PUBLICATION GRAVURE

SYNOPSIS SHEET

Prepared in the framework of EGTEI

1. Activity description and EGTEI contribution - summary

Rotogravure means a printing process using a cylindrical image carrier, in which the printing area is below the non-printing area, using liquid inks that dry through evaporation. The cells are filled with ink and the surplus is cleaned off the non-printing area before the surface to be printed contacts the cylinder and lifts the ink from the cells.

Only toluene based inks are used. Ink contains 50% toluene when leaving the ink factory. A dilution is made in the printing plant to obtain the proper concentration in toluene: machine ready ink contains up to 80% toluene. Emissions to air arise primarily from the organic solvents contained in inks. Carbon adsorbers are used for a long time to recycle the toluene into the process.

NMVOC emissions from this sector may vary significantly from country to country. At a EU25 level for the year 2000 (according to the RAINS model: version CP_CLE_Aug04(Nov04)), NMVOC emissions were 61 kt representing 0.58% of total NMVOC emissions. Total activity being, 191.48 kt of ink, average emission factor is about 0.32 kg NMVOC/kg of non diluted ink meaning that emissions from this sector are already well treated in EU25. These estimations could be modified in a near future due to information delivered by national experts during the bilateral consultation in 2005.

Publication gravure is addressed by the European Directive 1999/13/EC (SED) [1] 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, **this sector has been considered as an individual activity by EGTEI [2]**. This sector was already considered as an individual sector in the previous version of RAINS [5] but new measures and abatement costs have been defined in the EGTEI background document. The methodology for this sector was developed in close cooperation with the European Rotogravure Association (ERA) [3] and the European Printing Association (Intergraf) [4] in 2003. Since the EGTEI background document was finalised, new data have been provided by industry representatives. A meeting has been organized in Laxenburg in 2005 with Intergraf, IIASA and CITEPA. This new information relates to costs of the most efficient technique. This new information will be taken into account in the new RAINS version and used for the modelling work carried out in the scope of the revision of the Gothenburg Protocol and national emission ceiling Directive. The EGTEI background document will be updated in the coming weeks. T**his synopsis sheet presents the first data set provided by EGTEI in 2003 as the updated one has not been fully finalised yet.**

The representative unit used is the amount of non diluted ink consumed annually (kt/year). One installation's size is defined. It refers to a single printing press.

Only one primary measure is considered as only one type of ink can be used for this application. Abatement measures are based on different fugitive emission levels. These solutions allow being in compliance with the SED requirements and even going further as in some European countries, the regulation is stricter than the SED.

EGTEI provides default emission factors (EF) with abatement efficiencies, investments, variable operating costs (OC), savings as well as unit costs (€/t NMVOC abated and €/activity unit) for three secondary measures.

Abatement costs vary from 0.29 to 1.08 k€/t NMVOC abated or from 0.06 to 0.11 k€/t of non diluted ink consumed [These costs are susceptible to evolve in the updated version of the background document due to new information provided by industry as mentioned above).

National experts have to collect only 1 sector and country specific economic parameter (toluene cost). EGTEI provides a default cost 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 as well as the application and applicability rates of each abatement technique.

Even if the representation of this sector will be slightly modified in the new RAINS version compared to the current EGTEI proposal presented in the EGTEI background document (on the cost side), it is recommended to national experts to complete ECODAT with country specific parameters which are not known by CIAM. These data can be used directly in RAINS.

The EGTEI background document and the synopsis sheet will be updated as soon as possible.

2. European regulation

As mentioned above, the European Directive 99/13/EC [1] applies to this sector (annex IIA, n°2).

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

by complying with the canalised and fugitive emission limit values,

by introducing a reduction scheme to obtain an equivalent emission level (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 for publication gravure

Solvent consumption threshold [t / y]	NMVOC emission limit value in residual gases [mg C / Nm^3]	Fugitive emissions [% of solvent input*]
> 25	75	New installations: 10 Existing installations: 15

* 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 back into the printing cycle).

The respect of the reduction scheme defined in Annexe IIB of the SED leads to the following emission factors (the annual reference emission corresponds to the total mass of solids in the quantity of inks times a multiplication factor defined in the SED (4 for publication gravure). The target emission is equal to the annual reference emission multiplied by a percentage equal to the fugitive emission value + 5 for publication gravure):

For existing installations, this corresponds to (0.5 kg solid/kg of ink non diluted x 4 kg solvent/kg solid) x (0.05+0.15) = 0.4 kg VOC/kg ink non diluted.

For new installations, this corresponds to (0.5 kg solid/kg of ink non diluted x 4 kg solvent/kg solid) x (0.05+0.10) = 0.3 kg VOC/kg ink non diluted.

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

Only one average reference installation (RI) was defined with ERA [3]. The representative unit used is the amount of non diluted ink consumed annually (t/year).

Table 3.1.1: Reference installations

Reference Installation Code RIC	Description	Technical characteristics
01	Reference Installation: 1 medium press Non diluted ink consumption: 920 t / y	Solvent input (I*): 1,840 t/y

* As mentioned in the Solvent Management Plan implemented by the SED [2], inputs of organic solvents (I) equal the quantity of organic solvents or their quantity in preparations purchased (I1) + the quantity of organic solvents recovered and reused as solvent input into the process (I2).

3.2 Definition of emission abatement techniques

3.2.1 Primary measures

Only toluene based ink is used [3]. Ink contains 50% toluene when leaving the ink factory. A dilution is made in the printing plant to obtain the proper concentration in toluene: machine ready ink contains up to 80% toluene. This dilution is made with toluene recovered inside the plant.

Table 3.2.1.1: Primary measures

Primary Measure Code PMC	Description
00	Conventional solvent based ink

3.2.2 Secondary measures

All installations in Europe are equipped with an activated carbon adsorber [3]. No progress can be significantly made for reducing stack emissions. The best way to reduce total emissions is consequently to reduce fugitive emissions: this is done by increasing the efficiency of fugitive emission capture and routing them to the abatement device.

Three different secondary measures are defined:

- Measure 00 corresponds to the standard situation: only dryer ventilation air from running presses is sent to the abatement device.
- Measure 01: when the press is idling, the dryer air is also sent to the abatement device; all press room vents are also routed to the adsorber.
- Measure 02: same as 01 + use of new inks evaporating more efficiently in the dryer leading to significant reduction of fugitive emissions. This is not applicable in all cases of existing installations.

Table 3.2.2.1: Secondary measures

Secondary Measure Code SMC	Description
00	Activated carbon adsorption. Fugitive emission: 15% of solvent input
01	Activated carbon adsorption. Fugitive emission: 10% of solvent input
02	Activated carbon adsorption. Fugitive emission: 5% of solvent input

4. Country specific data to be collected

Only one country and sector specific economic parameter is necessary to calculate variable operating costs. It corresponds to the cost of toluene used to dilute the ink. The default cost proposed by EGTEI is presented in table 4.1.

Table 4.1: Toluene cost (net of taxes)

Parameter	Default cost provided by EGTEI [€/kg]	Country and sector specific cost [€/kg]
Toluene	0.5	To be provided by national experts

The best sources of information for the determination of country and sector specific economic parameter are: the national printing association, printing technique expert, solvent producers and it is recommended to national experts to contact them.

Default data are 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 [8].

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

Table 4.2: Unabated emission factor [kg of NMVOC / kg ink non diluted]

Default emission factor	Country specific emission factor
0.3	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 publication gravure: default emission factors (EF) with abatement efficiencies, investments, variable operating costs (OC) and savings as well as unit costs per t NMVOC abated and unit costs per unit of activity.

Higher variable costs are considered when more VOCs are routed to the carbon adsorber to be recycled. Savings are also taken into account as toluene can be reused directly in the process or sold: they are calculated by multiplying the amount of toluene recycled by the toluene cost defined in table 4.1.

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

RIC PMC SMC	NMVOC EF [kg NMVOC / kg ink]	Abatement efficiency [%]	Investment [k€] *	Variable Operating Costs [k€ / year] *	Savings [k€/year]	Unit cost [k€/t NMVOC abated]	Unit cost [k€/t]
01 00 00	0.3	0	0	0	0	-	0
01 00 01	0.2	33	500	100	46	1.08	0.11
01 00 02	0.1	67	500	100	92	0.29	0.06

* No better information was available when the background document was finalised

Investments correspond to the update of the press to route higher toluene amount to the carbon adsorber. The same costs (investments and operating costs) are considered for SMC01 and 02 but this parameter will be updated as new information has been provided by a representative from the industry [4] (meeting between IIASA/Intergraf/CITEPA held in Laxenburg in March 2005). This leads to lower unit costs for SMC02. This will evolve as new data will be introduced.

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).

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

In the previous version of RAINS [5], publication gravure was studied as a separate sector. Control options such as the use of low solvent or water-based inks were studied but these techniques seem to be not technically applicable to this sector so new reduction techniques with corresponding emission factors have been defined by EGTEI.

EGTEI provides now an approach to consider this sector and test the impact of the current legislation as well as the maximum achievable reduction. The approach has been developed in close cooperation with industry.

Data provided by EGTEI (emission factors and costs) were not implemented in the 2004 RAINS version [7] yet. Following a meeting held in Laxenburg in March 2005 with representatives from Intergraf, IIASA and CITEPA, some EGTEI proposals [2] and the new information provided by industry will be introduced in the new RAINS version. The background document and the synopsis sheet will be updated consequently.

Anyway, activity and emission data provided by national experts through ECODAT will still be directly used in RAINS.

7. Perspective for the future

In a near future, the EGTEI background document will be modified to take into account the updated information defined in cooperation with IIASA and the industry representative.

8. Bibliography

[1] 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.
[2] EGTEI background document. hhttp://citepa.org/forums/egtei/publication_gravure_170603.pdf
[3] European rotogravure association: ERA
[4] European Printing Industry Association. https://www.intergraf.org/
[5] 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
[6] http://citepa.org/forums/egtei/thermal_oxidation_costs_170603.pdf
[7] Review of data used in RAINS-VOC model
http://www.iiasa.ac.at/web-apps/tap/RainsWeb/
[8] Rapport d'inventaire national au format UNECE/NFR et NEC
Rapport d'étude du CITEPA - Décembre 2003
[9] Methodology: http://citepa.org/forums/egtei/egtei_index.htm
[10] 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 publication gravure with the help of CITEPA [10].

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

Country and sector specific economic parameter

The toluene cost has been defined based on its exchange price in Rotterdam [3].

Table A.1: French specific cost

Parameter	French specific costs [€/kg]
Toluene (net of taxes)	0.5

Activity level

The trend of publication gravure activities from 2000 to 2020 comes from data provided by the French national expert and reviewed by the printing association.

Table A.2: Activity levels on Reference Installations (t of ink non diluted / year)

RIC	2000	2005	2010	2015	2020
01	14,146	15,672	17,363	19,358	21,584
Total (t)	14,146	15,672	17,363	19,358	21,584

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, secondary measures are already used in all installations. Application rates have been derived from VOC emissions defined in the French inventory for the year 2000. Emissions come directly from industry reports as publication gravure plants are not very numerous in France.

The share of SMC01 is assumed to increase regularly as it is mandatory for new installations.

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 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	85	60	100	50	100	40	100	30	100
01 00 01	15	40	100	50	100	60	100	70	100
01 01 00	0	0	100	0	100	0	100	0	100
Total RIC 01	**100**	**100**	**-**	**100**	**-**	**100**	**-**	**100**	**-**

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	4,032	4,075	4,341	4,646	4,964
Annual total costs	**k€/year**	**k€/year**	**k€/year**	**k€/year**	**k€/year**
CLE scenario	228	674	934	1,249	1,625

Emissions shown in table B.1 for the year 2000 according to the CLE scenario correspond to the ones defined in the French inventory for the year 2000 are 4,100 tonnes of VOC.