SNAP CODE: **040515**

SOURCE ACTIVITY TITLE: **PROCESSES IN ORGANIC CHEMICAL INDUSTRIES (BULK PRODUCTION)**
Acrylonitrile Butadiene Styrene (ABS) Resins

NOSE CODE: **105.09.88**

NFR CODE: **2 B 5**

1 ACTIVITIES INCLUDED

Acrylonitrile butadiene styrene (ABS) is a combination of a graft copolymer and a polymer mixture.

2 CONTRIBUTION TO TOTAL EMISSIONS

The NMVOC emission of ABS plants contributes on average of less than 0.1% to the total NMVOC emission in a country.

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

3 GENERAL

3.1 Description

ABS can be produced in three ways:

- Emulsion polymerization.
  This is a two step process. In the first step a rubber latex is made, usually in a batch process. In the second step, which can be operated as batch, semi-batch and continuous, styrene and acrylonitrile are polymerized in the rubber latex solution to form an ABS latex. The ABS polymer is recovered through coagulation of the ABS latex by adding a destabilizing agent. The resulting slurry is filtered or centrifuged to recover the ABS resin. The ABS resin is then dried.

- Mass (or bulk) polymerization.
  Two or more continuous flow reactors are used in this process. Rubber is dissolved in the monomers, being styrene and acrylonitrile. During the reaction the dissolved rubber is replaced by the styrene acrylonitrile copolymer (SAN) and forms discrete rubber particles. Part of the SAN is grafted on the rubber particles, while another part is occluded in the particles. The reaction mixture contains several additives, e.g. initiator, chain-transfer agents, these are needed in the polymerization.

  The product is devolatilized ro remove unreacted monomer, which are recycled to the reactor, and then pelletized.

- Mass-suspension.

This batch process starts with a mass polymerization (see above) which is stopped at a monomer conversion of 15 - 30%. Then a suspension reaction completes the polymerization. For this reaction the mixture of polymer and monomer is suspended in water using a suspending agent and then the polymerization is continued.

Unreacted monomers are stripped, then the product is centrifuged and dried.

3.2 Definitions

Graft polymer: a polymer with a 'backbone' of one type of monomer and with 'ribs' of copolymers of two other monomers.

3.3 Techniques

See section 3.1.

3.4 Emissions

The VOC emission can be subdivided as follows:

Cause of the emission	[1]
leakage losses from appendages, pumps, etc.	99.4 %
flaring, disruptions	0.00%
losses due to storage and handling	0.4 %
combustion emissions	0.1 %
other process emissions	0.0 %

3.5 Controls

The losses due to leakage can be limited by use of certain types of seals and application of double seals near pumps.

4 SIMPLER METHODOLOGY

Use of an overall emission factor for the ABS production emissions. The amount of emitted VOC is then directly related to the ABS production.

5 DETAILED METHODOLOGY

A more detailed methodology is used by the United States EPA:

Instead of one emission factor for the whole plant, emission factors for each piece of equipment, like valves, flanges, etc., can be used. Each type of equipment has its own emission factor. The total emission factor for the plant can be calculated by multiplying each equipment emission factor by the number of pieces of that type of equipment. So, for this method it is necessary to know how many pieces of each type of equipment are present in the plant.

6 RELEVANT ACTIVITY STATISTICS

7 POINT SOURCE CRITERIA

SB plant can be considered as point source if individual plant data are available.

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

Table 8.1. Emission factors for ABS production

Source	factor (kg/ton)	Quality Code
TNO Emission Registration 1990 [2]	5	C
TNO Emission Registration 1992 [1]	1.4	C
EPA Airchief 1993 [3]	27.2	E

9 SPECIES PROFILES

Tables 9.1 and 9.2 list the VOC profile for the different sources and the overall profile respectively.

Table 9.1. The composition of the VOC emissions for the different sources [1]

	methane	ethylene	acrylonitrile	styrene	other HC's
leakage loss	0%	0%	12%	70%	18%
flaring and disruptions	-	-	-	-	-
storage and handling loss	0%	0%	16%	81%	3%
combustion	21%	5%	3%	43%	28%
other process emissions	-	-	-	-	-

Table 9.2. The overall VOC emission profile for ABS plants

	TNO ER [1]	TNO ER [2]	NAPAP [4]
methane	0%		0%
ethylene	0%		0%
acrylonitrile	12%	40	60%
styrene	70%	40	40%
1,3-butadiene	-	20	-
other HC's	18%		0%

10 UNCERTAINTY ESTIMATES

At the time of publication there were not enough data to establish an uncertainty estimate.

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

Emission factors need to be confirmed or improved.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

13 TEMPORAL DISAGGREGATION CRITERIA

The plants are operated in continuous flow, thus no variation in emissions diurnally or seasonally is expected to occur.

14 ADDITIONAL COMMENTS

15 SUPPLEMENTARY DOCUMENTS

- Kirk-Othmer, Encyclopedia of chemical technology, Volume 1, 4th edition (1991)
- Winnacker-Küchler, Chemische Technologie, Organische Technologie II, Band 6 4. Auflage (1982) (in German).

16 VERIFICATION PROCEDURES

Verification of the emissions can be done by comparing with measurements in the individual plant or by setting up a mass balance over the entire plant.
See Verification Chapter for further details.

17 REFERENCES

1 TNO Emission Registration 1992
2 TNO Emission Registration 1990
3 EPA AIRCHIEF 1993
4 NAPAP 1985

18 BIBLIOGRAPHY

19 RELEASE VERSION, DATE AND SOURCE

Version : 1.1
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20 POINT OF ENQUIRY

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