SNAP CODE: **030318**

SOURCE ACTIVITY TITLE: **PROCESSES WITH CONTACT**
Mineral Wool

NOSE CODE: **104.11.09**

NFR CODE: **1 A 2 f**

1 ACTIVITIES INCLUDED

This chapter covers emissions released from combustion processes within mineral wool production.
A mixture of minerals and coke is heated until it is molten and can be spun into fibres. The fibres are treated with resins to form a wool-like product.

2 CONTRIBUTION TO TOTAL EMISSION

The contribution of fuel use related emissions released from the production of mineral wool to total emissions in countries of the CORINAIR90 inventory is minor, as indicated in table 1.

Table 1:Contribution to total emissions of the CORINAIR90 inventory (*28 countries*)

Source-activity	**SNAP-code**	**Contribution to total emissions [%]**							
		SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	NH_3
Mineral Wool	0303018	0	0	-	-	0	0	-	-

0 = emissions are reported, but the exact value is below the rounding limit (0.1 per cent)
- = no emissions are reported

The emissions of phenol(s) is also relevant but no estimates are available at the European level.

3 GENERAL

3.1 Description of activities

Products manufactured from man-made mineral fibres (MMMF) generally consist of inorganic fibres produced from a silicate melt, and, depending on their application and use, contain binding agents, additives and filters. /3/

Whilst basically the melting technology closely resembles the technology commonly used in glass-works, there are considerable differences in the composition of the glass types which have to be adapted to meet the special demands made on the man-made mineral fibres with respect to processability, viscosity, melting range, hydrolytic class, heat resistance etc. In

particular, special glasses containing boron and glasses with additives of volcanic rock (phonolite, basalt, diabase) are used. /3/

3.2 Definitions

3.3 Techniques

Cupola furnaces are used for the production of silicate melts. The starting materials for the production of MMMF are silicate rocks (e.g. basalt, diabase) or metallurgical slags with alkaline or acid additives (e.g. limestone, dolomite, sandstone). Coke, fuel oil or gas are used as fuels. /3/

In electric melting units, the mineral raw materials are melted by electric resistance heating. Units of fireproof (refractory) materials and water-cooled metal containers are in use. /3/

The silicate melt is fed either in covered or open channels (feeders, troughs) or directly to the processing units in which the fibres are produced. The most commonly employed processes are the bushing blowing process, the centrifugal process and the bushing drawing process. /3/

Man-made mineral fibres are generally processed by impregnation, soaking or coating and possibly with subsequent drying processes to form a wide range of finished products. /3/

The impregnated or coated semi-finished product is dried by intensive contact with hot air. Continuous pass driers, single or multi-layer and chamber drying kilns are used. The hot air temperature can be up to 300 °C. The hot air is generally circulated (circulation air process), whereby both direct and indirect heating (e.g. by means of heat transfer oil) processes are in use. /3/ Hot pressing is commonly used for the manufacture of certain products, whereby the drying and hardening is performed by warming between heated moulds. /3/

Energy consumption is typically around 6 -10 GJ per ton produced.

3.4 Emissions

Dust emission can result from handling raw materials as well as from the melting process.

Other emissions result from the melting process, the spinning process as well as finishing the wool. Pollutants released are sulphur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds (non-methane VOC and methane (CH_4)), carbon monoxide (CO), carbon dioxide (CO_2), and nitrous oxide (N_2O). According to CORINAIR90 the main relevant pollutants are SO_2, No_x, CO and CO_2 (see also table 1).

The cupola is a source of CO, CO_2 and NO_x emissions; SO_2 and H_2S emissions also occur, because blast furnace slags contain sulphur /cf 4/.

Emissions of organic and inorganic substances arise from manufacturing products of man-made mineral fibres. The raw gas contents of the melting facilities are generally of a purely inorganic nature and free from fibrous constituents. Emissions of organic substances can arise preparating the binding agent. /cf. 3/

Where binding agents containing nitrogen (ammonia, aminoplasts) are processed, ammonia and/or organic compounds containing nitrogen may occur in the waste gases, depending on the operating conditions. /cf. 3/

No gaseous or particulate emissions arise during the actual production of the fibres /3/.

3.5 Controls

Dust emissions from handling raw materials can be reduced using fabric filters or using different handling techniques.

Extraction systems and driers (hardening kilns, presses) should be designed with respect to the product throughput in such a way that overloading of the facilities by increased temperatures and excessive flow velocities or increased evaporation of constituents of the binding agents or the transport in the air current of droplets and fibrous dusts is prevented. /3/

The malodorous and organically contaminated waste gases from the drying and hardening kilns are transfered to waste gas treatment plants. Multistage wet separator systems (washers) can be used in conjunction with wet electrostatic precipitators or aerosol separators as well as catalytic and thermal post-combustion. Processes employing high-frequency drying result in neither malodorous or organic emissions. No significant dust emissions occur during the process stages drying and hardening. Waste gases are released by stack. /cf 3/

4 SIMPLER METHODOLOGY

The simpler methodology involves applying an appropriate emission factor to either production or energy consumption statistics.

5 DETAILED METHODOLOGY

If an extensive measuring programme is available the emissions can be calculated on for an individual plant.

6 ACTIVITY STATISTICS

Standard production and energy statistics from national or international statistical publications.

7 POINT SOURCE CRITERIA

The production of mineral wool is a minor source of emissions and hence can be treated on an area basis. However, production usually connected to high chimneys can be regarded as point sources if plant specific data are available.

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

For the situation in the Netherlands, the following can be proposed:

Emission factors in kg per ton wool are as follows:

handling/shipping:

dust:	0.5 kg per ton wool

melting oven:

SO_2	1.5 kg per ton wool
CO_2	115 kg per ton wool
CO	3.2 kg per ton wool
F_g	0.008 kg per ton wool
dust	0.06 kg per ton wool (after dust collector)

spinning/wool manufacturing:

formaldehyde	0.2 kg per ton wool
phenol(s)	0.7 kg per ton wool
ammonia	1.8 kg per ton wool
VOS	1.0 kg per ton wool

fuel:

NO_x	1.1 kg per ton wool
CO_2	450 kg per ton wool

The following Table 2 contains fuel related emission factors for the production of mineral wool based on CORINAIR90 data in [g/GJ]. Technique related emission factors, mostly given in other units (e.g. g/Mg product, g/Mg charged), are listed in footnotes. In the case of using production statistics the specific energy consumption (e.g. GJ/Mg product) has to be taken into account, which is process and country specific. Within CORINAIR90 a range for the specific energy consumption of 7 - 5.000 GJ/Mg product has been reported.

Table 2: Emission factors for the production of mineral wool[7)]

Type of fuel				NAPFUE code	Emission factors SO_2[2)] [g/GJ]	NO_x[3)] [g/GJ]	NMVOC[4)] [g/GJ]	CH_4[4)] [g/GJ]	CO[5)] [g/GJ]	CO_2[6)] [kg/GJ]	N_2O [g/GJ]	NH_3 [g/GJ]
s	coal	hc	steam	102	584-610[1)]	150-200[1)]	15[1)]	5-15[1)]	20-97[1)]	93-95[1)]	3-5[1)]	
s	coke	hc	coke oven	107	138-584[1)]	90-100[1)]	1.5-83[1)]	1.5[1)]	97[1)]	101-110[1)]	3[1)]	
s	coke	bc	coke oven	108	650[1)]	220[1)]	5[1)]	15[1)]	90[1)]	86[1)]	3[1)]	
s	biomass		wood	111	130[1)]	130[1)]	48[1)]	32[1)]	160[1)]	102[1)]	4[1)]	
l	oil		residual	203	143-1,030[1)]	100-330[1)]	3[1)]	3-8[1)]	12-20[1)]	73-78[1)]	2-10[1)]	
l	oil		gas	204	55-94[1)]	100[1)]	1.5-2[1)]	1.5-8[1)]	12-20[1)]	73-74[1)]	2[1)]	
g	gas		natural	301	0.3-8[1)]	60-250[1)]	4-10[1)]	2-4[1)]	13-20[1)]	53-57[1)]	1-3[1)]	
g	gas		liquified petroleum gas	303	0.04[1)]	100[1)]	2.1[1)]	0.9	13[1)]	65[1)]	1[1)]	

1) CORINAIR90 data, area sources

2) SO_x:
- 8,480 g/Mg (1989) /1/
- 2,320 g/Mg (1991) /1/
- 10 g/Mg charged Cupola furnace /2/

3) NO_x:
- 210 g/Mg (1989) /1/
- 200 g/Mg (1991) /1/
- 800 g/Mg charged Cupola furnace /2/
- 80 g/Mg charged Curing furnace /2/

4) VOC:
- 450 g/Mg charged Blow chamber
- 500 g/Mg charged Curing oven

5) CO:
- 8,120 g/Mg (1989) /1/
- < 7,400 g/Mg (1991) /1/

6) CO_2:
- 67.4 kg/Mg product General for 1989 /1/
- 168 kg/Mg product General for 1991 /1/

7) It is assumed, that emission factors cited within the table are related to combustion sources in mineral wool production. Footnotes may also include emission factors for other process emissions.

9 SPECIES PROFILES

No general applicable profile for dust emissions available.

10 UNCERTAINTY ESTIMATES

The quality classification of the emission factors expressed per ton wool is estimated to be D.

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

Knowledge about measurements related to abatement techniques is limited.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

National emission estimates can be disaggregated on the basis of plant capacity, employment or population statistics.

13 TEMPORAL DISAGGREGATION CRITERIA

The production of mineral wool is a semi-continuous process but no further quantitative information is available.

14 ADDITIONAL COMMENTS

15 SUPPLEMENTARY DOCUMENTS

Emission inventory in The Netherlands, 1992. Emission to air and water.

Personal information and experience during emission inventories 1975 - 1995

Emission factors to be used for the building industry, TNO report 89/091 (1989 - in dutch)

Environmental Protection Agency

Compilation of Air Pollutant Emission Factors AP 42

16 VERIFICATION PROCESSES

Verification of the emissions can be done by comparing emission estimates with measurements at the individual plants.

17 REFERENCES

/1/ Kaskens, H. J. M.; Matthijsen, A. J. C. M.; Verburgh, J. J.: Productie van steenwol; RIVM-report 736301114; RIZA-report 92.0003/14; 1992

/2/ EPA (ed.): AIRS Facility Subsystem; EPA-Doc. 450/4-90-003; Research Triangle Park; 1990

/3/ VDI (ed.): Emissionsminderungsanlagen zur Herstellung von Mineralfaser-produkten/Emission Control Facilities for the Production of Man-Made Mineral Fibres (MMMF); VDI 3457; Düsseldorf; 1994

/4/ EPA (ed.): AP 42; CD-Rom; 1995

18 BIBLIOGRAPHY

For a detailed bibliography the primary literature mentioned in AP 42 may be used.

19 RELEASE VERSION, DATE, AND SOURCE

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20 POINT OF ENQUIRY

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