CHEMICAL SAFETY REPORT

Part B

Sulfur

EC Number: 231-722-6

CAS Number: 7704-34-9

Prepared by: CONCAWE

9. EXPOSURE ASSESSMENT

Table 9.1. Identified Use Description and Exposure Scenario Number Key

IU	Category	Identified Use Name	Sector	ES Number	Sector of Use (SU)	Product Category (PC)	Process Category (PROC)	Environmental Release Category (ERC)	Specific Environmental Release Category (SpERC)
1	Sulfur	01 – Manufacture of Substance	Industrial	ES 9.1.1	3, 8, 9	NA	1, 2, 3, 4, 8a, 8b, 15	1, 4	ESVOC SpERC 1.1.v1
2	Sulfur	01b – Use of Substance as Intermediate	Industrial	ES 9.2.1	3, 8, 9	NA	1, 2, 3, 4, 8a, 8b, 15, 22, 23	6a	ESVOC SpERC 6.1a.v1
3	Sulfur	01a – Distribution of Substance	Industrial	ES 9.3.1	3	NA	1, 2, 3, 4, 8a, 8b, 9, 15	1, 2, 3, 4, 5, 6a, 6b, 6c, 6d, 7	ESVOC SpERC 1.1b.v1
4	Sulfur	02 – Formulation & (Re)packing of Substances and Mixtures	Industrial	ES 9.4.1	3, 10	NA	1, 2, 3, 4, 5, 8a, 8b, 9, 14, 15, 23, 24	2	ESVOC SpERC 2.2.v1
5	Sulfur	10a – Use as Release Agents or Binders: Industrial	Industrial	ES 9.5.1	3	NA	1, 2, 3, 4, 6, 8a, 8b, 10, 13, 14	4	ESVOC SpERC 4.10a.v1
6	Sulfur	10b – Use as Release Agents or Binders: Professional	Professional	ES 9.6.1	22	NA	1, 2, 3, 4, 6, 8a, 8b, 10, 13, 14	8a, 8d	ESVOC SpERC 8.10b.v1
7	Sulfur	11a – Use in Agrochemicals: Professional	Professional	ES 9.7.1	22	NA	1, 4, 8a, 8b, 11, 13	8a, 8d	ESVOC SpERC 8.11a.v1

8	Sulfur	11b – Use in Agrochemicals: Consumer	Consumer	ES 9.8.1	21	12, 22, 27	NA	8a, 8d	ESVOC SpERC 8.11b.v1
9	Sulfur	15 – Use in Road and Construction Applications: Professional	Professional	ES 9.9.1	22	NA	8a, 8b, 9, 10, 11, 13	8d, 8f	ESVOC SpERC 8.15.v1
10	Sulfur	19 – Rubber Production and Processing: Industrial	Industrial	ES 9.10.1	3, 10, 11	NA	1, 2, 3, 4, 5, 6, 7, 8a, 8b, 9, 13, 14, 15, 21	1, 4, 6d	ESVOC SpERC 4.19.v1
11	Sulfur	12a – Use as a Fuel: Industrial	Industrial	ES 9.11.1	3	NA	1, 2, 3, 4, 8a, 8b, 16	7	ESVOC SpERC 7.12a.v1
12	Sulfur	18b – Explosives Manufacture & Use: Professional	Professional	ES 9.12.1	22	NA	1, 3, 5, 8a, 8b	8e	ERC DEFINED RELEASE FRACTIONS
13	Sulfur	Use in Matches	Consumer	ES 9.13.1	21	11	NA	8e	ERC DEFINED RELEASE FRACTIONS
14	Sulfur	Use in Fireworks	Consumer	ES 9.14.1	21	11	NA	8e	ERC DEFINED RELEASE FRACTIONS

Exposure Scenarios and Risk Characterisation Introduction

General considerations for the development of Exposure Scenarios

Most sulfur is produced in de-sulfurization processes of oil refinery streams and natural gas. In a refinery sulfur-containing petroleum streams are passed through a de-sulfurization unit where the sulfur is extracted in the form of hydrogen sulphide which is subsequently converted to elemental sulfur. The sulfur in oil refineries is produced, stored and shipped to customers in its molten state as a liquid (at approximately 130°C) or in solid form. Sour natural gas contains sulfur mainly as hydrogen sulphide. Similar conversion processes as in oil refineries may produce the elemental sulfur either as a hot liquid or in its solid form, e.g. as pellets, for shipment to customers over long distances.

Inputs for the development of the Exposure Scenarios

The process of mapping uses and characterising risks has often identified a series of supporting measures that may further contribute to the management of exposure. The measures are identified in *blue* text in the Appendices contained in section 10. These measures are not contained within the Exposure Scenarios (ES) as they do not need to be implemented in order to achieve satisfactory exposure control. However, they are identified within the CSA in order that stakeholders are able to benefit from access to other exposure control information that has been obtained during the process of CSA/ES development.

Sulfur is a solid at ambient temperature and hence inhalation exposures of workers and consumers to airborne dust require consideration. Although molten sulfur is a hot liquid, any airborne fraction at ambient temperatures is likely to be an aerosol and not a vapour, therefore inhalation exposures to airborne fraction at ambient temperature are assessed as dust. The assigned dustiness for the ECETOC TRA model is moderate. An inhalation DNEL is not appropriate to derive, but reference values for ‘nuisance dust’ or ‘non-specific’ dust are appropriate and available in several countries to assess occupational exposures to substances in the form of dusts without substance-specific Occupational Exposure Limits. These values range from 4 mg/m3 in Germany to 15 mg/m3 in the USA. In view of the possible health impact of sulfur dust in general, the lower value of this range has been selected in order to identify a set of recommended (non-mandatory) risk management measures (printed in blue) to minimise exposure to dust.

Sulfur is classified as a skin irritant (R38), which requires a qualitative risk characterisation of any dermal exposures according to REACH guidance Chapter E. The resulting risk management measures are considered mandatory and are printed in black in the Exposure Scenarios. A quantitative assessment of dermal exposures has not been conducted.

Sulfur is not classified as hazardous for environmental endpoints. A quantitative exposure assessment for the environment has not been conducted.

Impurities of concern potentially present in sulfur, e.g. in the headspace of a storage tank include hydrogen sulphide (H2S), a highly toxic gas, and sulfur dioxide, an irritant gas. Risk Management Measures fall outside the scope of the Exposure Scenarios but can be addressed in the main body of the Safety Data Sheet (see IUCLID Section 11 information). Proposed language for the SDS to deal with the H2S hazard is as follows:

- Product may release Hydrogen Sulphide: a specific assessment of inhalation risks from the presence of hydrogen sulphide in tank headspaces, confined spaces, product residue, tank waste and waste water, and unintentional releases should be made to help determine controls appropriate to local circumstances (E500)
- These controls may include: Segregation of areas, Access only to authorised persons, Permit to work systems, Confined space working procedures, Area H_2S alarms, Personal H_2S alarms, Personal escape sets, H_2S awareness training (E501)

9.1. Manufacture of Sulfur – Industrial

9.1.1. Exposure Scenario

Section 1 Exposure Scenario Title: Sulfur	
Title	
Manufacture of Substance	
Use Descriptor	
Sector(s) of Use	3, 8, 9
Process Categories	1, 2, 3, 4, 8a, 8b, 15 *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	1, 4
Specific Environmental Release Category	ESVOC SpERC 1.1.v1
Processes, tasks, activities covered	
Manufacture of the substance or use as a 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).	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop. E3
CS15 General exposures (closed systems)	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS56 With sample collection	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS55 Batch process CS56 With sample collection	No other specific measures identified. EI20
CS2 Process sampling	No other specific measures identified. EI20

CS16 General exposures (open systems)	No other specific measures identified. EI20
CS36 Laboratory activities	No other specific measures identified. EI20
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20
CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
CS85 Bulk product storage	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.1.2. Exposure Estimation

9.1.2.1. Human Health
See Appendix 1.a and 1.b.

9.1.2.2. Environment
Not applicable.

9.2. Use of Sulfur as Intermediate – Industrial

9.2.1. Exposure Scenario

Section 1 Exposure Scenario Title: Sulfur	
Title	
Use of Substance as Intermediate	
Use Descriptor	
Sector(s) of Use	3, 8, 9
Process Categories	1, 2, 3, 4, 8a, 8b, 15, 22, 23 *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	6a
Specific Environmental Release Category	ESVOC SpERC 6.1a.v1
Processes, tasks, activities covered	
Use of substance as an intermediate. Includes recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop. E3
CS15 General exposures (closed systems)	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS56 With sample collection	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS55 Batch process CS56 With sample collection	No other specific measures identified. EI20

CS2 Process sampling	No other specific measures identified. EI20
CS16 General exposures (open systems)	No other specific measures identified. EI20
CS36 Laboratory activities	No other specific measures identified. EI20
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20
CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
CS85 Bulk product storage	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.2.2. Exposure Estimation

9.2.2.1. Human Health
See Appendix 1.a and 1.b.

9.2.2.2. Environment
Not applicable

9.3. Distribution of Sulfur – Industrial

9.3.1. Exposure Scenario

Section 1 Exposure Scenario Title: Sulfur	
Title	
Distribution of Substance	
Use Descriptor	
Sector(s) of Use	3
Process Categories	1, 2, 3, 4, 8a, 8b, 9, 15 *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	1, 2, 3, 4, 5, 6a, 6b, 6c, 6d, 7
Specific Environmental Release Category	ESVOC SpERC 1.1b.v1
Processes, tasks, activities covered	
Bulk loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance, including its sampling, storage, unloading, maintenance and associated laboratory activities.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop. E3
CS15 General exposures (closed systems)	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS56 With sample collection	No other specific measures identified. EI20
CS15 General exposures (closed systems)CS55 Batch process CS56 With sample collection	No other specific measures identified. EI20

CS2 Process sampling	No other specific measures identified. EI20
CS16 General exposures (open systems)	No other specific measures identified. EI20
CS36 Laboratory activities	No other specific measures identified. EI20
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20
CS7 Small package filling	No other specific measures identified. EI20
CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
CS85 Bulk product storage	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.3.2. Exposure Estimation

9.3.2.1. Human Health
See Appendix 1.a and 1.b.

9.3.2.2. Environment
Not applicable

9.4. Formulation & (Re)packing of Sulfur – Industrial

9.4.1. Exposure Scenario

Section 1 Exposure Scenario Title: Sulfur	
Title	
Formulation & (Re)packing of Substances and Mixtures	
Use Descriptor	
Sector(s) of Use	3, 10
Process Categories	1, 2, 3, 4, 5, 8a, 8b, 9, 14, 15, 23, 24 *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	2
Specific Environmental Release Category	ESVOC SpERC 2.2.v1
Processes, tasks, activities covered	
Bulk loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance, including its sampling, storage, unloading, maintenance and associated laboratory activities.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin effects that may develop. E3
CS15 General exposures (closed systems)	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS56 With sample collection	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS55 Batch process CS56 With sample collection	No other specific measures identified. EI20

CS2 Process sampling	No other specific measures identified. EI20
CS16 General exposures (open systems)	No other specific measures identified. EI20
CS30 Mixing operations (open systems)	No other specific measures identified. EI20
CS512 Milling, grinding and similar activities	No other specific measures identified. EI20
CS7 Small package filling	No other specific measures identified. EI20
CS 53 Pelletising	No other specific measures identified. EI20
CS36 Laboratory activities	No other specific measures identified. EI20
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20
CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
CS16 General exposures (open systems) CS111 elevated temperature	No other specific measures identified. EI20
CS85 Bulk product storage	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.4.2. Exposure Estimation

9.4.2.1. Human Health

See Appendix 1.a and 1.b.

9.4.2.2. Environment

Not applicable

9.5. Use of Sulfur as Release Agents or Binders – Industrial

9.5.1. Exposure Scenario

Section 1 Exposure Scenario Title Sulfur	
Title	
Use as Release Agents or Binders	
Use Descriptor	
Sector(s) of Use	3
Process Categories	1, 2, 3, 4, 6, 8a, 8b, 10, 13, 14 *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	4
Specific Environmental Release Category	ESVOC SpERC 4.10a.v1
Processes, tasks, activities covered	
Covers the use as binders and release agents including material transfers, mixing, application (including spraying and brushing), mould forming and casting, and handling of waste.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19.	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin effects that may develop. E3 Other skin protection measures such as impervious suits and face shields may be required during high dispersion activities which are likely to lead to substantial aerosol release e.g. spraying. E4.
CS15 General exposures (closed systems)	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS56 With sample collection	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS55 Batch process	No other specific measures identified. EI20

CS56 With sample collection	
CS16 General exposures (open systems)	No other specific measures identified. EI20
CS30 Mixing operations (open systems)	No other specific measures identified. EI20
CS98 Roller, spreader, flow application	No other specific measures identified. EI20
CS4 Dipping, immersion and pouring	No other specific measures identified. EI20
CS130 Article formation in mould	No other specific measures identified. EI20
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20
CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.5.2. Exposure Estimation

9.5.2.1. Human Health

See Appendix 1.a and 1.b.

9.5.2.2. Environment

Not applicable

9.6. Use of Sulfur in Release Agents or Binders – Professional

9.6.1. Exposure Scenario

Section 1 Exposure Scenario Title Sulfur	
Title	
Use as Release Agents or Binders	
Use Descriptor	
Sector(s) of Use	22
Process Categories	1, 2, 3, 4, 6, 8a, 8b, 10, 13, 14 *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	8a, 8d
Specific Environmental Release Category	ESVOC SpERC 8.10b.v1
Processes, tasks, activities covered	
Covers the use as binders and release agents including material transfers, mixing, and application by spraying, brushing and handling of waste.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19.	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin effects that may develop. E3 Other skin protection measures such as impervious suits and face shields may be required during high dispersion activities which are likely to lead to substantial aerosol release e.g. spraying. E4.
CS15 General exposures (closed systems)	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS56 With sample collection	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS55 Batch process	No other specific measures identified. EI20

CS56 With sample collection	
CS16 General exposures (open systems)	No other specific measures identified. EI20
CS30 Mixing operations (open systems)	No other specific measures identified. EI20
CS98 Roller, spreader, flow application	No other specific measures identified. EI20
CS4 Dipping, immersion and pouring	No other specific measures identified. EI20
CS130 Article formation in mould	No other specific measures identified. EI20
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20
CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.6.2. Exposure Estimation

9.6.2.1. Human Health

See Appendix 1.a and 1.b.

9.6.2.2. Environment

Not applicable

9.7. Uses of Sulfur in Agrochemicals – Professional

9.7.1. Exposure Scenario

Section 1 Exposure Scenario Title: Sulfur	
Title	
Uses in Agrochemicals	
Use Descriptor	
Sector(s) of Use	22
Process Categories	1, 4, 8a, 8b, 11, 13 *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	8a, 8d
Specific Environmental Release Category	ESVOC SpERC 8.11a.v1
Processes, tasks, activities covered	
Use as an agrochemical excipient for application by manual or machine spraying, smokes and fogging; including equipment clean-downs and disposal.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop. E3. Other skin protection measures such as impervious suits and face shields may be required during high dispersion activities which are likely to lead to substantial aerosol release, e.g. spraying E4
CS15 General exposures (closed systems)	No other specific measures identified. EI20
CS16 General exposures (open systems)	No other specific measures identified. EI20
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20
CS10 Spraying	No other specific measures identified. EI20
CS4 Dipping, immersion and pouring	No other specific measures identified. EI20

CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.7.2. Exposure Estimation

9.7.2.1. Human Health
See Appendix 1.a and 1.b.

9.7.2.2. Environment
Not applicable

9.8. Uses of Sulfur in Agrochemicals – Consumer

9.8.1. Exposure Scenario

Section 1 Exposure Scenario Title: Sulfur		
Title		
Use in Agrochemicals		
Use Descriptor		
Sector(s) of Use	21	
Product Categories	12, 22, 27 *Further information on the mapping and allocation of PC codes is contained in Table 1.*	
Environmental Release Categories	8a, 8d	
Specific Environmental Release Category	ESVOC SpERC 8.11b.v1	
Processes, tasks, activities covered		
Covers the consumer use in agrochemicals in liquid and solid forms.		
Assessment Method		
See Section 3.		
Section 2 Operational conditions and risk management measures		
Section 2.1 Control of worker exposure		
Product characteristics		
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29	
Concentration of substance in product	Unless otherwise stated, cover concentrations up to 100% [ConsOC1]	
Amounts used	Unless otherwise stated, covers use amounts up to37500g [ConsOC2]; covers skin contact area up to 6600cm2 [ConsOC5]	
Frequency and duration of use/exposure	Unless otherwise stated, covers use frequency up to 4 times per day [ConsOC4]; covers exposure up to 8 hours per event [ConsOC14]	
Other Operational Conditions affecting exposure	Unless otherwise stated assumes use at ambient temperatures [ConsOC15]; assumes use in a 20 m^3 room [ConsOC11]; assumes use with typical ventilation [ConsOC8].	
Product Category	**Specific Risk Management Measures and Operating Conditions**	
PC12:Fertilizers	OC	Unless otherwise stated, covers concentrations up to 90% [ConsOC1]; covers use up to 1 days/year[ConsOC3]; covers use up to 1 time/on day of use[ConsOC4]; covers skin contact area up to 857.50 cm2 [ConsOC5]; for each use event, assumes swallowed amount of 0.3g [ConsOC13]; for each use event, covers use amounts up to 2500g [ConsOC2]; covers outdoor use [ConsOC12];
	RMM	No specific RMMs identified beyond those OCs stated
PC22: Lawn and garden preparations, including fertilizers	OC	Products containing Sulfur in high percentages (assume 90%) are sold for acidification of soil, to treat certain plant diseases (e.g. scab on potatoes) and as worm-deterrent (http://www.progreen.co.uk/index.php?c=61&p=132). The products are provided as prill (pellets) in bags of 1 kg. Recommended application frequency is of the order of once per year. The exposure assessment is conducted using the <0.1 Pa band values of the ESIG consumer assessment tool (Appendix 1.c).
	RMM	No specific RMMs identified beyond those OCs stated
PC27_n: Plant protection products--	OC	Unless otherwise stated, covers concentrations up to 90% [ConsOC1]; covers use up to 1 days/year[ConsOC3];

		covers use up to 1 time/on day of use[ConsOC4]; covers skin contact area up to 857.50 cm2 [ConsOC5]; for each use event, assumes swallowed amount of 0.3g [ConsOC13]; for each use event, covers use amounts up to 2500g [ConsOC2]; covers outdoor use [ConsOC12];
	RMM	No specific RMMs identified beyond those OCs stated
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2		
Section 2.2 Control of environmental exposure		
Not applicable		
Section 3 Exposure Estimation		
3.1. Health		
The ECETOC TRA tool has been used to estimate consumer exposures, consistent with the content of ECETOC Report #107 and the Chapter R15 of the IR&CSA TGD. Where exposure determinants differ to these sources, then they are indicated. G42		
3.2. Environment		
Not applicable		
Section 4 Guidance to check compliance with the Exposure Scenario		
4.1. Health		
Predicted exposures are not expected to exceed the applicable consumer reference values when the operational conditions/risk management measures given in section 2 are implemented. G39. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.		
4.2. Environment		
Not applicable		

9.8.2. Exposure Estimation

9.8.2.1. Human Health
See Appendix 1.b. & 1.c.

9.8.2.2. Environment
Not Applicable

9.9. Use of Sulfur in Road and Construction Applications – Professional

9.9.1. Exposure Scenario

Section 1 Exposure Scenario Title: Sulfur	
Title	
Use in Road and Construction Applications	
Use Descriptor	
Sector(s) of Use	22
Process Categories	8a, 8b, 9, 10, 11, 13 *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	8d, 8f
Specific Environmental Release Category	ESVOC SpERC 8.15.v1
Processes, tasks, activities covered	
Application of surface coatings and binders in road and construction activities, including paving uses, manual mastic and in the application of roofing and water-proofing membranes.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin effects that may develop. E3 Other skin protection measures such as impervious suits and face shields may be required during high dispersion activities which are likely to lead to substantial aerosol release, e.g. spraying E4
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20
CS7 Small package filling	No other specific measures identified. EI20
CS98 Roller, spreader, flow application	No other specific measures identified. EI20
CS10 Spraying	No other specific measures identified. EI20
CS4 Dipping, immersion	No other specific measures identified. EI20

and pouring	
CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.9.2. Exposure Estimation

9.9.2.1. Human Health
See Appendix 1.a and 1.b.

9.9.2.2. Environment
Not Applicable

9.10. Use of Sulfur in Rubber Production and Processing – Industrial

9.10.1. Exposure Scenario

Section 1 Exposure Scenario Title: Sulfur	
Title	
Rubber Production and Processing	
Use Descriptor	
Sector(s) of Use	3, 10, 11
Process Categories	1, 2, 3, 4, 5, 6, 7, 8a, 8b, 9, 13, 14, 15, 21 *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	1, 4, 6d
Specific Environmental Release Category	ESVOC SpERC 4.19.v1
Processes, tasks, activities covered	
Manufacture of tyres and general rubber articles, including processing of raw (uncured) rubber, handling and mixing of rubber additives, calendaring, vulcanising, cooling and finishing as well as maintenance.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin effects that may develop. E3 Other skin protection measures such as impervious suits and face shields may be required during high dispersion activities which are likely to lead to substantial aerosol release, e.g. spraying E4
CS15 General exposures (closed systems)	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS56 With sample collection	No other specific measures identified. EI20
CS15 General exposures	No other specific measures identified. EI20

(closed systems) CS55 Batch process CS56 With sample collection	
CS16 General exposures (open systems)	No other specific measures identified. EI20
CS30 Mixing operations (open systems)	No other specific measures identified. EI20
CS64 Calendering (including Banburys) CS70 Vulcanisation CS71 Cooling cured articles	No other specific measures identified. EI20
CS10 Spraying	No other specific measures identified. EI20
CS90 Small scale weighing	No other specific measures identified. EI20
CS4 Dipping, immersion and pouring	No other specific measures identified. EI20
CS73 Pressing uncured rubber blanks	No other specific measures identified. EI20
CS102 Finishing operations	No other specific measures identified. EI20
CS36 Laboratory activities	No other specific measures identified. EI20
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20
CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.10.2. Exposure Estimation

9.10.2.1. Human Health

See Appendix 1.a and 1.b.

9.10.2.2. Environment

Not Applicable

9.11. Use of Sulfur as a Fuel – Industrial

9.11.1. Exposure Scenario

Section 1 Exposure Scenario Title: Sulfur	
Title	
Use as a Fuel	
Use Descriptor	
Sector(s) of Use	3
Process Categories	1, 2, 3, 4, 8a, 8b, 16 *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	7
Specific Environmental Release Category	ESVOC SpERC 7.12a.v1
Processes, tasks, activities covered	
Covers the use as a fuel (or fuel additives and additive components) and includes activities associated with its transfer, use, equipment maintenance and handling of waste.	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19.	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin effects that may develop. E3
CS15 General exposures (closed systems)	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS56 With sample collection	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS55 Batch process CS56 With sample collection	No other specific measures identified. EI20
CS2 Process sampling	No other specific measures identified. EI20

CS16 General exposures (open systems)	No other specific measures identified. EI20
CS 107 (closed system)	No other specific measures identified. EI20
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20
CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
CS85 Bulk product storage	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.11.2. Exposure Estimation

9.11.2.1. Human Health

See Appendix 1.a and 1.b.

9.11.2.2. Environment

Not Applicable

9.12. Use of Sulfur in Explosives Manufacture and Use – Professional

9.12.1. Exposure Scenario

Section 1 Exposure Scenario Title: Sulfur	
Title	
Explosives Manufacture and Use	
Use Descriptor	
Sector(s) of Use	22
Process Categories	1, 3, 5, 8a, 8b *Further information on the mapping and allocation of PROC codes is contained in Table 9.1*
Environmental Release Categories	8e
Specific Environmental Release Category	*Not Applicable*
Processes, tasks, activities covered	
Covers exposures arising from the manufacture and use of slurry explosives (including materials transfer, mixing and charging) and equipment cleaning	
Assessment Method	
See Section 3.	
Section 2 Operational conditions and risk management measures	
Section 2.1 Control of worker exposure	
Product characteristics	
Physical form of product	Solid at STP, liquid at elevated operating temperature, vapour pressure < 0.5 kPa OC29
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) G13
Amount used	Not applicable
Frequency and duration of use/exposure	Covers daily exposures up to 8 hours (unless stated differently) G2
Human factors not influenced by risk management	Not applicable
Other Operational Conditions affecting exposure	Operation is carried out at elevated temperature (> 20°C above ambient temperature). OC7. Assumes a good basic standard of occupational hygiene is implemented G1.
Contributing Scenarios	**Specific Risk Management Measures and Operating Conditions**
General measures (skin irritants) G19.	Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop. E3
CS15 General exposures (closed systems)	No other specific measures identified. EI20
CS15 General exposures (closed systems) CS55 Batch process CS56 With sample collection	No other specific measures identified. EI20
CS30 Mixing operations (open systems)	No other specific measures identified. EI20
CS14 Bulk transfers CS81 Dedicated facility	No other specific measures identified. EI20

CS39 Equipment Cleaning and Maintenance	No other specific measures identified. EI20
Additional information on the basis for the allocation of the identified OCs and RMMs is contained in Appendices 1 to 2	
Section 2.2 Control of environmental exposure	
Not applicable	
Section 3 Exposure Estimation	
3.1. Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated. G21.	
3.2. Environment	
Not applicable	
Section 4 Guidance to check compliance with the Exposure Scenario	
4.1. Health	
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. G32. Risk Management Measures are based on qualitative risk characterisation. G37. Available hazard data do not support the need for a DNEL to be established for other health effects. G36. Users are advised to consider national Occupational Exposure Limits or other equivalent values. G38. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. G23.	
4.2. Environment	
Not applicable	

9.12.2. Exposure Estimation

9.12.2.1. Human Health
See Appendix 1.a and 1.b.

9.12.2.2. Environment
Not Applicable

9.13. Use of sulfur in Matches – Consumer

Basic data for the assessments:
Sulfur is classified for skin irritation effects (R38). There are no DNELs set for inhalation, dermal or oral route. A reference value of >5000 mg/kg, representing a "guide LD_{50}" was used in modeling. Specific gravity of Sulfur considered for this assessment is 2,07 g/cm^3. The Vapour Pressure considered for this assessment was 2.65E-20Pa@115.36°C (http://environmentalchemistry.com/yogi/periodic/S.html).

9.13.1. Human Health Exposure Scenario / Estimation for Use of Sulfur in Matches (PC 11; ERC 8e; ERC Defined release fractions):

Matches contain approximately 4% S
(http://nopr.niscair.res.in/bitstream/123456789/8636/1/IJCT%2012(3)%20369-380.pdf).

During intended use (lighting of a match) the S burns instantly and there is no exposure to Sulfur. Matches are considered a common household good. In line with REACH guidance (Chapter R.15) the only scenario requiring further analysis is an infant mouthing (not swallowing) a match. The calculation assumes a match head with radius of 3 mm, a layer of 0,01 cm removed by mouthing and a Sulfur content of 4%. Infant body weight is 7.62 kg (RIVM 320104002). The resulting dose is 0.12 mg/kg.

9.13.2. Environment Exposure Scenario / Estimation for Use of Sulfur in Matches (PC 11; ERC 8e; ERC Defined release fractions):

Not applicable

9.14. Use of sulfur in Fireworks – Consumer

9.14.1. Human Health Exposure Scenario / Estimation for Use of Sulfur in Fireworks (PC 11; ERC 8e; ERC Defined release fractions):

During intended use (explosion of fireworks) the Sulfur burns instantly and there is no exposure to Sulfur. Fireworks are not considered a common household good, hence infants are not expected to encounter mouthing opportunities. No exposure calculation is performed.

9.14.2. Environment Exposure Scenario / Estimation for Use of Sulfur in Fireworks (PC 11; ERC 8e; ERC Defined release fractions):

Not applicable

9.15. Regional Environment Exposure Estimation

Not applicable

10. RISK CHARACTERISATION

10.1. Manufacture of Sulfur – Industrial

10.1.1. Human Health
See Appendix 2.a and 2.b.

10.1.2. Environment
Not Applicable

10.2. Use of Sulfur as Intermediate – Industrial

10.2.1. Human Health
See Appendix 2.a and 2.b.

10.2.2. Environment
Not Applicable

10.3. Distribution of Sulfur – Industrial

10.3.1. Human Health
See Appendix 2.a and 2.b.

10.3.2. Environment
Not Applicable

10.4. Formulation & (Re)packing of Sulfur – Industrial

10.4.1. Human Health
See Appendix 2.a and 2.b.

10.4.2. Environment
Not Applicable

10.5. Uses of Sulfur in Release Agents or Binders – Industrial

10.5.1. Human Health
See Appendix 2.a and 2.b.

10.5.2. Environment
Not Applicable

10.6. Uses of Sulfur in Release Agents or Binders – Professional

10.6.1. Human Health
See Appendix 2.a and 2.b.

10.6.2. Environment
Not Applicable

10.7. Uses of Sulfur in Agrochemicals – Professional

10.7.1. Human Health
See Appendix 2.a and 2.b.

10.7.2. Environment
Not Applicable

10.8. Uses of Sulfur in Agrochemicals – Consumer

10.8.1. Human Health
See Appendix 2b. and 2.c for PC12 and 27

For PC22**,** risk characterisation for use of sulfur in lawn and garden preparations:

A reference value of 0.5 mg/kg bw/day is used in the assessment; this is not a formal DNEL, hence no mandatory RMMs were identified. Nevertheless, applying the reference value to the use conditions described there are no health concerns identified.

10.8.2. Environment
Not Applicable

10.9. Uses of Sulfur in Road and Construction Applications – Professional

10.9.1. Human Health
See Appendix 2.a and 2.b.

10.9.2. Environment
Not Applicable

10.10. Uses of Sulfur in Rubber Production and Processing – Industrial

10.10.1. Human Health
See Appendix 2.a and 2.b.

10.10.2. Environment
Not Applicable

10.11. Uses of Sulfur as a Fuel – Industrial

10.11.1. Human Health
See Appendix 2.a and 2.b.

10.11.2. Environment
Not Applicable

10.12. Uses of Sulfur in Explosives Manufacture and Use – Professional

10.12.1. Human Health
See Appendix 2.a and 2.b.

10.12.2. Environment
Not Applicable

10.13. Use of sulfur in Matches – Consumer

10.13.1. Human Health

Risk characterisation for infant mouthing of one match was considered. [

The exposure of 0.12 mg/kg is compared with a reference value of a conservative reference value for a human “guide LD_{50}”/10000, i.e. >0.5 mg/kg. This exposure does not present a concern.

10.13.2. Environment
Not Applicable

10.14. Use of sulfur in Fireworks – Consumer

10.14.1. Human Health

Sulfur is contained inside the fireworks. Fireworks are sold under age restrictions and should be kept away from children. Their hazards due to inadvertent explosion are well-known and hence adults can be expected to store fireworks in a safe place. There is no health concern associated with use of Sulfur in fireworks.

10.14.2. Environment
Not Applicable

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

10.15.1. Human health (combined for all exposure routes)
See Appendix 2.a, 2.b & 2.c

10.15.2. Environment (combined for all exposure routes)
Not applicable

10.16. Regional Environment
Not applicable

APPENDIX 1: Exposure Estimations

Appendix 1.a. Worker Exposure Estimation

APPENDIX 1.b. Qualitative Exposure Estimation

Qualitative Exposure Estimation for R38 substances

This general qualitative CSA approach aims to reduce/avoid contact or incidents with the substance. However, implementation of risk management measures (RMMs) and operational conditions (OCs) need to be proportional to the degree of concern for the health hazard presented by the substance. Exposures should be controlled to at least the levels that represent an acceptable level of risk, i.e. implementation of the chosen RMMs will ensure that the likelihood of an event occurring due to the hazard of the substance is negligible, and the risk is considered to be controlled to a level of no concern.

For skin irritation a qualitative risk characterisation was conducted. Handling and storage risk management measures that are generally identified for skin irritation and identified in the Table given in Appendix 3.b.

A review of these RMMs indicates that if the user complies with the following generic statements, risks due to skin irritation can be considered to be adequately controlled:

> E3: Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if direct hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin effects that may develop.

Plus (where there is the potential for additional and significant aerosol exposure, e.g. associated with PROCs 7, 11, 17 or 18):

> E4: Other skin protection measures such as impervious suits and face shields may be required during high dispersion activities which are likely to lead to substantial aerosol release, e.g. spraying.

Appendix 1.c. Consumer Exposure Estimation for Use in Agrochemicals, PC 12 and PC 27

APPENDIX 2: Risk Characterisations

Appendix 2.a. Worker Risk Characterisation

APPENDIX 2.b. Qualitative Risk Characterisation

Qualitative Risk Characterisation for R38 substances

The implementation of relevant RMMs will ensure that the likelihood of an event occurring due to the substance hazard of skin irritation is negligible and the risk is considered to be controlled to a level of no concern.

For the skin irritation (R38) hazard a qualitative risk characterisation has been conducted consistent with the considerations and risk management measures identified in the Table below.

Hazard	Material	Risk / Hazard Phrase	Examples of Relevant S Phrases and P Statements	Components of the Qualitative Risk Assessment
Skin Irritation (R38)	• Liquid	R38 / H315	• S24: Avoid contact with skin Prevention: • P264: Wash ... thoroughly after handling. • P280: Wear protective gloves. Response: • P280: Wear protective gloves/protective clothing/eye protection/face protection. • P302 + P352: IF ON SKIN: Wash with plenty of soap and water. • P321: Specific treatment (see ... on this label). • P332 + P313: If skin irritation occurs: Get medical advice/attenti	• Implementation of basic standards of occupational hygiene; • Avoid direct skin contact with product; • Wear gloves (tested to EN374) if direct hand contact with the substance is likely; wash off skin contamination immediately; • Avoid splashes and spills; • Avoidance of contact with contaminated tools and objects; • Clean up contamination/spills as soon as they occur; • Regular cleaning of equipment and work area; • Ensure suitable management/supervision is in place to check that the RMMs in place are being used correctly and OCs followed; • Train staff on good practice to prevent / minimise exposures and to report any skin problems that may develop; • Adopt good standards of personal skin hygiene. • Where activities may lead to aerosol release e.g. spraying, then additional skin protection measures such as impervious suits and face shields may be required.

			on. • P362 : Take off contaminated clothing and wash before re-use	

The outcome of the CSA is displayed within the relevant Exposure Scenarios by the inclusion of the general phrase

> E3: Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if direct hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin effects that may develop.

Together with (where there is the potential for additional and significant aerosol exposure):

> E4: Other skin protection measures such as impervious suits and face shields may be required during high dispersion activities which are likely to lead to substantial aerosol release, e.g. spraying.

Appendix 2.c. Consumer Risk Characterisation for use in Agrochemicals, PC 12 and PC 27