



Chapter 2 Appendix 5

Volatile Organic Compound Emissions from Various Sources

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The approach, given in this paper, has been presented earlier to the previous SETAC working group on Data Handling and Inventory in January 1995. The data are presently used by TNO-MEP in LCIA calculations.

Emission Profiles

In many cases, emissions are given in group names, rather than in individual substances. Examples include NO_x , C_xH_y , VOC, heavy metals, etc.

However, it is necessary to know the specific emissions in order to be able to carry out a correct impact assessment. In case that these emissions of individual substances are not given and the type of process is known, an adjustment can be made, based on average process data.

These 'emissions profiles' of processes can be defined on basis of literature or other sources. TNO uses also the results of the Dutch project "Emission Inventory" for this purpose.

See Table A5-1 for the current set of data. The table describes profiles of a set of general processes. Processes are defined in a broad sense. The process ' C_xH_y aromatics' describes the output of a process, as well as the average composition of an output flow of this type. The profile of a process may contain individual substances, together with other processes (e.g., the process ' C_xH_y aromatics' is used as a fraction in other profiles).

The data cannot be used as a standard profile, for the following reasons:

- the data are based on outdated sources,
- sources are not fully compatible, and
- technology and scale of processes are not defined.

Nevertheless, the data give an estimation of the possible profiles.

The following are the data sources:

- SPIN (Samenwerkingsproject Procesbeschrijvingen Industrie Nederland) Ministry of Environment, The Netherlands (year of publication is not mentioned in the reports). This set process description has been produced by RIVM (the State Laboratory of Public Health and Environment).
- PARCOM (Parish Committee) A part of UNECE. However the data source is a TNO study, which has been used by the Dutch Ministry of Environment for the PARCOM. This TNO study is based on results of the Emission Inventory project (van der Most PFJ, Veldt C. Emission factors manual PARCOM-ATMOS. 1992. TNO report 92-235.).
- ER Emission Inventory in the Netherlands.

- DGA Ministry of Social Affairs. 1986.
Chronische effecten ten gevolge van
blootstelling aan organische oplosmiddelen.
Ministry of Social Affairs, Directorate of
Labour, Publication S29-1/2.
- SB41 Gebler W. 1992. Okobilanzen in der
Abfallwirtschaft. Stuttgarter Berichte 41.
- EPA (Environmental Protection Agency) Various
publications of EPA-USA.
- CBS (Bureau of Statistics in the Netherlands)
Various publications of CBS.
- LAGA Mitteilungen der
Länderarbeitsgemeinschaft Abfall, Erich
Schmidt Verlag.
- est estimated

Table A5-1 Emission profile of industrial processes (time period 1990–2000)

Indication of process	substances	composition	source
CxHy ferrous melter		1	
	alcohols	70.00%	SPIN
	terpenes	10.00%	SPIN
	alkanes	15.00%	SPIN
	CxHy aromatic amines	4.00% 1.00%	SPIN SPIN
metals diesel		1	
	Ni	3.70%	PARCOM
	Cr	0.00%	PARCOM
	Cd	0.20%	PARCOM
	Cu	3.70%	PARCOM
	Pb	73.90%	PARCOM
CxHy chemical industry		1	
	methane	15.00%	ER
	alkenes	12.00%	est
	alkanes	37.00%	est
	toluene	4.00%	ER
	benzene	2.00%	ER
	styrene	1.00%	ER
	ethylene oxide	0.50%	ER
	ethane	10.00%	ER
	acrylonitrile	0.20%	ER
	CxHy aromatic	5.00%	est
	tetrachloromethane	0.50%	ER
	propylene oxide	1.00%	ER
	vinyl chloride	0.50%	ER
	alkanes halogenated	5.00%	ER
1,2-dichloroethane	2.00%	ER	

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Table A5-1 continued

Indication of process	substances	composition	source
	dichloromethane	0.50%	ER
	alcohols	1.30%	est
	ketones	1.00%	est
	ethers	0.50%	est
	esters	0.50%	est
	aldehydes	0.50%	est
CxHy aromatic		1	
	benzene	10.00%	SPIN
	toluene	15.00%	SPIN
	xylene	74.00%	SPIN
	naphthalene	1.00%	SPIN
CxHy ferrous industry		1	
	methane	10.00%	ER
	alkanes	74.89%	est
	ethane	2.00%	ER
	alkenes	3.00%	ER
	toluene	5.00%	ER
	benzene	2.00%	ER
	CxHy aromatic	3.00%	ER
	benzo(a)pyrene	0.01%	SPIN
	PAHs	0.10%	SPIN
CxHy solvents		1	
	ketones	2.00%	DGA
	esters	6.00%	DGA
	alcohols	3.00%	DGA
	toluene	13.00%	DGA
	xylene	15.00%	DGA
	alkanes	36.00%	DGA
	terpenes	25.00%	DGA
CxHy combustion coal		1	
	PAHs	0.02%	ER (0.12mg PAH/GJ)
	CxHy aromatic	2.00%	ER
	alkanes	62.48%	SB41
	methane	35.00%	SB41
	formaldehyde	0.50%	SB41
CxHy combustion wood		1	
	methane	37.50%	EPA/divers
	alkanes	10.00%	EPA/divers
	aldehydes	2.00%	EPA/divers
	formaldehyde	1.50%	EPA/divers
	alkenes	15.00%	EPA/divers
	ethane	15.00%	EPA/divers
	benzene	10.00%	EPA/divers
	alcohols	2.50%	EPA/divers
	CxHy aromatic	5.00%	EPA/divers
	ketones	0.50%	EPA/divers
	phenol	0.50%	EPA/divers
	diphenyl	0.50%	EPA/divers

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Table A5-1 continued

Indication of process	substances	composition	source
CxHy combustion diesel	PAH	?	
		1	
	alkanes	32.30%	CBS92
	methane	3.70%	ER
	aldehydes	8.00%	CBS92
	formaldehyde	6.00%	CBS92
	alkenes	12.00%	CBS92
	ethane	12.00%	CBS92
	benzene	2.00%	CBS92
	toluene	1.50%	CBS92
	CxHy aromatic	21.22%	CBS92
	naphthalene	1.05%	CBS92
	benzo(a)pyrene	0.00%	CBS92
PAHs	0.22%	CBS92	
CxHy combustion gasoline		1	
	alkanes	35.70%	CBS92
	methane	7.50%	ER (50% catalyst)
	aldehydes	2.20%	CBS92
	formaldehyde	1.10%	CBS92
	alkenes	12.00%	CBS92
	ethane	7.00%	CBS92
	benzene	3.50%	CBS92
	toluene	7.00%	CBS92
	CxHy aromatic	23.78%	CBS92
	naphthalene	0.19%	CBS92
	benzo(a)pyrene	0.00%	CBS92
	PAHs	0.03%	CBS92
CxHy combustion natural gas	formaldehyde	0.30%	SB41/ER
	alkenes	1.00%	ER
	ethene	1.00%	ER
	alkanes	3.00%	ER
	CxHy aromatic	2.00%	ER
	methane	92.70%	stelpost/ER
		1	
CxHy combustion LPG	alkanes	44.90%	CBS92
	methane	3.00%	CBS92
	aldehydes	2.00%	CBS92
	formaldehyde	4.00%	CBS92
	alkenes	31.00%	CBS92
	ethene	15.00%	CBS92
	benzene	0.000000%	CBS92
	toluene	0.000000%	CBS92
	CxHy aromatic	0.087400%	CBS92
	naphthalene	0.000000%	CBS92
	benzo(a)pyrene	0.000000%	CBS92
	PAHs	0.012600%	CBS92

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Table A5-1 continued

Indication of process	substances	composition	source
CxHy incineration MSW		1	
	alkanes	80.00%	est
	alkenes	5.00%	est
	CxHy aromatic	5.00%	est
	aldehydes	5.00%	est
CxHy landfill	CxHy polycyclic	5.00%	est
		1	
	methane	99.86%	LAGA
	ethene	0.01%	LAGA
	ethane	0.00%	LAGA
	aldehydes	0.04%	LAGA
	ketones	0.04%	LAGA
	alkanes	0.01%	LAGA
CxHy aromatic landfill	mercaptans	0.04%	LAGA
		1	
	benzene	22.34%	LAGA
	toluene	26.26%	LAGA
	CxHy aromatic	21.30%	LAGA
CxHy halogenated landfill	xylene	30.10%	LAGA
		1	
	vinyl chloride	6.00%	LAGA
NOx	alkanes halogenated	94.00%	LAGA
		1	
metals oil	NOx (exclusive N2O)	98.00%	est
	N2O	2.00%	est
		1	
metals gasoline	Ni	81.68%	PARCOM
	Cr	5.85%	PARCOM
	Cd	2.33%	PARCOM
	As	2.33%	PARCOM
	Se	0.12%	PARCOM
	Cu	2.33%	PARCOM
	Pb	3.03%	PARCOM
	Zn	2.33%	PARCOM
		1	
CxHy gasoline vapor	Ni	5.80%	PARCOM
	Cr	2.90%	PARCOM
	Cd	8.80%	PARCOM
	As	0.00%	PARCOM
	Se	0.60%	PARCOM
	Cu	23.40%	PARCOM
	Pb	0.00%	PARCOM
	Zn	58.50%	PARCOM
CxHy gasoline vapor		1	
	alkanes	74.50%	CBS92
	alkenes	23.00%	CBS92
	benzene	1.00%	CBS92
	CxHy aromatic	1.50%	CBS92