

### SECTION 1: Identification of the substance/mixture and of the company/undertaking

#### 1.1. Product identifier

Chemical type	: Substance
Substance name	: Sulfur
Trade name	: Sulfur
EC index no	: 016-094-00-1
EC no	: 231-722-6
CAS No.	: 7704-34-9
REACH registration No.	: 01-2119487295-27-0092
Product code	: 992 SDS # PbR0021
Synonyms	: Common solid sulfur

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

##### 1.2.1. Relevant identified uses

Use of the substance/preparation	: Manufacture of substances Intermediate Formulation [mixing] of preparations and/or re-packaging Release agent. Agrochemicals Building and construction work. Road work Manufacture of rubber products. Fuels Explosive
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##### 1.2.2. Uses advised against

No additional information available

#### 1.3. Details of the supplier of the safety data sheet

Petrobras International Braspetro B.V. – PIB BV  
Prins Bernhardplein 200, 1097 – JB Amsterdam  
The Netherlands

All communications shall be addressed exclusively to the following address:

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4th Floor, 20 North Audley Street  
London W1K 6WL – United Kingdom  
Fax number: +44(0) 20 7355 8750  
E-mail: reach@petrobras.com.br

#### 1.4. Emergency telephone number

Emergency number	: For Chemical Emergency, Spill, Leak, Fire, Exposure or Accident Call CHEMTREC Day or Night Within USA and Canada: 1-800-424-9300 Outside USA and Canada (collect calls accepted): 1-703-527-3887
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### SECTION 2: Hazards identification

#### 2.1. Classification of the substance or mixture

##### Classification according to Regulation (EC) No. 1272/2008 [CLP]

Skin Irrit. 2 H315

Full text of H-phrases: see section 16.

##### Classification according to Directive 67/548/EEC or 1999/45/EC

Xi; R38

Full text of R-phrases: see section 16.

##### Adverse physicochemical, human health and environmental effects

High concentration of vapours may induce: headache, dizziness, drowsiness, nausea and vomiting.

#### 2.2. Label elements

##### Labelling according to Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms (CLP)



GHS07

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according to Regulation (EC) No. 453/2010

Signal word (CLP)	: Warning
Hazard statements (CLP)	: H315 - Causes skin irritation
Precautionary statements (CLP)	: P280 - Wear eye protection, face protection, protective clothing, protective gloves. P302+P352 - IF ON SKIN: Wash with plenty of soap and water P332+P313 - If skin irritation occurs: Get medical advice/attention

### 2.3. Other hazards

This substance/mixture does not meet the PBT/vPvB criteria of REACH, annex XIII.

other hazards which do not result in classification : Combustible.

## SECTION 3: Composition/information on ingredients

### 3.1. Substances

Name	Product identifier	%	Classification according to Directive 67/548/EEC
Sulfur.	(CAS No.) 7704-34-9 (EC no) 231-722-6 (EC index no) 016-094-00-1	100	Xi; R38

  

Name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Sulfur.	(CAS No.) 7704-34-9 (EC no) 231-722-6 (EC index no) 016-094-00-1	100	Skin Irrit. 2, H315

Full text of R-, H- and EUH-phrases: see section 16.

### 3.2. Mixtures

Not applicable

## SECTION 4: First aid measures

### 4.1. Description of first aid measures

First-aid measures after inhalation	: Remove victim to fresh air. In case of irregular breathing or respiratory arrest provide artificial respiration. In case of breathing difficulties administer oxygen. Immediately get medical attention. If medical advice is needed, have product container or label at hand.
First-aid measures after skin contact	: Remove contaminated clothing immediately and dispose off safely. After contact with skin, wash immediately with plenty of water and soap. If skin irritation occurs: Get medical advice/attention.
First-aid measures after eye contact	: In case of contact with eyes, rinse immediately with plenty of flowing water for 10 to 15 minutes holding eyelids apart. Subsequently consult an ophthalmologist. If medical advice is needed, have product container or label at hand.
First-aid measures after ingestion	: Do not induce vomiting. If swallowed, rinse mouth with water (only if the person is conscious). In case of accident or if you feel unwell, seek medical advice immediately (show this label if possible).

### 4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries	: Symptoms include headache, dizziness, fatigue, muscular weakness, drowsiness and in extreme cases, loss of consciousness. On heating: release of toxic and corrosive gases/vapours sulphur oxides.
Symptoms/injuries after inhalation	: Inhalation of dust may cause irritation of the respiratory system.
Symptoms/injuries after skin contact	: With moisture, product develops an alkaline pH-value and can cause irritation.
Symptoms/injuries after eye contact	: Conjunctival redness.

### 4.3. Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

## SECTION 5: Firefighting measures

### 5.1. Extinguishing media

Suitable extinguishing media: : carbon dioxide (CO2), dry chemical powder, foam.

### 5.2. Special hazards arising from the substance or mixture

Fire hazard	: Explosive dust-air mixtures may form. Cool closed containers exposed to fire with water spray.
Reactivity	: On heating: release of toxic and corrosive gases/vapours sulphur oxides. Sulphur dioxide (SO2).

### 5.3. Advice for firefighters

Protective equipment for firefighters : Refer to section 8.

## SECTION 6: Accidental release measures

### 6.1. Personal precautions, protective equipment and emergency procedures

General measures : In case of fire, use foam. Carbon dioxide (CO2). Dry extinguishing powder. Cover spill with non combustible material, e.g.: sand/earth. Eliminate all ignition sources if safe to do so.

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according to Regulation (EC) No. 453/2010

### 6.1.1. For non-emergency personnel

Protective equipment : Wear suitable protective clothing, gloves and eye/face protection. Refer to section 8.

### 6.1.2. For emergency responders

Protective equipment : Wear suitable protective clothing, gloves and eye/face protection. In case of fire: Wear self-contained breathing apparatus. Refer to section 8.

### 6.2. Environmental precautions

Prevent spreading over great surfaces (e.g. by damming or installing oil booms). Do not discharge into drains or the environment.

### 6.3. Methods and material for containment and cleaning up

For containment : Stop leak if safe to do so.

Methods for cleaning up : Collect in closed containers for disposal. Avoid raising powdered materials into airborne dust.

### 6.4. Reference to other sections

Refer to sections 8 and 13.

## SECTION 7: Handling and storage

### 7.1. Precautions for safe handling

Precautions for safe handling : Danger of dust explosion. Handle in accordance with good industrial hygiene and safety procedures.

### 7.2. Conditions for safe storage, including any incompatibilities

Technical measures: : Provide adequate ventilation.

Storage condition(s) : Keep away from ignition sources (including static discharges).

Incompatible materials : Oxidizing agents, strong.

Prohibitions on mixed storage : Do not store near oxidizing agents.

Storage area : Ensure adequate ventilation of the storage area. Store at room temperature.

### 7.3. Specific end use(s)

No data available.

## SECTION 8: Exposure controls/personal protection

### 8.1. Control parameters

#### Sulfur (7704-34-9)

EU	Notation	National occupational / biological exposure limits: none known
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### 8.2. Exposure controls

Personal protective equipment : Gloves. High dust production: self-contained breathing apparatus. Protective clothing. Protective goggles.



Hand protection : Wear protective gloves. PVC (Polyvinyl chloride).

Eye protection : if necessary: tightly fitting safety goggles.

Skin and body protection : For the protection against direct skin contact, body protective clothing is essential (in addition to the usual working clothes).

Respiratory protection : Wear appropriate breathing apparatus if air renewal not sufficient to maintain dust/vapour under TLV. In case of fire: Wear self-contained breathing apparatus.

## SECTION 9: Physical and chemical properties

### 9.1. Information on basic physical and chemical properties

Physical state : Solid

Appearance : Crystalline solid.

Colour : yellow.

Odour : No data available

Odour threshold : No data available

pH : No data available

Melting point : 119 °C

Solidification point : No data available

Boiling point : 444.6 °C

Flash point : 207 °C

Relat. evapor. rate comp. to butylacetate : No data available

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according to Regulation (EC) No. 453/2010

Flammability (solid, gas)	: Not flammable.
Explosive limits	: No data available
Vapour pressure	: 1 mmHg @ 1838°C
Relative vapour density at 20 °C	: 2.07 kg/m <sup>3</sup>
Relative density	: No data available
Solubility	: Soluble in organic solvents. Water: Insoluble
Log Pow	: not applicable
Self ignition temperature	: 232 °C
Decomposition temperature	: No data available
Viscosity, kinematic	: No data available
Viscosity, dynamic	: No data available
Explosive properties	: No data available
Oxidising properties	: No data available

### 9.2. Other information

No additional information available

## SECTION 10: Stability and reactivity

### 10.1. Reactivity

On heating: release of toxic and corrosive gases/vapours sulphur oxides. Sulphur dioxide (SO<sub>2</sub>).

### 10.2. Chemical stability

Stable at normal conditions.

### 10.3. Possibility of hazardous reactions

No data available.

### 10.4. Conditions to avoid

Danger of dust explosion. Avoid generation of dust.

### 10.5. Incompatible materials

Store separately from oxidising agents and strongly alkaline and strongly acidic materials., amines, alcohol's and water.

### 10.6. Hazardous decomposition products

On heating/burning: release of toxic and corrosive gases/vapours nitrous vapours sulphur oxides.

## SECTION 11: Toxicological information

### 11.1. Information on toxicological effects

Acute toxicity : Not classified

Sulfur (7704-34-9)	
LD50 oral rat	> 2000 mg/kg
LD50 dermal rat	> 2000 mg/kg
LC50 inhalation rat (mg/l)	> 5.43 mg/l/4h

Skin corrosion/irritation : Causes skin irritation.

Serious eye damage/irritation : Not classified  
Not irritating

Respiratory or skin sensitisation : Not classified  
Not sensitizing

Germ cell mutagenicity : Not classified  
Negative

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : Not classified

Sulfur (7704-34-9)	
NOAEL (oral, rat, days)	1000 mg/kg bodyweight/day
NOAEL (dermal, rat/28 days)	> 400 mg/kg bodyweight/day Rats

Aspiration hazard : Not classified

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### SECTION 12: Ecological information

#### 12.1. Toxicity

Ecology - general : On combustion releases : air pollutant. Assure that emissions are compliant with all applicable air pollution control regulations.

Sulfur (7704-34-9)	
NOEC (chronic)	> 100 mg/l 21 days- daphnia

#### 12.2. Persistence and degradability

Sulfur (7704-34-9)	
Persistence and degradability	No data available.

#### 12.3. Bioaccumulative potential

Sulfur (7704-34-9)	
Log Pow	not applicable
Bioaccumulative Potential	No data available.

#### 12.4. Mobility in soil

Sulfur (7704-34-9)	
Mobility in soil	No data available.

#### 12.5. Results of PBT and vPvB assessment

Sulfur (7704-34-9)	
Results of PBT assessment	Not applicable. The substance is inorganic.

#### 12.6. Other adverse effects

Other adverse effects : No data available.

### SECTION 13: Disposal considerations

#### 13.1. Waste treatment methods

Waste treatment methods : Consult the local waste disposal expert about waste disposal.  
Waste disposal recommendations : Do not empty into drains or the aquatic environment. Do not remove as household garbage. Dispose of this material and its container to hazardous or special waste collection point.

### SECTION 14: Transport information

In accordance with ADR / RID / ADNR / IMDG / ICAO / IATA

#### 14.1. UN number

UN-No. : 1350

#### 14.2. UN proper shipping name

Proper shipping name : SULPHUR  
Transport document description : UN 1350 SULPHUR, 4.1, III, (E)

#### 14.3. Transport hazard class(es)

Class (UN) : 4.1- Flammable solids, self-reactive substance and solid desensitized explosives  
Hazard labels (UN) : 4.1



#### 14.4. Packing group

Packing group (UN) : III

#### 14.5. Environmental hazards

Other information : No supplementary information available.

#### 14.6. Special precautions for user

Special transport precautions : No data available.

##### 14.6.1. Overland transport

Hazard identification number (Kemler No.) : 40  
Classification code : F3

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according to Regulation (EC) No. 453/2010

Orange plates



Tunnel restriction code : E  
Limited quantities (ADR) : LQ09  
Excepted quantities (ADR) : E1

### 14.6.2. Transport by sea

4.1 – Flammable solids, self-reactive substance and solid desensitized explosives

### 14.6.3. Air transport

4.1 – Flammable solids, self-reactive substance and solid desensitized explosives

### 14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

IBC code : No data available.

## SECTION 15: Regulatory information

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

#### 15.1.1. EU-Regulations

Other regulations, restrictions and prohibition regulations : Compliance with following regulations: Regulation (EC) 1907/2006 as amended. Regulation (EC) 1272/2008 as amended. Directive 67/548/EEC as amended. Directive 1999/45/EC as amended.

#### 15.1.2. National regulations

Regional legislation : No data has been reported. In case of need contact our Product Safety office.

Hazard symbols



Xi - Irritant

R-phrases : R38 - Irritating to skin.

Classified dangerous in accordance with Directives 67/548/EEC and 1999/45/EC

S-phrases : S2 - Keep out of the reach of children.  
S46 - If swallowed, seek medical advice immediately and show this container or label.  
S24  
Avoid contact with skin  
S37  
Wear suitable gloves.

### 15.2. Chemical safety assessment

Chemical safety assessment has been established in the attachment.

## SECTION 16: Other information

Sources of Key data : PETROBRAS. MSDS.

Abbreviations and acronyms : ASTM - American Society for Testing and Materials . CLP - Classification, Labelling and Packaging. CSR - Chemical Safety Report. EC - European Community. EEC - European Economic Community. GHS - Globally Harmonised System. REACH - Registration, Evaluation, Authorisation and Restriction of Chemicals. SDS - Safety Data Sheet.

Full text of R-, H- and EUH-phrases:

Skin Irrit. 2	skin corrosion/irritation Category 2
H315	Causes skin irritation
R38	Irritating to skin.

*The information presented in this Safety Data Sheet is based on current knowledge and is believed to be complete and accurate. It describes the product for the purposes of health, safety and environment requirements only and shall, therefore, be used only as a guide. The data refers to a specific product and may not be valid for combined uses with other products. It is the user's obligation to evaluate and use this product safely and to comply with all applicable laws and regulations. Petrobras shall not be responsible for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices.*



# Sulfur

## Annex to the Safety Data Sheet

according to Regulation (EC) No. 453/2010  
Revision date: July 14, 2011

Supersedes:

Version: 1.0

### Exposure Scenarios for: Sulfur

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Trade Name : Sulfur  
CAS Number : 7704-34-9  
EC Number : 231-722-6  
SDS Reference : PbR0021

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### Acronyms:

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CSA	:	Chemical safety assessment
DNEL	:	Derived no effect level
DU	:	Downstream user
ERC	:	Environmental release category
ES	:	Exposure scenario
PC	:	Product category
PEC	:	Predicted environmental concentration
PNEC	:	Predicted no effect concentration
PPE	:	Personal protection equipment
PROC	:	Process category
RCR	:	Risk characterisation ratio
STP	:	Sewage treatment plant
SU	:	Sector of use
WWTP	:	Wastewater treatment plant

## Exposure Scenario (ES1):

### Manufacture of sulfur

9.1.1. Exposure scenario addressing uses carried out by workers	
Manufacture of sulfur	
Use descriptors related to the life cycle stage	<p>SU3 : Industrial uses: Uses of substances as such or in preparations at industrial sites</p> <p>SU8 : Manufacture of bulk, large scale chemicals (including petroleum products)</p> <p>SU9 : Manufacture of bulk, large scale chemicals (including petroleum products)</p> <p>PROC1 : Use in closed process, no likelihood of exposure</p> <p>PROC2 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC3 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC4 : Use in batch and other process (synthesis) where opportunity for exposure arises</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC15 : Use as laboratory reagent</p> <p>PROC22 : Potentially closed processing operations with minerals/metals at elevated temperature - Industrial setting</p> <p>PROC23 : Open processing and transfer operations with minerals/metals at elevated temperature</p> <p>ERC1 : Manufacture of substances</p> <p>ERC4 : Industrial use of processing aids in processes and products, not becoming part of articles</p>
Specific environmental release category	ESVOC SpERC 1.1.v1
9.1.2. Operational conditions and risk management measures	
9.1.2.1. Control of environmental exposure	
Not applicable as substance is not hazardous to the environment.	
9.1.2.2. Control of worker exposure	
Product characteristic	
Physical state	Solid at STP, liquid at elevated operating temperature

Concentration of substance in product	Up to 100%
Vapour pressure of substance	<0.5 kPa
<b>Frequency and duration of use/exposure</b>	
Frequency of use for which the ES ensures control of risk	days/year: not restricted
Duration of use for which the ES ensures control of risk	8 hours/day (all PROCs)
<b>Human factors not influenced by risk management</b>	
Not applicable.	
<b>Other given operational conditions affecting workers exposure</b>	
Operation is carried out at elevated temperature (>20° above ambient temperature).	
Assumes a good basic standard of occupational hygiene is implemented.	
<b>Technical conditions and measures at process level (source) to prevent release</b>	
No specific measured identified.	
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	
Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.	
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>	
No specific measured identified.	
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants)	
<b>9.1.3. Exposure information and reference to its source</b>	
<b>9.1.3.1. Prediction of environmental exposure resulting from the conditions described above</b>	
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.	
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).	
<b>9.1.3.2. Prediction of workers exposure resulting from the conditions described above</b>	
Workers exposure estimation is calculated with Ectoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure	

Process category	Inhalatory worker exposure (mg/m <sup>3</sup> )	Dermal worker exposure (mg/kg/day)
PROC 1	0.01 – 0.50	Not available
PROC 2	0.50	Not available
PROC 3	1	Not available
PROC 4	3.50	Not available
PROC 8a	1	Not available
PROC 8b	3.50	Not available
PROC 15	0.50	Not available
PROC 22	Not available	Not available
PROC 23	Not available	Not available

### Risk characterization:

Process category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
PROC 1	0.003 – 0.125	Not available	0.003 – 0.125
PROC 2	0.125	Not available	0.125
PROC 3	0.250	Not available	0.250
PROC 4	0.875	Not available	0.875
PROC 8a	0.250	Not available	0.250
PROC 8b	0.875	Not available	0.875
PROC 15	0.125	Not available	0.125
PROC 22	Not available	Not available	Not available
PROC 23	Not available	Not available	Not available

#### **9.1.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES**

The workers exposure has been evaluated using Ecetoc TRA integrated tool.

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

#### **9.1.5. Additional good practice advice beyond the REACH CSA**

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

## Exposure Scenario (ES2):

### Use of sulfur as as intermediate – Industrial

<b>9.2.1. Exposure scenario addressing uses carried out by workers</b>	
<b>Use of sulfur as as intermediate – Industrial</b>	
Use descriptors related to the life cycle stage	<p>SU3 : Industrial uses: Uses of substances as such or in preparations at industrial sites</p> <p>SU8 : Manufacture of bulk, large scale chemicals (including petroleum products)</p> <p>SU9 : Manufacture of bulk, large scale chemicals (including petroleum products)</p> <p>PROC1 : Use in closed process, no likelihood of exposure</p> <p>PROC2 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC3 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC4 : Use in batch and other process (synthesis) where opportunity for exposure arises</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC15 : Use as laboratory reagent</p> <p>PROC22 : Potentially closed processing operations with minerals/metals at elevated temperature - Industrial setting</p> <p>PROC23 : Open processing and transfer operations with minerals/metals at elevated temperature</p> <p>ERC6a : Industrial use resulting in manufacture of another substance (use of intermediates)</p>
Specific environmental release category	ESVOC SpERC 6.1a.v1
<b>9.2.2. Operational conditions and risk management measures</b>	
<b>9.2.2.1. Control of environmental exposure</b>	
Not applicable as substance is not hazardous to the environment.	
<b>9.2.2.2. Control of worker exposure</b>	
<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Concentration of substance in product	Up to 100%

Vapour pressure of substance	<0.5 kPa	
<b>Frequency and duration of use/exposure</b>		
Frequency of use for which the ES ensures control of risk	days/year: not restricted	
Duration of use for which the ES ensures control of risk	8 hours/day (all PROCs)	
<b>Human factors not influenced by risk management</b>		
Not applicable.		
<b>Other given operational conditions affecting workers exposure</b>		
Operation is carried out at elevated temperature (>20° above ambient temperature).		
Assumes a good basic standard of occupational hygiene is implemented.		
<b>Technical conditions and measures at process level (source) to prevent release</b>		
No specific measured identified.		
<b>Technical conditions and measures to control dispersion from source towards the worker</b>		
Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.		
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>		
No specific measured identified.		
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>		
1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants)		
<b>9.2.3. Exposure information and reference to its source</b>		
<b>9.2.3.1. Prediction of environmental exposure resulting from the conditions described above</b>		
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.		
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).		
<b>9.2.3.2. Prediction of workers exposure resulting from the conditions described above</b>		
Workers exposure estimation is calculated with Ectoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure		
<b>Process category</b>	<b>Inhalatory worker exposure (mg/m<sup>3</sup>)</b>	<b>Dermal worker exposure (mg/kg/day)</b>
PROC 1	0.01 – 0.35	Not available
PROC 2	0.35 - 0.50	Not available
PROC 3	1	Not available
PROC 4	3.50	Not available
PROC 8a	1	Not available
PROC 8b	3.50	Not available
PROC 15	0.50	Not available
PROC 22	3	Not available
PROC 23	3	Not available

### Risk characterization:

Process category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
PROC 1	0.003 – 0.088	Not available	0.003 – 0.088
PROC 2	0.088 - 0.125	Not available	0.088 - 0.125
PROC 3	0.250	Not available	0.250
PROC 4	0.875	Not available	0.875
PROC 8a	0.250	Not available	0.250
PROC 8b	0.875	Not available	0.875
PROC 15	0.125	Not available	0.125
PROC 22	0.750	Not available	0.750
PROC 23	0.750	Not available	0.750

### **9.2.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES**

The workers exposure has been evaluated using Ecetoc TRA integrated tool.

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

### **9.2.5. Additional good practice advice beyond the REACH CSA**

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

## Exposure Scenario (ES3):

### Distribution of sulfur – Industrial

9.3.1. Exposure scenario addressing uses carried out by workers	
Distribution of sulfur – Industrial	
Use descriptors related to the life cycle stage	<p>SU3 : Industrial uses: Uses of substances as such or in preparations at industrial sites</p> <p>PROC1 : Use in closed process, no likelihood of exposure</p> <p>PROC2 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC3 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC4 : Use in batch and other process (synthesis) where opportunity for exposure arises</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC9 : Transfer of substance or preparation into small containers (dedicated filling line, including weighing)</p> <p>PROC15 : Use as laboratory reagent</p> <p>ERC1 : Manufacture of substances</p> <p>ERC2 : Formulation of preparations</p> <p>ERC3 : Formulation in materials</p> <p>ERC4 : Industrial use of processing aids in processes and products, not becoming part of articles</p> <p>ERC5 : Industrial use resulting in inclusion into or onto a matrix</p> <p>ERC6a : Industrial use resulting in manufacture of another substance (use of intermediates)</p> <p>ERC6b : Industrial use of reactive processing aids</p> <p>ERC6c : Industrial use of monomers for manufacture of thermo-plastics</p> <p>ERC6d : Industrial use of process regulators for polymerisation processes in production of resins, rubbers, polymers</p> <p>ERC7 : Industrial use of substances in closed systems</p>
Specific environmental release category	ESVOC SpERC 1.1b.v1
9.3.2. Operational conditions and risk management measures	

<b>9.3.2.1. Control of environmental exposure</b>	
Not applicable as substance is not hazardous to the environment	
<b>9.3.2.2. Control of worker exposure</b>	
<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Concentration of substance in product	Up to 100%
Vapour pressure of substance	<0.5 kPa
<b>Frequency and duration of use/exposure</b>	
Frequency of use for which the ES ensures control of risk	days/year: not restricted
Duration of use for which the ES ensures control of risk	8 hours/day (all PROCs)
<b>Human factors not influenced by risk management</b>	
Not applicable.	
<b>Other given operational conditions affecting workers exposure</b>	
Operation is carried out at elevated temperature (>20° above ambient temperature).	
Assumes a good basic standard of occupational hygiene is implemented.	
<b>Technical conditions and measures at process level (source) to prevent release</b>	
No specific measured identified.	
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	
Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.	
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>	
No specific measured identified.	
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants)	
<b>9.3.3. Exposure information and reference to its source</b>	
<b>9.3.3.1. Prediction of environmental exposure resulting from the conditions described above</b>	
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.	
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).	
<b>9.3.3.2. Prediction of workers exposure resulting from the conditions described above</b>	
Workers exposure estimation is calculated with Ecetoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure	

Process category	Inhalatory worker exposure (mg/m <sup>3</sup> )	Dermal worker exposure (mg/kg/day)
PROC 1	0.01 – 0.35	Not available
PROC 2	0.35 - 0.50	Not available
PROC 3	1	Not available
PROC 4	3.50	Not available
PROC 8a	1	Not available
PROC 8b	3.50	Not available
PROC 9	3.50	Not available
PROC 15	0.50	Not available

### Risk characterization:

Process category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
PROC 1	0.003 – 0.088	Not available	0.003 – 0.088
PROC 2	0.088 - 0.125	Not available	0.088 - 0.125
PROC 3	0.250	Not available	0.250
PROC 4	0.875	Not available	0.875
PROC 8a	0.250	Not available	0.250
PROC 8b	0.875	Not available	0.875
PROC 9	0.875	Not available	0.875
PROC 15	0.125	Not available	0.125

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

The workers exposure has been evaluated using Ecetoc TRA integrated tool.  
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

### 9.3.5. Additional good practice advice beyond the REACH CSA

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

### **Exposure Scenario (ES4):**

#### Formulation & (Re)packing of sulfur – Industrial

9.4.1. Exposure scenario addressing uses carried out by workers	
Formulation & (Re)packing of sulfur – Industrial	
Use descriptors related to the life cycle stage	<p>SU3 : Industrial uses: Uses of substances as such or in preparations at industrial sites</p> <p>SU10 : Formulation [mixing] of preparations and/or re-packaging (excluding alloys)</p> <p>PROC1 : Use in closed process, no likelihood of exposure</p> <p>PROC2 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC3 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC4 : Use in batch and other process (synthesis) where opportunity for exposure arises</p> <p>PROC5 : Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC9 : Transfer of substance or preparation into small containers (dedicated filling line, including weighing)</p> <p>PROC14 : Production of preparations or articles by tableting, compression, extrusion, pelletisation</p> <p>PROC15 : Use as laboratory reagent</p> <p>PROC22 : Potentially closed processing operations with minerals/metals at elevated temperature - Industrial setting</p> <p>PROC23 : Open processing and transfer operations with minerals/metals at elevated temperature</p> <p>ERC2 : Formulation of preparations</p>
Specific environmental release category	ESVOC SpERC 2.2.v1
9.4.2. Operational conditions and risk management measures	
9.4.2.1. Control of environmental exposure	
Not applicable as substance is not hazardous to the environment	
9.4.2.2. Control of worker exposure	

<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Concentration of substance in product	Up to 100%
Vapour pressure of substance	<0.5 kPa
<b>Frequency and duration of use/exposure</b>	
Frequency of use for which the ES ensures control of risk	days/year: not restricted
Duration of use for which the ES ensures control of risk	8 hours/day (all PROCs)
<b>Human factors not influenced by risk management</b>	
Not applicable.	
<b>Other given operational conditions affecting workers exposure</b>	
Operation is carried out at elevated temperature (>20° above ambient temperature).	
Assumes a good basic standard of occupational hygiene is implemented.	
<b>Technical conditions and measures at process level (source) to prevent release</b>	
No specific measured identified.	
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	
Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.	
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>	
No specific measured identified.	
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants)	
<b>9.4.3. Exposure information and reference to its source</b>	
<b>9.4.3.1. Prediction of environmental exposure resulting from the conditions described above</b>	
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.	
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).	
<b>9.4.3.2. Prediction of workers exposure resulting from the conditions described above</b>	
Workers exposure estimation is calculated with Ectoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure	

Process category	Inhalatory worker exposure (mg/m <sup>3</sup> )	Dermal worker exposure (mg/kg/day)
PROC 1	0.01 – 0.35	Not available
PROC 2	0.35 – 0.50	Not available
PROC 3	1	Not available
PROC 4	3.50	Not available
PROC 5	3.50	Not available
PROC 8a	1	Not available
PROC 8b	3.50	Not available
PROC 9	2	Not available
PROC 14	1	Not available
PROC 15	0.50	Not available
PROC 23	3	Not available
PROC 24	2	Not available

### Risk characterization:

Process category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
PROC 1	0.003 – 0.088	Not available	0.003 – 0.088
PROC 2	0.088 - 0.125	Not available	0.088 - 0.125
PROC 3	0.250	Not available	0.250
PROC 4	0.875	Not available	0.875
PROC 5	0.875	Not available	0.875
PROC 8a	0.250	Not available	0.250
PROC 8b	0.875	Not available	0.875
PROC 9	0.500	Not available	0.500
PROC 14	0.250	Not available	0.250
PROC 15	0.125	Not available	0.125
PROC 23	0.750	Not available	0.750
PROC 24	0.500	Not available	0.500

### **9.4.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES**

The workers exposure has been evaluated using Ecetoc TRA integrated tool.

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

### **9.4.5. Additional good practice advice beyond the REACH CSA**

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

### **Exposure Scenario (ES5):**

#### Use of sulfur as release agents or binders – Industrial

<b>9.5.1. Exposure scenario addressing uses carried out by workers</b>	
<b>Use of sulfur as release agents or binders – Industrial</b>	
Use descriptors related to the life cycle stage	<p>SU3 : Industrial uses: Uses of substances as such or in preparations at industrial sites</p> <p>PROC1 : Use in closed process, no likelihood of exposure</p> <p>PROC2 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC3 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC4 : Use in batch and other process (synthesis) where opportunity for exposure arises</p> <p>PROC6 : Calendering operations</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC10 : Roller application or brushing</p> <p>PROC13 : Treatment of articles by dipping and pouring</p> <p>PROC14 : Production of preparations or articles by tableting, compression, extrusion, pelletisation</p> <p>ERC4 : Industrial use of processing aids in processes and products, not becoming part of articles</p>
Specific environmental release category	ESVOC SpERC 4.10a.v1
<b>9.5.2. Operational conditions and risk management measures</b>	
<b>9.5.2.1. Control of environmental exposure</b>	
Not applicable as substance is not hazardous to the environment	
<b>9.5.2.2. Control of worker exposure</b>	
<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Concentration of substance in product	Up to 100%
Vapour pressure of substance	<0.5 kPa
<b>Frequency and duration of use/exposure</b>	
Frequency of use for which the ES ensures control of risk	days/year: not restricted
Duration of use for which the ES ensures control of risk	8 hours/day (all PROCs)

<b>Human factors not influenced by risk management</b>		
Not applicable.		
<b>Other given operational conditions affecting workers exposure</b>		
Operation is carried out at elevated temperature (>20° above ambient temperature).		
Assumes a good basic standard of occupational hygiene is implemented.		
<b>Technical conditions and measures at process level (source) to prevent release</b>		
No specific measured identified.		
<b>Technical conditions and measures to control dispersion from source towards the worker</b>		
Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.		
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>		
No specific measured identified.		
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>		
<ol style="list-style-type: none"> <li>1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants)</li> <li>2. PPE: 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.</li> </ol>		
<b>9.5.3. Exposure information and reference to its source</b>		
<b>9.5.3.1. Prediction of environmental exposure resulting from the conditions described above</b>		
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.		
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).		
<b>9.5.3.2. Prediction of workers exposure resulting from the conditions described above</b>		
Workers exposure estimation is calculated with Ecetoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure		
<b>Process category</b>	<b>Inhalatory worker exposure (mg/m<sup>3</sup>)</b>	<b>Dermal worker exposure (mg/kg/day)</b>
PROC 1	0.01	Not available
PROC 2	0.50	Not available
PROC 3	1	Not available
PROC 4	3.50	Not available
PROC 6	3.50	Not available
PROC 8a	1	Not available
PROC 8b	3.50	Not available
PROC 10	1.50	Not available
PROC 13	1	Not available
PROC 14	1	Not available

### **Risk characterization:**

Process category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
PROC 1	0.003	Not available	0.003
PROC 2	0.125	Not available	0.125
PROC 3	0.250	Not available	0.250
PROC 4	0.875	Not available	0.875
PROC 6	0.875	Not available	0.875
PROC 8a	0.250	Not available	0.250
PROC 8b	0.875	Not available	0.875
PROC 10	0.375	Not available	0.375
PROC 13	0.250	Not available	0.250
PROC 14	0.250	Not available	0.250

### **9.5.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES**

The workers exposure has been evaluated using Ecetoc TRA integrated tool.

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

### **9.5.5. Additional good practice advice beyond the REACH CSA**

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

### Exposure Scenario (ES6):

#### Use of sulfur as release agents or binders – Professional

<b>9.6.1. Exposure scenario addressing uses carried out by workers</b>	
<b>Use of sulfur as release agents or binders – Professional</b>	
Use descriptors related to the life cycle stage	<p>SU22 : Professional uses: Public domain (administration, education, entertainment, services, craftsmen)</p> <p>PROC1 : Use in closed process, no likelihood of exposure</p> <p>PROC2 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC3 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC4 : Use in batch and other process (synthesis) where opportunity for exposure arises</p> <p>PROC6 : Calendering operations</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC10 : Roller application or brushing</p> <p>PROC13 : Treatment of articles by dipping and pouring</p> <p>PROC14 : Production of preparations or articles by tableting, compression, extrusion, pelletisation</p> <p>ERC8a : Wide dispersive indoor use of processing aids in open systems</p> <p>ERC8d : Wide dispersive outdoor use of processing aids in open systems</p>
Specific environmental release category	ESVOC SpERC 8.10b.v1
<b>9.6.2. Operational conditions and risk management measures</b>	
<b>9.6.2.1. Control of environmental exposure</b>	
Not applicable as substance is not hazardous to the environment	
<b>9.6.2.2. Control of worker exposure</b>	
<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Concentration of substance in product	Up to 100%
Vapour pressure of substance	<0.5 kPa
<b>Frequency and duration of use/exposure</b>	
Frequency of use for which the ES ensures control of risk	days/year: not restricted
Duration of use for which the ES ensures control of risk	8 hours/day (all PROCs)

<b>Human factors not influenced by risk management</b>		
Not applicable.		
<b>Other given operational conditions affecting workers exposure</b>		
Operation is carried out at elevated temperature (>20° above ambient temperature).		
Assumes a good basic standard of occupational hygiene is implemented.		
<b>Technical conditions and measures at process level (source) to prevent release</b>		
No specific measured identified.		
<b>Technical conditions and measures to control dispersion from source towards the worker</b>		
Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.		
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>		
No specific measured identified.		
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>		
1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants) 2. PPE: 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.		
<b>9.6.3. Exposure information and reference to its source</b>		
<b>9.6.3.1. Prediction of environmental exposure resulting from the conditions described above</b>		
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physicochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.		
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).		
<b>9.6.3.2. Prediction of workers exposure resulting from the conditions described above</b>		
Workers exposure estimation is calculated with Ectoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure		
<b>Process category</b>	<b>Inhalatory worker exposure (mg/m<sup>3</sup>)</b>	<b>Dermal worker exposure (mg/kg/day)</b>
PROC 1	0.01	Not available
PROC 2	1	Not available
PROC 3	1	Not available
PROC 4	3.50	Not available
PROC 6	3.50	Not available
PROC 8a	1	Not available
PROC 8b	3.50	Not available
PROC 10	1.50	Not available
PROC 13	1.50	Not available
PROC 14	1.50	Not available

### Risk characterization:

Process category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
PROC 1	0.003	Not available	0.003
PROC 2	0.250	Not available	0.125
PROC 3	0.250	Not available	0.250
PROC 4	0.875	Not available	0.875
PROC 6	0.875	Not available	0.875
PROC 8a	0.250	Not available	0.250
PROC 8b	0.875	Not available	0.875
PROC 10	0.375	Not available	0.375
PROC 13	0.375	Not available	0.375
PROC 14	0.375	Not available	0.375

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

The workers exposure has been evaluated using Ecetoc TRA integrated tool.  
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

#### 9.6.5. Additional good practice advice beyond the REACH CSA

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

### Exposure Scenario (ES7):

#### Use of sulfur in agrochemicals – Professional

<b>9.7.1. Exposure scenario addressing uses carried out by workers</b>	
<b>Use of sulfur in agrochemicals – Professional</b>	
Use descriptors related to the life cycle stage	<p>SU22 : Professional uses: Public domain (administration, education, entertainment, services, craftsmen)</p> <p>PROC1 : Use in closed process, no likelihood of exposure</p> <p>PROC4 : Use in batch and other process (synthesis) where opportunity for exposure arises</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC11 : Non industrial spraying</p> <p>PROC13 : Treatment of articles by dipping and pouring</p> <p>ERC8a : Wide dispersive indoor use of processing aids in open systems</p> <p>ERC8d : Wide dispersive outdoor use of processing aids in open systems</p>
Specific environmental release category	ESVOC SpERC 8.11a.v1
<b>9.7.2. Operational conditions and risk management measures</b>	
<b>9.7.2.1. Control of environmental exposure</b>	
Not applicable as substance is not hazardous to the environment	
<b>9.7.2.2. Control of worker exposure</b>	
<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Concentration of substance in product	Up to 100%
Vapour pressure of substance	<0.5 kPa
<b>Frequency and duration of use/exposure</b>	
Frequency of use for which the ES ensures control of risk	days/year: not restricted
Duration of use for which the ES ensures control of risk	8 hours/day (PROC 1, 4, 8b & 11) <4 hours/day (PROC 8a & 13)
<b>Human factors not influenced by risk management</b>	
Not applicable.	
<b>Other given operational conditions affecting workers exposure</b>	
Operation is carried out at elevated temperature (>20° above ambient temperature).	
Assumes a good basic standard of occupational hygiene is implemented.	

<b>Technical conditions and measures at process level (source) to prevent release</b>			
No specific measured identified.			
<b>Technical conditions and measures to control dispersion from source towards the worker</b>			
Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.			
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>			
No specific measured identified.			
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>			
<ol style="list-style-type: none"> <li>1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants)</li> <li>2. PPE: Wear a respirator conforming to EN140 with Type A/P2 filter or better (PROC 11 – if technical measures not practicable)</li> <li>3. PPE: 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.</li> </ol>			
<b>9.7.3. Exposure information and reference to its source</b>			
<b>9.7.3.1. Prediction of environmental exposure resulting from the conditions described above</b>			
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.			
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).			
<b>9.7.3.2. Prediction of workers exposure resulting from the conditions described above</b>			
Workers exposure estimation is calculated with Ecetoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure			
<b>Process category</b>	<b>Inhalatory worker exposure (mg/m<sup>3</sup>)</b>	<b>Dermal worker exposure (mg/kg/day)</b>	
PROC 1	0.01	Not available	
PROC 4	3.50	Not available	
PROC 8a	1	Not available	
PROC 8b	3.50	Not available	
PROC 11	2	Not available	
PROC 13	3	Not available	
<b>Risk characterization:</b>			
<b>Process category</b>	<b>RCR (inhalation)</b>	<b>RCR (dermal)</b>	<b>RCR (all routes)</b>
PROC 1	0.003	Not available	0.003
PROC 4	0.875	Not available	0.875
PROC 8a	0.250	Not available	0.250
PROC 8b	0.875	Not available	0.875
PROC 11	0.500	Not available	0.500
PROC 13	0.750	Not available	0.750



# Sulfur

## Annex to the Safety Data Sheet

according to Regulation (EC) No. 453/2010  
Revision date: July 14, 2011

Supersedes:

Version: 1.0

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

The workers exposure has been evaluated using Ecetoc TRA integrated tool.  
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

### 9.7.5. Additional good practice advice beyond the REACH CSA

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

## **Exposure Scenario (ES8):**

### Consumer use of sulfur in agrochemicals

<b>9.8.1. Exposure Scenario for Consumer use of sulfur in agrochemicals</b>	
Use descriptors related to the life cycle stage	SU21 : Consumer uses: Private households (= general public = consumers) PC12 : Fertilizers PC27 : Plant protection products ERC8a : Wide dispersive indoor use of processing aids in open systems ERC8d : Wide dispersive indoor use of reactive substances in open systems
Specific environmental release category	ESVOC SpERC 8.11b.v1
<b>9.8.2. Operational conditions and risk management measures</b>	
<b>9.8.2.1. Control of environmental exposure</b>	
Not applicable as substance is not hazardous to the environment	
<b>9.8.2.2. Control of consumer exposure</b>	
<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Vapour pressure of substance	<0.5 kPa
<b>Substance content in the product</b>	Up to 100%
<b>Amounts of product used / applied per event</b>	Up to 37,500 g
<b>Frequency and duration of use/exposure</b>	Covers use frequency up to 4 times per day
	Duration of exposure: up to 8 hours per event
<b>Consumer related measures</b>	Covers concentrations up to 100%; Covers use 1- 365 days/year; Covers use up to 1-4 times/on day of use; Covers skin contact area up to 857.50 cm <sup>2</sup> for each use event; Covers use amounts up to 2,500 – 37,500 g; Covers use in room size of 20m <sup>3</sup> ; For each use event, covers exposure up to 8.00hr/event;  RMM: No specific RMMs identified beyond those OCs stated
<b>Other Operational Conditions affecting exposure</b>	Assumes use at ambient temperatures; assumes use in a 20m <sup>3</sup> room; assumes use with typical ventilation.
<b>9.8.3. Exposure information and reference to its source</b>	
<b>9.8.3.1. Prediction of environmental exposure resulting from the conditions described above</b>	
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.	
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).	
<b>9.8.3.2. Prediction of consumer exposure resulting from the conditions described above</b>	
Consumer exposure estimation is calculated with Ecetoc TRA model.	

DNEL (dermal and oral) consumer: the reference value of 0.5 mg/kg/day has been used to assess consumer exposure.

DNEL inhalative (consumer): the reference value of 150 mg/m<sup>3</sup> has been used to assess consumer exposure

Risk Management Measures are based on qualitative risk characterisation.

Ranges for exposure estimates and RCR are listed below. For more information contact the supplier or refer to the CSR.

Consumers exposure	Dermal (mg/kg/day)	Oral (mg/kg/day)	Inhalation (mg/m <sup>3</sup> for 24hr day)	All routes systematic (mg/kg/day)
Exposure estimates	0.39	0.08	-	-

**Risk characterization:**

Process category	RCR (dermal)	RCR (oral)	RCR (inhalation)	RCR (all routes)
All PROCs	0.77	0.16	-	0.93

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

The consumer exposure has been evaluated using Ecetoc TRA integrated tool, consistent with the content of ECETOC Report #107 and the Chapter R15 of the IR&CSA TGD.

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

**9.8.5. Additional good practice advice beyond the REACH CSA**

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

### **Exposure Scenario (ES9):**

Use of sulfur in road and construction applications – Professional

<b>9.9.1. Exposure scenario addressing uses carried out by workers</b>	
<b>Use of sulfur in road and construction applications – Professional</b>	
Use descriptors related to the life cycle stage	<p>SU22 : Professional uses: Public domain (administration, education, entertainment, services, craftsmen)</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC9 : Transfer of substance or preparation into small containers (dedicated filling line, including weighing)</p> <p>PROC10 : Roller application or brushing</p> <p>PROC11 : Non industrial spraying</p> <p>PROC13 : Treatment of articles by dipping and pouring</p> <p>ERC8d : Wide dispersive outdoor use of processing aids in open systems</p> <p>ERC8f : Wide dispersive outdoor use resulting in inclusion into or onto a matrix</p>
Specific environmental release category	ESVOC SpERC 8.15.v1
<b>9.9.2. Operational conditions and risk management measures</b>	
<b>9.9.2.1. Control of environmental exposure</b>	
Not applicable as substance is not hazardous to the environment	
<b>9.9.2.2. Control of worker exposure</b>	
<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Concentration of substance in product	Up to 100%
Vapour pressure of substance	<0.5 kPa
<b>Frequency and duration of use/exposure</b>	
Frequency of use for which the ES ensures control of risk	days/year: not restricted
Duration of use for which the ES ensures control of risk	8 hours/day (all PROCs)
<b>Human factors not influenced by risk management</b>	
Not applicable.	
<b>Other given operational conditions affecting workers exposure</b>	
Operation is carried out at elevated temperature (>20° above ambient temperature).	
Assumes a good basic standard of occupational hygiene is implemented.	
<b>Technical conditions and measures at process level (source) to prevent release</b>	

No specific measured identified.																												
<b>Technical conditions and measures to control dispersion from source towards the worker</b>																												
Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.																												
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>																												
No specific measured identified.																												
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>																												
1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants) 2. PPE: 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.																												
<b>9.9.3. Exposure information and reference to its source</b>																												
<b>9.9.3.1. Prediction of environmental exposure resulting from the conditions described above</b>																												
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.																												
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).																												
<b>9.9.3.2. Prediction of workers exposure resulting from the conditions described above</b>																												
Workers exposure estimation is calculated with Ectoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure																												
<table border="1"> <thead> <tr> <th>Process category</th> <th>Inhalatory worker exposure (mg/m<sup>3</sup>)</th> <th>Dermal worker exposure (mg/kg/day)</th> </tr> </thead> <tbody> <tr> <td>PROC 8a</td> <td>1</td> <td>Not available</td> </tr> <tr> <td>PROC 8b</td> <td>1</td> <td>Not available</td> </tr> <tr> <td>PROC 9</td> <td>1</td> <td>Not available</td> </tr> <tr> <td>PROC 10</td> <td>1</td> <td>Not available</td> </tr> <tr> <td>PROC 11</td> <td>2.80</td> <td>Not available</td> </tr> <tr> <td>PROC 13</td> <td>1</td> <td>Not available</td> </tr> </tbody> </table>	Process category	Inhalatory worker exposure (mg/m <sup>3</sup> )	Dermal worker exposure (mg/kg/day)	PROC 8a	1	Not available	PROC 8b	1	Not available	PROC 9	1	Not available	PROC 10	1	Not available	PROC 11	2.80	Not available	PROC 13	1	Not available							
Process category	Inhalatory worker exposure (mg/m <sup>3</sup> )	Dermal worker exposure (mg/kg/day)																										
PROC 8a	1	Not available																										
PROC 8b	1	Not available																										
PROC 9	1	Not available																										
PROC 10	1	Not available																										
PROC 11	2.80	Not available																										
PROC 13	1	Not available																										
<b>Risk characterization:</b>																												
<table border="1"> <thead> <tr> <th>Process category</th> <th>RCR (inhalation)</th> <th>RCR (dermal)</th> <th>RCR (all routes)</th> </tr> </thead> <tbody> <tr> <td>PROC 8a</td> <td>0.250</td> <td>Not available</td> <td>0.250</td> </tr> <tr> <td>PROC 8b</td> <td>0.250</td> <td>Not available</td> <td>0.250</td> </tr> <tr> <td>PROC 9</td> <td>0.250</td> <td>Not available</td> <td>0.250</td> </tr> <tr> <td>PROC 10</td> <td>0.250</td> <td>Not available</td> <td>0.250</td> </tr> <tr> <td>PROC 11</td> <td>0.700</td> <td>Not available</td> <td>0.700</td> </tr> <tr> <td>PROC 13</td> <td>0.250</td> <td>Not available</td> <td>0.250</td> </tr> </tbody> </table>	Process category	RCR (inhalation)	RCR (dermal)	RCR (all routes)	PROC 8a	0.250	Not available	0.250	PROC 8b	0.250	Not available	0.250	PROC 9	0.250	Not available	0.250	PROC 10	0.250	Not available	0.250	PROC 11	0.700	Not available	0.700	PROC 13	0.250	Not available	0.250
Process category	RCR (inhalation)	RCR (dermal)	RCR (all routes)																									
PROC 8a	0.250	Not available	0.250																									
PROC 8b	0.250	Not available	0.250																									
PROC 9	0.250	Not available	0.250																									
PROC 10	0.250	Not available	0.250																									
PROC 11	0.700	Not available	0.700																									
PROC 13	0.250	Not available	0.250																									



# Sulfur

## Annex to the Safety Data Sheet

according to Regulation (EC) No. 453/2010  
Revision date: July 14, 2011

Supersedes:

Version: 1.0

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

The workers exposure has been evaluated using Ecetoc TRA integrated tool.  
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

### 9.9.5. Additional good practice advice beyond the REACH CSA

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

### Exposure Scenario (ES10):

#### Use of sulfur in rubber production and processing – Industrial

9.10.1. Exposure scenario addressing uses carried out by workers	
Use of sulfur in rubber production and processing – Industrial	
Use descriptors related to the life cycle stage	<p>SU3 : Industrial uses: Uses of substances as such or in preparations at industrial sites</p> <p>SU10 : Formulation [mixing] of preparations and/or re-packaging (excluding alloys)</p> <p>SU11 : Manufacture of rubber products</p> <p>PROC1 : Use in closed process, no likelihood of exposure</p> <p>PROC2 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC3 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC4 : Use in batch and other process (synthesis) where opportunity for exposure arises</p> <p>PROC5 : Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)</p> <p>PROC6 : Calendering operations</p> <p>PROC7 : Industrial spraying</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC9 : Transfer of substance or preparation into small containers (dedicated filling line, including weighing)</p> <p>PROC13 : Treatment of articles by dipping and pouring</p> <p>PROC14 : Production of preparations or articles by tableting, compression, extrusion, pelletisation</p> <p>PROC15 : Use as laboratory reagent</p> <p>PROC21 : Low energy manipulation of substances bound in materials and/or articles</p> <p>ERC1 : Manufacture of substances</p> <p>ERC4 : Industrial use of processing aids in processes and products, not becoming part of articles</p> <p>ERC6d : Industrial use of process regulators for polymerisation processes in</p>

	production of resins, rubbers, polymers
Specific environmental release category	ESVOC SpERC 4.19.v1
<b>9.10.2. Operational conditions and risk management measures</b>	
<b>9.10.2.1. Control of environmental exposure</b>	
Not applicable as substance is not hazardous to the environment	
<b>9.10.2.2. Control of worker exposure</b>	
<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Concentration of substance in product	Up to 100%
Vapour pressure of substance	<0.5 kPa
<b>Frequency and duration of use/exposure</b>	
Frequency of use for which the ES ensures control of risk	days/year: not restricted
Duration of use for which the ES ensures control of risk	8 hours/day (all PROCs)
<b>Human factors not influenced by risk management</b>	
Not applicable.	
<b>Other given operational conditions affecting workers exposure</b>	
Operation is carried out at elevated temperature (>20° above ambient temperature).	
Assumes a good basic standard of occupational hygiene is implemented.	
<b>Technical conditions and measures at process level (source) to prevent release</b>	
No specific measured identified.	
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	
Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.	
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>	
No specific measured identified.	
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants) 2. PPE: 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.	
<b>9.10.3. Exposure information and reference to its source</b>	
<b>9.10.3.1. Prediction of environmental exposure resulting from the conditions described above</b>	
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.	
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).	
<b>9.10.3.2. Prediction of workers exposure resulting from the conditions described above</b>	
Workers exposure estimation is calculated with Ectoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure	

Process category	Inhalatory worker exposure (mg/m <sup>3</sup> )	Dermal worker exposure (mg/kg/day)
PROC 1	0.01	Not available
PROC 2	0.50	Not available
PROC 3	1	Not available
PROC 4	3.50	Not available
PROC 5	3.50	Not available
PROC 6	3.50	Not available
PROC 7	1	Not available
PROC 8a	1	Not available
PROC 8b	3.50	Not available
PROC 9	3.50	Not available
PROC 13	1	Not available
PROC 14	1	Not available
PROC 15	0.50	Not available
PROC 21	5	Not available

### Risk characterization:

Process category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
PROC 1	0.003	Not available	0.003
PROC 2	0.125	Not available	0.125
PROC 3	0.250	Not available	0.250
PROC 4	0.875	Not available	0.875
PROC 5	0.875	Not available	0.875
PROC 6	0.875	Not available	0.875
PROC 7	0.250	Not available	0.250
PROC 8a	0.250	Not available	0.250
PROC 8b	0.875	Not available	0.875
PROC 9	0.875	Not available	0.875
PROC 13	0.250	Not available	0.250
PROC 14	0.250	Not available	0.250
PROC 15	0.125	Not available	0.125
PROC 21	0.750	Not available	0.750

### **9.10.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES**

The workers exposure has been evaluated using Ecetoc TRA integrated tool.

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.



# Sulfur

## Annex to the Safety Data Sheet

according to Regulation (EC) No. 453/2010  
Revision date: July 14, 2011

Supersedes:

Version: 1.0

### **9.10.5. Additional good practice advice beyond the REACH CSA**

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

## Exposure Scenario (ES11):

### Use of sulfur as a fuel – Industrial

<b>9.11.1. Exposure scenario addressing uses carried out by workers</b>	
<b>Use of sulfur as a fuel – Industrial</b>	
Use descriptors related to the life cycle stage	<p>SU3 : Industrial uses: Uses of substances as such or in preparations at industrial sites</p> <p>PROC1 : Use in closed process, no likelihood of exposure</p> <p>PROC2 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC3 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC4 : Use in batch and other process (synthesis) where opportunity for exposure arises</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>PROC16 : Using material as fuel sources, limited exposure to unburned product to be expected</p> <p>ERC7 : Industrial use of substances in closed systems</p>
Specific environmental release category	ESVOC SpERC 7.12a.v1
<b>9.11.2. Operational conditions and risk management measures</b>	
<b>9.11.2.1. Control of environmental exposure</b>	
Not applicable as substance is not hazardous to the environment	
<b>9.11.2.2. Control of worker exposure</b>	
<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Concentration of substance in product	Up to 100%
Vapour pressure of substance	<0.5 kPa
<b>Frequency and duration of use/exposure</b>	
Frequency of use for which the ES ensures control of risk	days/year: not restricted
Duration of use for which the ES ensures control of risk	8 hours/day (all PROCs)
<b>Human factors not influenced by risk management</b>	
Not applicable.	
<b>Other given operational conditions affecting workers exposure</b>	
Operation is carried out at elevated temperature (>20° above ambient temperature).	

Assumes a good basic standard of occupational hygiene is implemented.																								
<b>Technical conditions and measures at process level (source) to prevent release</b>																								
No specific measured identified.																								
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Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.																								
<b>Organisational measures to prevent /limit releases, dispersion and exposure</b>																								
No specific measured identified.																								
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>																								
1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants) 2. PPE: 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.																								
<b>9.11.3. Exposure information and reference to its source</b>																								
<b>9.11.3.1. Prediction of environmental exposure resulting from the conditions described above</b>																								
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.																								
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).																								
<b>9.11.3.2. Prediction of workers exposure resulting from the conditions described above</b>																								
Workers exposure estimation is calculated with Ecetoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure																								
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Process category	Inhalatory worker exposure (mg/m <sup>3</sup> )	Dermal worker exposure (mg/kg/day)																						
PROC 1	0.01 – 0.35	Not available																						
PROC 2	0.35 - 0.50	Not available																						
PROC 3	1	Not available																						
PROC 4	3.50	Not available																						
PROC 8a	1	Not available																						
PROC 8b	3.50	Not available																						
PROC 16	3.50	Not available																						

### **Risk characterization:**

Process category	RCR (inhalation)	RCR (dermal)	RCR (all routes)
PROC 1	0.003 – 0.088	Not available	0.003 – 0.088
PROC 2	0.088 – 0.125	Not available	0.088 – 0.125
PROC 3	0.250	Not available	0.250
PROC 4	0.875	Not available	0.875
PROC 8a	0.250	Not available	0.250
PROC 8b	0.875	Not available	0.875
PROC 16	0.875	Not available	0.875

#### **9.11.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES**

The workers exposure has been evaluated using Ectoc TRA integrated tool.

Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

#### **9.11.5. Additional good practice advice beyond the REACH CSA**

Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.

### Exposure Scenario (ES12):

#### Use of sulfur in explosives manufacture and use – Professional

<b>9.12.1. Exposure scenario addressing uses carried out by workers</b>	
<b>Use of sulfur in explosives manufacture and use – Professional</b>	
Use descriptors related to the life cycle stage	<p>SU22 : Professional uses: Public domain (administration, education, entertainment, services, craftsmen)</p> <p>PROC1 : Use in closed process, no likelihood of exposure</p> <p>PROC3 : Use in closed, continuous process with occasional controlled exposure</p> <p>PROC5 : Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)</p> <p>PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities</p> <p>PROC8b : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</p> <p>ERC8e : Wide dispersive outdoor use of reactive substances in open systems</p>
Specific environmental release category	Not applicable
<b>9.12.2. Operational conditions and risk management measures</b>	
<b>9.12.2.1. Control of environmental exposure</b>	
Not applicable as substance is not hazardous to the environment	
<b>9.12.2.2. Control of worker exposure</b>	
<b>Product characteristic</b>	
Physical state	Solid at STP, liquid at elevated operating temperature
Concentration of substance in product	Up to 100%
Vapour pressure of substance	<0.5 kPa
<b>Frequency and duration of use/exposure</b>	
Frequency of use for which the ES ensures control of risk	days/year: not restricted
Duration of use for which the ES ensures control of risk	8 hours/day (all PROCs)
<b>Human factors not influenced by risk management</b>	
Not applicable.	
<b>Other given operational conditions affecting workers exposure</b>	
Operation is carried out at elevated temperature (>20° above ambient temperature).	
Assumes a good basic standard of occupational hygiene is implemented.	
<b>Technical conditions and measures at process level (source) to prevent release</b>	
No specific measured identified.	

<b>Technical conditions and measures to control dispersion from source towards the worker</b>																											
Recommended measures for skin irritants (as determined by qualitative risk assessment): Avoid direct contact with product. Identify potential areas for indirect skin contact. Clean up contamination/spills as soon as they occur. Provide basic employee training to prevent/minimise exposures and to report any skin problems that may develop.																											
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No specific measured identified.																											
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>																											
1. PPE: Wear gloves (tested to EN374) if hand contact with substance likely (recommended for skin irritants)																											
<b>9.12.3. Exposure information and reference to its source</b>																											
<b>9.12.3.1. Prediction of environmental exposure resulting from the conditions described above</b>																											
Environmental exposures have not been conducted because the substance is inorganic and highly insoluble in water (water solubility < 5µg/l). Based on the physiochemical properties of the substance it is expected to have a low potential for adsorption and bioaccumulation.																											
PNEC values were not calculated as the substance is highly insoluble in water (water solubility < 5µg/l).																											
<b>9.12.3.2. Prediction of workers exposure resulting from the conditions described above</b>																											
Workers exposure estimation is calculated with Ecetoc TRA model. DNEL (dermal) worker: available data do not enable the derivation of a DNEL for dermal irritant effects. Risk Management Measures are based on qualitative risk characterisation. DNEL inhalative (worker): the reference value of 4 mg/m <sup>3</sup> has been used to assess occupational exposure																											
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<b>9.12.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES</b>																											
The workers exposure has been evaluated using Ecetoc TRA integrated tool. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.																											
<b>9.12.5. Additional good practice advice beyond the REACH CSA</b>																											
Use specific measures expected to reduce the predicted exposure beyond the level estimated based on the exposure scenario when possible.																											

### **Exposure Scenario (ES13):**

#### **Use of sulfur in matches – Consumer**

##### **Prediction of consumer exposure**

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<sub>50</sub> was used in modeling,

Specific gravity of Sulfur considered for this assessment is 2,07 g/cm<sup>3</sup>. The Vapour Pressure considered for this assessment was 2.65E-20Pa@115.36°C.

During intended use (lighting of a match) the sulfur burns instantly and there is no exposure to sulfur. Matches are considered a 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 a radius of 3mm, 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.

##### **Risk Characterization**

Risk characterization 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<sub>50</sub> / 10000, i.e. > 0.5 mg/kg. This exposure does not present a concern.

Environmental exposure scenario – Not applicable

### **Exposure Scenario (ES14):**

#### **Use of sulfur in fireworks – Consumer**

##### **Prediction of consumer exposure**

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.

##### **Risk Characterization**

Sulfur is contained inside the fire works. Fireworks are sold under age restrictions and should be kept away from children. Their hazard 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.

Environmental exposure scenario – Not applicable