SNAP CODE **60201**

SOURCE ACTIVITY TITLE **DEGREASING, DRY CLEANING & ELECTRONICS**
Metal degreasing

NOSE CODE: **107.02.01**

NFR CODE: **3 B**

1 ACTIVITIES INCLUDED

Degreasing is a process for cleaning products from water-insoluble substances as grease, fats, oils, waxes, carbon deposits, fluxes and tars. In most cases the process is applied to metal products, but also plastic, fibreglass, printed circuit boards and other products are treated by the same process. Therefore a wide range of NACE codes is covered. The metal-working industries are the major users of solvent degreasing. Solvent degreasing is also used in industries as printing and production of chemicals, plastics, rubber, textiles, glass, paper, and electric power.

Also repair stations for transportation vehicles use solvent cleaning part of the time.

2 CONTRIBUTION TO TOTAL EMISSIONS.

From the CORINAIR 90 inventory it can be concluded that the contribution of metal degreasing to total non-methane volatile organic compound emissions (including natural sources) for 21 of the 28 CORINAIR countries is about 1.8%.

The OSPARCOM-HELCOM-UNECE emission inventory gives for some specified substances the contributions given in Table 2.1. These substances are:

- tetrachloroethene (PER),
- trichloroethene (TRI),
- 1,1,1-trichloroethane (TCA),
- tetrachloromethane (TCM) and xylenes (XYL).

Table 2.1: Contribution to total emissions of some substances used for metal degreasing (from the OSPARCOM-HELCOM inventory)

Source-activity	SNAP-code	Contribution to total emissions [%]				
		PER	TRI	TCA	TCM	XYL
Metal degreasing	060201	3.3	5.2	1.1	0.1	0.4

In addition, metal degreasing could be a significant source of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), (ETC/AEM-CITEPA-RISOE 1997).

This activity is not believed to be a significant source of $PM_{2.5}$ (as of December 2006).

3 GENERAL

3.1 Description

As a result of the wide range of activities for which metal cleaning is used it is very difficult to get a reliable picture of the penetration of the different techniques. Assuming a stationary situation for practical reasons the nation-wide figures can be derived from sales information. The detailed description is more applicable to situations where the applied technology is known.

Metal degreasing by using organic solvents takes place in either open top or closed tanks. Closed tank apparatus offers better opportunities for recycling of solvents. For some applications water based solvents containing tensides, sodium carbonate and alcohol's can be used. Application of these processes will lead to a great reduction of VOC emissions.

3.2 Definitions

Solvent degreasing	Removing fats, oils, wax or soil from surfaces with solvents as petroleum distillates, chlorinated hydrocarbons, ketones and alcohol's.
Good housekeeping	Use covers, let the fluid drip off, avoid spraying technique, recirculate solvents.
Improved equipment	Improved covers, use higher freeboard, cool freeboard.

3.3 Techniques

The following technologies are described:

3.3.1 Cold cleaners

Cold cleaners are mainly applied in maintenance and manufacturing. They are batch loaded, non-boiling solvent degreasers, providing the simplest method of metal cleaning. A distinction can be made between cleaners for maintenance, using petroleum solvents, and production cleaners using more specialised solvents. Cold cleaner operations include spraying, brushing, flushing, and immersion phases. There is a wide range of designs possible. Emissions occur by waste solvent evaporation, solvent carryout, solvent bath evaporation, spray evaporation and agitation.

3.3.2 Open-top vapour systems

Open-top vapour degreasers are batch loaded degreasers where the cleaning effect is achieved by condensation of hot solvent vapour on colder metal parts. Vapour degreasers only use halogenated hydrocarbons as solvents. Vapour degreasers are usually equipped with a water separator which allows the solvent to flow back into the degreaser. The use of good housekeeping can greatly effect the size of the emissions. Sources of emissions are solvent carry-out, exhaust systems, and waste solvent evaporation.

3.3.3 Conveyorised degreasers

Conveyorised degreasers may operate with either cold or vaporised solvent, but are continuously loaded and are in most cases hooded or enclosed. The large workload capacity, and the fact that they are usually enclosed leads to less solvent emitted per amount product than is the case with other technologies.

3.4 Emissions

The most common organic solvents for vapour cleaning are:

- methylene chloride (MC)
- tetrachloroethylene (PER)
- trichloroethylene (TRI)
- 1,1,1-trichloroethane (TCA)
- xylenes (XYL)
- trichlorotrifluoroethane (CFC-113)

The CFC is displaced by HFC's or PFC's. Further details about the calculation of the emissions can be found in the IPCC Manual (see section 17 References).

For batch cold cleaners the primary solvents used are mineral spirits, Stoddard solvents and alcohol's like propyleneglycol.

3.5 Controls

In general it can be stated that good housekeeping can reduce emissions by about 20% compared to unabated emissions. Using water based technologies wherever possible also reduces the VOC emissions. Regarding the three different types of technologies the following measures can be taken:

Cold cleaners

- Waste solvent loss is the most important emission source. It can be reduced by distillation or incineration of waste solvent. Good housekeeping is for this technology also very important. Bath evaporation can be reduced by using a water layer of 5-10 cm on top of the solvent.

Open-top vapour systems

- Most emissions are due to diffusion and convection for which many abatement measures are available mostly like reducing the opening times, applying carbon adsorption etc.

Conveyorized degreasers

- As these degreasers are usually enclosed no extra primary measures are useful.

4 SIMPLER METHODOLOGY

The simplest way of calculating emissions from degreasing is based on solvent sales statistics, in combination with assumptions about the distribution over the different environmental compartments. This method assumes that a stationary situation is reached where only the solvent losses have to be supplied. Even in situations where it is possible to use the detailed method a comparison with sales to the sector will give a useful check on the information.

5 DETAILED STATE OF THE ART METHODOLOGY

A mass balance over an individual plant taking into account the technologies applied is the best approach for situations where the information about the technology is available.

6 RELEVANT ACTIVITY STATISTICS

Statistics about solvent sales should be used as a basis for the calculations when applying the simple method, and as a check when using the detailed methodology. For applying the detailed methodology an insight in the penetration of the different technologies is necessary. For the cold cleaners who are used in a very wide range of different maintenance- and production processes this will not be feasible in many cases. For the other processes who are more used as a part of a standardised process some information about the production derived from detailed production statistics may be available.

7 POINT SOURCE CRITERIA

Emissions from metal degreasing are either the main source for small activities or a secondary source for big metal producing plants. In both cases the emissions can be regarded as coming from a diffuse source.

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

In Table 8.1 solvent loss emission factors are given for degreasing operations [1]. These factors can be used for the simple sales based approach, and for the type dependant information of the detailed approach. If no information about penetration of techniques or sales is available the inhabitant related factors based on a mean west-European situation can be used.

The information given in these tables may be different when applied to individual situations. To give an example of this aspect some measurements from the Czech Republic are given in Table 8.3.

Table 8.1: Solvent loss emission factors for degreasing operations.
(Emission factor rating: C)

Degreasing technique	Activity	Uncontrolled emission factor [a]
All (simple method) [b]	Solvent used	1000 kg/Mg
Cold cleaner		
Entire unit [c]	Units in operation	0.30 Mg/yr/unit
Waste solvent loss		0.165 Mg/yr/unit
Solvent carry out		0.075 Mg/yr/unit
Bath and spray evaporation		0.06 Mg/yr/unit
Entire unit	Surface area and duty cycle [d]	0.4 kg/hr/m2
Open top vapour		
Entire unit	Units in operation	9.5 Mg/yr/unit
Entire unit	Surface area and duty cycle [e]	0.7 kg/hr/m2
Conveyorized, vapour		
Entire unit	Units in operation	24 Mg/yr/unit
Conveyorized, nonboiling		
Entire unit	Units in operation	47 Mg/yr/unit

(a) 100% nonmethane VOC.
(b) solvent consumption data will provide much more accurate emission estimates than any of the other factors presented.
(c) emissions generally would be higher for manufacturing units and lower for maintenance units.
(d) for trichloroethane degreaser.
(e) for trichloroethane degreaser. Does not include waste solvent losses.

In Table 8.2 inhabitant related emission factors as a first approximation are given for the emissions of non-methane VOC emissions from small cold cleaning degreasing operations. It should be noted that there is significant uncertainty in these emission factors.

Table 8.2: VOC emissions from small cold cleaning degreasing operations
(emission factor rating: C)

Operating period	Per capita emission factor
Annual	1.8 kg [a]
Diurnal	5.8 g [b]

[a] include 25% 1,1,1-trichloroethane, methylene chloride and trichlorotrifluoroethane
[b] assumes a 6 day operating week (313 days/yr)

Table 8.3: Examples of measurements on different apparatus are given. (Bretschneider 1997)

Type of equipment	Open top-vapour	Cold cleaner	Conveyorized vapour	Conveyorized nonboiling	Cold cleaner
Solvent used	TCE	Water and propylene glycol	TRI	TRI	TRI
Abatement	adsorption to activated coal	-	adsorption to activated coal	-	-
VOC kg emission/ Cycle	0.062	0.002	0.40	0.15	5.87
VOC kg emission/hr	0.286	0.005	0.27	0.29	2.71
VOC kg emission/ton product	1.20	0.01	1.68	5.84	392

9 SPECIES PROFILES

Emissions from metal degreasing should be related to the solvent use. A profile of the solvents used which may differ from country to country should be used.
No general applicable profile can be given.

10 CURRENT UNCERTAINTY ESTIMATES

The accuracy of the calculated emissions depends on the accuracy of the statistics used. When the sales based methodology is used the accuracy can be estimated to be about C. The overall accuracy of the detailed method will not be much better, the local accuracy may improve to B. The inhabitant related approach will have an accuracy from D to E, dependant on the comparability of the different countries.

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

The weakest aspect is the lack of sufficiently accurate statistics about solvent use and penetration of techniques.

More details on abatement methods, including efficiencies, should be added.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

Metal degreasing is a process that is used in a great number of small plants. Concentrations of these plants in a certain industrial area may be considered as point sources on a regional level. This may improve the local accuracy.

13 TEMPORAL DISAGGREGATION CRITERIA

Metal degreasing is a process that usually is only used during the daytime.

14 ADDITIONAL COMMENTS

15 SUPPLEMENTARY DOCUMENTS

16 VERIFICATION

Verification of the calculated emissions may be done be measurements at the plant level.

17 REFERENCES

ETC/AEM-CITEPA-RISOE (1997) Selected nomenclature for air pollution for CORINAIR94 inventory (SNAP 94), version 0.3 (Draft).

Holtmann, T. Document on metal degreasing for the UNECE Task Force on VOC abatement (draft version 1997)

PARCOM-ATMOS Emission factors Manual (adapted version 1993)

Bretschneider, B, Personal communications from Czech Hydrometeorological Institute (1997)

SPIN document Ontvetten (in Dutch)(1993)

OECD/IEA Revised IPCC Guidelines for National Greenhouse Gas Inventories 1997. Volume 1 Reference Manual. (Paris 1997)

18 BIBLIOGRAPHY

[1] Air Pollution Engineering Manual
Air and Waste Management Association
Anthony J.Buonicore, Wayne T.Davies
1992
ISBN 0-442-00843-0
Van Nostrand Reinhold
New York

[2] Chlorinated Solvents
Information document
Commission of the European Communities
1992
Conducted by:
BSM Gesellschaft fur Betriebsberatung,Dusseldorf
TAUW Infraconsult B.V.

19 RELEASE VERSION, DATE, AND SOURCEX

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20 POINT OF ENQUIRY

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