VEHICLE REFINISHING

SYNOPSIS SHEET

Prepared in the framework of EGTEI

Activity description and EGTEI contribution - summary

This sector covers the painting of cars, trucks or other vehicles, partly or totally, and of single parts of vehicles, often after mechanical or coachwork repairing. Vehicle refinishing is usually carried out by hand, using spray guns.

Almost all installations are equipped with closed, ventilated and heated spray booths. The use of spray booths does not reduce VOC-emissions. Spray booths are used in order to ensure safe working conditions for operatives. They disperse emissions by venting them through a stack, and thereby rendering them harmless to the local community.

The majority of the coating activities in vehicle refinishing were traditionally carried out by pneumatic spraying with application efficiency estimated at approximately 30 %. Increasingly, application with high transfer efficiency guns (e.g. High Volume, Low Pressure - HVLP) is used. This leads to an increase of the application efficiency by 10 – 20 % compared to conventional spraying guns.

Electrostatic application is not practicable in the car refinishing sector, because its use results in damage to the engine management system and other electronic components.

This activity emits NMVOC originating from the use of paints containing solvents and cleaning solvents. NMVOC emissions from this sector are rather homogeneous from country to country as the same paints are sold on the European market. At a EU25 level for the year 2000 (according to the RAINS model: version CP_CLE_Aug04(Nov04)), NMVOC emissions were 96 kt representing 0.9% of total NMVOC emissions. Total activity being, 146 kt of paints, average emission factor is about 657 g NMVOC/kg of paint used meaning that emissions from this sector are already partly treated in EU25 (unabated emission factor being 720 g/kg paint). These estimations could be modified in a near future due to information delivered by national experts during the bilateral consultation in 2005.

Vehicle refinishing 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 term 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]. Good housekeeping and substitution of solvent-based paints were studied as reduction techniques. Costs associated with these techniques were negative because the paint consumption is reduced with the use of more efficient application techniques (part of good housekeeping). EGTEI consider the same kind of techniques but costs as labour and productivity (which are also incurred) are now taken into account so unit costs are positive. The methodology for this sector was developed in close cooperation with a representative from the European Council of the Paint, Printing Ink and Artists' Colours Industry (CEPE) [4].

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 [5]** 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 amount of paint consumed annually (kt/year). Only one reference installation is defined to simplify the national data collection.

Four measures are considered based on different types of paints used. These measures represent the unabated case, a "natural" decrease in solvent content of certain paints, the respect of the Directive requirements and a potential additional step to further reduce VOC emissions. 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) with abatement efficiencies, variable operating costs (OC) as well as unit costs (€/t NMVOC abated and €/activity unit) for the four reduction measures.

National experts have only to provide the activity level trend from 2000 to 2020 and applicability rates of each abatement technique (control strategy).

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 (in the April version of ECODAT, only 3 abatement measures are defined. They should be sufficient to represent the situation from 2000 onwards. However, the uncontrolled measure will be added ASAP in the database).

EGTEI proposals for the representation of the vehicle refinishing sector and definitions of abatement techniques have been considered in the last RAINS update [5]. 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.

1. European regulation

As mentioned above, the European Directive 2004/42/EC [1] applies to this sector.

The Directive applies to all the installations because it fixes solvent limit contents for each product category used in this sector.

Table 2.1: Maximum VOC content limit values for vehicle refinishing products as defined in the Directive

Product subcategory	Coatings	VOC g/l of ready to use product
Preparatory and cleaning	Preparatory Pre-cleaner	850 200
Bodyfiller/stopper	All types	250
Primer	Surfacer/filler and general primer Wash primer	540 780
Topcoat	All types	420
Special finishes	All types	840

The compliance date is 01.01.2007.

2. Methodology developed within EGTEI to represent the sector

2.1 Definition of the reference installation

Installations of all sizes use very similar processes. As costs of reduction techniques are proportional to the production of the body shop, it has been decided in collaboration with CEPE representative [4] to define only one “typical” installation.

Table 3.1.1: Reference installation

Reference Installation Code RIC	Description
01	Medium Installation: 1,500 refinished vehicles/a, representative for the range 750 < refinished vehicles/a < 2,500 20 % one-coat topcoat; 80 % two-coat topcoat (basecoat/clearcoat)

2.2 Definition of emission abatement techniques

2.2.1 Primary measures

Three options to reduce VOC emissions are of relevance in this sector: improvement of application efficiency, switch to low solvent products (especially to water-based paints) and good housekeeping / solvent management. These techniques are combined in the following measures:

- PMC 00: this measure represents the reference case (it has been added in [2]),
- PMC 01: this measure represents a natural reduction in product solvent content,
- PMC 02: this measure is sufficient to respect the Directive requirements,
- PMC 03: this measure goes further than the regulation requirements.

Table 3.2.1.1: Primary measures

Primary Measure Code PMC	Description
00	• Putty: conventional (VOC content: 250 g VOC/l) • Primer: conventional (VOC content: 712 g VOC/l) - pneumatic application • Surfacer: high solid (VOC content: 518 g VOC/l) - pneumatic application • Topcoat: - **one-coat topcoat**: conventional (VOC content: 565 g VOC/l) - pneumatic application, **or** - **two-coat topcoat**: conventional (VOC content: 767 g VOC/l) - pneumatic application - and conventional (VOC content: 584 g VOC/l) - pneumatic application • Cleaning agent: 100 wt.-% solvent content for all coating layers
01	• Putty: conventional (VOC content: 250 g VOC/l) • Primer: conventional (VOC content: 712 g VOC/l) - pneumatic application • Surfacer: high solid (VOC content: 518 g VOC/l) - pneumatic application • Topcoat: - **one-coat topcoat**: conventional (VOC content: 565 g VOC/l) - pneumatic application, **or** - **two-coat topcoat**: conventional (VOC content: 767 g VOC/l) - pneumatic application - and conventional (VOC content: 584 g VOC/l) - pneumatic application • Cleaning agent: 100 wt.-% solvent content for all coating layers
02	• Putty: conventional (VOC content: 250 g VOC/l) • Primer: conventional (VOC content: 712 g VOC/l) - HVLP application • Surfacer: high solid (VOC content: 518 g VOC/l) - HVLP application • Topcoat: - **one-coat topcoat**: improved (VOC content: 410 g VOC/l) - HVLP application, **or** - **two-coat topcoat**: improved (VOC content: 99 g VOC/l) - pneumatic application - and high solid (VOC content: 417 g VOC/l) - HVLP application • Cleaning agent: 70 % with a solvent content of 100 wt.-%, 30 % with a solvent content of 15 wt.-%
03	• Putty: conventional (VOC content: 250 g VOC/l) • Primer: conventional (VOC content: 712 g VOC/l) - HVLP application • Surfacer: very high solid (VOC content: 221 g VOC/l) - HVLP application • Topcoat: - **one-coat topcoat**: improved (VOC content: 410 g VOC/l) - pneumatic application, **or** - **two-coat topcoat**: improved (VOC content: 99 g VOC/l) – HVLP application - and high solid (VOC content: 417 g VOC/l)- HVLP application • Cleaning agent: 40 % with a solvent content of 100 wt.-%, 60 % with a solvent content of 15 wt.-%

2.2.2 Secondary measures

No secondary measure is defined because the new European regulation (Directive 2004/42/EC [1]) defines maximum solvent contents for the different categories of paints.

3. Country specific data to be collected

For this activity, no economic parameter is required. Economic figures are assumed to be suitable for all countries.

Activity level and control strategy description from 2000 to 2020 are 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].

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

Table 4.1: Unabated emission factor [kg of VOC / t of paint used]

Default emission factor	User specific emission factor
720	

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

Table 5.1 gives an overview of all data provided by the EGTEI methodology for the vehicle refinishing sector: default emission factors with abatement efficiencies, additional variable operating costs as well as unit costs.

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

RIC PMC	NMVOC EF [kg VOC/t paint]	Abatement efficiency [%]	Variable OC [€/y]	R&D costs* [€/ t VOC abated]	Units costs [€/t VOC abated]	Units costs [€/t paint]
01 00	720	0.0	0	0	-	0.0
01 01	666	7.5	90	0	461	24.9
01 02	280	61.1	1,701	270	1,387 (1,117 after 10 years)	535.2 (431 after 10 years)
01 03	197	72.6	13,696	0	7,909	3,709.5

* R&D costs account for the development of new paints. They have to be considered only for the 10 first years.

Variable costs correspond to the following parameters: coating costs, cleaning activities and labour and productivity.

Unit costs are obtained by dividing the additional annual cost of a measure (compared to the unabated measure MC00) by the amount of VOC abated. For the measure 02, R&D costs have to be added to unit costs for the first 10 years after the implementation of the measure. After this period, these costs are considered to be amortised.

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

In the previous RAINS version [3], vehicle refinishing was already studied as a separate sector. Good housekeeping and substitution of solvent-based paints were studied as reduction techniques. Costs associated with these techniques were negative because the paint consumption is reduced with the use of more efficient application techniques (part of good housekeeping) and paints with higher dry matter contents.

EGTEI considers the same kind of techniques but costs as labour and productivity (which are also incurred) are now taken into account so unit costs are positive (as shown in table 5.1).

Data provided in the EGTEI approach (emission factors and costs) have been implemented in the new RAINS version [5] 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 be directly used by CIAM for introduction in RAINS.

A new measure has been added in the EGTEI document [2] (version 2) to represent the reference case (PMC00) with an unabated emission factor of 720 g of VOC / kg of paint used). This measure has been validated by CEPE representative [4]. In RAINS, 2 sub-sectors are defined: VEHR_P and VEHR_P_NEW to make it easier to take into account R&D costs which are only considered for 10 years.

6. 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 representation of the sector.

7. 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 (version_2 incorporating the new unabated measure PMC00 and the methodology presented in the addendum). http://citepa.org/forums/egtei/egtei_doc-Paint_coating.htm

[3] KLIMONT; M. AMANN; J. COFALA. Estimating costs for Controlling Emissions of Volatile Organic Compounds (NMVOC) 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

[4] The European Council of the Paint, Printing Ink and Artists' Colours Industry (CEPE). http://www.cepe.org/

[5] Review of data used in RAINS-VOC model http://www.iiasa.ac.at/web-apps/tap/RainsWeb/

[6] Methodology http://citepa.org/forums/egtei/egtei_index.htm

[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 CLE scenario developed

The French national expert has been able to complete ECODAT for the vehicle refinishing sector with the help of CITEPA [7].

All collected data have been provided to IIASA for the bilateral consultation France – IIASA 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 vehicle refinishing sector from 1995 to 2001. The trend corresponds to an annual increase of 0.85%.

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

RIC	2000	2005	2010	2015	2020
Total (t of paints)	20,735	21,630	22,565	23,540	24,560

Unabated emission factor

The default emission factor provided by EGTEI is slightly modified to represent the reference situation in France and to be consistent with the French inventory. This emission factor is regularly defined with experts from the French Association of the Paint, Printing Ink and Glue Industry (FIPEC).

Table A.2: Unabated emission factor [g of VOC / kg of paint]

Default emission factor	French emission factor
720	716

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, 100% of activity corresponds to the unabated measure PMC00 to be consistent with the French inventory. It is assumed that installations will have to comply with the Directive requirements in 2005 (this has to be checked in the French transposition of the European Directive). As only one stage is defined in the Directive [1], no further reduction is considered.

The application rates and applicability factors for the CLE scenario are presented in table A.3.

Table A.3: Definition of the CLE scenario

RIC PMC	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	100	0	100	0	100	0	100	0	100
01 01	0	0	100	0	100	0	100	0	100
01 02	0	100	100	100	100	100	100	100	100
01 03	0	0	0	0	0	0	25	0	50
Total RIC 01	**100**	**100**	**-**	**100**	**-**	**100**	**-**	**100**	**-**

Appl.: applicability factor

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

Data shown 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	14,846	6,056	6,318	6,591	6,877
Annual total costs	**k€/year**	**k€/year**	**k€/year**	**k€/year**	**k€/year**
CLE scenario	0	12,000	12,000	13,000	13,000

Emissions shown in table B.1 for the year 2000 according to the CLE scenario are exactly the same as the ones defined in the French inventory as the unabated emission factor has been modified. EGTEI approach allows representing very well NMVOC emissions from the vehicle refinishing sector.