

SNAP CODE: 040605

SOURCE ACTIVITY TITLE: PROCESSES IN WOOD, PAPER PULP, FOOD, DRINK
AND OTHER INDUSTRIES
Bread-making & Other food manufacturing

NOSE CODE: 105.03.02

NFR CODE: 2 D 2

1 ACTIVITIES INCLUDED

This chapter addresses NMVOC emissions from food manufacturing, except emissions from vegetable oil extraction (060404), tobacco products and alcoholic beverages (040606, 040607, 040608). Emissions are included from all processes in the food production chain which occur after the slaughtering of animals and the harvesting of crops.

2 CONTRIBUTION TO TOTAL EMISSIONS

There is considerable uncertainty over the contribution to total emissions from this sector. Nevertheless, preliminary estimates suggest that bread-making and other food manufacturing may contribute up to 2% of the UK's total emission of NMVOCs (Passant 1993). This contribution will vary significantly from country to country.

These activities are not believed to be a significant source of PM_{2.5} (as of December 2006).

3 GENERAL

3.1 Description

Food manufacturing may involve the heating of fats and oils and foodstuffs containing them, the baking of cereals, flour and beans, fermentation in the making of bread, the cooking of vegetables and meats, and the drying of residues. These processes may occur in sources varying in size from domestic households to manufacturing plants.

3.2 Definitions

to land	to bring to port a catch of fish or other seafood
feed	food for animals
compound feedstuffs	animal feed based on the processing of other animals and plants

3.3 Techniques

Food processing may occur in open vessels without forced ventilation, closed vessels with periodic purge ventilation or vessels with continuous controlled discharge to atmosphere. In the larger plants, the discharges may be extremely odorous and consequently emission may be controlled using end-of-pipe abatement.

3.4 Emissions/Controls

Emissions occur primarily from the following sources:

- the cooking of meat fish and poultry, releasing mainly fats and oils and their degradation products;
- the processing of sugar beet and cane and the subsequent refining of sugar;
- the processing of fats and oils to produce margarine and solid cooking fat;
- the baking of bread, cakes biscuits and breakfast cereals;
- the processing of meat and vegetable by-products to produce animal feeds;
- the roasting of coffee beans.

Where cooking or putrefaction are not involved, such as the production of fresh and frozen foods, emissions are considered negligible. Emissions from the pasteurisation of milk and the production of cheeses are also considered negligible

Control techniques typically involve incineration or biological treatment, resulting in more than 90% destruction of NMVOCs.

4 SIMPLER METHODOLOGY

The simpler methodology divides food manufacture into seven categories each with its own emission factor. These categories are:

- meat, fish and poultry
- sugar
- margarine and solid cooking fats
- bread
- cakes, biscuits and breakfast cereals
- animal feeds
- coffee roasting

To obtain an emission estimate for NMVOCs from each of these categories, national production statistics are multiplied by default emission factors presented in section 8. It is assumed that no controls of emissions are in place.

5 DETAILED METHODOLOGY

A detailed methodology for emission from bread-making requires production statistics for the following types of bread:

- sponge dough
- white bread
- white bread, shortened process
- wholemeal bread
- light rye bread
- dark rye bread

In addition, information about the extent of control of emissions from each of the major sectors is required.

6 RELEVANT ACTIVITY STATISTICS

6.1 Simpler Methodology

The relevant activity statistics are based on national production figures.

- total production of home-killed meat, including meat subsequently canned
- total fish and seafood landed
- total production of poultry meat
- total sugar production
- total production of fats excluding butter
- total production of bread
- total production of cakes, biscuits and breakfast cereals
- total production of compound feedstuffs for cattle, pigs, poultry and other animals
- total weight of beans roasted to produce coffee

The principal information source will be the country's national statistics of production.

6.2 Detailed Methodology

Requires all the activity statistics given in paragraph 6.1 together with:

- total production of bread by the sponge-dough process
- total production of white bread by the shortened process
- total production of wholemeal bread
- total production of light rye bread
- total production of dark rye bread

A national trade association relating to the manufacture and production of bread would be the principal source of information for these activities.

7 POINT SOURCE CRITERIA

Only a few food processing plants are likely to be large enough to be considered point sources.

To qualify for consideration as point sources, the following levels of production should be obtained:

Foodstuff	Production rate (tonne per year)
Bread	300 000
Meat etc.	1 500 000
Sugar	150 000
Margarine etc	150 000
Animal feed	1 500 000
Coffee roasting	2 700 000

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

8.1 Background Data

The following emission factors have been used to derive default emission factors for the simple and detailed methodologies:

Process	NMVOC Emission Factor	Quality Code	Source
Grain drying	1.31 k/t(grain)	E	USEPA,1985
Coffee roasting	0.55 k/t(beans)	D	Rentz et al, 1991
Animal rendering (uncontrolled)	0.326 k/t(meat)	D	Passant, 1993
Fish meal processing (uncontrolled)	1.04 k/t(fish)	D	Passant, 1993
Sponge-dough	8 k/t(bread)	D	Henderson, 1977
White bread	4.5 k/t(bread)	D	Bouscaren 1992
White bread, shortened process	2.0	D	Bouscaren 1992
Wholemeal bread	3.0	D	Bouscaren 1992
Light Rye bread	3.0	D	Bouscaren 1992
Dark Rye bread	0	D	Bouscaren 1992

The sponge dough process used in the manufacture of bread is not typical of Europe.

8.2 Default Emission Factors

Foodstuff	Default Emission Factor		Quality Code
	Simple	Detailed	
Bread (Europe)	4.5 k/t(bread)		E
Bread (North America)	8 k/t (bread)		E
Bread (sponge dough)		8 k/t(bread)	D
Bread (white)		4.5 k/t(bread)	D
Bread (wholemeal and light rye)		3 k/t(bread)	D
Bread (dark rye)		0 k/t(bread)	E
Cakes, biscuits and breakfast cereals	1 k/t(product)		E
Meat, Fish and Poultry	0.3 k/t(meat etc)		E
Sugar	10 k/t(sugar)		E
Margarine and solid cooking fats	10 k/t (product)		E
Animal feed	1 k/t		E
Coffee roasting	0.55kg/t(beans)		D

It is assumed that abatement equipment reduces emissions by 90% when used. Hence to obtain a default emission factor from a controlled source, multiply the uncontrolled emission factor by 0.1.

If, for example, the extent of control is 75%, assign 25% of the activity to an uncontrolled emission factor, and 75% of the activity to a controlled emission factor.

Note, since most domestic cooking of meat is within ovens, grills etc, emissions to the environment are likely to be very low. This source may be considered controlled.

9 SPECIES PROFILES

Emissions from the processing of cereals is known to involve a range of NMVOC including alcohols, ethers, aldehydes, aromatics, aliphatics, dimethyl sulphide and carboxylic acids (See SNAP codes 040606, 040607, 040608 Alcoholic Beverages).

The NMVOC emission from breadmaking is 95% ethanol arising from the fermentation process. The remaining 5% may include acetaldehyde and pyruvic acid (2-oxopropanoic acid) (Henderson, 1977). The following species profile of animal rendering has been produced, based on reports by a number of workers (Passant, 1993):

Compound	% wt
Aromatics	33
Alkanes	30
Aldehydes	21
Sulphur Compounds	13
Alcohols	3

In the absence of better data, the following default species profile may be used for emissions from the food industry as a whole, with a data quality E.

Compound	% wt
Ethanol	20
Other alcohols (e.g. propanol)	10
Aldehydes (e.g. acetaldehyde)	20
Sulphur Compounds (e.g. dimethylsulphide)	10
Carboxylic acids (e.g. pyruvic acid)	10
Alkanes	10
Aromatics	10
Ethers	10

10 UNCERTAINTY ESTIMATES

Uncertainty in the emission estimates is greater than a factor of 2.

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

The weakest aspect of the methodology is the quality of the data for emission factors. Those sectors with the largest emission estimate and data quality E for the default emission factor should be considered first. For the UK, the priority order would be as follows:

1. Sugar
2. Animal feeds
3. Margarine and solid cooking fats
4. Meat, fish and poultry

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

The proportion of the emission remaining once the contribution of point sources has been removed should be disaggregated by population.

13 TEMPORAL DISAGGREGATION CRITERIA

Assume continuous emission over 24 hours and throughout the year, unless better information is available.

14 ADDITIONAL COMMENTS

15 SUPPLEMENTARY DOCUMENTS

16 VERIFICATION PROCEDURES

Verification of the methodology is through the measurement of emissions from selected point sources.

17 REFERENCES

Bouscaren, M.R., 1992, Commission of the European Community Corinair Inventory Default Emission Factors Handbook, CITEPA

Henderson, D.C., 1977, Commercial Bakeries as a Major Source of Reactive Volatile Organic Gases, U.S. Environmental Protection Agency, Region XI Surveillance and Analysis Division

Passant, N.P., 1993, Emissions of Volatile Organic Compounds from Stationary Sources in the United Kingdom - A Review of Emission Factors by Species and Process, Warren Spring Laboratory.

Rentz O., Jourdan M., Roll C., Schneider C., Emissions of Volatile Organic Compounds (VOCs) from Stationary Sources and Possibilities for their Control, Institute of Industrial production, University of Karlsruhe, Germany, Report Number OBA 91 - 010, 1991

United States Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, Volume 1 Stationary Point and Area Sources, 4th d. US EPA AP42, September 1985

18 BIBLIOGRAPHY

19 RELEASE VERSION, DATE AND SOURCE

Version : 2.2

Date : 19 May 1995

Source : M A Emmott, S J Richardson
AEA Technology Environment

Updated with particulate matter details by:

Mike Woodfield
AEA Technology
UK
December 2006

20 POINT OF ENQUIRY

Any comments on this chapter or enquiries should be directed to:

Panagiota Dilara

Emissions and Health Unit
Institute for Environment and Sustainability (IES)
European Commission
Joint Research Centre
I-21020 Ispra (VA)
Italy

Tel: +39 0332 789207

Fax: +39 0332 785869

Email: panagiota.dilara@jrc.it