SNAP CODE: **030320**

SOURCE ACTIVITY TITLE: **PROCESSES WITH CONTACT**
Fine Ceramics Materials

NOSE CODE: **104.11.11**

NFR CODE: **1 A 2 f**

1 ACTIVITIES INCLUDED

This chapter covers emissions released from combustion processes within the production of fine ceramics. However, in the following if useful for description, also non-combustion emissions are mentioned.

2 CONTRIBUTION TO TOTAL EMISSION

The contribution of fuel use related emissions released from the production of fine ceramics to total emissions in countries of the CORINAIR90 inventory is given as follows:

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	PM*
Fine Ceramics Materials	030320	0.2	0.1	-	-	0.3	0.3	0.1	-	-

0 = emissions are reported, but the exact value is below the rounding limit (0.1 per cent)
- = no emissions are reported
* = PM (inclusive of TSP, PM_{10} and $PM_{2.5}$) is <0.1% of total PM emissions

3 GENERAL

3.1 Description of activities

The manufacture of ceramic clay involves the conditioning of the basic ores by several methods. These include the separation and concentration of the minerals by screening, floating, wet and dry grinding, and blending of the desired ore varieties. The basic raw materials in ceramic clay manufacture are kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$) and montmorillonite [$(Mg, Ca)O \cdot Al_2O_3 \cdot 5SiO_2 \cdot nH_2O$] clays. Caoline or limestone are used as additives. The clays are refined by separation and bleaching, blended, kiln-dried, and formed into such items as whiteware, heavy clay products (brick, etc.), various stoneware, and other products such as diatomaceous earth, which is used as a filter aid. /4/

The oven temperature reaches about 1100 ^oC. Most commonly natural gas is burned to heat the ovens, but other fuels are possible. Electric heated ovens are used in small scale ovens. Usually a tunnel shaped oven is used, but other types are used as well.

3.2 Definitions

3.3 Techniques

It can be assumed, that similar techniques are in use as described in chapter B3319.

3.4 Emissions

Pollutants released are dust, 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), nitrous oxide (N_2O), fluoride (F_g), Chlorine (Cl_g) and ammonia (NH_3). According to CORINAIR90 the main relevant pollutants are SO_2, NO_x, CO, and CO_2 (see also table 1).

In the Netherlands, emissions from fine ceramic materials production represent scarcely 5 % of the emissions from bricks and tiles production /2/. The high temperatures of the firing kilns are also conductive to the fixation of atmospheric nitrogen and the subsequent release of NO_x.

It can be assumed, that formation mechanisms and formation processes of pollutants are similar to those described in chapter B3319. /cf 4/

3.5 Controls

Emission reduction techniques are almost non-existent.

4 SIMPLER METHODOLOGY

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

N.B There are no emission factors available for $PM_{2.5}$. The source is <0.1% of the total PM emissions for most countries.

5 DETAILED METHODOLOGY

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

Should a key source analysis indicate this to be a major source of particulate matter (TSP, PM_{10} or $PM_{2.5}$) then installation level data should be collected using a measurement protocol such as that illustrated in Measurement Protocol Annex.

6 RELEVANT ACTIVITY STATISTICS

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

7 POINT SOURCE CRITERIA

The production of fine ceramics is usually executed in rather small plants can be considered as area sources.

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

For the situation in the Netherlands, the following can be proposed:
Emission factors are given in kg per ton product:

SO_2:	0.2 - 2.7
F_g :	0.2 - 2.8
Cl_g:	0.1
CO_2:	300 - 1600
NO_x:	0.6 - 2.0
dust *:	0.35 - 0.80

* dust consists of clay particles, the composition may vary widely.

The following Table 2 contains fuel related emission factors for the production of fine ceramics based on CORINAIR90 data in [g/GJ]. Technique related emission factors, mostly given in other units (e.g. g/Mg product), 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 8.8 - 100 GJ/Mg product has been reported. Table 3 contains the AP 42 emission factors for particulate matter (US EPA, 1996).

Table 2: Emission factors for the production of fine ceramics[7]

					Emission factors							
	Type of fuel			NAPFUE code	SO_2[3] [g/GJ]	NO_x[4] [g/GJ]	NMVOC [g/GJ]	CH_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	650[1]	160[1]	15[1]	15[1]	100[1]	93[1]	4[1]	
s	coal	hc	sub-bituminous	103	610[1], 609[2]	40[1], 39[2]	1.5	1.5[1]		99[1,2]	8[1]	
s	coal	bc	brown coal/lignite	105	600[1]	140[1]	15[1]	15[1]	100[1]	113[1]	3.5[1]	
s	coal	bc	briquettes	106	220[1]	140[1]	15[1]	15[1]	100[1]	98[1]	3.5[1]	
s	coke	hc	coke oven	107	145[1], 144[2]	45[1,2]	2.5[1]	2.5[1]		105[1,2]		
s	coke	bc	coke oven	108	650[1]	220[1]	5[1]	15[1]	90[1]	86[1]	3[1]	
s	biomass		wood	111		200[1]	50[1]	30[1]		83-92[1]	4-14[1]	
l	oil		residual	203	143-1,494[1]	100-180[1]	3-4[1]	0.1-5[1]	10-15[1]	73-78[1]	2-14[1]	
l	oil		gas	204	85-1,410[1]	70-100[1]	1.5-2.5[1]	1-2.5[1]	10-12[1]	73-74[1]	2-14[1]	
l	kerosene			206	69[1]	80[1]	2[1]	1[1]	12[1]	71[1]	14[1]	
l	gasoline		motor	208	45[1]	80[1]	2[1]	1[1]	12[1]	71[1]	14[1]	
g	gas		natural	301	0.3-8[1]	44-330[1]	2.5-10[1]	0.4-4[1]	10-111[1]	53-69[1]	1-3.7[1]	
g	gas		liquified petroleum gas	303	0.04-2[1]	20-100[1]	1-2[1]	1-4[1]	13[1]	60-65[1]	1-3[1]	
g	gas		coke oven	304	0.04-12[1]	50-100[1]	2.5-4[1]	2.5-4[1]	10-13[1]	49-59[1]	1-1.5[1]	

[1] CORINAIR90 data, area sources

[2] CORINAIR90 data, point sources

[3] SO_x: 9,611 g/Mm³ fuel — Mineral products, process heaters, NAPFUE 301 /1/
290 g/Mg product — General, SO_2 260 g/Mg, SO_x 30 g/Mg /2/
210 g/Mg product — Future Value /2/

[4] NO_x: 850 g/Mg product — /2/

[5] CO: 1,600 g/Mg product — EPA value for ceramic industry
130 g/Mg product — /2/

[6] CO_2: 255 kg/Mg product — General /2/

[7] It is assumed, that emission factors cited within the table are related to combustion sources in the production of fine ceramics. Footnotes may also include emission factors for other process emissions.

Table 3: AP 42 Particulate matter emission factors* for Fine Ceramics (g/Mg) /5/

Source	**PM (g/Mg)**	**RATING**
Comminution--raw material crushing and screening line with fabric filter	60	D
Dryer	1150	E
Cooler	55	E
Granulation--natural gas-fired spray dryer		
with fabric filter	30	E
with venturi scrubber	95	D
Firing--natural gas-fired kiln	245	D
Refiring--natural gas-fired kiln	33.5	E
Ceramic glaze spray booth		

Source	PM (g/Mg)	RATING
uncontrolled	9500	E
with wet scrubber	900	D

* = In the absence of more appropriate data use the AP 42 emission factors

9 SPECIES PROFILES

A profile of the clay used might be useful. This information however is not usually available.

10 UNCERTAINTY ESTIMATES

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

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

The fuel specific emission factors provided in table 2 are related to point sources and area sources without specification. CORINAIR90 data can only be used in order to give a range of emission factors with respect to point and area sources. Further work should be invested to develop emission factors, which include technical or fuel dependent explanations concerning emission factor ranges.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

13 TEMPORAL DISAGGREGATION CRITERIA

The production of fine ceramics can be either a continuous or a discontinuous process.

14 ADDITIONAL COMMENTS

15 SUPPLEMENTARY DOCUMENTS

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

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 the results of the calculations with measurements at the individual plant.

17 REFERENCES

/1/ EPA (ed.): AIRS Facility subsystem; EPA-Doc 450/4-90-003; Research Triangle Park; 1990

/2/ Huizinga, K.; Verburgh, J. J.; Mathijsen, A. J. C. M.; Loos, B.: Fijnkeramische Industrie; RIVM-report 736301124; RIZA-report 92.003/24; 1992

/3/ Bouscaren, M. R.: CORINAIR Inventory, Default Emission Factors Handbook; Second Edition; Comission of the European Communities; Paris; 1992

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

/5/ US EPA (1996) Compilation of Air Pollutant Emission Factors Vol.1 Report AP-42 (5^{th} ed.)

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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