SNAP CODE: **040610**

SOURCE ACTIVITY TITLE: **PROCESSES IN WOOD, PAPER PULP, FOOD, DRINK AND OTHER INDUSTRIES**
Asphalt Roofing Materials

NOSE CODE: **105.16.17**

NFR CODE: **2 A 5**

1 ACTIVITIES INCLUDED

The asphalt roofing industry manufactures saturated felt, roofing and siding shingles, and roll roofing and sidings. Most of these products are used in roofing and other building applications. This section covers emissions of NMVOC, CO and particulate material from all related facilities, with the exception of asphalt blowing, which is inventoried separately under SNAP code 060310.

2 CONTRIBUTIONS TO TOTAL EMISSIONS

Table 1 summarises emissions from asphalt roofing manufacturing facilities. Emissions of SOx and NOx are most likely related to combustion to produce steam or to process dryers and if so should be included under SNAP sector 0301.

Table 1: Emissions (Mg) from Asphalt Roofing Manufacture in 1990

Country	Particulate		Sox		NOx		CO		NMVOC	
	Emissions (Mg)	%[1]	Emissions (Mg)	%[1]	Emissions (Mg)	%[1]	Emissions (Mg)	%[1]	Emissions (Mg)	%[1]
Canada	20073	1.6	-	-	-	-	27763	0.3	707	0
Corinair90	-	-	~1000*	0	<100	0	-	-	~11000	0.1

[1] % of total anthropogenic emissions for that particular country.
* Reported as SO_2
0 = emissions are reported, but the exact value is below the rounding limit (0.1 per cent)
- = no emissions are reported

The source is believed to be <0.1% of the total PM emissions for most countries.

3 GENERAL

3.1 Description

Asphalt felt, roofing and shingle manufacture involves the saturation or coating of felt. Heated saturant and/or coating asphalt is applied through dipping and/or spraying. Key steps in the process include asphalt storage, asphalt blowing (see SNAP code 060310), felt

saturation, coating and mineral surfacing. When glass fibre is used in place of paper felt, the saturation step is eliminated.

3.2 Definitions

3.3 Techniques

For asphalt-saturated felt, a typical manufacturing line consists of a paper feed roll, a dry looper section, a saturator spray section (may not be used), a saturator dipping section, steam-heated drying-in drums, a wet looper, water cooled rollers, a finish floating looper, and a roll winder.

For asphalt shingles, smooth rolls and mineral-surfaced rolls, the manufacturing line is similar to the felt line, with the addition of a filled asphalt coater, a granule applicator, a press section, water cooled rollers, a finish floating looper, and either a roll winder or a shingle cutter and stacker. Filled asphalt coating is prepared by mixing heated coating asphalt with a mineral stabilizer (filler), which may or may not be pre-dried.

Detailed descriptions of these processes may be found in U.S. EPA 1980.

3.4 Emissions

The processes which contribute to emissions from asphalt roofing manufacturing are:

- the roofing manufacturing line;
- the delivery, transfer, and storage of asphalt and mineral products used in the manufacture of roofing products;
- the blowing of asphalt (see SNAP code 060310 for the latter).

Emission sources included under SNAP code 040610 are summarized in Table 2.

Table 2: Asphalt Roofing Manufacture - Sources of Emissions

Emission Source	Pollutant
saturator	particulate and gaseous hydrocarbons
wet looper	gaseous hydrocarbons
coater-mixer tank	particulate hydrocarbons, gaseous hydrocarbons, and inorganic particulates
coater	particulate hydrocarbons, gaseous hydrocarbons, and inorganic particulates
surface application	inorganic particulates
sealant strip application	gaseous hydrocarbons
asphalt storage tank	gaseous hydrocarbons and particulate

Emission Source	Pollutant
materials handling	inorganic particulates
filler dryer	inorganic particulate, combustion gases

3.5 Controls

The following process controls can be used to minimize emissions:

1. dip saturators, rather than spray or spray-dip saturators;
2. asphalts that inherently produce low emissions;
3. reduced temperatures in the asphalt saturant pan; and
4. reduced asphalt storage temperatures.

Add-on emission controls are summarized in Table 3.

Table 3: Emission Controls for Asphalt Roofing Manufacture.

Emission Sources	Control Devices	Comments
saturator, wet looper and coater	afterburner, high energy air filter, electrostatic precipitator, mist eliminators, fabric filters, or wet scrubbers	These sources usually share a common enclosure and are ducted to a common control device.
coater-mixer	high velocity air filter	Fumes may be routed to common control device (see above).
asphalt storage tanks	mist eliminator	may be routed to common control device during production periods.
mineral surfacing and granule application	bag-house, wet scrubber, cyclone	
granule and mineral delivery, storage, and transfer	bag-house(s), wet scrubber, cyclone	Storage and conveyors are usually enclosed to prevent moisture pick-up.

4 SIMPLER METHODOLOGY

The simplest inventory methodology is to combine total national production statistics with average emission factors to estimate total emissions. Emission factors used should reflect the level of control for the region being inventoried.

5 DETAILED METHODOLOGY

The detailed methodology would involve the measurement of emissions from each plant to develop site-specific emission factors. This would be the case where asphalt roofing

manufacturing plants are considered to be point sources. If they are considered to be area sources, then there is no detailed methodology.

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 protocol such as that illustrated in the Measurement Protocol Annex.

6 RELEVANT ACTIVITY STATISTICS

In order to estimate emissions, production data by plant or for the sector are required. The relevant activity statistic is the production of shingles.

7 POINT SOURCE CRITERIA

In a report by the U.S. EPA (1980), a large asphalt roofing plant was identified as having an annual production rate of 280,000 Mg per year. Table 4 summarizes releases for this facility calculated with emission factors from section 8.

Table 4: Estimated Annual Emissions from a Large Asphalt Roofing Manufacturing Facility (Mg)

	Uncontrolled	Controlled
particulates	168 - 448 (a)	4.5 - 9.8 (b)
carbon monoxide	3	no data
total organic compounds	13 - 36 (a)	13 - 45 (b)

a. Depending upon the technology
b. Depending upon the technology and the type of control.

The release estimates given in Table 4 do not include asphalt blowing, which, although it is often done at the roofing manufacturing location, is inventoried under a different SNAP code. The U.S. EPA reports that blowing still has the highest total emissions of any of the emission sources in an asphalt roofing plant (U.S. EPA 1980). For the large asphalt plant referred to above, about 120,000 Mg/yr of asphalt would be blown.

Emissions calculated with emission factors from AP-42 (see SNAP code 060310) and assuming approximately half saturant and half coating blowing (U.S. EPA 1985) are presented in Table 5.

Thus, based on non-combustion emissions, asphalt roofing manufacturing plants would likely not qualify as point sources of criteria pollutants in the CORINAIR 1990 project, where emissions must be in excess of 1000 Mg in a year for SO_2 and NOx and 1500 Mg of NMVOC.

Table 5: Estimated Emission from a Blowing Still associated with a Large Asphalt Roofing Manufacturing Facility (Mg)

	Uncontrolled	Controlled
Saturant Blowing		
particulates	216	15
carbon monoxide	8.4	36
total organics (as CH_4)	43.8	0.9
Coating Blowing		
particulates	804	27
carbon monoxide		264
NMVOC	111	3

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

Table 6: Emission Factors for Asphalt Roofing Manufacture (U.S. EPA, 1994)

Shingle Saturation Process	Emission Factors (Emission Factor Rating) (kg/Mg shingle produced)		
	Particulate[a, b]	TOC[c]	CO
Dip saturator[d] - Uncontrolled	no data	no data	0.0095 (D)
Dip saturator[e] - Uncontrolled	0.60 (D)	0.046 (D)	no data
Dip saturator[e-] ESP	0.016 (D)	0.049 (D)	no data
Dip saturator – HEAF[f]	0.035 (D)	0.047 (D)	no data
Spray / dip saturator[g] - Uncontrolled	1.6 (D)	0.13 (D)	no data
Spray / dip saturator[g] - HEAF	0.027 (D)	0.16 (D)	no data

a. As measured using EPA Method 5A: that particulate collected on or prior to the filter.
b. assume representative of TSP, PM_{10} and $PM_{2.5}$ - USEPA states that PM is primarily due to condensed asphalt fume in which case the emission can be reasonably considered as 100% PM_{10} and also likely to be all $PM_{2.5}$
c Total organic compounds as measured with EPA Method 25A (or equivalent) sampling train.d.With drying - in drum section and coater.e.With drying - in drum section, wet looper and coater.f.With drying - in drum section, wet looper and High-Energy Air Filter.g.Spray/dip saturator, drying-in drum section, wet looper, coater and storage tanks.

Emission factors are all rated D. The controlled CO emission factor is based on tests at one plant only, with an afterburner as a control device.

9 SPECIES PROFILES

No NMVOC speciation profiles specific to asphalt roofing manufacture were identified. However, Passant (1993) used the general speciation profile for emissions from petroleum refineries to characterize emissions from asphalt blowing, as summarized in Table 7.

Table 7: Speciation Profile for Asphalt Roofing Manufacture

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

This profile could be used as a default profile for the asphalt roofing industry. The reader is also referred to generalized species profiles provided chapter B411 (Petroleum Refining).

The U.S. EPA (1994) indicates that polycyclic organic matter comprises approximately 1.1 per cent of particulate matter for saturators.

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. 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

It is recommended that better emission factors be developed for these sources. Separate emission factors for felt vs shingle/roll products should be considered, as well as accounting for the level of control for this industry.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

Asphalt roofing manufacturing plants are likely to be within reasonable (i.e. cost effective) shipping distances of asphalt producers or distributors. If this data is not available, population may also be used to disaggregate these emissions.

13 TEMPORAL DISAGGREGATION CRITERIA

In the absence of data on the operational characteristics of the industry, it may be assumed that the emissions are continuous (24 hour operation).

14 ADDITIONAL COMMENTS

15 SUPPLEMENTARY DOCUMENTS

16 VERIFICATION PROCEDURES

17 REFERENCES

U.S. Environmental Protection Agency (U.S. EPA), 1980. "Asphalt Roofing Manufacturing Industry Background Information For Proposed Standards." EPA-450/3-80-021a. PB 80 212111. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

U.S. Environmental Protection Agency (U.S. EPA), 1994. "11.2 Asphalt Roofing" Supplement to Compilation of Air Pollutant Emission Factors: Stationary Point and Area Sources. AP-42, Fourth Edition. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

18 BIBLIOGRAPHY

19 RELEASE VERSION, DATE AND SOURCE

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20 POINT OF ENQUIRY

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