

DECORATIVE PAINTS

SYNOPSIS SHEET

Prepared in the framework of EGTEI

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1. Activity description and EGTEI contribution - summary

Surface coating is the application of decorative and/or protective materials in liquid form to substrates. Liquid paints include solvent-based coatings, varnishes, lacquers and water-based coatings. Solvents are used in the paints, thinners and cleaning agents. All un-recovered solvents can be considered as potential emissions. The major factor affecting these emissions is the amount of volatile matter contained in the paint. Conventional high solvent-based coatings contain approximately 50 % solids and 50 % organic solvents. In addition, other solvents may be added to the paint to thin the paints before application.

No large differences can be identified between architectural and domestic use of paints. In the first one, paint is supplied to professionals and used by painting contractors, local authorities, government departments, industrial and commercial companies etc. In the second one, paint is used principally by the "do-it-yourselfers" (DIY).

It is possible to distinguish the following main applications of paints for the whole architectural sector: walls, ceilings, floors in indoor applications; walls, floors in outdoor applications; wood substrates in indoor applications : floors, furniture, doors, window frames; wood substrates in outdoor applications : fences, garden sheds, gable boards, garden furniture, wooden chalets; metallic substrates in indoor applications : radiators, tanks; metallic substrates in outdoor applications : fences, portals, garden furniture.

For all of these cases, the application techniques are the same: while conventional spraying is certainly carried out by some commercial applicators, rolling for large flat areas and brushing for more complex shapes such as windows and door frames are the dominant application techniques. In the domestic use sector (decorative retail), application techniques are only brushing and rolling.

Emissions of NMVOC in paint application are due to the evaporation of the solvents used. At a EU25 level for the year 2000 (according to the RAINS model: version CP_CLE_Aug04(Nov04)), NMVOC emissions were 537 kt representing 5.0% of total NMVOC emissions. Total activity being 3,616 kt of paints, average emission factor is about 150 g NMVOC/kg of paint used meaning that emissions from this sector are already partly treated in EU25 (unabated emission factors are country specific but are above 200 g/kg of paint). These estimations could be modified in a near future due to information delivered by national experts during the bilateral consultation in 2005.

The use of decorative paints is addressed by the European Directive 2004/42/EC [1] **related to the reduction of VOC emissions from the use of certain paints. In order to be able to better represent the impact of this Directive in terms of emission reduction and costs**, this sector has been considered as an individual activity by EGTEI [2]. This sector was already considered separately in the previous RAINS version [3]. Different measures corresponding to the substitution of solvent-based paints were studied. Things have been clarified since the work done to prepare the European Directive was released [4]. Paints used in the different countries, solvent contents in the paints and potential costs incurred are better known. A lot of detail data were provided by the European Council of the Paint, Printing Ink and Artists' Colours Industry (CEPE) [5].

Presently, RAINS has been modified and integrates EGTEI proposals. **Data provided by EGTEI (emission factors and paint consumption shares) have been implemented in the new RAINS version [6]** 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 treatment of costs in RAINS has to be checked but it is not straight forward for this sector. An additional measure to go further than the Directive requirements has been added in RAINS. This measure is not studied in the EGTEI document.

The representative unit used is the amount of paint consumed annually (kt/year): no reference installation is defined.

Only one measure corresponding to the definition of the Directive requirements in 2010 (stage II) is presented in the EGTEI document. This measure is suitable among all European countries because the Directive gives maximum solvent content for the different types of paints. No secondary measure is studied as the Directive 2004/42/EC defines maximum VOC content limit values for vehicle refinishing products.

EGTEI provides default emission factors (EF), default paint consumption shares and unit costs (€/t NMVOC abated) for the abatement measure defined. These default data are just given for information purposes if national experts have no better data to provide to CIAM.

National experts have only to provide the activity level trend from 2000 to 2020 (for the paints and for the cleaning solvents), the total average solvent content in the paints (which correspond to the EF used in their country) and the shares of the different paints used. Again, all these data are provided by EGTEI in case national experts have no specific figures.

As the representation of this sector in RAINS is based on the EGTEI proposal (even specific national data have been introduced for the moment), it is recommended to national experts to check these data and complete ECODAT with country specific parameters if they are different from those used by CIAM.

In the future however, any new step 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. At first, the additional stage considered in RAINS could be checked.

2. European regulation

The European Directive 2004/42/EC [1] applies to this sector. The substitution of high solvent-based coatings by low solvent-based and water-based coatings will considerably reduce emissions. This regulation will be implemented in two phases (phase I in 2007 and phase II in 2010). Solvent content limit values are presented in table 2.1.

Table 2.1: VOC content limit values for decorative paints and varnishes

Coating categories	Type	Phase I (g/l)* (2007)	Phase II (g/l)* (2010)
Interior matt wall and ceilings	WB	55	30
	SB	350	30
Interior glossy walls and ceilings	WB	150	100
	SB	350	100
Exterior walls of mineral substrate	WB	60	40
	SB	450	430
Interior trim and cladding paints for wood and metal	WB	130	130
	SB	250	250
Exterior trim and cladding paints for wood and metal	WB	140	100
	SB	500	400
Interior/exterior trim varnishes and wood stains	WB	150	130
	SB	700	700
Primers	WB	50	30
	SB	450	350
Binding primers	WB	50	30
	SB	750	750
One pack performance coatings	WB	140	140
	SB	600	500
2 pack reactive performance coatings for specific end use	WB	140	140
	SB	550	500
Multi-coloured coatings	WB	150	100
	SB	400	100
Decorative effects coatings	WB	300	200
	SB	500	200

*g/l ready to use

3. Methodology developed within EGTEI to represent the sector

3.1 Definition of reference installations

No reference installation is defined in this chapter. This sector is defined by the total consumption of each type of products in the different countries.

3.2 Definition of emission abatement techniques

As average solvent contents of each type of coatings differ from one country to another (this information has to be provided by national experts for the year 2000), the unabated situation has to be defined at a country level. In 2010, solvent contents of the different coating types will have to fulfill the Directive requirements so the primary measure has been defined.

No primary measure going further than the Directive requirements is defined in the EGTEI document [2] because no specific study has been done and it is not known yet if this is technically and economically feasible.

4. Country specific data to be collected

For this activity, the definition of cleaning solvent cost is required. As fewer cleaning solvents will be used because of the substitution of solvent-based paints, savings will occur.

Table 4.1: Country specific costs

Parameter	Default costs provided by EGTEI	Country specific cost
Cleaning solvents [€/t] (net of taxes)	450	To be provided by national experts

Activity level (paint and cleaning solvent consumptions), average solvent contents and control strategy description from 2000 to 2020 are necessary (these data can be directly entered in the database ECODAT) to properly define this sector in terms of emissions and costs.

If no data are available at a country level, default data presented in paragraph 5 can be used.

Average solvent contents in the paints depend on the types of products used at a country level. These concentrations will evolve in the future (with the implementation of national or European regulations) so the possibility is given to national experts to modify this parameter.

Cleaning products are considered to be pure solvents (100%). The solvent content is not assumed to differ in the future but their consumption should be reduced with the increased use of alternative coatings.

Table 4.2: Average solvent content of the products (weight %)

Products	2000	CI%	2005	CI%	2010	CI%	2015	CI%	2020	CI%
Coatings										
Diluting/cleaning solvents	100		100		100		100		100	

The definition of the control strategy corresponds to the table 4.3 bellow. VOC emissions can be defined according to the different types of paints used. This table is also used for the definition of total unit costs (€/tonne VOC abated).

Table 4.3: Consumption shares of the different types of paints

Coating categories	Type	Shares (%)
Interior matt wall and ceilings	WB	
	SB	
Interior glossy walls and ceilings	WB	
	SB	
Exterior walls of mineral substrate	WB	
	SB	
Interior trim and cladding paints for wood and metal	WB	
	SB	
Exterior trim and cladding paints for wood and metal	WB	
	SB	
Interior/exterior trim varnishes and wood stains	WB	
	SB	
Primers	WB	
	SB	
Binding primers	WB	
	SB	
One pack performance coatings	WB	
	SB	
2 pack reactive performance coatings for specific end use	WB	
	SB	
Multi-coloured coatings	WB	
	SB	
Decorative effects coatings	WB	
	SB	

5. Default emission factors and cost data defined with the EGTEI methodology for all European countries

5.1 Average solvent content of the paints at a country level

Emission factors (EF) at a country level (t VOC / t product consumed) depend on the shares of use of the different coatings (table 4.3) and of the solvent content of the paints (different in each country).

Average solvent contents are provided in the table below 5.1.1. They are derived from the Decopaint study [4] and from statistics from the European Industry CEPE [5]. Solvent contents from 2010 onwards were defined from the solvent content limit values presented in the table 2.1.

Table 5.1.1: Average solvent content (weight %) of the ready to use coatings for different European countries (DEFAULT VALUES) [4], [5]

Types of coatings	Countries																
	B	DK	D	GR	E	F	I	L	NL	N	A	P	CH	FIN	S	UK	Av.
Solvent content in 1999 [4]	17.9	16.3	13.6	18.3	20.4	20.5	17.9	17.9	17.9	22.3	17.9	18.3	18.7	17.3	19.1	17.9	17.3
Solvent content in 2000 [5]	13.2	11.1	6.9	13.1	17.3	18.4	12.6	13.2	13.4	17.4	12.6	13.1	13.6	11.7	13.9	11.7	12.1
Solvent content from 2010 onwards	9.2	7.8	5.7	8.9	10.8	10.1	8.7	9.2	9.0	13.2	8.7	8.9	9.3	8.4	10.8	9.0	8.4

Av.: Average

5.2 Default consumption shares of the different paints defined

Default shares of each sub-category of paints are provided in table 5.2. They have been provided by the European industry [5] for each country and by the Decopaint study [4] at an average level for EU15 countries.

These data can be used by national experts if no better statistics are available at a country level.

Table 5.2.1: Shares of each sub-category of paints (% of total consumption) [4], [5]

Countries Types of coatings		Reference [5]																[4]
		B	DK	D	GR	E	F	I	L	NL	N	A	P	CH	FIN	S	UK	EU ₁₅
Interior matt and glossy walls and ceilings	Water	37.0	52.9	61.4	52.9	40.4	24.9	52.9	37.0	46.0	52.9	52.9	52.9	52.9	52.9	52.9	54.5	53.5
	Solvent	1.5	3.4	0.0	3.4	1.3	22.4	3.4	1.5	1.4	3.4	3.4	3.4	3.4	3.4	3.4	2.9	5.9
Exterior walls of mineral substrates	Water	25.1	17.6	17.7	17.6	17.9	22.6	17.6	25.1	17.0	2.7	17.6	17.6	17.6	16.3	3.6	8.3	15.1
	Solvent	0.5	0.5	0.4	0.5	2.0	5.6	0.5	0.5	0.5	15.4	0.5	0.5	0.5	1.8	14.5	2.8	3.3
Interior/exterior trim and cladding paints for wood and metal	Water	3.8	4.8	2.0	1.0	3.9	0.3	1.9	3.9	7.3	1.0	1.9	1.0	1.0	4.8	4.8	2.2	2.3
	Solvent	12.2	4.8	4.7	8.7	28.8	3.5	7.7	12.2	15.4	8.7	7.7	8.7	8.7	4.8	4.8	12.4	8.9
Interior/exterior trim varnishes and woodstains	Water	1.2	4.4	4.1	0.4	0.4	1.2	0.9	1.2	4.4	1.8	0.9	0.4	0.9	1.8	5.3	9.8	2
	Solvent	5.7	4.4	2.7	8.4	5.3	5.5	8.0	5.7	5.4	7.1	8.0	8.4	8.0	7.1	3.5	4.2	3.2
Primers	Water	1.5	0.2	0.9	0.6	0.0	1.2	0.6	1.5	0.1	0.2	0.6	0.6	0.2	0.6	0.6	0.1	0.5
	Solvent	0.6	1.0	0.2	0.6	0.0	1.1	0.6	0.6	0.3	1.0	0.6	0.6	1.0	0.6	0.6	0.5	0.5
Binding primers	Water	1.5	0.2	0.9	0.6	0.0	1.2	0.6	1.5	0.1	0.2	0.6	0.6	0.2	0.6	0.6	0.1	0.5
	Solvent	0.6	1.0	0.2	0.6	0.0	1.1	0.6	0.6	0.3	1.0	0.6	0.6	1.0	0.6	0.6	0.5	0.5
One pack performance coatings	Water	1.5	0.2	0.9	0.6	0.0	1.2	0.6	1.5	0.1	0.2	0.6	0.6	0.2	0.6	0.6	0.1	0.5
	Solvent	0.6	1.0	0.2	0.6	0.0	1.1	0.6	0.6	0.3	1.0	0.6	0.6	1.0	0.6	0.6	0.5	0.5
Two pack performance Coatings for specific end	Water	1.5	0.2	0.9	0.6	0.0	1.2	0.6	1.5	0.1	0.2	0.6	0.6	0.2	0.6	0.6	0.1	0.5
	Solvent	0.6	1.0	0.2	0.6	0.0	1.1	0.6	0.6	0.3	1.0	0.6	0.6	1.0	0.6	0.6	0.5	0.5
Multi-coloured coatings	Water	1.5	0.2	0.9	0.6	0.0	1.2	0.6	1.5	0.1	0.2	0.6	0.6	0.2	0.6	0.6	0.1	0.5
	Solvent	0.6	1.0	0.2	0.6	0.0	1.1	0.6	0.6	0.3	1.0	0.6	0.6	1.0	0.6	0.6	0.5	0.5
Decorative effect coatings	Water	1.5	0.2	0.9	0.6	0.0	1.2	0.6	1.5	0.1	0.2	0.6	0.6	0.2	0.6	0.6	0.1	0.5
	Solvent	0.6	1.0	0.2	0.6	0.0	1.1	0.6	0.6	0.3	1.0	0.6	0.6	1.0	0.6	0.6	0.5	0.5
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

5.3 Cost issues

Unit costs (€/t VOC abated) are based on costs defined in the Decopaint study [4]. Switching from solvent-based to water-based paints will imply an increase in costs. This is mainly due to more expensive raw materials for water-based paints, but also due to some additional research and development and investment costs. Usually, costs to reduce the solvent content of existing water-based paints are rather low. However, in some cases the lowering of solvent content of paint requires a significant technological shift and the costs are then the same order of magnitude as in the case of shifting from solvent to water-based paints.

Four parameters have been taken into account: increase in production costs, R&D costs, additional investments, and savings on cleaning solvent use.

These parameters have been studied in the EGTEI document [2] according to the shares of coatings provided by CEPE [5] because they are country specific. They are given as a guide just in case national experts do not have any statistics. Unit costs (€/t VOC abated) are not so easy to calculate and depends on the way to take into account the four parameters defined above.

They are just **presented as an example** in the table 5.3.1 and might evolve if national experts modify the average solvent contents and the shares of the different paints given in tables 5.1.1 and 5.2.1. **Solvent contents defined in the Decopaint study [4] are used as the starting point for the cost calculation.**

Table 5.3.1: Unit costs [€/ t VOC abated] to take into account 2010 onwards

Countries	B	DK	D	GR	E	F	I	L	NL	N	A	P	CH	FIN	S	UK
Types of coatings																
Unit costs [€/ t VOC]	673	539	350	515	587	1,325	517	673	491	515	517	515	523	504	518	469

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

In the previous RAINS version [3], the use of decorative paints was already studied as a separate sector. It has been reviewed with data developed for the preparation of the Directive [1].

Data provided in the EGTEI approach have been implemented in the new RAINS version [6] for the modelling work carried out in the scope of the CAFÉ programme and the revision of the Gothenburg protocol. Country specific data used in the RAINS model can be reviewed and modified if national experts have better data. For this activity, data provided by national experts through ECODAT can be directly used by IIASA for introduction in the RAINS model.

The treatment of cost parameters in the RAINS model might be different from the exercise realised in the EGTEI background document [2]. This analysis is not straight forward for this particular sector.

A new abatement measure has been added in the RAINS model to go further than the Directive requirements. Costs have been assumed by IIASA. This measure is not defined in the background document as it needs to be checked before its use by EGTEI.

7. Perspective for the future

In the future, new measures to go beyond the Directive requirements should be defined. This has to be further discussed with the European industry.

8. Bibliography

- [1] Council Directive 2004/42/EC of the European Parliament and the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in decorative paints and varnishes and vehicle refinishing products (amending Directive 1999/13/EC).
- [2] EGTEI background document
http://citepa.org/forums/egtei/decorative_paint_180703.pdf
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- [4] EC DG Environment Decopaint, Study on the Potential for Reducing Emissions of VOC Due To The Use Of Decorative Paints and Varnishes for Professional and Non-professional Use, Final report. Tender E1/ETU/980084. June 2000.
- [5] The European Council of the Paint, Printing Ink and Artists' Colours Industry (CEPE). <http://www.cepe.org/>
- [6] Review of data used in RAINS-VOC model
<http://www.iiasa.ac.at/web-apps/tap/RainsWeb/>
- [7] CITEPA: National reference centre for emission inventories

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 use of paints in the decorative sector with the help of CITEPA [7].

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

Activity level

Activity in 2000 was deduced from the French statistics on paint consumption per sector. The activity forecast from 2000 to 2020 comes from data provided by the French expert and based on the added value of the French construction sector and on the household consumption from 1995 to 2001. The trend corresponds to an annual decrease of 1.08% for the construction and an annual increase of 2.07% for the DIY sector.

Table A.1: Activity level from 2000 to 2020 (t of paints / year)

	2000	2005	2010	2015	2020
Total (t of paints)	501,813	505,280	511,799	521,557	534,770
Total (t of cleaning solvents)	20,964	16,291	11,736	11,960	12,263

Average solvent content in the coatings are directly derived from data provided by the European federation CEPE which are consistent with the French federation (FIPEC). See table 5.1.1. for 2000. In 2005, an average solvent content (between 18.4 and 10.1) is assumed.

Table A.2: Average solvent content of the products (weight %)

Products	2000	CI%	2005	CI%	2010	CI%	2015	CI%	2020	CI%
Coatings	18.4		14.2		10.1		10.1		10.1	
Diluting/cleaning solvents	100		100		100		100		100	

Unabated emission factor

The French emission inventory has been updated with CEPE statistics. Emission factor considered now is the one defined in the EGTEI process as new data have been collected.

Current legislation control scenario (CLE)

The shares of the different coating types are derived from data provided by CEPE [5]. EGTEI default shares are used for the French case. They are presented in the table below (A.3). They are not expected to change with time: only the solvent content of each coating type is assumed to evolve with respect of the Directive [1].

Table A.3: Consumption shares of the different types of paints

Coating categories	Type	Shares (%)
Interior matt and glossy walls and ceilings	WB	24.9
	SB	22.4
Exterior walls of mineral substrates	WB	22.6
	SB	5.6
Interior/exterior trim and cladding paints for wood and metal	WB	0.3
	SB	3.5
Interior/exterior trim varnishes and woodstains	WB	1.2
	SB	5.7
Primers	WB	1.2
	SB	1.1
Binding primers	WB	1.2
	SB	1.1
One pack performance coatings	WB	1.2
	SB	1.1
Two pack performance Coatings for specific end	WB	1.2
	SB	1.1
Multi-coloured coatings	WB	1.2
	SB	1.1
Decorative effect coatings	WB	1.2
	SB	1.1

B. Trends in emissions

Table B.1 presents NMVOC emissions from 2000 to 2020 for the CLE scenario. These emissions are directly calculated from the average solvent content of the paints (calculated from the shares of the different paints) and of the cleaning solvents times activity levels.

Table B.1: Trends in emissions for the CLE scenario

	2000	2005	2010	2015	2020
NMVOC emissions	t NMVOC	t NMVOC	t NMVOC	t NMVOC	t NMVOC
CLE scenario	113,297.6	89,249.8	63,428.1	64,637.4	66,274.9