SNAP CODE: **060310**

SOURCE ACTIVITY TITLE: **CHEMICALS PRODUCTS MANUFACTURING OR PROCESSING**
Asphalt Blowing

NOSE CODE:

NFR CODE: **3 C**

1 ACTIVITIES INCLUDED

Asphalt blowing is used for polymerising and stabilising asphalt to improve its weathering characteristics. Air blown asphalts are used in the production of asphalt roofing products, in the installation of built-up roofs and for the repair of leaky roofs. Air blowing of asphalt may be conducted at oil refineries, asphalt processing plants, and asphalt roofing plants. The emissions from a blowing still are primarily organic particulate with a fairly high concentration of gaseous hydrocarbon and polycyclic organic matter.

2 CONTRIBUTIONS TO TOTAL EMISSIONS

Asphalt blowing emitted the following percentages of anthropogenic emissions:

Table 1: Percent of Total Anthropogenic Emissions in 1990

Region	Particulate	SOx	NOx	CO	VOC
BG					0.1
Canada					0.04
DEw					1.0
ES					0.2
GR					<0.0
United States	0.2	0	0.004	0.001	0.004
CORINAIR					0.1

Emissions of SOx and NOx are most likely related to combustion for process heating (see SNAP Code 030100).

3 GENERAL

3.1 Description

The process involves blowing air through a hot asphalt flux to raise the temperature at which it will soften. Blowing may be done in vertical or horizontal stills. Catalysts may be used to achieve certain properties and to increase the rate of reaction.

3.2 Definitions

Blowing still: A blowing still is a tank fitted near its base with a 'sparger', which increases contact between the air and the asphalt.

3.3 Techniques

Asphalt blowing involves the oxidation of hot asphalt flux which is achieved by the bubbling air of the blowing still. Air is forced through holes in the sparger into a tank of hot asphalt flux. The result is an exothermic oxidation reaction, which raises the softening temperature of the asphalt, as well as modifying other characteristics.

The process is highly temperature dependent, as the rate of oxidation increases rapidly with increases in temperature. Since the reaction is exothermic, the temperature rises as blowing proceeds. Temperatures must be kept safely below the flash point of the asphalt. The temperature is therefore kept at an optimum level of 260 ^{o}C during blowing by spraying water onto the asphalt surface. For some crudes auxiliary cooling may also be required.

Inorganic salts such as ferric chloride ($FeCl_3$) may be used as catalysts to achieve the desired properties and/or to increase the rate of reaction, thus decreasing the blowing time. Blowing times may vary in duration from 30 minutes to 12 hours, depending on the desired characteristics of the asphalt (softening point, penetration rate).

Stills may be either vertical or horizontal. Vertical stills are preferred because of the increased asphalt-air contact and consequent reduction in blowing times, as well as lower asphalt losses.
Asphalt blowing can be either a batch process or a continuous operation. Typically, stills at roofing plants and processing plants may be run as batch processes, while refineries may run in both modes, depending on the product demand.

In Canada, the percentage of asphalt produced that was sold for non-asphalt purposes, and was therefore likely to have been blown, ranged from 16.4 to 24.7 % of total reported asphalt sales in the period 1983 to 1991. In the U.S., 14% of total sales was reported for non-paving uses in 1991. (Asphalt Institute 1992)

3.4 Emissions

Asphalt blowing stills are sources of particulate hydrocarbon, gaseous hydrocarbon and carbon monoxide. Emissions of gaseous hydrocarbons are small because of the prior removal of volatile hydrocarbons in the distillation units.

The type of crude and characteristics of the asphalt may influence the emissions. For instance, the US EPA (1980) hypothesizes that uncontrolled emissions are higher for asphalts derived from the more volatile West Coast or Middle East crudes than from the mid-continent crudes. Process parameters influencing emissions include the blowing temperature, air rate, design/configuration of the still, and the type of product desired (e.g. saturant or coating asphalt).

3.5 Controls

Process controls include the following:

1. vertical rather than horizontal stills;
2. asphalts that inherently produce lower emissions;
3. higher flash point asphalts;
4. lower asphalt blowing temperatures.

Thermal afterburners in combination with closed capture systems are used to control combustible emissions from asphalt blowing stills. Although they consume less supplemental fuels, catalytic afterburners cannot be used because the catalyst is subject to rapid poisoning and plugging due to constituents of the fumes from the process.

4 SIMPLER METHODOLOGY

The simplest inventory methodology is to combine total national production statistics with default emission factors to estimate total emissions. Default emission factors for this simplified approach re provided in Table 8.1.

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

The detailed methodology would involve procuring production statistics and control information for each plant. The latter information would be used to select the most appropriate emission factor. This would be for the case where asphalt blowing stills are considered to be point sources. If they are considered to be area sources, then the detailed methodology is not applicable. Reference emission factors for comparison with user's own data are provided in Table 8.2.

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

The total weight of asphalt blown is required to estimate emissions from asphalt blowing stills. This information may be available on a national or regional basis from industry; for

example, the Asphalt Institute publishes annual asphalt usage statistics for the United States and Canada.

7 POINT SOURCE CRITERIA

Release estimates only for asphalt blowing are difficult to obtain. For a large roofing manufacturing location, the U.S. EPA (1980) reports that about 120,000 Mg/yr. of asphalt would be blown. Emissions for this blowing facility in (Mg), calculated with emission factors from AP-42 (see Table 4) and assuming approximately half saturant and half coating blowing (U.S. EPA 1994) are summarised in Table 2.

Table 2: Calculated Annual Emissions for A Large Blowing Still (Mg)

Saturant Blowing		
Particulates	198	8.4
Total organic compounds	40	0.1
Coating Blowing		
Particulates	720	not available
Total organic compounds	102	5.1

Thus this asphalt blowing operation does not qualify as a point source of criteria pollutants in the CORINAIR 1990 classification, where emissions should be in excess of 1000 Mg in a year for SO_2 or NOx and 1500 Mg per year of NMVOC.

Note that the location of the still may be the most important parameter in determining if it is a point source under the CORINAIR system: stills located at a refinery would likely be inventoried as a point source because the rest of the facility will qualify for this designation. Stills at other locations may qualify depending on total production and/or what other emission sources, such as combustion sources, are present.

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

8.1 Simpler Methodology

A summary of default emission factors for use with the simpler methodology are provided in Table 8.1.

Table 8.1 Default emission factors for asphalt blowing

Pollutant	Emission factor	Units
Particulate matter Total suspended particulate	0.4[1]	kg/Mg
Arsenic	0.5	mg/Mg
Cadmium	0.1	mg/Mg

Chromium	6.0	mg/Mg
Nickel	54.7	mg/Mg
Selenium	0.5	mg/Mg
Polyaromatic hydrocarbons	3.75	kg/Mg

8.2 Detailed Methodology

Tables 8.2a and 8.2b provide reference emission factors for comparison with user's own emission factors.

Table 8.2a Emission Factors for Asphalt Blowing (Passant 1993)

	NMVOC	Data	Data
Asphalt blowing	**Emission Factor**	**Quality**	**Source**
Controlled	27.2 kg/t asphalt	D*	Robinson and Sullivan 1992
Uncontrolled	0.54 kg/t asphalt	D	Robinson and Sullivan 1992

* An estimate based on an engineering calculation derived from a number of relevant facts and assumptions

Emission factors from the U.S. EPA compilation of air pollutant emission factors for asphalt roofing manufacturing plants are summarised in Table 8.2b.

Table 8.2b Emission Factors for Asphalt Blowing (U.S. EPA 1994)

Operation	**Particulates**	**TOC[a]**
	Emission Factor (Data Quality) (kg/Mg asphalt processed)	
Uncontrolled		
Saturant	3.3	0.66 (E)
Coating	12	1.71 (E)
Controlled		
Saturant	0.14	0.0022 (D)
Coating		0.085

[a] total organic compounds , [b] both processes are controlled with after burners

For blowing stills associated with petroleum refineries, the U.S. EPA (1985) cites an uncontrolled VOC emission factor of 30 kg/Mg of asphalt, stating that emissions may be controlled to negligible levels by vapour scrubbing, incineration or both. No quality factor is given.

9 SPECIES PROFILES

Passant (1993) used the general speciation profile summarised in Table 9 for emissions from petroleum refineries to characterise emissions from asphalt blowing.

Table 9: Asphalt Blowing - NMVOC Speciation (Passant 1993)

Compound	% Weight
Ethane	6.0
Propane	18.8
Butanes	30.5
Pentanes	17.2
Hexanes	8.4
Heptanes	9.8
Octanes	7.4
Cycloparaffins	1.9
Benzene	0.1

UN ECE groups: 2% group I; 73% group II; 25% group III.
POCP factor:43

10 UNCERTAINTY ESTIMATES

It is not possible to estimate the accuracy of estimates based on the emission factors summarised in section 8. Based on the low data qualities and the large differences in emission factors, the level of uncertainty is high. The comments received from other panel members suggest that the uncertainty is greater than a factor of 2.

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

Quality factors assigned to emission factors for NMVOC and CO are low. It is recommended that improvements be made in the emission factors for these sources through new testing programs for uncontrolled and controlled blowing of asphalt.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

If asphalt blowing is inventoried as an area source, emissions may be disaggregated based on population.

13 TEMPORAL DISAGGREGATION CRITERIA

Asphalt blowing may be expected to occur year round. The U.S. EPA indicates that a typical blowing plant at a roofing manufacturing site may operate 16 hours a day, five days a week. Similar information for asphalt blowing at other facilities was not identified.

14 ADDITIONAL COMMENTS

There is considerable uncertainty on how much asphalt is actually blown. For instance, asphalts used for paving in France may be blown.

15 SUPPLEMENTARY DOCUMENTS

16 VERIFICATION PROCEDURES

Emissions estimates at selected facilities could be verified against plant measurements.

17 REFERENCES

Asphalt Institute, 1992. "1991 Asphalt Usage. United States and Canada". Lexington, Kentucky.

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18 BIBLIOGRAPHY

19 RELEASE VERSION, DATE AND SOURCE

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Environment Canada
Canada

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Mike Woodfield
AEA Technology
UK
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20 POINT OF ENQUIRY

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

Marc Deslauriers

Environment Canada
Criteria Air Contaminants Division
Pollution Data Branch
351 St Joseph Boulevard, 9th Floor
Hull, Quebec, K1A 0H3
Canada

Tel: +1 819 994 3069
Fax: +1 819 953 9542
Email: marc.deslauriers@ec.gc.ca