

## ADDITIONAL NOTE ON SOLVENT USE

The following additional note may prove useful when preparing emission inventories from the solvent use sector.

The NMVOC emission from solvent use can be calculated using consumption (or production) statistics for several categories. The user categories which are often most suitable for this purpose are:

- paint, all applications
- industrial degreasing and dry cleaning
- glues & adhesives
- graphic arts (ink)
- rubber & plastics industry

Two user categories, which also contribute substantially, are hard to inventorise, namely:

- chemical industry (e.g. pharmaceuticals)
- household products (e.g. toiletries)

In the other group 6 chapters solvent content and/or emission factors for several user (sub)categories are given. Multiplying the user category consumption with the solvent content or emission factor gives the NMVOC emission for that user category.

When the emissions from all known user categories are calculated, the emission for the unknown user categories has to be estimated. This can be done by using the percentages that the unknown user categories contribute to the total NMVOC in countries, which have a complete inventory. For the U.K., West Germany, Italy, Sweden, France, the Netherlands and Western Europe relatively complete inventories are available (see [9], [10], [16], [15], [17], [18] and [19]); Table 4 gives the subdivision in user categories for these countries.

To provide an idea of the size of some user categories table 1 lists solvent emissions per user category reported by several industrialised countries. The table was originally made by Veldt [20] and has been updated and expanded by Bloos. The table can also be used to estimate a per capita emission for the user categories mentioned.

**Table 1: Reported solvent emissions for some user categories (in kg/cap./year)**

Country	year	paint	industrial degreasing	graphic arts	glues & adhesives	household products	total
Australia	1990						11.0
Austria	1987	5.3		0.60	1.45		
Canada	1985	4.8					12.7
Finland	1991	3.7	2.7 <sup>1</sup>	0.4	0.17	0.27	12.3
France	1985	4.8	0.84	0.47	0.26	1.1	10.4
W. Germany	1986	6.8	2.0	1.5	1.1	±2	18.8
Italy	'84-'86	4.55	0.75	0.60	1.0	0.8	12.9
Japan	1983	6.4	0.74	1.15	0.29		10.4
Netherlands	1990	4.5	0.40	0.76		1.5	10.0
Norway	<1992	4.5		0.36			7.5
Poland	1989	4.45					
Sweden	1988	4.7	1.4	0.82		2.6	12.1
U.K.	1988?	4.8	0.81	0.68	1.02	3.3	13.7
USA	1989	8.6	2.8	1.3	1.3	1.5	21.3
W. Europe	1990	5.3	1.0	0.86	0.84	1.1	14.4

1 includes industrial and dry cleaning

Table 2 gives an idea of the NMVOC profile for solvent use. All profiles are for the complete solvent use category, for profiles per user category see the relevant chapters for group 6. As for table 1, this table was originally made by Veldt [20] and updated by Bloos.

**Table 2: Reported solvent emissions per substance group (wt.% of total solvent emissions)**

Country	year	alkanes	aromatics	alcohols	esters	cellosolves	ketones	CIHCs	other
Australia	1990	36.5	27.9	10.4	4.9	5.6	3.7	8.6	2.4
Austria	1987	29.5	11.3 <sup>1</sup>	18.8	8.1	4.4	16.7 <sup>2</sup>	10.7	0.5 <sup>3</sup>
Finland	1991	26.1	18.0	34.4	7.4	4.4	6.5	3.3	0.0
France	1985	26.1	14.6	27.5	5.6 <sup>5</sup>	<sup>5</sup>	9.8	14.5	1.9
Germany	1986	20 <sup>4</sup>	20 <sup>4</sup>	15.7	9.6	4.2	8.9	15.6	6.0 <sup>3</sup>
Italy	'84-'86	15.1	24.0	14.8	9.9	4.3	13.8	15.4	2.7
Sweden	1988	12.4	13.7	29.8	8.8	4.8	2.6	9.6	18.3 <sup>6</sup>
W. Europe	1990	27.3	18.7	16.3	10.2	5.3	11.8	10.1	0.3
USA	1989	30.9	8.7	17.9	14.7 <sup>5</sup>	<sup>5</sup>	11.1	12.8	3.8

1 toluene and xylene

2 acetone (propanone)

3 includes CFCs

4 corrected for aromatics in alkanes

5 esters include cellosolves

6 includes unknowns

Table 3, also originally by Veldt [20] and updated by Bloos, gives the NMVOC profile for the user category paint applications.

**Table 3: Reported solvent emissions from paint applications per substance group (wt. %)**

Country	year	alkanes	aromatics	alcohols	esters	cellosolves	ketones	CIHC	other
Finland	1991	28.3	32.1	13.1	13.1	11.4	1.8	0.2	-
France	1985	29.6	18.4	28.8	8 <sup>1</sup>	-	14.6	0.6	-
Germany	1986	11 <sup>2</sup>	23 <sup>2</sup>	17.8	17.8	11.5	10.4	6.9	1.6
Italy	'84-'86	13.4	42.1	11.5	11.5	7.7	11.5	1.5	0.8
Sweden	1988	15.6	26.4	24.0	23.6	8.4	2.0	-	-
W. Europe	1990	29.7	24.1	11.5	17.7	6.9	9.9	0.0	0.2
U.K. <sup>3</sup>	recent	11.4	49.5	13.8	6.3	4.8	12.5	0.5	1.2
USA	1989	17.1	15.9	16.0	29.8 <sup>1</sup>	-	16.5	2.9	1.8

1 includes cellosolves

2 corrected for aromatics in alkanes

3 industrial paint

Table 4 lists the percentages of user categories as found in several European countries. With table 4 it is possible to estimate which percentage of the total NMVOC emission due to solvent use is covered by known user categories, in order to determine which percentage for unknown user categories should be added to provide the total NMVOC emission.

**Table 4: Reported user category subdivisions in country studies**

user category	Country						
	France	Germany	Italy	Netherlands	Sweden	U.K.	W. Europe
Paint	46.1	39.6	35.2	40.4	36.1	35.6	36.7
Household prod	10.6	9.2	3.5	15.5	18.5	21.6	8.2
Chem. ind.	14.0	10.8	13.7	12.4	4.7	5.5	11.8
Other solv. use	0.5	8.2	14.8	11.7	16.3	8.7	20.5
Ind. degreasing	8.1	10.8	5.8	6.4	10.5	5.8	6.9
Graphic arts	4.5	8.2	8.0	8.8	6.3	5.6	5.9
Glues & Adh.	2.5	5.8	8.0	0.4	<sup>1</sup>	7.9	5.8
Rubber & plastic	7.5	3.5	2.3	3.5	4.3	0.9	<sup>1</sup>
Dry cleaning	3.1	2.0	4.7	0.9	1.5	1.5	2.1
Pesticides	2.7	0.5	2.1	<sup>1</sup>	1.4	5.3	<sup>1</sup>
Veg. oil extr.	0.5	1.4	2.0	<sup>1</sup>	<sup>1</sup>	1.4	2.2
Leather	<sup>1</sup>	<sup>1</sup>	<sup>1</sup>	0.2	0.5	0.3	<sup>1</sup>

1 included in other solvent use

2 rubber industry only

## REFERENCES

- S. Terraneo, *La sicurezza nell'impiego dei solventi*, Milan, Italy, June 1988.
- R. Bouscaren et N. Allemand, Inventaire expérimental des émissions dans l'atmosphère de Composés Organiques Volatiles (COV), CITEPA, Paris, France, 1989.
- Projekt KWS 2000, *KWS 2000 jaarrapport 1992*, The Hague, the Netherlands, 1993?.
- ECSA, personal communication on solvent use in 1990, Brussels, Belgium, 1994.
- C. Veldt, A little learning is a dangerous thing, TNO/EURASAP workshop on the reliability of VOC emission databases, TNO-MW Delft, the Netherlands, June 1993.