Final Background Document

on the sector

Preservation of wood

Prepared in the framework of EGTEI

Prepared by CITEPA, Paris

Summary

1. Data from the bibliography (p.3)

General data currently used in RAINS are displayed in this paragraph. Country specific data are downloadable on http://www.iiasa.ac.at/~rains/voc_review/single.html

2. Short technology description (p.6)

3. EU regulation : Directive 1999/13/EC of 11 March 1999 (p.7)

4. Definition of Reference Installation (p.8)

Two reference installations are defined according to the annual volume of wood treated (m^3/y).

5. Emission abatement techniques and costs (p.8)

Four primary and two secondary measures are defined.
Table 5.3.1 summarizes the emission factors with the corresponding abatement efficiencies for each combination.
Table 5.3.2 summarizes investments and operating costs.

If a measure is missing in the document, national experts have to contact the Secretariat to add it in the background documents.

6. Data to be provided by national experts for the completion of the database for their own country (p.10)

Tables to be filled in by national experts are displayed :

Table 6.2.1 : Country specific data.

Table 6.2.2 : Country and sector specific data.

Table 6.2.3 : Activity levels in absolute value per Reference Installation (m^3 of wood coated / year)

Table 6.2.4 : Application rate and applicability.

If detailed information is available, table 6.2.2 can be filled in.
If only sparse information is available, then table 6.2.2 can be filled in with the same "Application rates" for all RI (this corresponds to the filing of table 6.2.3).

Table 6.2.5 : Aggregated table

Table 6.2.6 : Unabated emission factor

Default data means can be modified in a range of ± 10%.

7. Explanatory notes on emission factors and costs (p.13)

Explanations about the figures are given in this paragraph. Investments and operating costs of primary measures have been provided by industrial experts. For secondary measures, costs are derived from the equations displayed in the document "Methodology".

8. References (p.16)

9. Modifications compared to the draft document

Sector : Preservation of wood

SNAP: 06 04 06 – NFR : 3D other including products

This sector covers the wood impregnation in organic solvent-based preservatives, creosote and water-based preservatives. Wood preservatives may be supplied for both industrial and domestic use. Only industrial applications are treated in this document.

ACTIVITY : volume of wood treated (m^3 / year) or quantity of solvent used (t /year)
POLLUTANT CONSIDERD : VOC

1 Data from the bibliography

Following data are just displayed for comparison reasons

1.1 Data currently used in the RAINS model [5] , [6]

In the RAINS model, preservation of wood is considered as a separated sector.

1.1.1 Control options

In the present stage of development of RAINS, the following groups of control options are considered:

- NoC : Reference case;
- DVS + ENC : Double vacuum impregnation system and enclosure of the drying stage (applicable to the whole sector; abatement efficiency : 40%);
- ACA or INC : Add-on techniques like thermal oxidation and adsorption. (applicable to most of the sector; efficiency : 60%);
- DVS + ENC + ACA/INC : Combination of 01 and 02 (applicable to the whole sector; abatement efficiency : 75%).

DVS + ENC is assumed to become an integral part of new-built plants.
Literature indicates that abatement potentials and costs will vary substantially between small and large installations. Due to scarce information on size distribution, no further disaggregation of this sector is done in the RAINS model.

1.1.2 Abatement costs

Examples for three countries are displayed below :

No comments are made on the figures displayed in the following tables because no further information is available.
Data on the other countries are downloadable on
http://www.iiasa.ac.at/~rains/voc_review/single.html

Table 1.1.2.1 : French situation

Activity level 1990 : 283,000 kt solvents used (Old installations); 2 862,000 kt solvents used (NEW); 2010 : 320,356 kt solvents used (Old installations); 3 239,784 kt solvents used (NEW); **VOC emission scenario business as usual :** 1990 : 4,47 kt VOC (Old); 0,57 kt VOC (NEW) 2010 : 5,06 kt VOC (Old); 0,65 kt VOC (NEW)					
Measure	**Emission factor [kt VOC / kt of solvent]**	**Efficiency [%]**	**Technical Eff, [%]**	**Applicability [%]**	**Unit cost [€$_{1990}$/t VOC]**
NoC	0,0158	0	0	0	0
DVS + ENC	0,0158	0	99	0	2 835
ACA	0,0158	0	58	0	4 114
INC	0,0101	36	45	80	9 100
DVS+ENC+ACA	0,0158	0	75	0	3 823
DVS+ENC+INC	0,0158	0	75	0	7 415
NoC NEW*	0,0002	0	0	0	0
ACA NEW*	0,0002	0	58	0	6 857
INC NEW*	0,0002	0	45	0	14 272

* NEW : New installations

Table 1.1.2.2 : German situation (Old Laender)

Activity level 1990 : 36,570 kt solvents used (Old installations) 2010 : 10,583 kt solvents used (Old installations); 42,333 kt solvents used (NEW); **VOC emission scenario business as usual :** 1990 : 36,57 kt VOC (Old) 2010 : 6,35 kt VOC (Old); 10,59 kt VOC (NEW)					
Measure	**Emission factor [kt VOC / kt of solvent]**	**Efficiency [%]**	**Technical Eff, [%]**	**Applicability [%]**	**Unit cost [€$_{1990}$/t VOC]**
NoC	1,0000	0	0	0	0
DVS + ENC	0,6000	40	40	100	2 835
ACA	0,4168	58	58	100	4 114
INC	0,4168	58	58	100	9 100
DVS+ENC+ACA	0,2500	75	75	100	3 823
DVS+ENC+INC	0,2500	75	75	100	7 415
NoC NEW*	0,6000	0	0	0	0
ACA NEW*	0,2501	58	58	100	6 857
INC NEW*	0,2501	58	58	100	14 272

* NEW : New installations

Table 1.1.2.3 : German situation (New Laender)

Activity level : No information **VOC emission scenario business as usual :** No information					
Measure	**Emission factor [kt VOC / kt of solvent]**	**Efficiency [%]**	**Technical Eff. [%]**	**Applicability [%]**	**Unit cost [€$_{1990}$/t VOC]**
NoC	1,0000	0	0	0	0
DVS + ENC	0,6000	40	40	100	2 835
ACA	0,4168	58	58	100	4 114
INC	0,4168	58	58	100	9 100
DVS+ENC+ACA	0,2500	75	75	100	3 823
DVS+ENC+INC	0,2500	75	75	100	7 415
NoC NEW*	0,6000	0	0	0	0
ACA NEW*	0,2501	58	58	100	6 857
INC NEW*	0,2501	58	58	100	14 272

* NEW : New installations

Table 1.1.2.4 : Hungarian situation

Activity level : No information **VOC emission scenario business as usual :** No information					
Measure	**Emission factor [kt VOC / kt of solvent]**	**Efficiency [%]**	**Technical Eff. [%]**	**Applicability [%]**	**Unit cost [€$_{1990}$/t VOC]**
NoC	0,7300	0	0	0	0
DVS + ENC	0,4380	40	40	100	2 835
ACA	0,3043	58	58	100	4 114
INC	0,3043	58	58	100	9 100
DVS+ENC+ACA	0,1825	75	75	100	3 823
DVS+ENC+INC	0,1825	75	75	100	7 415
NoC NEW*	0,4380	0	0	0	0
ACA NEW*	0,1826	58	58	100	6 857
INC NEW*	0,1826	58	58	100	14 272

* NEW : New installations

1.2 Situation in the UK [7]

According to [7], two principle impregnation materials are used (i.e.: light organic solvent preservatives based on white spirit and water base preservatives such as CCA (copper chrome arsenic)). The use of creosote is small compared to other products.
Techniques to comply with the Directive limits are :

- Better housekeeping,
- Solvent management plans,
- Process optimisation (i.e.: the use of more concentrated preservative formulations together with improved impregnation systems),
- Preservative substitution to water/emulsion based chemicals,
- Abatement equipment including thermal oxidation and solvent recovery.

A small number of firms unable to use solvent free or low solvent techniques, will have to install abatement or recovery systems.
Smaller firms are less likely to adopt abatement or recovery systems.

Table 1.2.1 : Distribution of Compliance Techniques used in the medium sized sector (solvent input of 25 to 80 tpa) to comply with the Directive

Techniques	**Proportion of use by 2007 (%)**
Housekeeping/solvent management plans	5
Water/emulsion preservatives	70
Process Optimisation	15
Thermal oxidation	5
Solvent recovery	5
Total	100

2 Short technology description

Wood is preserved to protect it against fungal and insect attack and also against weathering. Three types of preservatives are used: water-based ones, solvent-based ones and creosote. The estimation of emissions can either be based on the quantity of preservatives consumed or on the quantity of timber treated.
The application of the preservative may be carried out via vacuum processes, pressure processes, dipping, spraying or brushing. The vacuum process may vary slightly, depending on the preservative product. [1]

2.1 Products used to protect timber

2.1.1 Creosote (see regulation in chapter 3.2)

Creosote is the oldest form of wood preservative and is used for external applications such as telegraph poles and railway sleepers. It is an oil prepared from coal tar distillation and is used at temperatures around 80 to 90°C in vacuum processes.
Creosote is an effective preservative, almost insoluble in water and therefore resistant to leaching. Other attributes are that it is normally not corrosive to metals, it protects timber against splitting and weathering, it has a high electrical resistance and it is available in several grades to suit different applications [8].

VOC content depends on the type of creosote used. According to [2], three types of creosotes (A, B, C) with different vapour pressures can be used. Type A is no more used. Type C has a vapour pressure below 10 Pa at 20 °C but above when used at 80°C. Type B contains approximately 10 % of VOC. [2]

2.1.2 Water-Based Preservatives (see regulation in chapter 3.2)

These preservatives constitute formulations of either organic or inorganic origins. They differ from each other in their activity spectra, their leaching resistance, their impregnation process and therefore the final use of the treated wood [8].
Today, compounds such as CCA (copper/chrome/arsenate) are widely used. Other available formulations contain : quaternary ammoniums, hydrogen fluorides, fluorosilicates, or some boron compounds [8]. These products are applied by high pressure processes.
Water based micro emulsion such as azoles or quaternary ammoniums can also be used to replace solvent based products. They are applied either by dipping or in vacuum processes.

These products contain 1% solvent [1], [2].

2.1.3 Solvent-Based Preservatives

These preservatives consist of active ingredients, an insecticide and/or a fungicide, dissolved in an organic solvent. Treatment with these compounds gives long lasting protection due mainly to their natural insolubility in water. After being carried out into the wood by an organic solvent, the latter evaporated, leaving the active ingredient [8].

Pentochlorophenol (PCP) has been a common organic solvent preservative. Other examples of active chemicals used include : lindane, permethrin or similar pyrethroids, triazoles, tributyltin compounds, aluminium-HDO, dichlofuanid, carbendazim, copper, naphtenate, and azoles and zinc carboxylate [8].

Solvent based preservative products consist of approximately 5 % active ingredient and 95 % organic solvent, usually white spirit or other petroleum based hydrocarbons. [2]
In industrial installations, timber enters a chamber which is subsequently evacuated. The chamber is flooded with preservative and pressurised for 5 to 20 minutes. After draining the chamber, a final vacuum is applied to draw off excess preservative. The timber is left to dry in the open air.
These preservatives can also be applied by dipping processes.

2.2 Methods of applying wood preservatives [8]

The successful treatment by any timber preserving process requires that the preservative penetrates evenly into the wood to a sufficient depth.
Several techniques exist. For our purpose, three are described hereafter to facilitate the comprehension of chapter 5.

2.2.1 Brushing, spraying and deluging

Liquid preservatives based on organic solvents or low viscosity creosote may be applied to timber surfaces by brush, spray or deluge. The low surface tension of such liquids enables the preservative to creep into the wood and creates an envelope of protection against infestation. These methods are typically employed by amateur (do it yourself : DIY) users and by professionals treating existing infestations in buildings.

2.2.2 Dipping or immersion

Dipping or immersion involves immersing of timber in a tank of organic, creosote or water based preservatives. There is usually a lifting device for moving the load in and out and some means of keeping the wood submerged during treatment. This method provides timber with a good degree of protection against attack by creating a complete envelope of treatment. Dipping is more efficient than brushing, spraying or deluging because all surfaces can absorb liquid freely and the duration of immersion can be suited to the standard of treatment required.

2.2.3 Pressure processes

The most effective method of preservative treatment of wood is the use of pressure impregnation. Depending on the actual process to be used, the timber may be subjected to a preliminary vacuum. The cylinder is then filled with the preservative solution, and pressure is applied to it. The usaual pressure applied is between 800 and 1400 kPa. At the end of the pressure period the preservative is drained from the vessel and typically a final vacuum is applied to promote drying of the wood surface and/or to recover a proportion of the preservative from the wood cells.

3 EU regulations

3.1 Directive 1999/13/EC of 11 March 1999 [4]

Operators concerned can conform to the Directive in either of the following ways:

- by complying with the canalised and fugitive emission limit values (**Option I**);.
- by complying with the total emission limit (**Option II**).

Directive applies to installations with a solvent consumption above 25 t per year.

Emission limits for application of the Directive are presented in table 3.1.1

Table 3.1.1 : Emission limits

	Option I		Option II
Solvent consumption threshold [t/y]	**VOC emission limit value in residual gases [mg C / Nm^3]**	**Fugitive emissions [% of solvent input *]**	**Total emissions [kg VOC / m^3 of wood treated]**
> 25	100	45	11

* Solvent input : quantity of organic solvents used as input into the process in the time frame over which the mass balance is being calculated (purchased solvent) + quantity of organic solvents recovered and reused as solvent input into the process (recycled solvents are counted every time they are put back into the cleaning cycle).

All obligations of the Directive are not described in this chapter.

3.2 Directive 76/769/EC about certain dangerous substances and preparations

Two products have been regulated by Directive 76/769 on the marketing and use of dangerous substances and preparations. This concerns creosote [9] and arsenic compounds [10].

Creosote may be used for wood treatment in industrial installations or by professionals covered by Community legislation on the protection of workers for *in situ* retreatment only if they contain :
- benzo-a-pyrene at a concentration of less than 0,005% by mass;
- and water extractable phenols at a concentration of less than 3% by mass.

Other requirements about sectors for which creosote's use is allowed are displayed in Annex of reference [9].

Preparations and substances using arsenic in the preservation of wood can only be used by industrial installations using vacuum or pressure to impregnate wood if they are solutions of inorganic compounds of the copper, chromium, arsenic (CCA) type C. Wood so treated may not be placed on the market before fixation of the preservative is completed.
Other requirements about sectors for which CCA preparation's uses are not allowed are displayed in Annex of reference [10].

4 Definition of Reference Installations

The consumption factor of creosote being between 70 and 100 kg/m^3 of wood treated with a solvent content of 10%, emissions are below the Directive limit of 11 kg/m^3 treated.

The use of creosote is not considered hereafter as emission factors are below the Directive limit and its use is strongly regulated (see Chapter 3.2).

Reference installations are presented in table 4.1.

Table 4.1 : Reference installations

Reference Installation Code RIC	Description
01	Small Reference Installation : wood volume to be treated : 300 m^3/y; included in the range: 0 < volume to be treated ≤ 2 000 m^3/y
02	Large Reference Installation : wood volume to be treated: 5 000 m^3/y;

5 Emission abatement techniques and costs

According to reference [7], medium sized firms will mostly opt to comply with the limit of 11 kg of solvent per m^3 timber treated specified in the Directive. Fixed costs of installing end-of-pipe devices are high which makes compliance with the emission limits option less viable for these medium sized firms. A small number of firms however, unable to use solvent free or low solvent techniques, will have to install abatement techniques.

5.1 Definitions of primary measures

Installations are supposed to use only one type of preservation product [3].
Emissions can be reduced by using alternative low solvent coatings wherever technically feasible (impregnation systems have to be upgraded to be compatible with water based emulsions), and by the use of double vacuum systems with process optimisation (use of more concentrated preservative formulations together with improved impregnation systems).

Table 5.1.1 : Primary measures

Primary Measure Code PMC	Description
00	• 100% of solvent based preservatives • conventional application techniques (dipping, brushing, spraying)
01	• 100% of solvent based preservatives • improved application technique (vacuum impregnation system)
02	• Process optimisation • 100% of more concentrated solvent based preservatives • improved application technique (vacuum impregnation system)
03	• 100% of water based preservatives • conventional application techniques (dipping, brushing, spraying)
04	• 100% of water based preservatives • improved application technique (vacuum impregnation system)

5.2 Definitions of secondary measures

VOC emissions result from the evaporation of organic solvents. These emissions may be fugitive or captured and vented via a stack. Stack emissions may be controlled using waste gas cleaning devices.

Table 5.2.1 : Secondary measures [1], [7]

Secondary Measure Code SMC	Description
00	No secondary measure
01	Thermal oxidation
02	Adsorption and solvent recovery

5.3 Emission factors and cost data for the different combinations

Table 5.3.1 : Emission factors (EF) and abatement efficiencies for each relevant combination

RIC PMC SMC	VOC EF [kg / m^3 wood treated]	Abatement efficiency [%]	Q	CI %
01 00 00	19,8	0,0	3	25
01 00 01	7,3	63,1	3	25
01 01 00	16,6	16,2	3	25
01 01 01	6,1	69,2	3	25
01 02 00	11	44,4	3	25
01 03 00	0,25	98,7	3	25
01 04 00	0,15	99,2	3	25
02 00 00	19,8	0,0	3	25
02 00 01	7,3	63,1	3	25
02 00 02	7,3	63,1	3	25
02 01 00	16,6	16,2	3	25
02 01 01	6,1	69,2	3	25
02 01 02	6,1	69,2	3	25
02 02 00	11	44,4	3	25
02 03 00	0,25	98,7	3	25
02 04 00	0,15	99,2	3	25

Q : Quality of data
CI : Coefficient of variation

Table 5.3.2 : Investments and variable operating costs

RIC PMC SMC	Investment [€]	Q	CI %	Variable OC [€ / y]	Q	CI %	Fixed OC [€ / y]	Q	CI %	Savings [€/y]	Q	CI %
01 00 00	6 600	3	20	4 320	3	20	-	-	-	-	-	-
01 00 01	412 600	3	20	11 500	3	20	20 300	3	20	-	-	-
01 01 00	48 000	3	20	3 630	3	20	-	-	-	-	-	-
01 01 01	425 200	3	20	10 300	3	20	18 860	3	20	-	-	-
01 02 00	50 800	3	20	2 960	3	20	-	-	-	-	-	-
01 03 00	7 100	3	20	6 000	3	20	-	-	-	-	-	-
01 04 00	48 500	3	20	3 600	3	20	-	-	-	-	-	-
02 00 00	33 000	3	20	72 000	3	20	-	-	-	-	-	-
02 00 01	1 074 000	3	20	147 000	3	20	52 160	3	20	-	-	-
02 00 02	527 500	3	20	93 360	3	20	24 700	3	20	45 000	3	20
02 01 00	120 000	3	20	60 480	3	20	-	-	-	-	-	-
02 01 01	1 088 500	3	20	127 380	3	20	48 435	3	20	-	-	-
02 01 02	575 900	3	20	80 380	3	20	22 800	3	20	37 800	3	20
02 02 00	135 000	3	20	49 280	3	20	-	-	-	-	-	-
02 03 00	36 000	3	20	100 000	3	20	-	-	-	-	-	-
02 04 00	123 000	3	20	60 000	3	20	-	-	-	-	-	-

6 Data to be provided by national experts for the completion of the database for their own country

The following tasks are required :

6.1 Validation work

For representing costs in this sector, the national expert is invited to comment the methodology defined by the Secretariat.

- Validate investments and operating costs provided,

Or

- Provide other costs for the same combination of techniques and justify them.

Comments have to be sent to the Secretariat in the two weeks after having received the document.

6.2 Provision of specific data

Tables to be filled in by national experts

- Determination of country specific data to calculate variable costs (they are valid for all VOC sectors and only have to be entered in the tool once).

Table 6.2.1 : Country-specific data

Parameters	Costs used in the tool	Costs
Electricity [€/kWh]	0,0686	
Natural gas [€/kWh]	0,0192	
Wages [€/h]	25,9	
Steam [€/kg]	0,016	

Table 6.2.2 : Country and sector specific data

Parameters	Default costs [€/kg]	Country specific costs [€/kg]
Solvent based preservatives	0,72	
Solvent based preservatives used for process optimisation	0,88	
Water based preservatives	0,80	
Solvent recovered	0,72	

- Respective shares (m^3 of wood treated / y) of the total activity level carried out on each reference installation in 2000, 2005, 2010, 2015, 2020. Some default values for the confidence interval are given. They can be used by the Party if no data are available.

Table 6.2.3 : Activity levels in absolute value per Reference Installation (m^3 of wood treated / y)

RIC	2000	CI%	2005	CI%	2010	CI%	2015	CI%	2020	CI%
01										
02										
Default values proposed for CI		10		20		50		100		100
Total	Calculated automatically by the tool									

For explanations on the coefficient of variation (CI), please refer to the Methodology.

Total activity (m^3 of wood treated / y) has to be estimated from 2000 to 2020 and distributed according to the different installations.
If no detailed information is available in 2000, total activity can be divided equally between all RI (i.e.: 50% for each one).
If no prevision on the structure of this sector is available (for 2005 to 2020), the proportions used in 2000 can be used. But total activity m^3 of wood treated / y) should evolve.

- Respective percentage of combinations of reduction measures in 2000 for each reference installation as well as if possible, the percentage of use in 2005, 2010, 2015, 2020 due to the VOC Directive or national regulations and applicability according to the definition used in the RAINS model.

Table 6.2.4 : Application rate and Applicability

RIC PMC SMC	Application rate in 2000 [%]	Application rate in 2005 [%]	Appl. [%]	Application rate in 2010 [%]	Appl. [%]	Application rate in 2015 [%]	Appl. [%]	Application rate in 2020 [%]	Appl. [%]
01 00 00									
01 00 01									
01 01 01									
01 01 00									
01 02 00									
01 03 00									
01 04 00									
Total RIC 01	**100**	**100**		**100**		**100**		**100**	
02 00 00									
02 00 01									
02 00 02									
02 01 00									
02 01 01									
02 01 02									
02 02 00									
02 03 00									
02 04 00									
Total RIC 02	**100**	**100**		**100**		**100**		**100**	

If detailed information is available, table 6.2.4 can be filled in.
If only sparse information is available, then table 6.2.4 can be filled in with the same "Application rates" for all RI (this corresponds to the filing of table 6.2.5).

Table 6.2.5 : Aggregated table

RIC PMC SMC	Application rate in 2000 [%]	Application rate in 2005 [%]	Appl. [%]	Application rate in 2010 [%]	Appl. [%]	Application rate in 2015 [%]	Appl. [%]	Application rate in 2020 [%]	Appl. [%]
Aggreg. 00 00									
Aggreg. 00 01									
Aggreg. 00 02									
Aggreg. 01 00									
Aggreg. 01 01									
Aggreg. 01 02									
Aggreg. 02 00									
Aggreg. 03 00									
Aggreg. 04 00									
Total aggreg.	**100**	**100**		**100**		**100**		**100**	

Aggreg. : Aggregation

Table 6.2.6 : Unabated emission factor [kg VOC / m^3 wood treated]

PMC SMC	Default data mean	CI %	User input mean	CI %
00 00	19,8	20		

"Default data means" can be modified in a range of ± 10%.
If a measure is missing in the document, national experts have to contact the secretariat to add it in the background documents.

7 Explanatory notes

7.1 Consumption factors (CF)

Preservative product consumption factors are given in quantity of product per volume of wood treated (kg products / m^3 of wood treated). These factors are derived from [1] and [11]. Knowing product solvent concentrations, emission factors are easily derived.
The double vacuum process is a closed system : wood is brought into the chamber which is only filled with the preservative solution after closure of the chamber. This allows to extract superfluous product from the wood before opening the chamber and thus, reduce consumptions.
For dipping, product is less efficiently used. A lot of solvents evaporate from the open tanks so over consumption factors are higher.

Table 7.1.1 : Consumption factors

PMC SMC	Consumption factor [kg / m^3 of wood treated]	Solvent concentration [%]	Solvent CF [kg solvent / m^3 of wood treated]
00 00	20 [1]	99	20 × 0,99 = 19,8
01 00	21 (l/m^3) × 0,8 (kg/l) = 16,8 [11]	99	16,8 × 0,99 = 16,6
02 00	14 (l/m^3) × 0,8 (kg/l) = 11,2 [11]	98,5	11,2 × 0,985 = 11
03 00	25 [1]	1	25 × 0,01 = 0,25
04 00	15 [11]	1	25 × 0,01 = 0,15

7.2 Emission factors (EF) [1]

ü In installations where the application and drying process are not enclosed and without secondary abatement devices, all the solvent used is emitted into the air.
ü In installations with secondary abatement devices, only fugitive emissions occur (i.e.30% of emissions are uncontained). An abatement efficiency of 90% is assumed [7].

Table 7.2.1 : Emission factors (EF) related to the volume of wood treated

PMC SMC	Solvent CF [kg / m^3 of wood treated]	VOC EF [kg VOC / m^3 of wood treated]	Abatement efficiency [%]
00 00	19,8	19,8	0,0
00 01	19,8	19,8 × (0,7 × 0,1 + 0,3) = 7,3	63,1
00 02	19,8	19,8 × (0,7 × 0,1 + 0,3) = 7,3	63,1
01 00	16,6	16,6	16,2
01 01	16,6	16,6 × (0,7 × 0,1 + 0,3) = 6,1	69,2
01 02	16,6	16,6 × (0,7 × 0,1 + 0,3) = 6,1	69,2
02 00	11	11	44,4
03 00	0,25	0,25	98,7
04 00	0,15	0,15	99,2

7.3 Derivation of cost data

7.3.1 Primary Measures

Ø Investments

- According to [1], investments for the <u>modification of the process</u> are 48 000€ for a small installation and 120 000€ for a large one.
- Costs for <u>dipping tanks</u> come from [3].

- Cost for process optimisation is derived from [7] and is assessed to be around 15 000 € (£10000) for a large installation. For small installation, this corresponds to 2 800 €.
- A switch to water based products would cost around 3 000€ (£2 100) for a large installation according to [7]. This costs has been used to define investment for combination 020300 & 020400. For combinations 010300 & 010400, this corresponds to about 500 €.

Ø Operating costs

Table 7.3.1 : Preservative's costs [11]

Type of preservative	Costs [€/kg]
Solvent based	0,9[€/l] × 0,8[kg/l] = 0,72
Solvent based used for process optimisation *	1,1[€/l] × 0,8[kg/l] = 0,88
Water based	0,8

* Costs are higher because active ingredients are more concentrated.

Table 7.3.2 : Total operating costs

RIC PMC SMC	Preservative consumption [kg/y]	Annual preservative costs [€/y]
01 00 00	20 × 300 = 6 000	6 000 × 0,72 = 4 320
01 01 00	16,8 × 300 = 5 040	5 040 × 0,72 = 3 630
01 02 00	11,2 × 300 = 3 360	3 360 × 0,88 = 2 957
01 03 00	25 × 300 = 7 500	7 500 × 0,8 = 6 000
01 04 00	15 × 300 = 4 500	4 500 × 0,8 = 3 600
02 00 00	20 × 5 000 = 100 000	100 000 × 0,72 = 72 000
02 01 00	16,8 × 5 000 = 84 000	84 000 × 0,72 = 60 480
02 02 00	11,2 × 5 000 = 56 000	56 000 × 0,88 = 49 280
02 03 00	25 × 5 000 = 125 000	125 000 × 0,8 = 100 000
02 04 00	15 × 5 000 = 75 000	75 000 × 0,8 = 60 000

Table 7.3.2 : Emission factors, investments, operating costs and technical lifetime for primary measures

RIC PMC SMC	VOC EF [kg / m^3 of wood treated]	Investment [€]	Variable OC [€/y]	Tech. Lifetime [y]
01 00 00	19,8	6 600 [3]	4 320	20
01 01 00	16,6	48 000 [1]	3 630	20
01 02 00	11	50 800	2 957	20
01 03 00	0,25	7 100	6 000	20
01 04 00	0,15	48 500	3 600	20
02 00 00	19,8	33 000 [3]	72 000	20
02 01 00	16,6	120 000 [1]	60 480	20
02 02 00	11	135 000	49 280	20
02 03 00	0,25	36 000	100 000	20
02 04 00	0,15	123 000 [7]	60 000	20

Secondary Measures

Investments and operating costs for thermal oxidation and adsorption are calculated from equations of the document "Methodology".
An additional cost of 30% of thermal oxidiser's investment is taken into account for the enclosure of the drying system [3]. We consider that enclosure costs are similar for SMC 01 and 02.

Information on annual working time and VOC-concentration of the reference installations proposed in this sector is rather scarce. Nevertheless, investments and operating costs are derived from the following assumptions [3] on annual working times for the different reference installations and on VOC concentrations in the waste gas streams :

Small reference installations : 2 000 h/y
Large reference installations : 6 000 h/y
The VOC-concentration is assumed to be 0,5 g/m^3.

30% of emissions are considered to be fugitive and abatement efficiency of the devices around 90% [7].

Flow rates are calculated with the following equation :

Flow rate [m^3/h] = 0,70 × [(g COV / m^3 treated) × (m^3 treated/y)] / [(g VOC/m^3) × (h/y)]

Investments and operating costs are based on the equations displayed in the document "Methodology". Operating costs are country specific : figures in table 7.3.4 are displayed as examples).

Adsorption is not considered for Reference Installations 01 because flow rates are to low.

Table 7.3.3 : Flow rate calculations

RIC PMC SMC	Calculations	Flow rate [m^3/h]
01 00 01	0,7 × (19 000 × 300) / (0,5 × 2000)	4 000
01 01 01	0,7 × (16 600 × 300) / (0,5 × 2000)	3 500
02 00 01	0,7 × (19 000 × 5000) / (0,5 × 6000)	22 200
02 00 02	0,7 × (19 000 × 5000) / (0,5 × 6000)	22 200
02 01 01	0,7 × (16 600 × 5000) / (0,5 × 6000)	19 400
02 01 02	0,7 × (16 600 × 5000) / (0,5 × 6000)	19 400

Table 7.3.4 : Emission factors, investments, operating costs and technical lifetime for secondary measures

RIC PMC SMC	VOC EF [kg / m^3 of wood treated]	Investment [€]	Additional costs [€]	Variable OC [€/y]	Fixed OC [€/y]	Savings [€/y] *	Tech. Lifetime [y]
01 00 01	7,3	312 300	93 700	7 168	20 300	-	10
01 01 01	6,1	290 200	87 000	6 677	18 860	-	10
02 00 01	7,3	800 000	240 800	75 152	52 160	-	10
02 00 02	7,3	253 700	240 800	21 360	24 700	45 000	10
02 01 01	6,1	745 000	223 500	66 900	48 435	-	10
02 01 02	6,1	232 400	223 500	19 900	22 800	37 800	10

* Savings (value of recovered products = 0,72 €/kg) [11]

8 References

[1] Task force on the assessment of abatement options and techniques for VOC from stationary sources. Draft background document – Prepared by IFARE for UN/ECE-May 1999.

[2] N. ALLEMAND, R. BOUSCAREN, N. AVCI, T. ZUNDEL. Impact économique de la directive européenne sur la limitation des émissions de COV en provenance de l'utilisation des solvants en France. Tome II. Février 2000.

[3] N. ALLEMAND, R. BOUSCAREN, N. AVCI, T. ZUNDEL. Impact économique de la directive européenne sur la limitation des émissions de COV en provenance de l'utilisation des solvants en France. Tome III. Février 2000. .

[4] Council Directive 1999/13/EC of 11 March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations

[5] Z. KLIMONT; M. AMANN; J. COFALA. Estimating costs for Controlling Emissions of Volatile Organic Compounds (VOC) from Stationary Sources in Europe. Interim Report IR-00-51. IIASA. August 1, 2000. http://www.iiasa.ac.at/~rains/voc_review/voc_ir-00-51.pdf

[6] Review of data used in RAINS-VOC model. http://www.iiasa.ac.at/~rains/voc_review/single.html

[7] Regulatory and Environmental Impact Assessment for the Implementation of the EC Solvent Emissions Directive. Final Report. Entec UK Limited. 20 December 1999.

[8] UNEP IE/PAC – United nations Environment Programme industry and Environment Programme activity Centre. Environment Aspects of industrial Wood Preservation. A Technical Guide. Technical report series n° 20. 1994.

[9] Commission Directive 2001/90/EC of 26 October 2001 adapting to technical progress for the seventh time Annex I to Council Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (creosote).

[10] Commission Directive 2003/2/EC of 6 January 2003 relating to restrictions on the marketing and use of arsenic (tenth adaptation to technical progress to Council Directive 76/769/EEC).

[11] Industrial contact. Osmose. UK. May 2003.

9. Modifications compared to the draft document

9.1 Modification of chapter 4

It has just been highlighted that the use of creosote is not considered as a technique of reduction in this document.

9.2 Modifications of chapter 5

Abatement efficiencies have been recalculated.

Corrections of 170304

Investments of measures 010200, 010300 and 010400 have been corrected (tables 5.3.2 and 7.3.2):
Combination 010200: investment = 48 000+2 800 = 50 800 euros
Combination 010300: investment = 6 600 + 500 = 7 100 euros
Combination 010400: investment = 48 000+500 = 48 500 euros