PRESERVATION OF WOOD

SYNOPSIS SHEET

Prepared in the framework of EGTEI

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1. Activity description and EGTEI contribution - summary

Wood is preserved to protect it against fungal and insect attack and also against weathering. Three types of preservatives are used: water-based, solvent-based and creosote. 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.

The use of creosote is not considered in the EGTEI document [1] as emission factors are below the solvent Directive limit values [2] and its use is strongly regulated. However, a specific sector for creosote is defined in RAINS [3].

This activity emits NMVOC originating from the evaporation of solvents contained in the preservatives. At a EU25 level in 2000, (according to the RAINS model: version CP_CLE_Aug04(Nov04)), NMVOC emissions were 54.9 kt representing 0.5% of total NMVOC emissions. Total activity being, 11.5 Mm^3, average emission factor is about 4.8 kg NMVOC/m^3 meaning that emissions from this sector are already partly treated in EU25 (unabated emission factor being 19.8kg/m^3). These estimations could be modified in a near future due to information delivered by national experts during bilateral consultations in 2005 with CIAM.

Wood preservation is addressed by the European Directive 1999/13/EC (SED) [2] related to the reduction of NMVOC emissions from the use of solvents in some industrial activities. In order to be able to better represent the impact of this Directive in term of emission reduction and costs, **it has been considered as an individual activity by EGTEI [1]**. This sector was already considered separately in the previous RAINS version [4] but new abatement techniques are presented in the EGTEI document. Theses new data were developed in cooperation with a European timber industry's leading supplier of **wood** preservatives [5]. Presently, RAINS has been modified and integrates EGTEI proposals. **Data provided by EGTEI (emission factors and costs) have been implemented in the new RAINS version** for the modelling work carried out in the scope of the CAFÉ programme and the revision of the Gothenburg Protocol and national emission ceiling Directive.

The representative unit used is the volume of wood treated annually (m^3/year). Two reference installations (RI) are considered: the small one is under the Directive solvent consumption threshold and the large one is above so that emissions have to be treated.

Five primary measures are considered based on different types of preservatives: solvent-based and water-based products as well as different application processes (dipping or vacuum impregnation) which leads to different product consumption. The use of more concentrated solvent-based preservatives and water-based preservatives allows installations being in compliance with total emission limit values defined in the SED.

Traditional solvent-based preservatives have to be treated with end-of-pipe techniques in order to be in compliance with the SED requirements. Two secondary measures are defined: thermal oxidation and carbon adsorption.

EGTEI provides default emission factors (EF) with abatement efficiencies, investments and variable and fixed operating costs (OC) as well as unit costs (€/t NMVOC abated and €/activity unit) for five primary measures and two secondary measures according to the installation size.

The cheapest ways of reducing VOC emissions are the use of substitution preservatives (i.e. more concentrated solvent-based products or water-based ones).

National experts have to collect 4 country specific parameters (wages, electricity, steam and natural gas costs) and 4 country and sector specific parameters (costs of three different types of preservatives and recovered solvents). The first ones can be very easily known. The second ones can be defined with the help of national wood preservation associations. EGTEI provides default costs for country and specific parameters which can be used if no better national data exist. National experts have also to provide the trends in activity level from 2000 to 2020, the activity shares according to the different RI as well as the application and applicability rates of each abatement technique.

As the representation of this sector in RAINS is based on the EGTEI proposal, it is recommended to national experts to complete ECODAT with country specific parameters which are not known from CIAM.

EGTEI proposals have been considered in the last update of RAINS [3]. In the future however, any new technology which could be developed should be considered by EGTEI in the background

document to continuously improve the representation of the sector and the capacity of EGTEI to describe new technologies.

2. European regulation

As mentioned above, the European Directive 99/13/EC [2] applies to this sector (annex IIA, n°12).

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

by complying with the canalised and fugitive emission limit values,

by complying with the total emission limit values (in particular by replacing conventional products with a high solvent content with low-solvent or solvent-free products).

The SED applies to installations with a solvent consumption above 25 t per year. Emission limit values defined in the SED are presented in table 2.1. All obligations are not described in this chapter.

Table 2.1: Emission limit values

Solvent consumption threshold [t/y]	VOC emission limit value in residual gases [mg C / Nm^3]	Fugitive emissions [% of solvent input *]	Total emission limit values [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).

The compliance date for existing installations is October 30th, 2007. Following the transcription of the Directive in Member States, this date can be different from country to country. For example, in France, the compliance date is October 30th, 2005.

3. Methodology developed within EGTEI to represent the sector

3.1 Definition of reference installations

Two reference installations are considered to take into account secondary measure costs which greatly depend on the size. The small installation falls under the Directive solvent consumption threshold according to the definition of the unabated emission factor presented in paragraph 4.

Table 3.1.1: Reference installations

Reference Installation Code RIC	Description	Technical characteristics
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	Solvent input: 5.9 t/y Full load hours: 2,000 h/y [VOC]: 0.5 g/m^3 Flow rate: 4,000 m^3/h
02	Large Reference Installation : wood volume to be treated: 5,000 m^3/y	Solvent input: 99 t/y Full load hours: 6,000 h/y [VOC]: 0.5 g/m^3 Flow rate: 22,200 m^3/h

3.2 Definition of emission abatement techniques

3.2.1 Primary measures

In this sector, VOC emissions can be reduced by using products containing fewer solvents and by introducing more efficient application techniques. These techniques have been defined with information provided by an industrial operator [5].

Table 3.2.1.1: 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)

3.2.2 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 such as carbon adsorption or thermal oxidation.

Carbon adsorption is just considered for the largest installation because it is not adapted to the flow rate of the small installation.

Table 3.2.2.1: Secondary measures

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

4. Country specific data to be collected

Different types of country specific data have to be collected to give a clear picture of the situation in each Party. EGTEI proposes default values for the economical parameters which can be modified by the national expert if better data are available.

For this activity as for all NMVOC sectors, country specific economical parameters are used to calculate variable operating costs. They are presented in table 4.1 as the default costs proposed by EGTEI (these costs are entered only once in ECODAT).

Table 4.1: Country specific costs

Parameters	Default costs provided by EGTEI	Country specific costs
Electricity [€/kWh] (net of taxes)	0.0686	To be provided by national experts
Natural gas [€/GJ] (net of taxes)	5.926	To be provided by national experts
Steam [€/kg]	0.016	To be provided by national experts
Wages [€/h]	25.9	To be provided by national experts

For the preservation of wood, some additional country and sector specific parameters are necessary to calculate variable operating costs. They correspond to costs of different types of preservatives and cleaning solvents. Default costs proposed by EGTEI are presented in table 4.2.

Table 4.2: Country and sector specific economic parameters (net of taxes)

Parameters	Default costs provided by EGTEI [€/kg]	Country and sector specific costs [€/kg]
Solvent-based preservatives	0.72	To be provided by national experts
Solvent-based preservatives used for process optimisation	0.88	To be provided by national experts
Water-based preservatives	0.80	To be provided by national experts
Solvent recovered	0.72	To be provided by national experts

The best source of information for the determination of country and sector specific economic parameters is the national industrial wood preservation association and it is recommended to national experts to contact it.

Default data have been used to calculate variable and annual unit costs presented in table 5.1.

Information concerning activity levels from 2000 to 2020 as well as the description of the control strategy is also necessary (these data can be directly entered in the database ECODAT). A full definition of the work to be done by national experts is provided in the general EGTEI methodology [6].

National experts can also modify the default unabated emission factor proposed by EGTEI to represent the reference situation for all Parties, in a range of ± 10%. If the modification is higher than 10%, then appropriate explanations are required.

Table 4.3: Unabated emission factor [kg of NMVOC / m^3 of wood treated]

Default emission factor	Country specific emission factor
19.8	To be provided by national expert

5. Default emission factors and cost data defined with the EGTEI methodology

Table 5.1 gives an overview of all data provided by EGTEI for this sector: default emission factors (EF) with abatement efficiencies, investments, and variable and fixed operating costs (OC) as well as unit costs per t NMVOC abated and unit costs per unit of activity.

Variable costs account for chemical consumptions for the primary measures and electricity, natural gas, steam and labour if a secondary measure is used. Fixed operating costs are only considered for secondary measures and correspond to 5% of the secondary measure investment (for maintenance and insurance). As no economic data is available, it is assumed that fixed operating costs are the same for all primary measures so no additional costs are taken into account (that is why fixed operating costs appear as 0 costs in table 5.1).
Investments are defined for process modification to switch from solvent-based to water-based products and for secondary measure when appropriate.

Investments and variable operating costs of secondary measures presented in table 5.1 are calculated from the equations defined in the documents “derivation of secondary measure costs: thermal oxidation” and “derivation of secondary measure costs: carbon adsorption” downloadable on EGTEI website [7], [8]. Secondary energy recovery is possible with thermal oxidation but this is not considered in the calculations. Technical characteristics of the installations are given in table 3.1.1.

Table 5.1: Default emission factors (EF), abatement efficiencies and costs for each combination

RIC	PMC	SMC	NMVOC EF [kg / m^3]	Abatement efficiency [%]	Investment [k€]	Variable Operating Costs [k€ / year]	Fixed Operating Costs [k€/y]	Unit cost [€/t VOC abated]	Unit cost [€/m^3]
01	00	00	19.80	0.0	0.0	0.0	-	-	0.0
01	00	01	7.30	63.1	406.0	7.2	20.3	20,765	258.5
01	01	00	16.60	16.2	41.4	-0.7	-	2,455	7.9
01	01	01	6.10	69.2	418.6	6.0	18.9	17,730	248.0
01	02	00	11.00	44.4	44.2	-1.4	-	717	6.3
01	03	00	0.25	98.7	0.5	1.7	-	293	5.7
01	04	00	0.15	99.2	41.9	-0.7	-	401	7.9
02	00	00	19.80	0.0	0.0	0.0	-	-	0.0
02	00	01	7.30	63.1	1,040.8	75.0	52.2	4,114	51.1
02	00	02	7.30	63.1	494.5	21.4	24.7	1,019	21.4
02	01	00	16.60	16.2	87.0	-11.5	-	-320	-1.0
02	01	01	6.10	69.2	1,055.5	55.4	48.4	3,293	45.9
02	01	02	6.10	69.2	542.9	8.4	22.8	827	18.8
02	02	00	11.00	44.4	102.0	-22.7	-	-346	-3.0
02	03	00	0.25	98.7	3.0	28.0	-	289	5.6
02	04	00	0.15	99.2	90.0	-12.0	-	-55	-1.1

Unit costs [k€/ t of NMVOC abated] are obtained by dividing the annual total additional cost of a measure by the amount of NMVOC abated (costs and emissions are compared to the uncontrolled measure PMC 00 / SMC 00).

As presented in table 5.1, the cheapest way of reducing NMVOC emissions and being in compliance with the SED requirements (11 kg/m^3) is the process optimisation and the use of water-based preservatives because VOC emission reductions are very high.

6. Relevance of EGTEI information for Integrated Assessment Modelling (IAM)

In the previous RAINS version [4], this sector was already separately considered. The use of alternative preservatives was not considered though. EGTEI provides now an approach which has was developed with industrial operators and which considers all types of abatement techniques with specific efficiencies and costs.

Data provided by EGTEI (emission factors and costs) have been implemented in the new RAINS version [3] for the modelling work carried out in the scope of the CAFÉ programme and the revision of the Gothenburg protocol.

For this activity, data provided by national experts through ECODAT can then be directly used by CIAM for introduction in RAINS.

7. Perspective for the future

In the future, any new technology which could be developed should be considered by EGTEI in the background document to continuously improve the sector representation. Additional work on the different measure costs and on applicability factors should also to be carried out to have more robust data.

8. Bibliography

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[2] 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.
[3] Review of data used in RAINS-VOC model http://www.iiasa.ac.at/web-apps/tap/RainsWeb/
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ANNEXE: Example of data collection and use of EGTEI data – Case of France

A. Country specific data collection and scenario CLE developed

The French national expert has been able to complete ECODAT for the wood preservation with the help of CITEPA [9].

All collected data have been provided to CIAM for the bilateral consultation France – CIAM in March 2004.

Country and sector specific economic parameters

Country specific parameter costs have been defined from costs encountered in the medium size industry which are monthly published by official French statistic organizations.

Table A.1: French specific costs (net of taxes)

Parameters	French specific costs
Electricity [€/kWh] (net of taxes)	0.05
Natural gas [€/GJ] (net of taxes)	5.33
Steam [€/kg] (net of taxes)	0.013
Wages [€/h]	23.4

As no better product costs are available, default costs for country and sector specific parameters are taken into account for describing the French situation.

Table A.2: French and sector specific costs (net of taxes)

Parameters	Default costs [€/kg]	French and sector specific costs [€/kg]
Solvent based preservatives	0.72	0.72
Solvent based preservatives used for process optimisation	0.88	0.88
Water based preservatives	0.80	0.80
Solvent recovered	0.72	0.72

Activity level

The activity level in 2000 is derived from the consumption of the different types of preservatives: consumption (tonnes of preservatives) / consumption factor (t of preservatives / volume of wood treated) gives the activity. The activity trend from 2000 to 2020 comes from data provided by the French national expert. These trends are based on the added value trend from 1995 to 2001 for the branch “wood and paper industry”. This corresponds to an annual activity increase of 2.76%.

Respective shares (m^3 wood/y) of total activity level carried out on each reference installation in 2000, 2005, 2010, 2015, 2020 are derived from a 1999 French report concerning the respect of the SED requirements. The activity trend and shares are presented in table A.3.

Table A.3: Activity levels on Reference Installations (m^3 wood / year)

RIC	2000	2005	2010	2015	2020
01	798,000	914,375	1,047,725	1,200,500	1,375,570
02	1,482,000	1,698,125	1,945,775	2,229,500	2,554,630
Total (m^3)	2,280,000	2,612,500	2,993,500	3,430,000	3,930,200

Unabated emission factor

Default emission factors are adapted to the French situation.

Current legislation control scenario (CLE)

In the current legislation control scenario (CLE), the application rates of the different abatement techniques depend on the regulation implemented and on the dates of compliance.

In 2000, according to a study realised by CITEPA [9] concerning the influence of the SED on the French market, 89% of the activity was realised by dipping in small installations and 50% in large ones. From 2005 onwards, large installations (RIC02) will have to comply with the SED requirements. No secondary measure should be used in France: it is assumed that only water-based preservatives will be used.

Small installations (RIC01) are under the Directive threshold. They do not have to comply with the Directive: however, a "natural" decrease of solvent-based preservatives is assumed in these installations.

The application rates and applicability factors for the CLE scenario are presented in table A.4.

Table A.4: Definition of the CLE scenario

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	5	5	100	4	100	3	100	2	100
01 00 01	0	0	100	0	100	0	100	0	100
01 01 00	0.6	0.6	100	0.5	100	0.4	100	0.3	100
01 01 01	0	0	100	0	100	0	100	0	100
01 02 00	0	0	90	0	90	0	90	0	90
01 03 00	84	84	87	85	87	86	87	87	87
01 04 00	10.4	10.4	10.7	10.5	10.7	10.6	10.7	10.7	10.7
Total RIC 01	**100**	**100**		**100**		**100**		**100**	
02 00 00	2.8	0	100	0	100	0	100	0	100
02 00 01	0	0	100	0	100	0	100	0	100
02 00 02	0	0	100	0	100	0	100	0	100
02 01 00	2.8	0	100	0	100	0	100	0	100
02 01 01	0	0	100	0	100	0	100	0	100
02 01 02	0	0	100	0	100	0	100	0	100
02 02 00	0	0	90	0	90	0	90	0	90
02 03 00	47.2	50	50	50	50	50	50	50	50
02 04 00	47.2	50	50	50	50	50	50	50	50
Total RIC 02	**100**	**100**		**100**		**100**		**100**	**-**

Appl.: applicability factor

B. Trends in emissions and total costs of the CLE scenario

Data presented in the table below are directly provided by ECODAT and based on input parameters defined in chapter A.

Table B.1 presents NMVOC emissions from 2000 to 2020 and total annual costs of emissions reduction for the CLE scenario.

Table B.1: Trends in emissions and total annual costs of emission reductions in the CLE scenario

	2000	2005	2010	2015	2020
NMVOC emissions	**t NMVOC**	**t NMVOC**	**t NMVOC**	**t NMVOC**	**t NMVOC**
CLE scenario	2,840	1,542	1,545	1,516	1,445
Annual total costs	**k€/year**	**k€/year**	**k€/year**	**k€/year**	**k€/year**
CLE scenario	7,681	9,067	10,449	12,041	13,876

Emissions presented in table B.1 for the year 2000 according to the CLE scenario have been calculated with EGTEI emission factors. These emissions are consistent with the French inventory.