposure Controls

Appropriate Engineering Controls
The use of local exhaust ventilation is recommended to control emissions near the source. Laboratory samples should be handled in a fume-hood. Provide mechanical ventilation of confined spaces.

Individual protection measures and personal protective equipment

Eye Protection:
Wear chemical splash goggles and a full-face shield.
Skin Protection:
Wear chemical resistant gloves, chemical suit, rubber boots, and full-face shield. Replace gloves regularly.
Material: neoprene
Thickness: 18 mil (0.46 mm)
Note: this specification is for incidental exposure, not immersion
Hygiene Recommendations:
Eye wash station and safety-shower are necessary. If clothing is contaminated, remove and thoroughly wash affected area(s). Launder contaminated clothing before reuse. Do not smoke, eat or drink in general vicinity of product.

If significant mists, vapors, or aerosols are generated, or where concentrations exceed the limits given in this section, a NIOSH/MSHA approved respirator is recommended. An organic vapor cartridge with dust/mist pre-filter or supplied air may be used. In the event of emergency or planned entry into unknown concentrations, a positive pressure, full face, self-contained breathing apparatus should be used. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance, and inspection.

Section 9 – Physical and Chemical Properties

9.1 Information on the basic physical and chemical properties:
Appearance: Clear, water white to pale yellow mobile liquid
Odor: Mild characteristic odor
Odor Threshold: Not available
pH: 5/6 (25%)
Melting/Freezing Point: <-120°C (OECD 102)
Boiling point: 177.7°C (OECD 103)
Evaporation Rate: 0.04 (butyl acetate = 1)
Flashpoint: 73°C (ISO 3679)
Upper / Lower flammability or explosive limits: Lower: 1.5% / Upper: 9.7%
Vapor Pressure: 186 Pa at 25°C (OECD 104)
Vapor Density at 1 atm: (Air =1): 3.5
Relative Density: 1.05 (Handbook)
Solubility in Water: >250 g/l at 20°C and pH 4.6 - 4.7 (OECD 105)
Partition coefficient -0.14 at 24.7°C and pH 6.7 - 6.8 (OECD 107)
Autoignition Temperature: 282±5°C (EU Method A .15)

Viscocity: 6.24 mPa.s (Handbook)
Flammability: Non flammable

Explosive Properties: Not explosive
Oxidising Properties: Not oxidising

9.2 Other Information:
None

Section 10 – Stability and Reactivity

10.1 Reactivity
No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical Stability
Stable.
10.3 Possibility of hazardous reactions
Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid
Heat, sparks, flame or other sources of ignition.
10.5 Incompatible materials:
Oxidizers, strong acids.
10.6 Hazardous decomposition products:
Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11 – Toxicological Information

11.1 Information on toxicological effects:

Relevant hazard classes

Acute Toxicity: Oral LD50: >2000 mg/Kg (female Rat, OECD 423)
Inhalation LC50: >3.1 mg/L (male/female rat, OECD 403)

Skin corrosion / irritation: Not irritating (rabbit, EPA OPP 81-5)

Serious eye damage / irritation: Irritating (rabbit, EPA OPP 81-4)

Respiratory or skin sensitisation: Not sensitising (LLNA, OECD 429)

Repeated dose toxicity: Oral NOAEL: 35 mg/kg bw/day (subchronic 90-day male/female rat, OECD 408)
Inhalation LOAEC: 209 mg/m^3, 50 ppm (subchronic 90-day male/female rat, OECD 413)
Dermal NOAEL: 100 mg/kg bw/day (subchronic 90-day male/female rat, OECD 411)

Mutagenicity (*in vitro)*: Ames test: negative (OECD 471)
Chromosome aberration: negative (OECD 473)
Mouse Lymphoma: negative (OECD 476)

Germ cell mutagenicity: Not classified as a mutagen (EC, MAK)

Carcinogenicity: Not listed as a carcinogen (IARC, EC, TLV, MAK)

Reproductive toxicity: Fertility, oral NOAEL: 50 mg/kg bw/day (male/female rat, OECD 422)
Fertility, inhalation NOAEC: 200 mg/m^3 (male/female rat, OECD 413)
Developmental, oral NOAEL: 50 mg/kg bw/day (male/female rat, OECD 414)

Specific target organ toxicity (STOT) – single exposure: Not classified

Specific target organ toxicity – repeated exposure: Not classified

Aspiration hazard: Not available

Information on likely routes of exposure:
Routes of entry anticipated: Oral, Dermal, Inhalation.

Symptoms related to the physical, chemical and toxicological characteristics
Potential acute health effects
Inhalation : No known significant effects or critical hazards.
Ingestion : No known significant effects or critical hazards.
Skin contact : No known significant effects or critical hazards.
Eye contact : Causes serious eye irritation.

Skin contact: No specific data
Ingestion: No specific data
Inhalation: No specific data
Eye contact: Adverse symptoms may include the following: pain or irritation, watering, redness, Irritation / Corrosion

Delayed and immediate effects and also chronic effects from short and long term exposure
Data not available

Interactive effects:
Data not available

ACUTE EFFECTS: May cause irritation of eye tissue on eye contact.

CHRONIC EFFECTS: Not listed as a carcinogen (IARC, EC, TLV, MAK), mutagen (EC, MAK), Classified as toxic to reproduction.

Section 12 – Ecological Information

12.1 Toxicity:
Ecotoxicity: Fish: LC50 (96 h): >101 mg/L (OECD 203)
Daphnia, acute: EC50 (48 h): >91.7 mg/L (OECD 202
Daphnia, long-term: NOEC (21 d): >= 95.1 mg/L (OECD 211)
Algae: EC50 (72 h): >98.9 mg/L; NOEC (72 h): >=98.9 mg/L (OECD 201)

12.2 Persistence and Degradability

Biodegradation: readily biodegradable (OECD 301C)
Hydrolysis: >1 year at pH 4, 7 and 9 and 50°C (OECD 111)

12.3 Bioaccumulative Potential
Partition coefficient / n-Octanol water: -0.14 at 24.7°C and pH 6.7 - 6.8 (OECD 107)

Bioconcentration factor (BCF): not needed as the log Kow is <3 and thus has low potential for bioaccumulation.

12.4 Mobility in Soil
Adsorption coefficient: not needed as the log Kow is <3**12.5 Results of PBT and vPvB Assessment:**
The substance does not meet the criteria for PBT/vPvB according to Regulation (EC) No.1907/2006, Annex XIII.

12.6 Other adverse effects:
No known significant effects or critical hazards.

Section 13 – Disposal Considerations

13.1 Waste treatment methods:

Disposal methods: Recycle by distillation, remove to authorized incinerator equipment with an afterburner and flue gas scrubber, do not discharge into surface water.

This product is a hazardous waste

The generation of waste should be avoided or minimized wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

European waste catalogue (EWC)
Waste material code: 07 01 04
Waste designation: other organic solvents, washing liquids and mother liquors.

Waste material code (Flanders): 015, 034
KCA (The Netherlands): Category 03
Hazardous waste (91/689/EEC)

Special precautions:
This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

Section 14 – Transport Information

14.1 UN Number: *Identification No. 9003 (*ADN/ADNR) Not regulated for (ADR/RID IMDG IATA)

14.2 UN Proper shipping name (ADN/ADNR): Substances with a flash-point above 60°C and not more than 100°C. Not regulated for (ADR/RID IMDG IATA)

14.3 Transport hazard class(es)
Not classified

14.4 Packing group:
--

14.5 Environmental hazards:
Marine pollutant: No

14.6 Special precautions for user:
Not available

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code:
Not applicable

Section 15 – Regulatory Information

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

EU Regulation (EC) No. 1907/2006 (REACH) Annex XIV - List of substances subject to authorization:
Substances of very high concern: None of the components of this product are listed

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles:
Not applicable.

Europe Inventory : This material is listed or exempted.

Black List Chemicals : Not listed

Priority List Chemicals : Not listed
Integrated pollution prevention and control list (IPPC) - Air: Not listed

Integrated pollution prevention and control list (IPPC) – Water: Not listed

Chemical Weapons Convention List Schedule I Chemicals: Not listed

Chemical Weapons Convention List Schedule II Chemicals: Not listed

Chemical Weapons Convention List Schedule III Chemicals: Not listed

15.2 Chemical Safety Assessment
A chemical safety assessment (CSA) has been carried out.

Section 16 – Other Information

Original Creation Date: December 20, 2006
Current Revision Number: 006 Effective Date: February, 2014
Past Updates:
Revision 001: Updated per Regulation (EC) No 1272/2008 Annex VI / Regulation (EC) No 1272/2008
Revision 002: Revised O/R from Notox to WIL Research Europe
Revision 003: 2.1.1 Classification in accordance with Regulation (EC) No 1272/2008 Annex VI Table 3.1
Revision 004: Updated self-classification to add in H361: Suspected of damaging fertility or the unborn child H302: Repr. 2
Revision 005: Added Reach Registration number
Revision 006: Updated with information provided in the Chemical Safety Report

For additional product information, contact customer service at 800-445-6682 or 608-754-6682.

Nova Molecular Technologies requires that all users of Tetrahydrofurfuryl Alcohol inform their employees of the information on this Material Safety Data Sheet. Employees must be notified of the potential health risks. Additionally, copies of this information should be readily available to employees, the local emergency officials, and fire departments. In most states, these procedures are required.

ES FOR COMMUNICATION

Substance Name: Tetrahydrofurfuryl alcohol

EC Number: 202-625-6

CAS Number: 97-99-4

Registration Number: 01-2119968921-26-0002

Date of Generation/Revision:

Table of Contents

1.0. Introduction **13**
1.1. Overview of exposure scenarios 13

2.0. Exposure scenario: PPP GES 1: Use as a co-formulant in plant protection products, spray applications by professionals **15**
2.1. Title section 15
2.2. Conditions of use affecting exposure 15
2.2.1. Control of environmental exposure: Spray application of plant protection products containing co-formulants, indoor or outdoor 15
2.2.2. Control of worker exposure: Mixing and loading of plant protection products into delivery equipment (PROC 8a) 16
2.2.3. Control of worker exposure: Delivery and dispersion of plant protection products (PROC 11) 17
2.3. Exposure estimation 18
2.3.1. Environmental release and exposure: Spray application of plant protection products containing co-formulants, indoor or outdoor 18
2.3.2. Worker exposure: Mixing and loading of plant protection products into delivery equipment (PROC 8a) 19
2.3.3. Worker exposure: Delivery and dispersion of plant protection products (PROC 11) 20
2.3.4. Worker exposure: Combined tasks (PROC 8a + PROC 11) 20
2.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES 21
2.4.1. Environment 21
2.4.2. Human health 21

3.0. Exposure scenario: PPP GES 2: Use as a co-formulant in plant protection products, seed and granular applications by professionals **22**
3.1. Title section 22
3.2. Conditions of use affecting exposure 22
3.2.1. Control of environmental exposure: Direct application of plant protection products (granules or treated seeds) containing co-formulants to soil (indoor or outdoor) 22
3.2.2. Control of worker exposure: Mixing and loading of plant protection products into seed treatment or delivery equipment (PROC 8a) 23
3.2.3. Control of worker exposure: Transfer of treated seeds from batch treater into bags (PROC 8b) 24
3.2.4. Control of worker exposure: Delivery and dispersion of agrochemical plant protection products or treated seeds (PROC 8a) 24
3.3. Exposure estimation 25
3.3.1. Environmental release and exposure: Direct application of plant protection products (granules or treated seeds) containing co-formulants to soil (indoor or outdoor) 25
3.3.2. Worker exposure: Mixing and loading of plant protection products into seed treatment or delivery equipment 27
3.3.3. Worker exposure: Transfer of treated seeds from batch treater into bags 28
3.3.4. Worker exposure: Delivery and dispersion of agrochemical plant protection products or treated seeds 28
3.3.5. Worker exposure: Combined tasks 28
3.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES 29
3.4.1. Environment 29
3.4.2. Human health 29

4.0. Exposure scenario: PPP GES 3: Use as a co-formulant in plant protection products, spray applications by consumers **30**
4.1. Title section 30
4.2. Conditions of use affecting exposure 30
4.2.1. Control of environmental exposure: Spray application of plant protection products containing co-formulants (indoor or outdoor) 30
4.2.2. Control of consumer exposure: Mixing and loading of plant protection products into delivery equipment and spray application 31

4.3. Exposure estimation 31
4.3.1. Environmental release and exposure: Spray application of plant protection products containing co-formulants (indoor or outdoor) 31
4.3.2. Consumer exposure: Mixing and loading of plant protection products into delivery equipment and spray application 33
4.3.3. Consumer exposure: Combined tasks 34
4.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES 34
4.4.1. Environment 34
4.4.2. Human health 34

5.0. Exposure scenario: PPP GES 4 - Use as a co-formulant in plant protection products, seed and granular applications by consumers 35
5.1. Title section 35
5.2. Conditions of use affecting exposure 35
5.2.1. Control of environmental exposure: Direct application of plant protection products (granules or treated seeds) containing co-formulants to soil (indoor or outdoor) 35
5.2.2. Control of consumer exposure: Manual spreading of granular plant protection products or treated seeds 36
5.3. Exposure estimation 36
5.3.1. Environmental release and exposure: Direct application of plant protection products (granules or treated seeds) containing co-formulants to soil (indoor or outdoor) 36
5.3.2. Consumer exposure: Manual spreading of granular plant protection products or treated seeds 38
5.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES 39
5.4.1. Environment 39
5.4.2. Human health 39

1.0. Introduction

The substance is used as a co-formulant in plant protection products. The European Crop Protection Association (ECPA) has developed an approach for applying REACH requirements to co-formulants used in Plant Protection Products, with tools specifically designed to estimate exposure of workers, consumers and the environment resulting from crop protection uses. On the website http://www.ecpa.eu/information-page/regulatory-affairs/reach this approach is explained in detail. The tools were designed in a way to generate the CSA for any co-formulant, in a standardized way.

For the CSA of this substance it was decided to perform all parts of the approach, in the provided standardized way, although some parts may not be applicable for the substance or could be performed in a more suitable, substance specific, manner. As a result, the worst-case exposure is carried forward for risk characterisation; for instance, the substance is a liquid while the provided approach does not differentiate between co-formulants in the solid and liquid state, which may therefore result in calculating risk characterization ratios using dust exposure estimates for this liquid substance (as the tool selects worst-case exposures for risk characterisation).

In accordance with the by ECPA recommended approach, the Local Environmental Tool (ECPA LET) has been used for the local environmental assessment. For this assessment, the regional concentrations have been set to 0, although ECPA recommends to generate regional PECs in another tool, like EUSES or ECETOC TRA. The background environmental concentrations resulting from localized application are considered to be negligible, when compared to the local concentrations. Moreover, as the substance has a low log Kow value, a low log Koc value and is readily biodegradable in water (see Chapter 4 for details), it is not considered justified to increase the PECs determined by the tool (suggesting more reliable estimates).

1.1. Overview of exposure scenarios

The European Crop Protection Association (ECPA) has developed four plant protection product Generic Exposure Scenarios (PPP GES) for assessing human and environmental exposure to non-active substances (co-formulants) resulting from their use in plant protection products (PPP). The GESs have been built using exposure models that are established in the EU and US for assessing human and environmental exposure to PPP. The models have been adapted to suit the requirements of REACh, e.g. the need for a route-specific external exposure rather than a systemic exposure assessment, and the application of the REACh use descriptor system.

The PPP GESs cover the following application types of PPPs.

- PPP GES 1: Use as a co-formulant in plant protection products, spray applications by professionals
- PPP GES 2: Use as a co-formulant in plant protection products, seed and granular applications by professionals
- PPP GES 3: Use as a co-formulant in plant protection products, spray applications by consumers
- PPP GES 4: Use as a co-formulant in plant protection products, seed and granular applications by consumers

The non-dietary human exposure scenarios associated with each GES have been generated by an Excel-based software tool called ‘ECPA OWB’. ‘OWB’ stands for “operator, worker, bystander”. ECPA OWB incorporates exposure models which are well-established for the safety

assessment of PPPs in the EU. The individual models implemented in ECPA OWB are explained under the subheading of each ES in the following sections.

Within a given contributing scenario (e.g. PROC) described by a GES, there may be several sub-activities described by the standard PPP models (e.g. loading liquid, or powder, or granules into tractor mounted or hand-held equipment). The largest value of one of these sub-activities is taken as a representative ("sentinel") value for the overall contributing scenario. To maintain transparency a summary of all the considered sub-activities and their resulting human exposures is presented as a table within the contributing scenario. However, only the worst-case exposure is selected and carried forward for risk characterisation.

The most significant exposure determinant in standard PPP exposure models is the use rate, which can be directly related to the potential exposure. To minimise "artificial" restrictions on co-formulant uses, the standard PPP exposure models were adapted for use under REACH to output the maximum use rate for a desired target RCR. For example, if a target RCR of 0.90 was specified, the maximum use rate which delivers this RCR is calculated iteratively.

2.0. Exposure scenario: PPP GES 1: Use as a co-formulant in plant protection products, spray applications by professionals

2.1. Title section

Sector of use:	
Professional uses	SU 22
Agriculture, forestry and fishing	SU 1
Product category:	
Plant protection product	PC 27
Environment:	
Spray application of plant protection products containing co-formulants, indoor or outdoor	ECPA SPERC 8d.2.v1
Worker	
Mixing and loading of plant protection products into delivery equipment	PROC 8a
Delivery and dispersion of plant protection products	PROC 11

2.2. Conditions of use affecting exposure

2.2.1. Control of environmental exposure: Spray application of plant protection products containing co-formulants, indoor or outdoor

Further specification: Spray application of a substance used as a co-formulant in a plant protection product, in fields, orchards or greenhouses.

Amount used, frequency and duration of use (or from service life)
Maximum soil application rate: 2,40E-01 kg/ha *This maximum soil application rate is set based on the results of the risk assessment for human health. With this application rate, a combined RCR of 0.90 is obtained (see Chapter 2.4 for further guidance).*
Maximum number of applications: 1
Application interval (days): 1
Technical and organisational conditions and measures
Labelling required as part of plant protection product approval process under Directive 91/414/EEC (now Regulation (EC) 1107/2009) lays out specific RMMs which must be followed in order to ensure environmental safety.
Conditions and measures related to municipal sewage treatment plant
Municipal STP: No
Conditions and measures related to treatment of waste (including article waste)

Specific conditions of waste treatment: Labelling required as part of plant protection product approval process under Directive 91/414/EEC (now Regulation (EC) 1107/2009) provides guidance regarding appropriate disposal.
Other conditions affecting environmental exposure
Application type: Spray treatment
Crop: No specific restrictions
Soil incorporation: No
Interception type: No interception
Region and timing of application: No specific restrictions

2.2.2. Control of worker exposure: Mixing and loading of plant protection products into delivery equipment (PROC 8a)

Further specification: The transfer (and inherent diluting and mixing) of solid and liquid PPPs which occurs during loading of tractor mounted/trailed boom sprayers, loading of tractor mounted/trailed broadcast air-assisted sprayers, and loading of hand-held spray equipment.

PROC 8a: mixing and loading of plant protection products into delivery equipment	
Product characteristic	
Substance in preparation: yes, up to 100%	
Liquid, granule or powder	
Amounts used	
Tractor mounted spraying:	4,71 kg/day
Hand-held spraying:	0,21 kg/day
Frequency and duration of use/exposure	
Full shift (8 h/day)	
Human factors not influenced by risk management	
Surface of skin exposed: both hands	
Other given operational conditions affecting workers exposure	
Ventilation conditions at workplace: Good natural ventilation Place of use: Outdoors and indoors	
Technical conditions and measures at process level (source) to prevent release	
Level of containment: open process	
Technical conditions and measures to control dispersion from source towards the worker	
None specified	
Organisational measures to prevent / limit releases, dispersion and exposure	
All label instructions on the plant protection product must be followed. Preparation of the spray mixture should only be carried out by trained personnel.	
Conditions and measures related to personal protection, hygiene and health evaluation	
Personal protective equipment (PPE):	

Tractor mounted spraying:	Gloves (PF100)
Hand-held spraying:	Gloves (PF100); Eye protection
Respiratory protective equipment (RPE):	
Tractor mounted spraying:	no RPE
Hand-held spraying:	no RPE

2.2.3. Control of worker exposure: Delivery and dispersion of plant protection products (PROC 11)

Further specification: The spray application of PPPs using tractor mounted/trailed boom sprayers, tractor mounted/trailed broadcast air-assisted sprayers, and hand-held spray equipment (knapsack sprayers and mist blowers) for high-level targets, indoor greenhouse spraying, as well as the indirect exposure of workers on field re-entry and bystanders.

PROC 11: delivery and dispersion of plant protection products	
Product characteristic	
Substance in preparation: yes, up to 100%	
Liquid	
Amounts used	
Tractor mounted spraying:	0,24 kg/ha = 4,71 kg/day
Hand-held spraying:	0,21 kg/ha = 0,21 kg/day
Frequency and duration of use/exposure	
20 ha/day for boom sprayers, 8 ha/day for orchard sprayers, 1 ha/day or 6 h/day for hand-held sprayers	
Human factors not influenced by risk management	
Surface of skin exposed: both hands, body (half of upper arms, forearms, thighs, lower legs), head	
Other given operational conditions affecting workers exposure	
Ventilation conditions at workplace: Good natural ventilation; 1 air change per hour for greenhouses.	
Place of use: Outdoors and indoors	
Technical conditions and measures at process level (source) to prevent release	
Level of containment: open process	
Technical conditions and measures to control dispersion from source towards the worker	
Local Exhaust Ventilation: No	
Organisational measures to prevent / limit releases, dispersion and exposure	
All label instructions on the plant protection product must be followed.	
Conditions and measures related to personal protection, hygiene and health evaluation (for workers)	
Personal protective equipment (PPE):	

Tractor mounted spraying:	no PPE
Hand-held spraying:	Eye protection
Respiratory protective equipment (RPE):	
Tractor mounted spraying:	no RPE
Hand-held spraying:	no RPE

2.3. Exposure estimation

2.3.1. Environmental release and exposure: Spray application of plant protection products containing co-formulants, indoor or outdoor

Compartment	Release factor estimation method	Explanation / Justification
Water	**Regional Assessment:**	Regional release factor (%): 0
	ECPA SPERC 8d.2.v1	
	Local Assessment:	Local spray drift (%): 15,7
	ECPA Local Environment Tool v2.0	Fraction available for local drainage/runoff (%): 5
		Explanation / Justification:
		Direct release to surface water not considered in the ECPA SPERCs, since this triggers a local-scale assessment at STP-catchment scale based on tonnage. In reality, potential emission will be to edge-of-field waterbodies and will depend on co-formulant application rate. Therefore a specific assessment of spray drift and drainage/runoff was performed using the ECPA Local Environment Tool. This utilises the FOCUS Step 2 approach for assessment of surface water exposure which is part of a standardised methodology routinely applied for assessment of plant protection products. For a Default assessment, the ECPA Local Environment Tool suggests figures of 15.7% and 5% for spray drift and the fraction available for runoff/drainage, respectively. However, these figures can be refined by taking account of more specific information regarding the target crop and region/season of application. In the case of co-formulants included in solid formulations (granules or treated seeds) the fraction emitted via spray drift is always 0.
Air	**Regional Assessment:**	Regional release factor (%): 100
	ECPA SPERC 8d.2.v1	
		Explanation / Justification:
		For co-formulants included in spray formulations the fraction emitted to air during spraying is estimated on the basis of vapour pressure of the co-formulant. The emission fractions to air are taken from the pesticides field application module in USES 4.0. PEC in air not reported in ECPA Local Environment Tool. However, bystander exposure via air is considered in the ECPA OWB tool
Soil	**Regional Assessment:**	Regional release factor (%): 0
	ECPA SPERC 8d.2.v1	
	Local Assessment:	Local release factor (%): 0
	ECPA Local Environment Tool v2.0	Explanation / Justification:
		For co-formulants included in spray formulations the dose which reaches the soil can be significantly reduced due to drift or volatilization of spray droplets. The emission fractions to air are taken from the pesticides field application module in USES 4.0 (RIVM, 2002) and the remaining fraction estimates emissions to soil. It is assumed that these emission fractions apply for both indoor and outdoor use.

Protection target	Exposure concentration
Water: Fresh Water	**Local PEC:** 1,26E-02 mg/L
(Pelagic)	**Regional concentration:** 0,00E+00 mg/L
	Local concentration: 1,26E-02 mg/L
Water: Fresh Water	**Local PEC:** 8,72E-04 mg/kg dwt
(Sediment)	**Regional concentration:** 0,00E+00 mg/kg dwt
	Local concentration: 8,72E-04 mg/kg dwt
Water: Marine Water	**Local PEC:** 1,26E-03 mg/L
(Pelagic)	**Regional concentration:** 0,00E+00 mg/L
	Local concentration: 1,26E-03 mg/L
Water: Marine Water	**Local PEC:** 8,72E-05 mg/kg dwt
(Sediment)	**Regional concentration:** 0,00E+00 mg/kg dwt
	Local concentration: 8,72E-05 mg/kg dwt
Water: Sewage	
Treatment Plant	
(Effluent)	
Air	
Soil: Agricultural Soil	**Local PEC:** 0,00E+00 mg/kg dwt
	Regional concentration: 0,00E+00 mg/kg dwt
	Local concentration: 0,00E+00 mg/kg dwt
Food chain: Aquatic Food	**Local PEC:** 1,91E-03 mg/kg wet fish
Chain	**Regional concentration:** 0,00E+00 mg/kg wet fish
	Local concentration: 1,91E-03 mg/kg wet fish
Food chain: Terrestrial Food	**Local PEC:** 0,00E+00 mg/kg wet earthworm
Chain	**Regional concentration:** 0,00E+00 mg/kg wet earthworm
	Local concentration: 0,00E+00 mg/kg wet earthworm

Protection target	Risk characterisation ratio
Fresh Water (Pelagic)	**6,61E-03**
Fresh Water (Sediment)	**1,01E-04**
Marine Water (Pelagic)	**6,61E-03**
Marine Water (Sediment)	**1,01E-04**
Agricultural soil	**0,00E+00**
Aquatic food chain	**N/A**
Terrestrial food chain	**N/A**

2.3.2. Worker exposure: Mixing and loading of plant protection products into delivery equipment (PROC 8a)

Exposure estimates for typical tasks covered by PROC 8a: Loading of plant protection products into delivery equipment.

Type of equipment and conditions	Model	Formulation type	PPE	RPE	Dermal exposure [mg/kg bw/day]	Inhalation Exposure [mg/m³]	Total external exposure [mg/kg	Total RCR
Mixing and loading tractor mounted/trailed boom sprayer	BBA	Liquid	gloves	no RPE	0,002	0,0003	0,002	0,005
	BBA	Powder (WP)	gloves	no RPE	0,004	0,0329	**0,009**	0,035
	BBA	Granule (WG)	gloves	no RPE	0,001	0,0038	0,002	0,007
Mixing and loading tractor mounted/trailed broadcast air-assisted sprayer	BBA	Liquid	gloves	no RPE	0,001	0,0001	0,001	0,002
	BBA	Powder (WP)	gloves	no RPE	0,002	0,0132	0,003	0,014
	BBA	Granule (WG)	gloves	no RPE	0,001	0,0015	0,001	0,003
Mixing and loading hand-held sprayer, outdoors or indoors	BBA	Liquid	gloves	no RPE	0,006	0,0011	0,006	0,019
	BBA	Powder (WP)	gloves	no RPE	0,002	0,0170	0,004	0,016
	BBA	Granule (WG)	gloves	no RPE	0,001	0,0004	0,001	0,002

2.3.3. Worker exposure: Delivery and dispersion of plant protection products (PROC 11)

Exposure estimates for typical tasks covered by PROC 11: Delivery and dispersion of plant protection products. While not explicitly considered in exposure assessments, worker re-entry and indirect exposure of bystanders are included as they form part of the typical risk assessment paradigm used in agrochemical exposure assessments.

Type of equipment and conditions	Model	Formulation type	PPE	RPE	Dermal exposure [mg/kg bw/day]	Inhalation Exposure [mg/m³]	Total external exposure [mg/kg bw/day]	Total RCR
Tractor mounted/trailed boom spraying	BBA*	Liquid	no PPE	no RPE	0,137	0,0005	0,1372	0,392
Tractor mounted/trailed broadcast air-assisted spraying	BBA	Liquid	no PPE	no RPE	0,309	0,0034	**0,3097**	0,886
Hand-held spraying, high-level target, outdoors	BBA	Liquid	no PPE	no RPE	0,123	0,0064	0,1235	0,355
Hand-held spraying, high-level target, indoors (greenhouses)	CRRM*	Liquid	no PPE	no RPE	0,123	0,7438	0,2288	0,881
Worker re-entry (indirect exposure)	BBA	Liquid			0,0000		0,000	0,000
Indirect exposure of bystanders	Martin *et al.* 2008	Liquid			0,0418	0,0150	0,0439	0,299

*BBA: German operator exposure model, CRRM: constant rate release model

2.3.4. Worker exposure: Combined tasks (PROC 8a + PROC 11)

The mixing and loading, as well as spray application of PPP, are correlated tasks as they are usually carried out in conjunction by the same workers. The table below reports the relevant combined worst-case exposures from PROCs 8a and 11.

Contributing Scenarios	Use rate [kg/d]	Dermal exposure [mg/kg bw/day]	Inhalation Exposure [mg/m³]	PPE	RPE	Dermal RCR	Inhalation RCR	Total RCR
Tractor-mounted spraying								
PROC 8a: Mixing & loading WP formulation into tractor-mounted airblast sprayer	**4,71**	0,002	0,0132	gloves	no RPE	0,005	0,009	0,014
PROC 11: Tractor-mounted airblast spraying		0,309	0,0034	no PPE	no RPE	0,884	0,002	0,886
PROC 8a+11		**0,311**	**0,017**			**0,888**	**0,012**	**0,900**
Hand-held spraying								
PROC 8a: Mixing & loading liquid formulation into knapsack sprayer	**0,21**	0,006	0,001	gloves	no RPE	0,018	0,001	0,019
PROC 11: Hand-held spraying, indoors (greenhouse)		0,123	0,744	no PPE	no RPE	0,350	0,531	0,881
PROC 8a+11		**0,129**	**0,745**			**0,368**	**0,532**	**0,900**

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

2.4.1. Environment

The above exposure scenario may be scaled using the ECPA Local Environmental Tool and using the parameters: co-formulant application rate, number of applications, application interval, crop (drift rate), location and period of application.

2.4.2. Human health

The above exposure scenario may be scaled using the ECPA OWB tool and using the parameters: application rate, personal protection (PPE), respiratory protection (RPE) and local exhaust ventilation (LEV).

3.0. Exposure scenario: PPP GES 2: Use as a co-formulant in plant protection products, seed and granular applications by professionals

3.1. Title section

Sector of use:	
Professional uses	SU 22
Agriculture, forestry and fishing	SU 1
Product category:	
Plant protection product	PC27
Environment:	
Direct application of plant protection products (granules or treated seeds) containing co-formulants to soil (indoor or outdoor)	ECPA SPERC 8d.2.v1
Worker	
Mixing and loading of plant protection products into seed treatment or delivery equipment	PROC 8a
Transfer of treated seeds from batch treater into bags	PROC 8b
Delivery and dispersion of agrochemical plant protection products or treated seeds	PROC 8a

3.2. Conditions of use affecting exposure

3.2.1. Control of environmental exposure: Direct application of plant protection products (granules or treated seeds) containing co-formulants to soil (indoor or outdoor)

Amount used, frequency and duration of use (or from service life)
Maximum soil application rate: 5,62E-01 kg/ha *This maximum soil application rate is set based on the results of the risk assessment for environment. With this application rate, a RCR (soil) of 0.90 is obtained (see Chapter 3.4 for further guidance).*
Maximum number of applications: 1
Application interval (days): 1
Technical and organisational conditions and measures
Labelling required as part of plant protection product approval process under Directive 91/414/EEC (now Regulation (EC) 1107/2009) lays out specific RMMs which must be followed in order to ensure environmental safety.
Conditions and measures related to municipal sewage treatment plant
Municipal STP: No
Conditions and measures related to treatment of waste (including article waste)

Specific conditions of waste treatment: Labelling required as part of plant protection product approval process under Directive 91/414/EEC (now Regulation (EC) 1107/2009) provides guidance regarding appropriate disposal.
Other conditions affecting environmental exposure
Application type: Granule application / Seed treatment
Crop: No specific restrictions
Soil incorporation: No
Interception type: No interception
Region and timing of application: No specific restrictions

3.2.2. Control of worker exposure: Mixing and loading of plant protection products into seed treatment or delivery equipment (PROC 8a)

Further specification: The transfer of treated seed and granular PPPs which occurs during loading of tractor mounted broadcast spreaders, and the loading of mechanical equipment with solid and liquid PPPs for the treatment of seeds.

PROC 8a: mixing and loading of plant protection products into seed treatment or delivery equipment	
Product characteristic	
Substance in preparation: yes,	up to 100%
Powder, granules or liquid	
Amounts used	
Seed treatment:	10 kg/day
Granular applications:	0,562 kg/day
Frequency and duration of use/exposure	
Full shift (8 h/day)	
Human factors not influenced by risk management	
Surface of skin exposed: 960 cm² (two hands)	
Other given operational conditions affecting workers exposure	
Ventilation conditions at workplace: Natural ventilation	
Place of use: Outdoors and indoors	
Technical conditions and measures at process level (source) to prevent release	
Level of containment: open process	
Technical conditions and measures to control dispersion from source towards the worker	
Local Exhaust Ventilation: No	
Organisational measures to prevent / limit releases, dispersion and exposure	
All instructions on the plant protection product label must be followed	
Conditions and measures related to personal protection, hygiene and health evaluation	
Personal protective equipment (PPE):	
Seed treatment:	Gloves; eye protection

Granular applications:	Gloves; eye protection
Respiratory protective equipment (RPE):	
Seed treatment:	no RPE
Granular applications:	no RPE
Work clothing (long-sleeve shirt, long pants, shoes plus socks).	

3.2.3. Control of worker exposure: Transfer of treated seeds from batch treater into bags (PROC 8b)

Further specification: Transfer of treated seeds from batch treater into bags.

PROC 8b: Transfer of treated seeds from batch treater into bags	
Product characteristic	
Substance content in seed dust:	50%
Substance form: dusty	
Amounts used	
10 kg/day	
Frequency and duration of use/exposure	
Full shift (8 h/day)	
Human factors not influenced by risk management	
Surface of skin exposed: two hands, one side (480 cm^2)	
Other given operational conditions affecting workers exposure	
Ventilation conditions at workplace: natural ventilation	
Place of use: Indoors or outdoors	
Technical conditions and measures at process level (source) to prevent release	
Level of containment: semi-enclosed	
Technical conditions and measures to control dispersion from source towards the worker	
Local Exhaust Ventilation:	yes, 95% efficiency
Organisational measures to prevent /limit releases, dispersion and exposure	
All instructions on the plant protection product label must be followed	
Conditions and measures related to personal protection, hygiene and health evaluation	
Personal protective equipment (PPE):	
Gloves (PF100); Eye protection	
Respiratory protective equipment (RPE):	
no RPE	

3.2.4. Control of worker exposure: Delivery and dispersion of agrochemical plant protection products or treated seeds (PROC 8a)

Further specification: Delivery and dispersion of agrochemical plant protection products or treated seeds by open-cab solid broadcast spreaders, push type rotary spreaders, belly grinders, or by hand.

PROC 8a: Delivery and dispersion of agrochemical plant protection products or treated seeds
Product characteristic
Substance in preparation: yes, up to 100%
Amounts used
0.562 kg/ha = 0.562 kg/day
Frequency and duration of use/exposure
Full shift (8 h/day)
Human factors not influenced by risk management
Surface of skin exposed: 960 cm^2 (two hands)
Other given operational conditions affecting workers exposure
Ventilation conditions at workplace: Good natural ventilation
Place of use: Indoors or outdoors
Technical conditions and measures at process level (source) to prevent release
Level of containment: open process
Technical conditions and measures to control dispersion from source towards the worker
Local Exhaust Ventilation: No
Organisational measures to prevent / limit releases, dispersion and exposure
Conditions and measures related to personal protection, hygiene and health evaluation
Personal protective equipment (PPE): Gloves (PF100); Eye protection Respiratory protective equipment (RPE): no RPE Work clothing (long-sleeve shirt, long pants, shoes plus socks).

3.3. Exposure estimation

3.3.1. Environmental release and exposure: Direct application of plant protection products (granules or treated seeds) containing co-formulants to soil (indoor or outdoor)

Compartment	Release factor estimation method	Explanation / Justification
Water	**Regional Assessment:**	Regional release factor (%): 0
	ECPA SPERC 8d.1.v1	
	Local Assessment:	Local spray drift (%): 15,7
	ECPA Local Environment Tool v2.0	Fraction available for local drainage/runoff (%): 5
		Explanation / Justification:
		Direct release to surface water not considered in the ECPA SPERCs, since this triggers a local-scale assessment at STP-catchment scale based on tonnage. In reality, potential emission will be to edge-of-field waterbodies and will depend on co-formulant application rate. Therefore a specific assessment of spray drift and drainage/runoff was performed using the ECPA Local Environment Tool. This utilises the FOCUS Step 2 approach for assessment of surface water exposure which is part of a standardised methodology routinely applied for assessment of plant protection products. For a Default assessment, the ECPA Local Environment Tool suggests figures of 15.7% and 5% for spray drift and the fraction available for runoff/drainage, respectively. However, these figures can be refined by taking account of more specific information regarding the target crop and region/season of application. In the case of co-formulants included in solid formulations (granules or treated seeds) the fraction emitted via spray drift is always 0.
Air	**Regional Assessment:**	Regional release factor (%): 0
	ECPA SPERC 8d.1.v1	
		Explanation / Justification:
		For co-formulants included in solid formulations (granules or treated seeds) the emission fraction to air is 0.
Soil	**Regional Assessment:**	Regional release factor (%): 100
	ECPA SPERC 8d.1.v1	
	Local Assessment:	Local release factor (%): 100
	ECPA Local Environment Tool v2.0	Explanation / Justification:
		For co-formulants included in solid formulations (granules or treated seeds) it is assumed that the entire fraction goes to soil.

Protection target	Exposure concentration
Water: Fresh Water	**Local PEC:** 7,75E-02 mg/L
(Pelagic)	**Regional concentration:** 0,00E+00 mg/L
	Local concentration: 7,75E-02 mg/L
Water: Fresh Water	**Local PEC:** 7,75E-03 mg/kg dwt
(Sediment)	**Regional concentration:** 0,00E+00 mg/kg dwt
	Local concentration: 7,75E-03 mg/kg dwt
Water: Marine Water	**Local PEC:** 7,75E-03 mg/L
(Pelagic)	**Regional concentration:** 0,00E+00 mg/L
	Local concentration: 7,75E-03 mg/L
Water: Marine Water	**Local PEC:** 7,75E-04 mg/kg dwt
(Sediment)	**Regional concentration:** 0,00E+00 mg/kg dwt
	Local concentration: 7,75E-04 mg/kg dwt
Water: Sewage	
Treatment Plant	
(Effluent)	
Air	
Soil: Agricultural Soil	**Local PEC:** 5,40E-01 mg/kg dwt
	Regional concentration: 0,00E+00 mg/kg dwt
	Local concentration: 5,40E-01 mg/kg dwt
Food chain: Aquatic Food	**Local PEC:** 1,18E-02 mg/kg wet fish
Chain	**Regional concentration:** 0,00E+00 mg/kg wet fish
	Local concentration: 1,18E-02 mg/kg wet fish
Food chain: Terrestrial Food	**Local PEC:** 4,21E-01 mg/kg wet earthworm
Chain	**Regional concentration:** 0,00E+00 mg/kg wet earthworm
	Local concentration: 4,21E-01 mg/kg wet earthworm

Protection target	Risk characterisation ratio
Fresh Water (Pelagic)	**4,08E-02**
Fresh Water (Sediment)	**9,01E-04**
Marine Water (Pelagic)	**4,08E-02**
Marine Water (Sediment)	**9,01E-04**
Agricultural soil	**9,00E-01**
Aquatic food chain	**N/A**
Terrestrial food chain	**N/A**

3.3.2. Worker exposure: Mixing and loading of plant protection products into seed treatment or delivery equipment

Exposure estimates for typical tasks covered by PROC 8a: Mixing and loading of plant protection products into seed treatment or delivery equipment.

Type of equipment and conditions	Model	Formulation type	PPE	RPE	Dermal exposure [mg/kg bw/day]	Inhalation Exposure [mg/m³]	Total external exposure [mg/kg	Total RCR
Mixing and loading mechanical equipment for coating of seeds	BBA	Liquid	gloves	gloves	0,0034	0,0006	0,004	0,010
Mixing and loading mechanical equipment for coating of seeds	BBA	Solid (WP)	gloves	gloves	0,0086	0,0700	**0,019**	0,074
Mixing and loading granules/treated seeds	PHED	Solid (GR)	gloves	no RPE	0,0049	0,0084	0,006	0,020
Mixing and loading granules/seeds, Belly Grinder and "Push-type" Rotary Spreaders	PHED	Solid (GR)	gloves	no RPE	Loading exposure included in delivery and dispersion			

3.3.3. Worker exposure: Transfer of treated seeds from batch treater into bags

Exposure estimates for typical tasks covered by PROC 8b: Transfer of treated seeds from batch treater into bags.

Type of equipment and conditions	Model	Formulation type	PPE	RPE	LEV	Dermal exposure [mg/kg bw/day]	Inhalation Exposure [mg/m³]	Total external exposure [mg/kg	Total RCR
Bagging of treated seeds	ECETOC TRA	Solid	gloves	no RPE	90% efficiency	0,0069	1,250	0,1854	0,912

3.3.4. Worker exposure: Delivery and dispersion of agrochemical plant protection products or treated seeds

Exposure estimates for typical tasks covered by PROC 8a: Delivery and dispersion of agrochemical plant protection products or treated seeds.

Type of equipment and conditions	Model	Formulation type	PPE	RPE	Dermal exposure [mg/kg bw/day]	Inhalation Exposure [mg/m³]	Total external exposure [mg/kg	Total RCR
Applicator, Granules by Hand	PHED	Solid (GR)	gloves	no RPE	0,025	0,001	0,025	0,073
Loader / Applicator, "Push-type" Rotary Spreaders	PHED	Solid (GR)	gloves	no RPE	0,004	0,001	0,004	0,013
Loader / Applicator, Belly Grinder	PHED	Solid (GR)	gloves	no RPE	0,165	0,008	**0,166**	0,476
Applicator, Open Cab Solid Broadcast Spreader	PHED	Solid (GR)	gloves	no RPE	0,005	0,008	0,006	0,021

3.3.5. Worker exposure: Combined tasks

The mixing and loading as well as dispersion of PPP and treated seeds or bagging of treated seeds, are correlated tasks as they are usually carried out in conjunction by the same workers. The table below reports the relevant combined worst-case exposures from PROCs 8a and 8b.

Contributing Scenarios	Use rate [kg/d]	Dermal exposure [mg/kg bw/day]	Inhalation Exposure [mg/m³]	PPE	RPE	LEV	Dermal RCR	Inhalation RCR	Total RCR
Seed treatment									
PROC 8a: Mixing & loading solid formulation into batch treater	**10,00**	0,009	0,070	gloves	gloves		0,024	0,050	0,074
PROC 8b: Bagging of treated seeds		0,007	1,250	gloves	no RPE	90% efficiency	0,020	0,893	0,912
PROC 8a+8b		**0,015**	**1,320**				**0,044**	**0,943**	**0,987**
Dispersion of granules or treated seeds, tractor									
PROC 8a: Mixing and loading granules (including treated seeds)	**22,5**	0,005	0,008	gloves	no RPE		0,014	0,006	0,020
PROC 8a: Applicator, open cab solid broadcast spreader		0,005	0,008	gloves	no RPE		0,015	0,006	0,021
PROC 8a+8a		**0,010**	**0,017**				**0,029**	**0,012**	**0,041**
Dispersion of granules or treated seeds									
PROC 8a: Spreading of granules or treated seeds using belly grinder, including loading of equipment	**0,56**	**0,165**	**0,008**	gloves	no RPE		**0,471**	**0,005**	**0,476**

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

3.4.1. Environment

The above exposure scenario may be scaled using the ECPA Local Environmental Tool and using the parameters: co-formulant application rate, number of applications, application interval, crop (drift rate), location and period of application.

3.4.2. Human health

The above exposure scenario may be scaled using the ECPA OWB tool and using the parameters: application rate, personal protection (PPE), respiratory protection (RPE) and local exhaust ventilation (LEV).

4.0. Exposure scenario: PPP GES 3: Use as a co-formulant in plant protection products, spray applications by consumers

4.1. Title section

Market Sector:	
Plant protection product	PC27
Environment:	
Spray application of plant protection products containing co-formulants (indoor or outdoor)	ECPA SPERC 8d.2.v1
Consumer:	PC27
Mixing and loading of plant protection products into delivery equipment and spray application	

4.2. Conditions of use affecting exposure

4.2.1. Control of environmental exposure: Spray application of plant protection products containing co-formulants (indoor or outdoor)

Amount used, frequency and duration of use (or from service life)
Maximum soil application rate: 7,60E-01 kg/ha *This maximum soil application rate is set based on the results of the risk assessment for human health. With this application rate, a combined RCR of 0.90 is obtained (see Chapter 3.4 for further guidance).*
Maximum number of applications: 1
Application interval (days): 1
Technical and organisational conditions and measures
Labelling required as part of plant protection product approval process under Directive 91/414/EEC (now Regulation (EC) 1107/2009) lays out specific RMMs which must be followed in order to ensure environmental safety.
Conditions and measures related to municipal sewage treatment plant
Municipal STP: No
Conditions and measures related to treatment of waste (including article waste)
Specific conditions of waste treatment: Labelling required as part of plant protection product approval process under Directive 91/414/EEC (now Regulation (EC) 1107/2009) provides guidance regarding appropriate disposal.
Other conditions affecting environmental exposure
Application type: Spray treatment
Crop: No specific restrictions
Soil incorporation: No
Interception type: No interception
Region and timing of application: No specific restrictions

4.2.2. Control of consumer exposure: Mixing and loading of plant protection products into delivery equipment and spray application

Further specification: Mixing and loading of plant protection products into hand-held sprayers, and hand-held spraying of high- and low-level targets.

PC 27: Mixing and loading of plant protection products into delivery equipment and spray application
Product characteristic
Substance in preparation: yes, up to 100%
Liquid, granule, or powder
Amounts used
0,76 kg/ha = 15 g/day
Frequency and duration of use
Once per day, 200 m²
Human factors not influenced by risk management
Surface of skin exposed: both hands, body (half of upper arms, forearms, thighs, lower legs), head
Other given operational conditions affecting consumer exposure
Ventilation conditions: natural ventilation
Place of use: outdoors and indoors
Conditions and measures related to information and behavioural advice to consumers
All instructions on the plant protection product label must be followed.

4.3. Exposure estimation

4.3.1. Environmental release and exposure: Spray application of plant protection products containing co-formulants (indoor or outdoor)

Compartment	Release factor estimation method	Explanation / Justification
Water	**Regional Assessment:**	Regional release factor (%): 0
	ECPA SPERC 8d.2.v1	
	Local Assessment:	Local spray drift (%): 15,7
	ECPA Local Environment Tool v2.0	Fraction available for local drainage/runoff (%): 5
		Explanation / Justification:
		Direct release to surface water not considered in the ECPA SPERCs, since this triggers a local-scale assessment at STP-catchment scale based on tonnage. In reality, potential emission will be to edge-of-field waterbodies and will depend on co-formulant application rate. Therefore a specific assessment of spray drift and drainage/runoff was performed using the ECPA Local Environment Tool. This utilises the FOCUS Step 2 approach for assessment of surface water exposure which is part of a standardised methodology routinely applied for assessment of plant protection products. For a Default assessment, the ECPA Local Environment Tool suggests figures of 15.7% and 5% for spray drift and the fraction available for runoff/drainage, respectively. However, these figures can be refined by taking account of more specific information regarding the target crop and region/season of application. In the case of co-formulants included in solid formulations (granules or treated seeds) the fraction emitted via spray drift is always 0.
Air	**Regional Assessment:**	Regional release factor (%): 100
	ECPA SPERC 8d.2.v1	
		Explanation / Justification:
		For co-formulants included in spray formulations the fraction emitted to air during spraying is estimated on the basis of vapour pressure of the co-formulant. The emission fractions to air are taken from the pesticides field application module in USES 4.0. PEC in air not reported in ECPA Local Environment Tool. However, bystander exposure via air is considered in the ECPA OWB tool
Soil	**Regional Assessment:**	Regional release factor (%): 0
	ECPA SPERC 8d.2.v1	
	Local Assessment:	Local release factor (%): 0
	ECPA Local Environment Tool v2.0	Explanation / Justification:
		For co-formulants included in spray formulations the dose which reaches the soil can be significantly reduced due to drift or volatilization of spray droplets. The emission fractions to air are taken from the pesticides field application module in USES 4.0 (RIVM, 2002) and the remaining fraction estimates emissions to soil. It is assumed that these emission fractions apply for both indoor and outdoor use.

Protection target	Exposure concentration
Water: Fresh Water	**Local PEC:** 3,98E-02 mg/L
(Pelagic)	**Regional concentration:** 0,00E+00 mg/L
	Local concentration: 3,98E-02 mg/L
Water: Fresh Water	**Local PEC:** 2,76E-03 mg/kg dwt
(Sediment)	**Regional concentration:** 0,00E+00 mg/kg dwt
	Local concentration: 2,76E-03 mg/kg dwt
Water: Marine Water	**Local PEC:** 3,98E-03 mg/L
(Pelagic)	**Regional concentration:** 0,00E+00 mg/L
	Local concentration: 3,98E-03 mg/L
Water: Marine Water	**Local PEC:** 2,76E-04 mg/kg dwt
(Sediment)	**Regional concentration:** 0,00E+00 mg/kg dwt
	Local concentration: 2,76E-04 mg/kg dwt
Water: Sewage	
Treatment Plant	
(Effluent)	
Air	
Soil: Agricultural Soil	**Local PEC:** 0,00E+00 mg/kg dwt
	Regional concentration: 0,00E+00 mg/kg dwt
	Local concentration: 0,00E+00 mg/kg dwt
Food chain: Aquatic Food	**Local PEC:** 6,03E-03 mg/kg wet fish
Chain	**Regional concentration:** 0,00E+00 mg/kg wet fish
	Local concentration: 6,03E-03 mg/kg wet fish
Food chain: Terrestrial Food	**Local PEC:** 0,00E+00 mg/kg wet earthworm
Chain	**Regional concentration:** 0,00E+00 mg/kg wet earthworm
	Local concentration: 0,00E+00 mg/kg wet earthworm

Protection target	Risk characterisation ratio
Fresh Water (Pelagic)	**2,09E-02**
Fresh Water (Sediment)	**3,21E-04**
Marine Water (Pelagic)	**2,09E-02**
Marine Water (Sediment)	**3,21E-04**
Agricultural soil	**0,00E+00**
Aquatic food chain	**N/A**
Terrestrial food chain	**N/A**

4.3.2. Consumer exposure: Mixing and loading of plant protection products into delivery equipment and spray application

Exposure estimates for loading of plant protection products into delivery equipment, as well as the spray application. Only the largest “sentinel” value (in bold face) for mixing and loading is used.

Type of equipment and conditions	Model	Formulation type	PPE	RPE	Dermal exposure [mg/kg bw/day]	Inhalation Exposure [mg/m³]	Total external exposure [mg/kg	Total RCR
Mixing and loading hand-held sprayer, outdoors	BBA	Liquid			0,109	0,0001	0,109	0,310
	BBA	Granule (WG)			0,043	0,0000	0,043	0,124
	BBA	Powder (WP)			0,109	0,0012	**0,109**	0,311
Hand-held spraying, high-level target, outdoors	BBA	Liquid			0,05	0,0006	0,048	0,137

4.3.3. Consumer exposure: Combined tasks

Exposure estimates calculated for worst-case “sentinel” value from each correlated task.

Sub-activities	Use rate [g/d]	Dermal exposure [mg/kg bw/day]	Inhalation Exposure [mg/m³]	PPE	RPE	Dermal RCR	Inhalation RCR	Total RCR
Task 1: Mixing & loading powder formulation into knapsack sprayer	15	0,1085	0,0012			0,620	0,0046	0,310
Task 2: Hand-held spraying, outdoors		0,048	0,0006			0,273	0,0025	0,137
Task 1 + 2		**0,156**	**0,002**			**0,893**	0,0071	**0,900**

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

4.4.1. Environment

The above exposure scenario may be scaled using the ECPA Local Environmental Tool and using the parameters: co-formulant application rate, number of applications, application interval, crop (drift rate), location and period of application.

4.4.2. Human health

The above exposure scenario may be scaled using the ECPA OWB tool and using the parameters: application rate, personal protection (PPE), respiratory protection (RPE) and local exhaust ventilation (LEV).

5.0. Exposure scenario: PPP GES 4 - Use as a co-formulant in plant protection products, seed and granular applications by consumers

5.1. Title section

Market sector:	
Plant protection product	PC27
Environment:	
Direct application of plant protection products (granules or treated seeds) containing co-formulants to soil (indoor or outdoor)	ECPA SPERC 8d.2.v1
Consumers:	
Manual spreading of granular plant protection products or treated seeds	PC27

5.2. Conditions of use affecting exposure

5.2.1. Control of environmental exposure: Direct application of plant protection products (granules or treated seeds) containing co-formulants to soil (indoor or outdoor)

Amount used, frequency and duration of use (or from service life)
Maximum soil application rate: 6,00E-01 kg/ha *This maximum soil application rate is set based on the results of the risk assessment for human health, as well as based on the risk assessment for environment. With this application rate, a RCR (soil) of 0.962 is obtained and a combined RCR for consumers of 0.90 (see Chapter 3.4 for further guidance).*
Maximum number of applications: 1
Application interval (days): 1
Technical and organisational conditions and measures
Labelling required as part of plant protection product approval process under Directive 91/414/EEC (now Regulation (EC) 1107/2009) lays out specific RMMs which must be followed in order to ensure environmental safety.
Conditions and measures related to municipal sewage treatment plant
Municipal STP: No
Conditions and measures related to treatment of waste (including article waste)
Specific conditions of waste treatment: Labelling required as part of plant protection product approval process under Directive 91/414/EEC (now Regulation (EC) 1107/2009) provides guidance regarding appropriate disposal.
Other conditions affecting environmental exposure
Application type: Granule application / Seed treatment
Crop: No specific restrictions

Soil incorporation: No
Interception type: No interception
Region and timing of application: No specific restrictions

5.2.2. Control of consumer exposure: Manual spreading of granular plant protection products or treated seeds

Further specification: Manual spreading by hand, push rotary spreader, or belly grinder of granular plant protection products or treated seeds on residential lawns/turf, gardens (flowers, fruits, vegetables), and trees (fruits, nuts, shrubs, ornamentals).

PC 27: Manual spreading of granular plant protection products or treated seeds
Product characteristic
Substance in preparation: yes, up to 100% Granules or treated seeds
Amounts used
0,6 kg/ha = 0,01 kg/day
Frequency and duration of use/exposure
Once per day, 200 m^2
Human factors not influenced by risk management
Surface of skin exposed: 960 cm^2 (both hands)
Other given operational conditions affecting consumer exposure
Ventilation conditions: natural ventilation Place of use: outdoors
Conditions and measures related to information and behavioural advice to consumers
All instructions on the plant protection product label must be followed

5.3. Exposure estimation

5.3.1. Environmental release and exposure: Direct application of plant protection products (granules or treated seeds) containing co-formulants to soil (indoor or outdoor)

Compartment	Release factor estimation method	Explanation / Justification
Water	**Regional Assessment:**	Regional release factor (%): 0
	ECPA SPERC 8d.1.v1	
	Local Assessment:	Local spray drift (%): 15,7
	ECPA Local Environment Tool v2.0	Fraction available for local drainage/runoff (%): 5
		Explanation / Justification:
		Direct release to surface water not considered in the ECPA SPERCs, since this triggers a local-scale assessment at STP-catchment scale based on tonnage. In reality, potential emission will be to edge-of-field waterbodies and will depend on co-formulant application rate. Therefore a specific assessment of spray drift and drainage/runoff was performed using the ECPA Local Environment Tool. This utilises the FOCUS Step 2 approach for assessment of surface water exposure which is part of a standardised methodology routinely applied for assessment of plant protection products. For a Default assessment, the ECPA Local Environment Tool suggests figures of 15.7% and 5% for spray drift and the fraction available for runoff/drainage, respectively. However, these figures can be refined by taking account of more specific information regarding the target crop and region/season of application. In the case of co-formulants included in solid formulations (granules or treated seeds) the fraction emitted via spray drift is always 0.
Air	**Regional Assessment:**	Regional release factor (%): 0
	ECPA SPERC 8d.1.v1	
		Explanation / Justification:
		For co-formulants included in solid formulations (granules or treated seeds) the emission fraction to air is 0.
Soil	**Regional Assessment:**	Regional release factor (%): 100
	ECPA SPERC 8d.1.v1	
	Local Assessment:	Local release factor (%): 100
	ECPA Local Environment Tool v2.0	Explanation / Justification:
		For co-formulants included in solid formulations (granules or treated seeds) it is assumed that the entire fraction goes to soil.

Protection target	Exposure concentration
Water: Fresh Water	**Local PEC:** 8,28E-02 mg/L
(Pelagic)	**Regional concentration:** 0,00E+00 mg/L
	Local concentration: 8,28E-02 mg/L
Water: Fresh Water	**Local PEC:** 8,28E-03 mg/kg dwt
(Sediment)	**Regional concentration:** 0,00E+00 mg/kg dwt
	Local concentration: 8,28E-03 mg/kg dwt
Water: Marine Water	**Local PEC:** 8,28E-03 mg/L
(Pelagic)	**Regional concentration:** 0,00E+00 mg/L
	Local concentration: 8,28E-03 mg/L
Water: Marine Water	**Local PEC:** 8,28E-04 mg/kg dwt
(Sediment)	**Regional concentration:** 0,00E+00 mg/kg dwt
	Local concentration: 8,28E-04 mg/kg dwt
Water: Sewage	
Treatment Plant	
(Effluent)	
Air	
Soil: Agricultural Soil	**Local PEC:** 5,77E-01 mg/kg dwt
	Regional concentration: 0,00E+00 mg/kg dwt
	Local concentration: 5,77E-01 mg/kg dwt
Food chain: Aquatic Food	**Local PEC:** 1,26E-02 mg/kg wet fish
Chain	**Regional concentration:** 0,00E+00 mg/kg wet fish
	Local concentration: 1,26E-02 mg/kg wet fish
Food chain: Terrestrial Food	**Local PEC:** 4,50E-01 mg/kg wet earthworm
Chain	**Regional concentration:** 0,00E+00 mg/kg wet earthworm
	Local concentration: 4,50E-01 mg/kg wet earthworm

Protection target	Risk characterisation ratio
Fresh Water (Pelagic)	**4,36E-02**
Fresh Water (Sediment)	**9,63E-04**
Marine Water (Pelagic)	**4,36E-02**
Marine Water (Sediment)	**9,63E-04**
Agricultural soil	**9,62E-01**
Aquatic food chain	**N/A**
Terrestrial food chain	**N/A**

5.3.2. Consumer exposure: Manual spreading of granular plant protection products or treated seeds

Exposure estimates for consumers from mechanical or manual spreading of granular plant protection products or treated seeds. Manual spreading by hand, push rotary spreader or belly grinder of granular plant protection products or treated seeds on residential lawns/turf, gardens (flowers, fruits, vegetables) and trees (fruits, nuts, shrubs, ornamentals).

Type of equipment and conditions	Model	Formulation type	PPE	RPE	Dermal exposure [mg/kg bw/day]	Inhalation Exposure [mg/m³]	Total external exposure [mg/kg bw/day]	Total RCR
"Push-type" Spreaders	SOPREA*	Solid (GR)			0,000	0,0000	0,000	0,002
Belly grinders	SOPREA	Solid (GR)			0,157	0,0001	**0,157**	**0,900**
Hand dispersal, spoon	SOPREA	Solid (GR)			0,003	0,0000	0,003	0,015
Hand dispersal, cup	SOPREA	Solid (GR)			0,000	0,0000	0,000	0,000
Hand dispersal	SOPREA	Solid (GR)			0,070	0,000	0,070	0,402

*SOPREA: US EPA SOP for Residential Exposure Assessments, Feb. 2012

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

5.4.1. Environment

The above exposure scenario may be scaled using the ECPA Local Environmental Tool and using the parameters: co-formulant application rate, number of applications, application interval, crop (drift rate), location and period of application.

5.4.2. Human health

The above exposure scenario may be scaled using the ECPA OWB tool and using the parameters: application rate, personal protection (PPE), respiratory protection (RPE) and local exhaust ventilation (LEV).