SECTION 1: Identification of the substance and of the company

1.1 Product identifier
This material safety data sheet is valid for Oil Shale Thermal Processing Residue with the following specific commercial name: Burnt Oil Shale (BOS)

1.2 Relevant identified uses of the substance and uses advised against
BOS is primarily used in industrial installations for the production of cements and other hydraulic binders. It is also used in soil stabilization and as a fertilizer in agriculture.

REACH registroerimisnumber 01-2119703178-42-0002
EC number 297-648-1
CAS number 93685-99-5

1.3 Details of the supplier of the material safety data sheet
Manufacturer / supplier Enefit Energiatootmine AS
Street / post box Auvere küla, Vaivara vald
Postal code / city 40107, Ida-Virumaa
Phone +372 46 67222
Enquiries about this material safety data sheet: tootmine@energia.ee

1.4 Emergency telephone number
Public emergency number: 112 (within Estonia)

SECTION 2: Hazards identification

2.1 Classification of the substance
Classification according to the regulation (EC) No 1272/2008:

- GHS05 Corrosion
- GHS07 Exclamation mark
- GHS08 Health hazard

Signal word: Danger
Eye Dam. 1 Serious eye damage / eye irritation category 1
STOT SE 3 Specific target organ toxicity (single exposure) category 3
STOT RE 2 Specific target organ toxicity (repeated exposure) category 2
H318 Causes serious eye damage.
H335 May cause respiratory irritation.
H373 May cause damage to organs (lung) through prolonged or repeated exposure.

2.2 Label elements of the substance
2.2.1 Label elements of the substance according to the regulation (EC) No 1272/2008:
Hazard pictograms and signal word:
Material Safety Data Sheet (MSDS)
according to regulations (EC) No 1907/2006 / (EU) No 453/2010
Burnt Oil Shale (BOS)
Date of creation: 27 June 2011
Updated: 27.01.2017
08.11.2017
28.02.2018
19.09.2019

Signal word: Danger

Hazard statements
H318 Causes serious eye damage.
H335 May cause respiratory irritation.
H373 May cause damage to organs (lung) through prolonged or repeated exposure.

Precautionary statements
P260 Do not breathe dust.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P305+351+338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337+P313 If eye irritation persists: Get medical advice/attention.

2.3 Additional information on hazards
The main hazard of the substance is the release of dust. Long term inhalation of this dust may lead to lung disease known as silicosis. Symptoms are cough and dyspnoea. Silicosis may lead to an enhanced risk of lung cancer.
On the short term the principal risk is severe eye irritation and damage
When the substance accidentally comes into contact with water, a strongly alkaline solution is produced.

SECTION 3: Composition/information on ingredients

3.1 Substance

OIL SHALE THERMAL PROCESSING RESIDUE
Commercial Name: Burnt Oil Shale (BOS)
EC number: 297-648-1
CAS number: 93685-99-5

Classification of Burnt Oil Shale (BOS):
Classification according to regulation (EC) No 1272/2008: Eye Dam. 1; GHS05; H318
STOT SE 3; GHS07; H335
STOT RE 2; GHS08; H373;

Signal word: Danger
Physical form: Fine powder

For the wording of the abbreviations used in this section, refer to section 2.1.

Oil shale thermal processing residue is produced in thermal reactors at temperatures above 850°C. Input into these reactors is natural raw oil shale only. This multiconstituent substance consists essentially of SiO₂, Al₂O₃, Fe₂O₃, CaO, SO₃ and MgO.
Various qualities may contain various associated minerals depending on the origin of the oil shale and on the processing conditions. These belong to the substance, as indicated by the REACH definition of substances.

Burnt oil shale BOS contains several main mineral phases, namely Anhydrite, Calcium oxide (Free Lime), Calcite, Periclase and Quartz within the following concentration ranges:
SECTION 4: First aid measures

4.1 Description of first aid measures

General notes
No personal protective equipment is needed for first aid responders, except under very dusty conditions, where a dust mask as defined in section 8.2.2 should be worn.

Inhalation
Move the person to fresh air. Clear rapidly any dust in throat and nasal passages. Contact a physician if irritation persists or later develops or if discomfort, coughing or other symptoms persist.

Skin contact
Remove dry material mechanically, and then rinse abundantly with water. Contaminated clothing, footwear, watches, etc. should be removed and cleaned thoroughly before re-using them.

Eye contact
Do not rub eyes in order to avoid possible corneal damage by mechanical stress. Remove contact lenses if any. Incline head to injured eye, open the eyelids widely and flush eye(s) immediately by thoroughly rinsing with plenty of clean water for several minutes to remove all particles. Avoid flushing particles into uninjured eye. If possible, use isotonic water (0.9% NaCl). Always contact a specialist of occupational medicine or an eye specialist.

Ingestion
If victim is conscious, rinse mouth and give abundantly water to drink. Do not induce vomiting. In case of persisting effects contact a physician.

4.2 Most important symptoms and effects, both acute and delayed

Eyes: Eye contact with BOS particles in eyes may cause corneal damage when rubbed with hands/fingers.

Inhalation: Repeated inhalation of BOS dust over a long period of time increases the risk of developing lung diseases.

4.3 Indication of any immediate medical attention and special treatment needed
No need of immediate attention or special treatment has been identified. When contacting a physician with a reasonable ground for suspecting an adverse effect of BOS, this MSDS should be presented to him.

SECTION 5: Fire fighting measures

5.1 Extinguishing media
In case of a fire of other materials nearby, do not use water - avoid humidification of BOS, if possible. Otherwise all usual extinguishing media are compatible with BOS.

5.2 Special hazards arising from the substance
BOS is not combustible and does not facilitate or sustain the combustion of other materials. In case of a fire of other materials nearby, additional hazards caused by BOS have not to be feared.

5.3 Advice for fire-fighters
Avoid generation of dust. If spreading of dust is unavoidable, use breathing apparatus (filter P3, see section 8.2.2)

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
In the absence of dust and in well ventilated locations, no personal protective equipment is needed. In other situations, respiratory protection according to section 8.2.2. is needed and the advices for safe handling and use given in section 7 should be considered.
Avoid humidification of BOS.
Remark: harmful respirable dust is invisible.

6.2 Environmental precautions
Do not wash BOS into sewage and drainage systems or into bodies of water (because of rise of pH).

6.3 Methods and material for containment and cleaning up
Collect spilled material as dry as possible in a container for future use. Do not sweep. Use dry cleanup methods, not causing dust spreading, such as vacuum clean-up or vacuum extraction which do not cause airborne dispersion, as e.g. industrial portable units, equipped with high efficiency particulate filters (HEPA filter) or equivalent technique. Never use compressed air. Ensure that the workers wear appropriate personal protective equipment and prevent dust from spreading.

6.4 Reference to other sections
Information about safe handling, see section 7.
Information about personal protective equipment, see section 8.2.
Information about disposal, see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

7.1.1 Protective measures
For personal protective measures follow the recommendations given in Section 8.

Measures to prevent fire Not applicable.

Measures to prevent aerosol and dust generation
Handle with care in order to avoid airborne dispersion. Provide efficient ventilation. In industrial environment use closed handling, storage and transport systems. In semi-closed systems, remediate emission sources by containment, local exhaust ventilation etc. as far as feasible. Keep respirable dust concentration as low as possible, at least below applicable occupational limit values.

Measures to protect the environment
Provide industrial production units with state of the art air cleaning equipment in consultation with local authorities (e.g. cyclones, wet scrubbers or bag filters). No particular measures are needed for professional or consumer use.

7.1.2 Information on general occupational hygiene
Use protective gloves to avoid skin contact. Don't inhale dust. In dusty or not well ventilated environment, wear dust mask and protective goggles. Do not handle or store near food and beverages or smoking materials and do not eat, drink or smoke. Wash hands before breaks and at the end of work. Change clothes at the end of work.
7.2 Conditions for safe storage, including any incompatibilities

Information about fire and explosion prevention

As BOS is not combustible and has no explosive properties, no such measures have to be taken.

Storage conditions

The storage conditions should allow keeping the concentration of respirable dust at the work places below the TLV limit values. BOS should be stored under waterproof, dry conditions (i.e. with internal condensation minimised), clean and protected from contamination.

If BOS is supplied in drums or sacks, keep it in the closed original containers in a cool and dry place.
If BOS is supplied as bulk material, store it in appropriate silos or vessels.

Precautions to be taken in the case of bulk storage

Never enter a confined space, such as a silo, bin, bulk truck, or other storage container or vessel that stores or contains BOS without taking the proper safety measures to prevent engulfment/suffocation.
BOS can build-up or adhere to the walls of a confined space. It can release, collapse or fall unexpectedly.

Requirements to be met by storerooms and receptacles

Storage rooms, silos and other receptacles and their filling systems and discharge systems should protect the material from moisture and be operable with minimal dust emission.

Mixed storage

VCI storage class: 13 (non-combustible solids)
Mixed storage should be avoided with materials, which require water as extinguishing medium in case of a fire.
Keep away from food, beverages and animal feed.

7.3 Specific end use(s)

No additional information on specific end uses (identified end uses see Annex 1).

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

European indicative limit values (according to directives 91/322/EEC, 2000/39/EC and 2006/15/EC):
none

DNEL and PNEC values

DNEL = Derived no effect level (concentration or dose, below which no effects on humans are to be expected)
PNEC = Predicted no effect concentration (concentration, below which no effects on the environment are to be expected)

<table>
<thead>
<tr>
<th>Systemic toxicity effects</th>
<th>Values for the work place</th>
<th>Values for the population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic, inhalation</td>
<td>DNEL = 0.233 mg/m³</td>
<td>DNEL = 0.233 mg/m³</td>
</tr>
</tbody>
</table>

Effects on the environment

There is no PNEC value for effects on the environment as the substance has no properties by which it could significantly affect the environment.

8.2 Exposure control

8.2.1 General protective and hygienic measures

Use measures to reduce the generation of dust and to avoid dust propagating in the environment such as dedusting and dry clean-up methods which do not cause airborne dispersion.
Provide adequate ventilation, including appropriate local extraction to ensure that the workplace exposure limits are not exceeded.
Do not inhale dust; avoid contact with the eyes and skin.
Do not eat, drink or smoke at work. Keep away from food, beverages and animal feed.
Wash hands before breaks and at the end of work.
Remove contaminated clothing, footwear, watches, etc. and clean thoroughly before re-using them.

8.2.2 Personal protective equipment (PPE)

The personal protective equipment shall be selected according to the specific working place, depending on the quantities handled, the concentration of dangerous substances as well as the risk of exceeding the TLV limit value.
The equipment suppliers must ensure that their PPE provided fully complies with the EU Machinery Directive 2006/42/CE, the EU Product Safety Directive (RS 930.111) and also with EN international standards on personal protective equipment (according to directive 89/686/EEC).

Respiratory protection

In case of exposure to dust levels potentially above exposure limits, use appropriate respiratory protection. It should be adapted to the existing dust concentration and meet the relevant EN standards.
Depending on the result of the evaluation of the risk and the possible extent of exceeding the TLV limit value, use a suitable dust respirator shall be selected as follows:
- Typically filter P3 shall be used
- Full mask P2 only protects against dust concentrations of up to 10 times the TLV value.
- Semif mask P3 or FFP3 protects against dust concentrations of up to 30 times the TLV value.
- Full mask P3 protects against dust concentrations of up to 400 times the TLV value provided the mask fits tight to the face.

The use of FFP1 disposable masks as a protection against quartz-containing dusts would be illegal

Hand protection

Use impervious, abrasion- and alkali-resistant gloves, internally lined with cotton.
Suitable glove-material: Nitril rubber and many other (more expensive) alkali-resistant elastomer materials.
Unsuitable glove-material: leather, textile tissues, natural latex (because of risk of allergies).

Eye/face protection

Wear approved glasses or safety goggles according to EN 166 when handling BOS to prevent contact of dust particles with the eyes.

Body protection

Wear closed long-sleeved protective clothing with close fittings at openings. Use closed boots.

8.2.3 Environmental exposure controls

Take the necessary measures to avoid dust propagation into the environment, e.g. provide industrial production units with the necessary air cleaning equipment, as indicated in section 7.1.
Contain any spills as indicated in section 6.3.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

The information in this section is taken from the Chemical Safety Report of the substance.
Appearance: greyish to slightly brownish fine solid
Odour: odourless
Odour threshold: none (odourless)
pH: (T = 20°C, suspension in water): 11-13.5
Melting point range: 1050 - 1200 °C
Boiling point: not applicable (mineral solid)
Flash point: not applicable (mineral solid)
Evaporation rate (ether = 1): not applicable (mineral solid)
Flammability: non flammable solid
Lower flammability limit: not applicable (mineral solid)
Upper flammability limit: not applicable (mineral solid)
Vapour pressure (20°C): not applicable (mineral solid)
Vapour density (air = 1): not applicable (mineral solid)
Relative density (20 °C): 2.7 - 2.9 g/cm³
Solubility in water (20°C): <1 g/l
Solubility and stability in solvents: not applicable (mineral solid)
Partition coefficient (n-octanol/water) not applicable (mineral solid)
Auto-ignition temperature: not applicable (mineral solid, stable at 400 °C)
Decomposition temperature: above 650 °C
Dynamic viscosity: not applicable (mineral solid)
Kinematic viscosity: not applicable (mineral solid)
Explosive properties: none
Oxidising properties: none

9.2 Other information
Not applicable

SECTION 10: Stability and reactivity

10.1 Reactivity
BOS reacts with water in a similar way to cement.

10.2 Chemical stability
BOS is stable as long as it is properly stored under dry conditions (see Section 7) and without contact with incompatible materials (as indicated in section 10.5).

10.3 Possibility of hazardous reactions
In the absence of the incompatible substances mentioned in section 10.5, no hazardous reactions have to be expected.

10.4 Conditions to avoid
Humid conditions during storage may cause lump formation and loss of product quality.
Apart from intended uses of BOS, it should not be mixed with water.

10.5 Incompatible materials
BOS is incompatible with acids and ammonium salts as well as with hydrofluoric acid and its salts.
Under humid conditions, BOS corrodes aluminium or other non-noble metals, e.g. brass.

10.6 Hazardous decomposition products
Under foreseeable conditions, BOS will not decompose into any hazardous products.

SECTION 11: Toxicological information

The information in this section is taken from the Chemical Safety Report of BOS.
For the wording of the abbreviations used in this section, refer to section 16.

11.1 Information on toxicological effects
In general:
BOS is an only slightly water-soluble solid mineral substance of natural origin which was thermally treated and finely ground. BOS presents the following potential adverse effects to humans:
- Long term inhalation of respirable dust (particle diameter < 5 µm) of BOS may lead to irritation of the respiratory system and finally to lung diseases, mainly silicosis, enhancing the risk of lung cancer.
- Contained hard particles may lead to corneal damage when got in the eye and being rubbed in it.
- Alkaline particles (containing free lime) may lead to strong eye irritation.

**Single dose (acute) toxicity**

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD50, oral, rat</td>
<td>&gt;2000 mg/kg</td>
</tr>
<tr>
<td>LD50, dermal</td>
<td>no data</td>
</tr>
<tr>
<td>LC50, inhalation</td>
<td>no data</td>
</tr>
</tbody>
</table>

**Repeated dose toxicity**

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeated dose, oral</td>
<td>no data</td>
</tr>
<tr>
<td>Repeated dose, dermal</td>
<td>no data</td>
</tr>
<tr>
<td>Repeated dose, inhalation</td>
<td>LOAEC = 0.05 mg/m³ respirable quartz (target organ: lung)</td>
</tr>
</tbody>
</table>

**Irritation/corrosion of the skin:**
- not irritating

**Irritation of the eyes:**
- irritating

**Irritation of the respiratory system:**
- irritating

**Corrosivity:**
- not corrosive

**Sensitisation:**
- not sensitising to the skin
- no data for the respiratory system (no sensitisation expected)

**Mutagenicity**

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutagenicity to bacteria</td>
<td>test negative</td>
</tr>
<tr>
<td>Mutagenicity to mammalian cells</td>
<td>test negative</td>
</tr>
<tr>
<td>Erythrocyte Micronucleus test</td>
<td>negative</td>
</tr>
</tbody>
</table>

**Carcinogenicity**

No data (carcinogenicity is not expected because of negative results of mutagenicity studies.)

**Reproductive toxicity** (development toxicity / influence on fertility)

No data (no studies exist which would suggest or indicate reproductive toxicity by this kind of material)

**Available DNEL values**

<table>
<thead>
<tr>
<th>Test</th>
<th>Value for the work place</th>
<th>Value for consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long term effects, inhalation</td>
<td>DNEL = 0.233 mg/m³, inhalable</td>
<td>DNEL = 0.233 mg/m³, inhalable</td>
</tr>
<tr>
<td></td>
<td>(LOAEL = 0.699 mg/m³, inhalable)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DNEL = 0.017 mg/m³, respirable</td>
<td></td>
</tr>
</tbody>
</table>

**Aspiration hazard**

Based on available data, the classification criteria are not met.
SECTION 12: Ecological information

The information in this section is taken from the Chemical Safety Report of BOS. For the wording of the abbreviations used in this section, refer to section 16.

12.1 Environmental toxicity

As the water solubility of BOS is rather low (<1 g/l), the material has been tested using accommodated suspensions of the material powder in freshwater (Water Accommodated Fraction, WAF). The values given below in mg/l correspond to the quantity of powder dispersed in water.

Test results

**Short–term toxicity to fish**

- LL50 (3.2 months) for freshwater fish: 100 mg/L
- NOELR (4 days) for freshwater fish: 100 mg/L

**Long–term toxicity to aquatic invertebrates**

- NOELR (21 days) for the growth and reproduction of freshwater invertebrates (Daphnia Magna): 1.0 mg/L
- LOELR (21 days) for the survival of adult freshwater invertebrates (Daphnia Magna): 3.2 mg/L
- EL50 (48 days) for aquatic invertebrates (Daphnia Magna): 100 mg/l

**Toxicity to aquatic algae and cyanobacteria**

- EL50 (72 h): 82.7 mg/L
- LOELR (72 h): 3.2 mg/L
- NOEC (72 h): 10 mg/L

**Toxicity to microorganisms**

- EC50 (3h) for land microorganisms: 1 g/L
- NOEC (3h) for activated sludge (sewage) microorganisms: 1 g/L

**Sediment toxicity**

- NOEC (28 days): 1000 mg/kg sediment dw
- EC10 (28 days): 1000 mg/kg sediment dw

**Toxicity to terrestrial macroorganisms except arthropods**

- NOEC (56 days): 1 g/kg soil dw
- NOEC (28 days): 1 g/kg soil dw

**PNEC-Values (Predicted No Effect Concentration)**

- Freshwater: PNEC = 0.02 mg/l, assessment factor = 50
- Seawater: PNEC = 0.002 mg/l, assessment factor = 500
- Aqua intermittent releases *): PNEC = 0.827 mg/l, assessment factor = 100
- Sewage microorganisms: PNEC = 100 mg/l, assessment factor = 10
- Sediment microorganisms: no data
- Soil micro-organisms: no data
- Soil macro-organisms: no data

*: “Aqua intermittent release” is defined as: less than 1x per month during less than 24 hours.

Possible toxicity effects of leachable heavy metals - if any - are already included in the test results presented in this section.

12.2 Persistence and degradability:
Not applicable. BOS is an inorganic, not oxidisable material.

12.3 Bioaccumulative potential:
Bioconcentration factor (BCF): not applicable for inorganic materials
Distribution coefficient octanol/water: not applicable for inorganic materials

12.4 Mobility in soil
Not applicable. BOS is an inorganic solid material of natural origin.

12.5 Results of PBT and vPvB assessment:
PBT: not applicable  vPvB: not applicable
PBT and vPvB criteria do not apply to inorganic substances. No bioconcentration in organisms is to be expected.

12.6 Other adverse effects
no data

SECTION 13: Considerations about disposal

13.1 Waste treatment methods
Dry BOS may always be reused and is therefore no waste. Thus, waste treatment methods do not apply. In case of a spill, collect carefully under dry conditions for re-use as described in section 6.3.
Never flush into sewage systems or surface waters.
Moist or wet BOS or slurries of it in water should be allowed to harden on a suitable ground and then be disposed of as concrete waste. Waste code is 10 13 14 (waste concrete and concrete sludge).

SECTION 14: Transport information

BOS is not covered by the international regulations on the transport of dangerous goods (IMDG, IATA, ADR/RID); no classification is required

14.1 UN number
None

14.2 UN proper shipping name
Not relevant for all routes of transportation

14.3 Transportation hazard class and label
Not relevant for all routes of transportation

14.4 Packing group
Not relevant for all routes of transportation

14.5 Environmental hazards
Not relevant for all routes of transportation

14.6 Special precautions for user
Not relevant for all routes of transportation

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
Not relevant for all routes of transportation

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance
Specific EU legislation
Regulation (EC) 1907/2006 (REACH regulation) registered substance
Authorisation according to title VII of the REACH regulation (EC) No 1907/2006: not subject to authorisation
Restrictions according to title VIII of the REACH regulation (EC) No 1907/2006: no restriction
Regulation (EC) No 2037/2000 (substances that deplete the ozone layer): not applicable
Regulation (EC) No 850/2004 (persistent organic pollutants): not applicable
Regulation (EC) No 689/2008 (exportation and importation of dangerous chemicals): not applicable
Machines directive 2006/42/EC (section on personal protective equipment) (see section 8.2.2)
Directive 89/686/EEC (on EN standards for personal protective equipment) (see section 8.2.2)
European Social Dialogue Agreement on Crystalline Silica
Under the Social Dialogue “Agreement on Workers’ Health Protection Through the Good Handling and Use of Crystalline silica and Products Containing it”, the Employee and Employer European sectoral associations adopted the so-called “Good practice guides” which contain advice on safe handling practices: http://www.nepsi.eu/agreement-good-practice-guide/good-practice-guide.aspx.

SECTION 16: Other information

This safety data sheet has been updated 27 January 2017 on the basis of the changes the information of the supplier of the safety data sheet and on the basis of the ”Registered Substances ECHA” information. This safety data sheet was updated on November 08, 2017 with exposure scenarios. This safety data sheet has been updated 28.02.2018 on the basis of the changes the information of the supplier of the safety data sheet. This safety data sheet has been updated 19 September 2018 in order to comply with Guidance on the compilation of safety data sheets.

16.1 Abbreviations and acronyms

| AC  | Article Category |
| ADR | European Agreement concerning the International Carriage of Dangerous Goods by Road |
| BOS | Burnt Oil Shale |
| CAS | Chemical Abstracts Service |
| DNEL | Derived no-effect level |
| EC  | European Community |
| EC50 | Effect concentration, 50 % (Effect: e.g. immobilisation of water flea) |
| EL50 | Effect Load for 50 % |
| EN  | European standard |
| EU  | European Union |
| GHS | Globally Harmonised System |
| IATA | International Air Transport Association |
| IATA-DGR | International Air Transport Association - Dangerous Goods Regulations |
| IBC-Code | International Code for construction and equipment of ships carrying dangerous chemicals in bulk |
| ICAO-TI | International Civil Aviation Organization-Technical Instructions |
| IMDG-Code | International Maritime Code for Dangerous Goods |
| ISO | Norme de la “International Standards Organization” |
| IUCLID | International Uniform Chemical Information Database |
| LC50 | Lethal concentration, 50 % |
| LD50 | Lethal dose, 50% |
| LL50 | Lethal Loading, 50% |
| LOAEC | Lowest Observable Adverse Effect Concentration |
| LOAEL | Lowest Observable Adverse Effect Level |
| Log Kow | Distribution coefficient between octanol and water |
| MARPOL | Maritime Pollution Convention = International Convention for the Prevention of Pollution from Ships |
| MSDS | Material Safety Data Sheet |
| NOEC | No Observed Effect Concentration |
| NOEL | No Observed Effect Level |
| NOELR | No Observable Effect Loading Rate |
| OECD | Organisation for Economic Cooperation and Development |
| PBT | Persistent, bioaccumulative and toxic |
| PNEC | Predicted no-effect concentration |
| RID | Regulations concerning the International Carriage of Dangerous Goods by Rail |
| STOT | Specific target organ toxicity |
Material Safety Data Sheet (MSDS)
according to regulations (EC) No 1907/2006 / (EU) No 453/2010

Burnt Oil Shale (BOS)
Date of creation: 27 June 2011

Updated: 27.01.2017
08.11.2017
28.02.2018
19.09.2019

TLV  Threshold Level Value
UN  United Nations
vPvB  very Persistent and very Bioaccumulative
WAF  Water Accommodated Fraction
ANNEX I

1. ES 1: Manufacture of substance

1.1. Manufacture of substance

Sector of Use: SU 8 – Manufacture of bulk, large scale chemicals

<table>
<thead>
<tr>
<th>Environment contributing scenario(s):</th>
<th>ERC 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of substance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Worker contributing scenario(s):</th>
<th>PROC 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use in closed batch process (synthesis or formulation)</td>
<td>PROC 3</td>
</tr>
<tr>
<td>Use in batch and other process (synthesis) where opportunity for exposure arises</td>
<td>PROC 4</td>
</tr>
<tr>
<td>Transfer of chemicals from/to vessels/ large containers at dedicated facilities</td>
<td>PROC 8b</td>
</tr>
<tr>
<td>Transfer of chemicals into small containers (dedicated filling line)</td>
<td>PROC 9</td>
</tr>
</tbody>
</table>

1.2. Conditions of use affecting exposure

1.2.1. Control of environmental exposure: Manufacture and of substance

<table>
<thead>
<tr>
<th>Product characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly dusty solid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount used, frequency and duration of use (or from service life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400,000 tonnes/year</td>
</tr>
<tr>
<td>220 days per year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical conditions and measures at process level (source) to prevent release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process is enclosed with measures to prevent exposure of the environment (MSDS p. 7 and 8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>The thermal processing of raw oil shale is performed as a closed and water free process. RMMs entirely results in keeping the process operations completely water free. Air emissions are controlled in accordance to national regulations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organizational measures to prevent/limit release from site</th>
</tr>
</thead>
</table>
• Discharges to wastewater, surface water and air must comply with local regulations/restrictions on the release of the specific compounds into the environment.

Conditions and measures related to municipal sewage treatment plant

• Onsite STP or municipal sewage treatment plant discharge: 2,000,000 L/day

Environment factors not influenced by risk management

• River flow rate: 18,000 m³/day

Conditions and measures related to external treatment of waste for disposal

• MSDS p.13

1.2.2. Control of worker exposure: Manufacture of substance

Product characteristics

• Highly dusty solid

Amount used (or contained in articles), frequency and duration of use/exposure

• 400,000 tonnes/year
• 220 days per year
• Duration of exposure per operation: <15 minutes.

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

• LEV (≥90% efficiency) is present at all transfer points.

Organisational measures to prevent /limit releases, dispersion and exposure

• The facility is compliant with the following Integrated Management Systems: ISO 9001 (Quality), 14001 (Environment), OHSAS 18001 (Occupational Health and Safety);
• For every production unit and work place, an OHS risk assessment has been compiled. All workers are fully trained and familiarised with the necessary OC/RMMs;
• Every production process is clearly described with company SOPs (Standard Operating Procedures). These documents include all relevant technical and operational RMMs (environmental and occupational);
• All production processes have instructions on safe use for workers;
• Workers’ proficiency in the process instructions is periodically reviewed (quarterly) by managers and the occupational safety manager;
• For every worker instructing card is kept and will be kept after he has left the company for 55 years;
• Internal and 3rd party audits according to ISO standards;
• All workers have to pass medical check periodically (every 1-3 years, depending on the occupation);
• On production site, workers have access to medical cabinet;
• All technical equipment is checked, maintained and repaired periodically accordingly to maintenance plans that have been put together by technical staff;
• In order to ensure fluent production processes (24/7) a system of journals has been established to coordinate work between shifts.

**Conditions and measures related to personal protection, hygiene and health evaluation**

Dust masks (PF≥10) must be worn when handling BOS under open conditions. BOS is a severe eye irritant. Goggles must be worn.

**1.3. Exposure estimation**

**1.3.1. Environmental exposure: Manufacture of substance**

As a natural raw material oil shale mainly contains silica (10-76% w/w SiO₂ by weight). The remainder chiefly are oxides as Al₂O₃, Fe₂O₃, CaO and MgO. Oil shale thermal processing residues are most common in soils. Oil shale itself may even be a natural component of the earth crust or rather build up own soil horizons. The man made intake of BOS constituents into soil compartment will by far not result in concentrations higher than the natural concentration in soils.

It should be noted, that the active substance has to be treated carefully to prevent uncontrolled emission into environment. Industrial activities are primarily considered to be indoor processes. It is assumed that the production of burned oil shale must be a strictly moisture free process to avoid unintentional hardening. Consequently, the release rate from manufacturing is 0% representing a water-free process. An indirect contamination of the soil compartment via sludge application is considered negligible.

The main environmental issues associated with oil shale thermal processing residues are emissions to air. Based on the physical-chemical properties of the substance significant volatilisation is not expected. To reduce the emission of particles to the air the cyclones, wet scrubbers or bag filters are used. The efficiency of processes is maximized. Assuming that air filter techniques are implemented in accordance to national regulations, air emissions cause no substantial contribution to environmental concentrations.

For this exposure scenario, the risk to the environment can be considered to be adequately controlled. Since the likelihood and severity of an environmental exposure is not indicated, neither a PEC calculation nor a risk characterization is conducted.

**1.3.2. Worker exposure: Manufacture of substance**

Workers exposure estimation is calculated with ECETOC TRA model v2.

<table>
<thead>
<tr>
<th>Workers exposure</th>
<th>Exposure estimate</th>
<th>DNEL</th>
<th>RCR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture and filling under fully closed conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacture under enclosed conditions (PROC 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation (mg/m³)</td>
<td>0.001</td>
<td>0.233</td>
<td>0.004</td>
<td>Duration ≤15 min RPE (PF≥10) LEV (≥90% efficiency)</td>
</tr>
<tr>
<td>Dermal (mg/kg/day)</td>
<td>0.034</td>
<td>n.a.</td>
<td>n.a.</td>
<td></td>
</tr>
</tbody>
</table>
Material Safety Data Sheet (MSDS)
according to regulations (EC) No 1907/2006 / (EU) No 453/2010
Burnt Oil Shale (BOS)

Date of creation: 27 June 2011
Updated: 27.01.2017
08.11.2017
28.02.2018
19.09.2019

Filling at dedicated facilities (PROC 8b), large containers

<table>
<thead>
<tr>
<th></th>
<th>Inhalation (mg/m³)</th>
<th>Dermal (mg/kg/day)</th>
<th>Duration ≤15 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation</td>
<td>0.0125</td>
<td>0.233</td>
<td>RPE (PF≥10)</td>
</tr>
<tr>
<td>Dermal</td>
<td>0.686</td>
<td>n.a.</td>
<td>LEV (≥90% efficiency)</td>
</tr>
<tr>
<td>Combination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROC 3+ 8b</td>
<td>0.058</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Manufacture and filling under not fully closed conditions

Manufacture (PROC 4)

<table>
<thead>
<tr>
<th></th>
<th>Inhalation (mg/m³)</th>
<th>Dermal (mg/kg/day)</th>
<th>Duration ≤15 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation</td>
<td>0.025</td>
<td>0.233</td>
<td>RPE (PF≥10)</td>
</tr>
<tr>
<td>Dermal</td>
<td>0.686</td>
<td>n.a.</td>
<td>LEV (≥90% efficiency)</td>
</tr>
<tr>
<td>Combination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROC 4+ 9</td>
<td>0.193</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Filling at dedicated facilities (PROC 9), small containers

<table>
<thead>
<tr>
<th></th>
<th>Inhalation (mg/m³)</th>
<th>Dermal (mg/kg/day)</th>
<th>Duration ≤15 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation</td>
<td>0.02</td>
<td>0.233</td>
<td>RPE (PF≥10)</td>
</tr>
<tr>
<td>Dermal</td>
<td>0.686</td>
<td>n.a.</td>
<td>LEV (≥90% efficiency)</td>
</tr>
<tr>
<td>Combination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROC 4+ 9</td>
<td>0.193</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. ES 2: Formulation of BOS into construction materials (cement, clinker)

2.1. Formulation of BOS into construction materials (cement, clinker)

Sector of use: SU 13 Manufacture of other non-metallic mineral products, e.g. plasters, cement or SU 10 – Formulation [mixing] of preparations and/or re-packaging (excluding alloys)

Environment contributing scenario(s):

Formulation of preparations: ERC 2

Worker contributing scenario(s):

Use in closed batch process (synthesis or formulation): PROC 3
Mixing or blending in batch processes (multistage and/or significant contact): PROC 5
Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities: PROC 8b
Transfer of substance or preparation into small containers (dedicated filling line, including weighing): PROC 9
2.2. Conditions of use affecting exposure

2.2.1. Control of environmental exposure: *Formulation of BOS into construction materials (cement, clinker)*

<table>
<thead>
<tr>
<th>Product characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Highly dusty solid</td>
</tr>
<tr>
<td>• BOS is mixed with other ingredients to give cement (dusty solid). These preparations contain 100% BOS. The final mixture is bagged into small or large containers using dedicated and automated equipment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount used, frequency and duration of use (or from service life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 400000 tonnes/year</td>
</tr>
<tr>
<td>• 220 days per year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical conditions and measures at process level (source) to prevent release</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Process is enclosed with measures to prevent exposure of the environment (MSDS p. 7 and 8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The final mixture is bagged into small or large containers using dedicated and automated equipment.</td>
</tr>
<tr>
<td>• RMMs related to environmental exposure aims to avoid uncontrolled discharge of BOS into air, soil or water bodies. Although oil shale thermal processing residue is not expected to cause harmful effects to organisms all formulation steps are conducted as closed and water free processes. European cement producers using burned oil shale have implement filter techniques to keep release to air below emission limits determined in national legislations. It can be assumed that the formulation and handling of burned oil shale is done as a strictly moisture free process to avoid unintentional hardening of the product.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organizational measures to prevent/limit release from site</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Discharges to wastewater, surface water and air must comply with local regulations/restrictions on the release of the specific compounds into the environment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions and measures related to municipal sewage treatment plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Onsite STP or municipal sewage treatment plant discharge: 2000000 L/day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environment factors not influenced by risk management</th>
</tr>
</thead>
<tbody>
<tr>
<td>• River flow rate: 18000 m³/day</td>
</tr>
</tbody>
</table>

| Conditions and measures related to external treatment of waste for disposal |
2.2.2. Control of worker exposure: **Formulation of BOS into construction materials (cement, clinker)**

<table>
<thead>
<tr>
<th>Product characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly dusty solid</td>
</tr>
<tr>
<td>BOS is mixed with other ingredients to give cement (dusty solid). These preparations contain 100% BOS.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount used (or contained in articles), frequency and duration of use/exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>400000 tonnes/year</td>
</tr>
<tr>
<td>220 days per year</td>
</tr>
<tr>
<td>Duration of exposure per operation: &lt;15 minutes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical conditions and measures at process level (source) to prevent release</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEV (≥90% efficiency) is present at all transfer points.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organisational measures to prevent /limit releases, dispersion and exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSDS p.5, 6, 7, 8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions and measures related to personal protection, hygiene and health evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust masks (PF≥10) must be worn when handling BOS under open conditions.</td>
</tr>
<tr>
<td>BOS is a severe eye irritant. Goggles must be worn.</td>
</tr>
</tbody>
</table>

2.3. Exposure estimation

**2.3.1. Environmental release and exposure: Formulation of BOS into construction materials (cement, clinker)**

As a natural raw material oil shale mainly contains silica (10-76% w/w SiO₂ by weight). The remainder chiefly are oxides as Al₂O₃, Fe₂O₃, CaO and MgO. Oil shale thermal processing residues are most common in soils. Oil shale itself may even be a natural component of the earth crust or rather build up own soil horizons. The man made intake of BOS constituents into soil compartment will by far not result in concentrations higher than the natural concentration in soils.

It should be noted, that the active substance has to be treated carefully to prevent uncontrolled emission into environment. Industrial activities are primarily considered to be indoor processes. It is assumed that the production of burned oil shale must be a strictly moisture free process to avoid unintentional hardening. Consequently, the release rate from manufacturing is 0% representing a water-free process. An indirect contamination of the soil compartment via sludge application is considered negligible.
The main environmental issues associated with oil shale thermal processing residues are emissions to air. Based on the physical-chemical properties of the substance significant volatilisation is not expected. To reduce the emission of particles to the air the cyclones, wet scrubbers or bag filters are used. The efficiency of processes is maximized. Assuming that air filter techniques are implemented in accordance to national regulations, air emissions cause no substantial contribution to environmental concentrations.

For this exposure scenario, the risk to the environment can be considered to be adequately controlled. Since the likelihood and severity of an environmental exposure is not indicated, neither a PEC calculation nor a risk characterization is conducted.

2.3.2. Worker exposure: Formulation of BOS into construction materials (cement, clinker)

The exposure estimates given in the following table are exposures to total dust. However, the general dust limit for cement dust (5 mg/m³) must also be complied with. Thus, the indicated LEV, RPE and exposure time must be applied to maintain a safe working environment.

<table>
<thead>
<tr>
<th>Workers exposure</th>
<th>Exposure estimate</th>
<th>DNEL</th>
<th>RCR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formulation and filling under fully closed conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batch mixing under closed conditions (PROC 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation (mg/m³)</td>
<td>0.001</td>
<td>0.233</td>
<td>0.004</td>
<td>Duration ≤15 min RPE (PF≥10) LEV (≥90% efficiency)</td>
</tr>
<tr>
<td>Dermal (mg/kg/day)</td>
<td>0.034</td>
<td>n.a.</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>Filling at dedicated facilities (PROC 8b), large containers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation (mg/m³)</td>
<td>0.0125</td>
<td>0.233</td>
<td>0.054</td>
<td>Duration ≤15 min RPE (PF≥10) LEV (≥90% efficiency)</td>
</tr>
<tr>
<td>Dermal (mg/kg/day)</td>
<td>0.686</td>
<td>n.a.</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>Combination PROC 3+ 8b</td>
<td></td>
<td></td>
<td>0.058</td>
<td></td>
</tr>
<tr>
<td>Formulation and filling under not fully closed conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Batch mixing under semi-closed or open conditions (PROC 5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation (mg/m³)</td>
<td>0.025</td>
<td>0.233</td>
<td>0.107</td>
<td>Duration ≤15 min RPE (PF≥10) LEV (≥90% efficiency)</td>
</tr>
<tr>
<td>Dermal (mg/kg/day)</td>
<td>0.0686</td>
<td>n.a.</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>Filling at dedicated facilities (PROC 9), small containers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. ES 3: Industrial use of BOS-containing construction materials

3.1. Industrial use of BOS-containing construction materials

Sector of use: SU 0 Other: NACE C23.6.1 - Manufacture of concrete products for construction purposes

Environment contributing scenario(s):

- Industrial use resulting in inclusion into or onto a matrix

Worker contributing scenario(s):

- Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

3.2. Conditions of use affecting exposure

3.2.1. Control of environmental exposure: Industrial use of BOS-containing construction materials

Product characteristics

- Highly dusty solid (BOS in cement powder)
- Slurry (BOS in concrete slurry)
- Solid block (BOS in concrete article)
- Oil shale thermal processing residues are present in cement at a concentration of <35%

Amount used, frequency and duration of use (or from service life)

- 350000 tonnes/year
- 220 days per year

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

- Process is enclosed with measures to prevent exposure of the environment (MSDS p. 7 and 8)

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

- The dry cement powder is transferred into large mixing vessels (dedicated facilities) to produce concrete slurry. Concrete slurry is transported to construction sites or used on-site to produce pre-cast concrete articles.
- No specific technical measures. However, general measures and practice employed to avoid environmental exposure

Organizational measures to prevent/limit release from site

- Discharges to wastewater, surface water and air must comply with local regulations/restrictions on the release of the specific compounds into the environment.

Conditions and measures related to municipal sewage treatment plant

- Municipal sewage treatment plant discharge: 2,000,000 L/day

Environment factors not influenced by risk management

- River flow rate: 18000 m³/day

3.2.2. Control of worker exposure: *Industrial use of BOS-containing construction materials*

**Product (Article) characteristics**

- Highly dusty solid (BOS in cement powder)
- Slurry (BOS in concrete slurry)
- Solid block (BOS in concrete article)

Oil shale thermal processing residues are present in cement at a concentration of <35%.

**Amount used, frequency and duration of use/exposure**

- ca. 100 kg per day
- Duration of exposure per operation: <15 minutes.

**Technical and organisational conditions and measures**

- MSDS p.7, 8.

**Organisational measures to prevent/limit releases, dispersion and exposure**

- MSDS p.5, 6, 7, 8

**Conditions and measures related to personal protection, hygiene and health evaluation**

- Generally accepted occupational hygiene standards are maintained.

3.3. Exposure estimation

3.3.1. Environmental release and exposure: *Industrial use of BOS-containing construction materials*
materials

As no hazard was identified for the environment, exposure estimation was not conducted.

3.3.2. Worker exposure: *Industrial use of BOS-containing construction materials*

Workers exposure estimation is calculated with ECETOC TRA model v2.

<table>
<thead>
<tr>
<th>Workers exposure</th>
<th>Exposure estimate</th>
<th>DNEL</th>
<th>RCR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated discharge from large containers into large mixing vessels (PROC 8b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation (mg/m³)</td>
<td>0.0125</td>
<td>0.233</td>
<td>0.054</td>
<td>Duration ≤15 min RPE (PF≥10) LEV (≥90% efficiency)</td>
</tr>
<tr>
<td>Dermal (mg/kg/day)</td>
<td>0.686</td>
<td>n.a.</td>
<td>n.a.</td>
<td></td>
</tr>
</tbody>
</table>

4. ES 4: Professional use of BOS-containing construction

4.1. Professional use of BOS-containing construction

**Sector of use:** SU 19 Building and construction work

**Environment contributing scenario(s):**
- Wide dispersive indoor use resulting in exclusion of or onto a matrix
  - ERC 8c
- Wide dispersive outdoor use resulting in inclusion into or onto a matrix
  - ERC 8f

**Worker contributing scenario(s):**
- Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities
  - PROC 8a

4.2. Conditions of use affecting exposure

4.2.1. Control of environmental exposure: *Professional use of BOS-containing construction materials*

**Product characteristics**
- Highly dusty solid (BOS in cement powder)
- Slurry (BOS in concrete slurry)
- Solid block (BOS in concrete article)
- BOS is present in cement at a concentration of <35%.
### Amount used, frequency and duration of use (or from service life)
- 40000 to per year
- 365 days per year

### Technical conditions and measures at process level (source) to prevent release
- Process is enclosed with measures to prevent exposure of the environment (MSDS p. 7 and 8)

### Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
- The dry cement powder is transferred into mixing vessels (outdoors, non-dedicated facilities) to produce concrete slurry.
- No specific technical measures. However, general measures and practice employed to avoid environmental exposure

### Organizational measures to prevent/limit release from site
- Discharges to wastewater, surface water and air must comply with local regulations/restrictions on release of fuel oils.

### Conditions and measures related to municipal sewage treatment plant
- Municipal sewage treatment plant discharge: 2,000,000 L/day

### Environment factors not influenced by risk management
- River flow rate: 18,000 m3/day

#### 4.2.2. Control of worker exposure: Professional use of BOS-containing construction materials

### Product (Article) characteristics
- Highly dusty solid (BOS in cement powder)
- Slurry (BOS in concrete slurry)
- Solid block (BOS in concrete article)
- BOS is present in cement at a concentration of <35%.

### Amount used (or contained in articles), frequency and duration of use/exposure
- 40000 to per year
- 365 days per year
- Duration of exposure per shift: <1 h

### Technical and organisational conditions and measures
- MSDS p.7, 8

### Organisational measures to prevent /limit releases, dispersion and exposure
Conditions and measures related to personal protection, hygiene and health evaluation

- Generally accepted occupational hygiene standards are maintained.

4.3. Exposure estimation

4.3.1. Environmental release and exposure: Professional use of BOS-containing construction materials

As no hazard was identified for the environment, exposure estimation was not conducted.

4.3.2. Worker exposure: Professional use of BOS-containing construction materials

The exposure estimates given in the following table are exposures to total dust. The dust contains up to 35% BOS. This means that under the described use conditions the exposure estimates during cement discharge (PROC 8b) are around 3-fold lower than initially estimated by ECETOC TRA. This was accordingly corrected in the following table.

<table>
<thead>
<tr>
<th>Workers exposure</th>
<th>Exposure estimate</th>
<th>DNEL</th>
<th>RCR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge from large bags into mixing vessels (PROC 8a)</td>
<td></td>
<td></td>
<td></td>
<td>_duration ≤1 hour RPE (PF≥20)</td>
</tr>
<tr>
<td>Inhalation (mg/m³)</td>
<td>0.123</td>
<td>0.233</td>
<td>0.529</td>
<td>Outdoors</td>
</tr>
<tr>
<td>Dermal (mg/kg/day)</td>
<td>4.798</td>
<td>n.a.</td>
<td>n.a.</td>
<td>35% BOS content in dust</td>
</tr>
</tbody>
</table>

5. ES 5: Consumer Use of BOS-containing construction materials

5.1. Consumer Use of BOS-containing construction materials

Sector of use: SU 21 Consumer uses: Private households

Product category: PC 13 – Fuels

Environment contributing scenario(s):

- Wide dispersive indoor use resulting in exclusion of into or onto a matrix ERC 8c
- Wide dispersive outdoor use resulting in inclusion into or onto a matrix ERC 8f
5.2. Conditions of use affecting exposure

5.2.1. Control of environmental exposure: Consumer Use of BOS-containing construction materials

**Product characteristics**

- Highly dusty solid (BOS in cement powder)
- Slurry (BOS in slurry or paste, e.g. putty)
- The products contain up to 35% BOS

**Amount used, frequency and duration of use (or from service life)**

- 10000 to per year
- 365 days per year

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

- Process is enclosed with measures to prevent exposure of the environment (MSDS p. 7 and 8)

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

- No specific technical measures. However, general measures and practice employed to avoid environmental exposure.

**Conditions and measures related to municipal sewage treatment plant**

- Municipal sewage treatment plant discharge: 2,000,000 L/day

**Environment factors not influenced by risk management**

- River flow rate: 18,000 m³/day

5.2.2. Control of worker exposure: Consumer Use of BOS-containing construction materials

**Product characteristics**

- Highly dusty solid (BOS in cement powder)
- Slurry (BOS in slurry or paste, e.g. putty)
- The products contain up to 35% BOS

**Amount used (or contained in articles), frequency and duration of use/exposure**

- 10000 to per year
- 365 days per year
5.3. Exposure estimation

5.3.1. Environmental release and exposure: Consumer Use of BOS-containing construction materials

As no hazard was identified for the environment, exposure estimation was not conducted.

5.3.2. Worker exposure: Consumer Use of BOS-containing construction materials

There is no suitable scenario for consumer exposure assessment of non-volatiles within ECETOC TRA. Inhalation exposure to dust is not covered, only to vapours gassing out of products. As a surrogate, the exposure estimate for the professional use (ES 4) is adopted to consumers by omitting RPE and regarding the frequency of use per year for consumers.

As ECETOC TRA calculates for professionals the risk for daily exposure (5 days/week), consumer exposure to BOS-containing construction materials is less than 240 days/year. This means that under the described use conditions the exposure estimates for cement discharge (PROC 8a) by consumers are lower than initially estimated by ECETOC TRA. The maximum frequency of exposure in days, that gives a daily average exposure which is below the DNEL values, can be calculated by the use of Haber’s Law (recommended adaption method in the “Guidance on the Application of Regulation (EC) No 1272/2008”, Chapter 3.1.2.2). ECETOC TRA estimates under the given conditions a daily inhalation exposure of 5 mg/m³ for professionals for 240 days/year. If this exposure is limited to 11 days/year for consumers, the daily average exposure would be 0.229 mg/m³ which is below the DNEL value of 0.233 mg/m³ and therefore regarded as a safe use. This was accordingly corrected in the following table.

The Dermal exposure is expected to occur but there is no toxicological significance for this route of exposure.

<table>
<thead>
<tr>
<th>Workers exposure</th>
<th>Exposure estimate</th>
<th>DNEL</th>
<th>RCR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge from large bags into mixing vessels (PROC 8a)</td>
<td>Inhalation (mg/m³)</td>
<td>0.229</td>
<td>0.233</td>
<td>0.984</td>
</tr>
</tbody>
</table>
### 6. ES 6: Professional use in bound applications (binder, soil stabilizer, subgrade stabilisation)

6.1. Professional use in bound applications (binder, soil stabilizer, subgrade stabilisation)

**Product category:** PC 0 – Other: UCN S60000: Stabilizer  
PC 12 - Fertilisers  

**Sector of use:** SU 0 Other  
SU 22 Professional uses: Public domain

**Environment contributing scenario(s):**
- Wide dispersive indoor use resulting in exclusion of into or onto a matrix  
  ERC 8c  
- Wide dispersive outdoor use resulting in inclusion into or onto a matrix  
  ERC 8f

**Worker contributing scenario(s):**
- Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities  
  PROC 8a

### 6.2. Conditions of use affecting exposure

6.2.1. Control of environmental exposure: *Professional use in bound applications (binder, soil stabilizer, subgrade stabilisation)*

**Product characteristics**
- Highly dusty solid (BOS in powder preparations)  
- Slurry (BOS in concrete slurry)  
- The preparations contain up to 100% BOS.

**Amount used, frequency and duration of use (or from service life)**
- 10000 to per year
6.3. Exposure estimation

6.3.1. Environmental release and exposure: Professional use in bound applications (binder, soil stabilizer, subgrade stabilisation)
stabilizer, subgrade stabilisation)

As no hazard was identified for the environment, exposure estimation was not conducted.

6.3.2. Worker exposure: Professional use in bound applications(binder, soil stabilizer, subgrade stabilisation)

The exposure estimates given in the following table are exposures to total dust. However, the general dust limit for nuisance dust (5 mg/m³) must also be complied with. Thus, the indicated RPE and exposure time must be applied to maintain a safe working environment.

<table>
<thead>
<tr>
<th>Workers exposure</th>
<th>Exposure estimate</th>
<th>DNEL</th>
<th>RCR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge from large bags into mixing vessels (PROC 8a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation (mg/m³)</td>
<td>0.175</td>
<td>0.233</td>
<td>0.751</td>
<td>Duration ≤15 min RPE (PF≥20) Outdoors</td>
</tr>
<tr>
<td>Dermal (mg/kg/day)</td>
<td>13.71</td>
<td>n.a.</td>
<td>n.a.</td>
<td>100% BOS content in dust</td>
</tr>
</tbody>
</table>

7. ES 7: Use as fuel component

7.1. Use as fuel component

Product category: PC 13 Fuels

Sector of use: SU 3 Industrial uses: Uses of substances as such or in preparations at industrial sites

Environment contributing scenario(s):

Industrial use resulting in inclusion into or onto a matrix ERC 5

Worker contributing scenario(s):

Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities PROC 8a

7.2. Conditions of use affecting exposure

7.2.1. Control of environmental exposure: Use as fuel component

Product characteristics

- Highly dusty solid (BOS)
Material Safety Data Sheet (MSDS) according to regulations (EC) No 1907/2006 / (EU) No 453/2010

Burnt Oil Shale (BOS)
Date of creation: 27 June 2011
Updated: 27.01.2017
08.11.2017
28.02.2018
19.09.2019

- BOS present in the fuel around 50%.

### Amount used, frequency and duration of use (or from service life)
- 10,000 to per year
- 220 days per year

### Technical conditions and measures at process level (source) to prevent release
- Process is enclosed with measures to prevent exposure of the environment (MSDS p. 7 and 8)

### Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
- No specific technical measures. However, general measures and practice employed to avoid environmental exposure.

### Conditions and measures related to municipal sewage treatment plant
- Municipal sewage treatment plant discharge: 2,000,000 L/day

### Environment factors not influenced by risk management
- River flow rate: 18,000 m3/day

#### 7.2.2. Control of worker exposure: Use as fuel component

### Product characteristics
- Highly dusty solid (BOS)
- BOS present in the fuel around 50%.

### Amount used (or contained in articles), frequency and duration of use/exposure
- 10,000 to per year
- 220 days per year
- Duration of exposure: full shift

### Technical and organisational conditions and measures
- LEV (≥ 90% efficiency)

### Organisational measures to prevent /limit releases, dispersion and exposure
- MSDS p.5, 6, 7, 8

### Conditions and measures related to personal protection, hygiene and health evaluation
- RPE (PF≥10) must be worn during handling of BOS

#### 7.3. Exposure estimation
7.3.1. Environmental release and exposure: Use as fuel component

As no hazard was identified for the environment, exposure estimation was not conducted.

7.3.2. Worker exposure: Use as fuel component

Workers exposure estimation is calculated with ECETOC TRA model v2.

<table>
<thead>
<tr>
<th>Workers exposure</th>
<th>Exposure estimate</th>
<th>DNEL</th>
<th>RCR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge from large bags into mixing vessels (PROC 8a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation (mg/m³)</td>
<td>0.05</td>
<td>0.233</td>
<td>0.215</td>
<td>Duration ≤15 minutes RPE (PF≥10) LEV (≥90% efficiency)</td>
</tr>
<tr>
<td>Dermal (mg/kg/day)</td>
<td>0.137</td>
<td>n.a.</td>
<td>n.a.</td>
<td></td>
</tr>
</tbody>
</table>

8. ES 8: Consumer Use of BOS in cat litter & animal bedding material

8.1. Consumer Use of BOS in cat litter & animal bedding material

Product category: PC 2 Adsorbent; C 20 Products such as pH-regulators, flocculants, precipitants, neutralization agents, other unspecified

Sector of use: SU 21 Consumer uses: Private households

| Environment contributing scenario(s):       |
| Wide dispersive indoor use of processing aids in open systems | ERC 8a |
| Wide dispersive indoor use of reactive substances in open systems | ERC 8b |

| Worker contributing scenario(s):            |
| Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities | PROC 8a |

8.2. Conditions of use affecting exposure

8.2.1. Control of environmental exposure: Consumer Use of BOS in cat litter & animal bedding material

Product characteristics
• Low dusty solid (BOS in granules)
• The consumer product contains 100% BOS.

<table>
<thead>
<tr>
<th>Amount used, frequency and duration of use (or from service life)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 40000 to per year</td>
</tr>
<tr>
<td>• 365 days per year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical conditions and measures at process level (source) to prevent release</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Process is enclosed with measures to prevent exposure of the environment (MSDS p. 7 and 8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No specific technical measures. However, general measures and practice employed to avoid environmental exposure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions and measures related to municipal sewage treatment plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Municipal sewage treatment plant discharge: 2,000,000 L/day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environment factors not influenced by risk management</th>
</tr>
</thead>
<tbody>
<tr>
<td>• River flow rate: 18,000 m3/day</td>
</tr>
</tbody>
</table>

8.2.2. Control of worker exposure: *Consumer Use of BOS in cat litter & animal bedding material*

<table>
<thead>
<tr>
<th>Product characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Low dusty solid (BOS in granules)</td>
</tr>
<tr>
<td>• The consumer product contains 100% BOS.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount used (or contained in articles), frequency and duration of use/exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 40000 to per year</td>
</tr>
<tr>
<td>• 365 days per year</td>
</tr>
<tr>
<td>• Duration of exposure: &lt; 15 min</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical and organisational conditions and measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>• MSDS p.7, 8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organisational measures to prevent /limit releases, dispersion and exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>• MSDS p.5, 6, 7, 8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions and measures related to personal protection, hygiene and health evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Generally accepted occupational hygiene standards are maintained.</td>
</tr>
</tbody>
</table>
8.3. Exposure estimation

8.3.1. Environmental release and exposure: Consumer Use of BOS in cat litter & animal bedding material

As no hazard was identified for the environment, exposure estimation was not conducted.

8.3.2. Consumer exposure: Consumer Use of BOS in cat litter & animal bedding material

There is no suitable scenario for consumer exposure assessment of non-volatiles within ECETOC TRA. Inhalation exposure to dust is not covered, only to vapours gassing out of products. As a surrogate, the exposure estimate for the professional use of PROC 8a that covers sampling, loading, filling, transfer, dumping, and bagging in non dedicated facilities is adapted to consumers. Exposure related to dust, vapour, aerosols or spillage, and cleaning of equipment to be expected. Dermal exposure is expected to occur but there is no toxicological significance for this route of exposure.

<table>
<thead>
<tr>
<th>Workers exposure</th>
<th>Exposure estimate</th>
<th>DNEL</th>
<th>RCR</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge from bags into vessels (PROC 8a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation (mg/m³)</td>
<td>0.05</td>
<td>0.233</td>
<td>0.21</td>
<td>Duration ≤15 min no RPE Indoors, no LEV</td>
</tr>
<tr>
<td>Dermal (mg/kg/day)</td>
<td>13.71</td>
<td>n.a.</td>
<td>n.a.</td>
<td>100% BOS content in dust</td>
</tr>
</tbody>
</table>

Consumer exposure estimation is calculated with ECETOC TRA model v2.