

SNAP CODE: 060404

SOURCE ACTIVITY TITLE: OTHER USE OF SOLVENTS & RELATED ACTIVITIES
Fat, Edible and Non Edible Oil Extraction

NOSE CODE: 107.04.04

NFR CODE: 3 D

1 ACTIVITIES INCLUDED

Solvent extraction of edible oils from oilseeds. Drying of leftover seeds before resale as animal feed.

2 CONTRIBUTION TO TOTAL EMISSIONS

Emissions of NMVOC from the solvent extraction and subsequent drying of oilseeds represent between 0 and 0.5% of a country's total NMVOC emission.

For example, in the UK the contribution is 0.34% (Passant, 1993).

This activity is not believed to be a significant source of PM_{2.5} (as of December 2006).

3 GENERAL

3.1 Description

The extraction of oil from oil seeds is performed either mechanically or through the use of solvents, or both. Where solvent is used, it is generally recovered and cleaned for reuse. The seed may be subjected to solvent treatment many times before all the oil is extracted. The remaining seed residue is then dried and may be used as an animal feed.

3.2 Definitions

3.3 Techniques

If the oil content of the seed is high, for example olives, the majority of the oil is pressed out mechanically. Where the oil content is lower, or the remaining oil is to be taken from material which has already been pressed, solvent extraction is used.

Hexane has become a preferred solvent for extraction. In extracting oil from seeds, the cleaned and prepared seeds are washed several times in warm solvent. The remaining seed residue is treated with steam to capture the solvent and oil which remains in it.

The oil is separated from the oil-enriched wash solvent and from the steamed out solvent. The solvent is recovered and re-used. The oil is further refined.

3.4 Emissions/Controls

Solvent recovery is an integral part of solvent extraction plant. The economics of a plant may be finely balanced on the proportion of solvent which is recovered. The efficiency of recovery is usually high, but is dictated by economic considerations, and will be limited to recovery plant on which the capital investment can be paid for by reduction in expenditure on new solvent.

Emissions of NMVOC will also arise from the drying of spent oil seeds.

Emissions may be controlled by improving the efficiency of the solvent extraction plant and by adding abatement equipment such as water scrubbers to the drying plant.

Particulate emissions can arise from transport and related mechanical handling of seed materials, in addition the material is mechanically processed (for example dehulled, flaked and milled) which can give rise to PM emissions. Particulate emission controls include cyclones and fabric filters.

4 SIMPLER METHODOLOGY

The simpler methodology is to combine an activity statistic with an appropriate emission factor for processing of the materials.

5 DETAILED METHODOLOGY

A more detailed methodology would combine activity statistics and emission factors for different vegetable oil types and for the production of different VOC and particulate species. It might also consider other stages within the oil extraction process.

6 RELEVANT ACTIVITY STATISTICS

For the simpler methodology, the relevant activity statistics are the quantities of oil extracted and seed used in units of tonnes per year. In addition, the total solvent consumption by the industry is a measure of the solvent required to replace that lost during the recovery process.

For the more detailed methodology, the activity for different oil types and for different NMVOC species are needed. Data on other stages within the oil extraction process could also be used.

7 POINT SOURCE CRITERIA

There are relatively few oil extraction plants in the UNECE area. These could be considered as point sources, if plant specific data are available. Otherwise the activity is a relatively small source of NMVOC and hence should be considered as an area source.

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

8.1 Simpler Methodology

VOC emissions

Solvent extraction:

<u>Emission Factor</u>	<u>Quality Code</u>	<u>Reference.</u>
19 kg VOC. t ⁻¹ of seed	D	Finelt (1979)
6 kg VOC. t ⁻¹ of seed	D	Munday (1990)
0.85 kg VOC. t ⁻¹ of seed	C	Swannell et al. (1991)

Grain Drying:

<u>Emission Factor</u>	<u>Quality Code</u>	<u>Reference</u>
1.31 kg VOC. t ⁻¹ of seed	D	US EPA (1985)

Particulate emissions

<u>Emission Factor</u>	<u>Quality Code</u>	<u>Reference.</u>
1.1 kg TSP. t ⁻¹ of seed	E	USEPA (AP-42)
0.9 kg PM ₁₀ . t ⁻¹ of seed		
0.6 kg PM _{2.5} . t ⁻¹ of seed		

The TSP data represent the sum of USEPA dehulling, hull grinding, conditioning, flaking rolls, flake cooler, meal grinder/sizing and loadout emission factors with either cyclone abatement or no controls. Some of these activities may not be appropriate for a particular process and differing degrees of abatement may be applied. PM₁₀ and PM_{2.5} estimates are 'expert judgment'. Estimates of PM emissions from grain handling processes are provided by USEPA in AP42 Chapter 9.9.1 Grain Elevators and Processes (USEPA, 2003).

8.2 Detailed Methodology

No data available.

9 SPECIES PROFILES

The only solvent identified is hexane (Rentz *et al.*, 1990), and any solvent which fails to be recycled will eventually be emitted. Hexane is therefore suggested as the major species emitted (Data Quality D). Aldehydes and Fatty acids are liberated during steam treatment (Swannell *et al.*, 1991).

10 UNCERTAINTY ESTIMATES

The range of emission factors available suggests that there is considerable variation from plant to plant on the efficiency of the solvent recovery systems, with older plant being

considerably less efficient than new plant. If this is not taken into account then the emission estimate may vary by a factor of 20.

There is only one reference emission factor for the drying of seed. This may not be expected to vary as much as the efficiency of solvent recovery plants. Nevertheless an uncertainty estimate of 100% cannot be ruled out.

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

The weakest aspect of the methodology is the application of general emission factors to different types of plant and different types of feedstock. The methodology would be considerably improved if emission factors could be established for old and modern plants and for the different types of seed e.g. corn, cotton seed, sunflower, rape, soya-bean, peanut.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

(Plants should be considered as point sources if possible.)

13 TEMPORAL DISAGGREGATION CRITERIA

It may be assumed that emissions occur uniformly over diurnal and annual cycles.

14 ADDITIONAL COMMENTS

15 SUPPLEMENTARY DOCUMENTS

Passant N.R., Richardson S.J., Swannell R.P.J., Gibson N., Woodfield M.J., van der Lugt J.P., Wolsink J.H., and Hesselink P.G.M. Emissions of Volatile Organic Compounds (VOCs) from the Food and Drink Industries of the European Community. Atmos. Environ. 27A, 2555-2566, 1993.

16 VERIFICATION PROCEDURES

Emission estimates based on emission factors may be compared with data on the total solvent consumption of this industrial sector. Emission factors should also be verified through measurements if possible.

17 REFERENCES

Finelt S. Air pollution abatement facilities at soybean processing plants, J. Air Pollut. Control Ass. 29, 1192-1196, 1979.

Munday P.K. U.K. emissions of air pollutants 1970-1988. Warren Spring Laboratory, Stevenage, Herts, UK, 1990. Report Number LR 764 (AP).

Passant N.R., Emissions of Volatile Organic Compounds from Stationary Sources in the UK, Warren Spring Laboratory, Stevenage, UK, 1993, ISBN 0 85624 850 9.

Rentz O., Jourdan M., Roll C. and Schneider C. Emissions of Volatile Organic Compounds (VOCs) from Stationary Sources and Possibilities for their Control. Published by the Institute of Industrial Production, University of Karlsruhe, Germany, 1990. Report No. OBA 91-010.

Swannell R.P.J., Richardson S.J., Passant N.R., Woodfield M.J., van der Lugt J.P., Wolsink J.H., Hesselink P.G.M., Hecht V., Brebbermann D. and Bischoff H. Biodegradability and Emissions of Volatile Organic Carbon Compounds from the Food, Drink and Metal Degreasing Industries. Published by TNO Environmental and Energy Research, P.O. Box 6011, Delft, Netherlands for the Commission of the European Communities DG XII, 1991. Report No. R91/381.

United States Environmental Protection Agency Compilation of air pollutant emission factors. Volume 1. Stationary point and area sources. 5th Edition, 1995. EPA Report AP-42. North Carolina, U.S.A. <http://www.epa.gov/ttn/chief/ap42/ch09/index.html> and <http://www.epa.gov/ttn/chief/ap42/ch09/final/c9s0909-1.pdf> (grain elevators).

18 BIBLIOGRAPHY

19 RELEASE VERSION, DATE AND SOURCE

Version : 2.2

Date : February, 1994.

Source : Stephen Richardson and Gavin Costigan
AEA Technology Environment
UK

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