National Pollutant Inventory

Emissions Estimation Technique Manual

for

Dry Cleaning

Environment Australia

First Published in March 1999

EMISSIONS ESTIMATION TECHNIQUES
FOR
DRY CLEANING

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DRY CLEANING MANUAL

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1.0 Introduction

The purpose of all Emission Estimation Technique (EET) manuals in this series is to assist Australian manufacturing, industrial, and service facilities to report emissions of listed substances to the National Pollutant Inventory (NPI). This Manual describes the procedures and recommended approaches for estimating emissions from facilities engaged in dry cleaning.

The dry cleaning activities covered by this Manual include commercial and industrial facilities primarily engaged in on-site dry cleaning of clothes, curtains, carpets and rugs, linen, and general manchester.

EET MANUAL :	Dry Cleaning
HANDBOOK :	Laundries & Dry Cleaners
ANZSIC CODE :	9521

This Manual was drafted by the NPI Unit of the Queensland Department of Environment and Heritage on behalf of the Commonwealth Government. It has been developed through a process of national consultation involving State and Territory environmental authorities and key industry stakeholders.

2.0 Process Description

The dry cleaning industry is a service industry for the convenient cleaning of clothes, manchester, leather goods, and other items made of fibres including household furnishings and drapes. Dry cleaners typically use either synthetic halogenated or petroleum distillate organic solvents for cleaning purposes.

Dry cleaners process garments in a way that avoids saturating fabrics with water. Because dry cleaning solvents do not saturate the fibres of the fabric, the swelling and shrinking from water is avoided, allowing nearly all types of fabrics and garments to be dry cleaned. (There is less wrinkling and shrinkage of fabrics because fibres are less distorted than by other cleaning methods.) Dry cleaning processes also enable the use of water to be all but eliminated.

Fabric or garment cleaning consists of three basic functions: cleaning, drying, and finishing. Garments are pre-treated for stains, and then machine cleaned in a solution of solvent and detergents. The solvent is extracted by first draining, and then spinning the clothes. Finally, the garments are dried through a combination of aeration, heat and tumbling before being examined for spots. When satisfied that the garments are clean, they are pressed. This final step of steam pressing has the effect of reducing to a minimum the solvent remaining in a garment at the end of the other processes.

2.1 The Dry Cleaning Solvents

In Australia, the principle solvent used is tetrachloroethylene, or perchloroethylene (Perc) as it is more commonly referred to in the industry. A small amount of petroleum solvent is also used.

Perc does have certain toxic properties and proper procedures must be followed to reduce exposure risks. Users should avoid inhalation of excessive concentrations of Perc vapour, prolonged or repeated contact of the liquid with the skin, swallowing the liquid, and splashing into the eyes. Manufacturers of dry cleaning equipment design their machines with these precautions in mind. When such equipment is operated and maintained in an appropriate manner in facilities that comply with applicable regulations, the risks are minimised. When used, stored or disposed of inappropriately it can be a health and environment risk.

The other solvent used in the dry cleaning industry is white spirit. The use of this solvent is very small compared to that of Perc, and accounts for only 2-3% of national dry cleaning solvent turnover. Perc (as tetrachloroethylene) and the white spirit aromatics (toluene and xylene isomers) are listed on the NPI, and reporting of emissions is required if thresholds are triggered for their annual use.

2.2 The Dry cleaning Machines

One important characteristic of the dry cleaning industry in Australia is that the machinery used is constantly evolving. The vast majority of machines in use are third and fourth generation machines, and some of the newly developed fifth generation machines now being commissioned. First generation machines are no longer in use and only very few second generation machines are still in operation. Many third generation machines are being replaced.

The third generation machines were designed in the late 1970s and early 1980s and are dry-to-dry machines with built-in refrigerated condensers. These are closed loop machines. A closed loop machine does not vent gas to the atmosphere but recycles it continuously throughout the dry cleaning cycle. The only air exchange with the atmosphere occurs during loading and unloading operations.

Fourth generation machines are non-vented, with closed loop processes incorporating additional internal vapour recovery equipment to further reduce emissions. Dry cleaners required reporting to the NPI will need to identify the types of machines in operation at their facility and the volumes of solvents used by each machine type in estimating emissions.

3.0 Emission Sources

Figure 1 shows a schematic for a dry cleaning facility using Perc and illustrates the likely emission points.

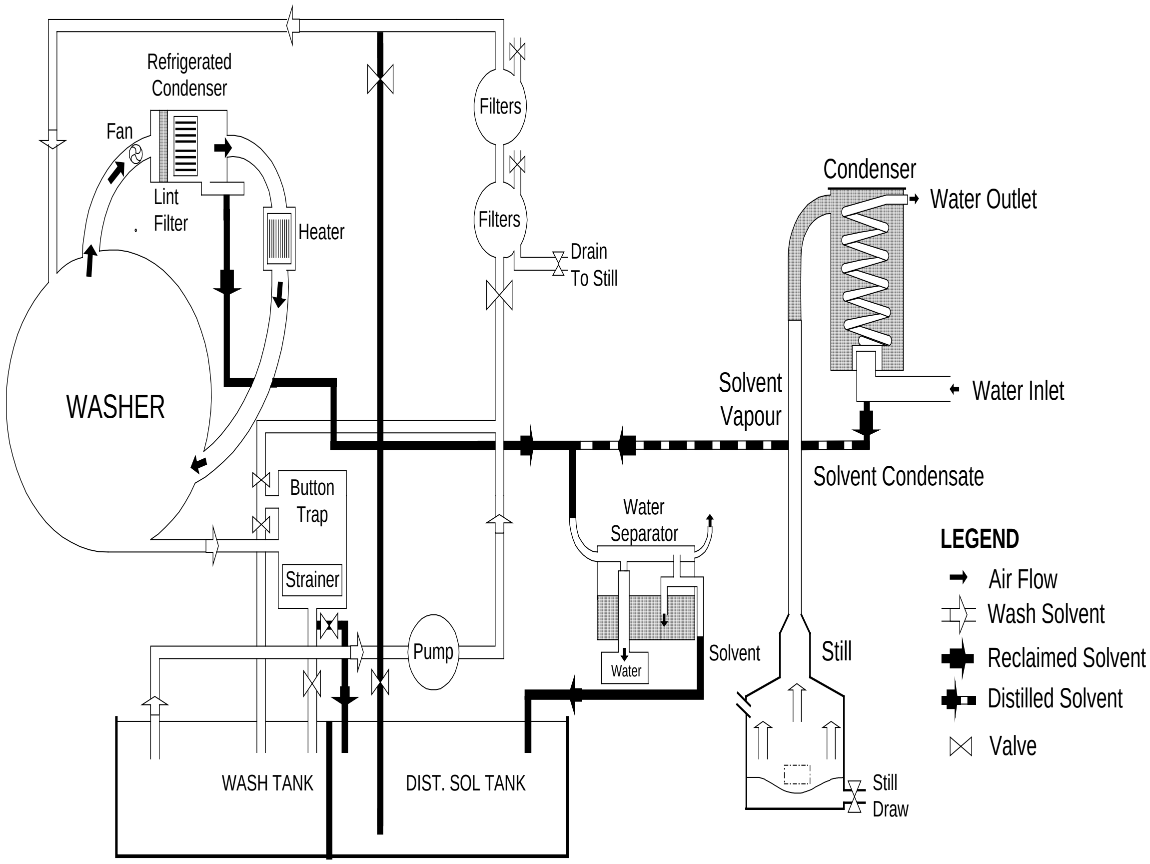

Figure 1. Perchloroethylene Dry Cleaning Facility Flow Diagram

Source: Dry Cleaning Institute of Australia, 1998.

Table 1 summarises to which medium emissions of Perc are likely to occur.

Table 1. Emission Sources from Dry Cleaning Operations

Emission Medium	Emissions
Air	Solvent spills Fugitive leaks from piping Vapour emitted when removing clothes from machines
Water	Water from separator
Solid Waste	Residue from solvent still

Source: Queensland Department of Environment and Heritage, 1998.

3.1 Emissions to Air

The primary dry cleaning emissions of solvents are to air through both fugitive and direct emissions at the end of the cycle when the machine door is opened during loading and unloading operations. Other emissions may occur through poorly fitted or perished gaskets, and seals fitted on filters and other integral parts of the machine that are used to filter and distil the dirty solvent.

The Dry cleaning Industry Code of Practice for the Safe Handling of Perc and the Code of Practice for Plant in the Dry cleaning Industry sets out recommended safe procedures and maintenance programs to manage and eliminate these types of leaks.

3.2 Emissions to Water

Dry cleaning produces a certain amount of wastewater that may contain a very low concentration (0.015 percent) of Perc. The amount of Perc in the wastewater is minimised by using water separators. The amount of wastewater depends on the generation of equipment used. Currently, most machines use two separators, the second of which effectively and efficiently captures most residues. As new technology and new generation machines are introduced, machines will be fitted with a third carbon filter to eliminate any remaining residue.

Wastewater containing Perc is classified as a hazardous waste by most State and Territory environment agencies, and by local water authorities. Melbourne Water, for example, has a ceiling limit of 1 ppm for Perc and prohibits the emission of dry cleaning wastewater to sewer.

This water is transferred to a licensed hazardous waste hauler for handling and treatment, or disposal as hazardous waste. Although emissions of Perc in wastewaters to sewers or hazardous waste contractors do not require reporting to the NPI, these emissions will still require estimation if the dry cleaner is calculating emissions by a mass balance.

3.3 Emissions via Solid Waste

Solid waste can remain even after recycling processes. In most Australian cities, there is an active recycling market for solvent recovered from dry cleaners, and disposal of all waste material and contaminated filters is conducted in accordance with applicable State, Territory, and local health and environmental regulations.

The Dry Cleaning Institute of Australia endorses the removal and disposal of waste by the suppliers of the solvent who are certified in EPA waste programs. Although emissions of Perc off-site via solid wastes do not require reporting, these emissions will require estimation if the dry cleaner is calculating facility emissions using a mass balance.

4.0 Emission Estimation Techniques: Acceptable Reliability and Uncertainty

Although the National Pollutant Inventory does not favour one emission estimation technique over another, the experience of the dry cleaning industry has demonstrated that the mass balance technique is the most appropriate in terms of the accuracy and reliability of the calculation. The technique ultimately chosen by a dry cleaner will depend on available data, and resources, (and the degree of accuracy sought by the facility in undertaking the estimate). Generally, site-specific data is more accurate than industry averaged data such as the emission factors.

This Section describes the techniques available for calculating emissions from dry cleaning facilities, and identifies the different techniques of calculation available for estimating the emissions of different pollutants. These emission estimation techniques are not listed in any particular order and the reader should not infer a preference based on the order in which they are listed.

This Manual seeks to provide the most effective emission estimation techniques for the NPI substances relevant to this industry. However, the absence of an EET for a substance in this handbook does not necessarily imply that an emission should not be reported to the NPI. The obligation to report on all relevant emissions remains if reporting thresholds have been exceeded.

You are able to use emission estimation techniques that are not outlined in this document. You must, however, seek the consent of your relevant environmental authority. For example, if your company has developed site specific emission factors, you may use these if approved by your relevant environmental authority.

You should note that the EETs presented in this manual relate principally to average process emissions. Emissions resulting from non-routine events are rarely discussed in the literature, and there is a general lack of EETs for such events. However, it is important to recognise that emissions resulting from significant operating excursions and/or accidental situations (eg: spills) will also need to be estimated. Emissions to land, air and water from spills must be estimated and added to process emissions when calculating total emissions for reporting purposes. The emission resulting from a spill is the net emission, ie. the quantity of the NPI reportable substance spilled, less the quantity recovered or consumed during clean up operations.

Category 1 and 1a Substances

The reporting criteria for Category 1 and 1a substances, as detailed in Clause 10 of the NPI NEPM, are:

- a Category 1 listed substance is only reportable if 10 tonnes or more of the substance is used per annum;
- the only Category 1a substance is Total Volatile Organic Compounds (VOCs) for which the throughput threshold is 25 tonnes per annum;

- “use” means processed (eg. crude oil throughput, production chemicals, drilling fluids), or coincidental production (eg substances contained in produced formation water, emissions from dehydrator regeneration etc); and

- substances in proprietary mixtures are not reportable unless the substance is specified in a Material Safety Data Sheet or, in the case of any other material, the occupier of the facility could reasonably be expected to know that the substance is contained in the material.

The usage of each of the substances listed as Category 1 and 1a under the NPI must be estimated to determine whether the 10 tonnes (or 25 tonnes for VOCs) reporting threshold is exceeded. If the threshold is exceeded, emissions of these Category 1 and 1a substances must be reported for all operations/processes relating to the facility, even if the actual emissions of the substances are very low or zero.

The total amount of each Category 1 and 1a substance ‘used’ must be calculated in order to determine whether the threshold is exceeded. This involves developing a cumulative total for the use of each NPI substance from various sources

4.1 Process and Pipe Sampling or Direct Measurement

Process and pipe sampling provides a snapshot of emissions during the period of the process or pipe test. Machine process and pipe tests are typically performed during either representative, (ie. normal), or worst case conditions, depending on the requirements of the facility operator, or on the conditions of the State and Territory licensing requirements. For the purposes of the NPI, representative samples should be collected. Sample collection is difficult as machines do not vent to air, pipes have to be modified and valves inserted, then the emission collected and sent to a laboratory for analysis. Because of these difficulties, and because of the many steps in the sampling procedures where errors can occur, this EET is not recommended by industry experts.

4.2 Emission Factors

Emission factors are available for several dry cleaning sources and processes and are based on the results of source tests performed at an individual facility, or at one or more facilities within the industry. An emission factor is the pollutant emission rate relative to the level of source activity. The user should recognise that, in most cases, emission factors adopted for the NPI are averages of available industry-wide data, (usually US or European, and seldom Australian), with varying degrees of reliability. Emission factors are, however, an acceptable technique for estimating emissions from all industry sectors and source categories for the NPI where estimations of emissions are required to quantify medium to long-term emission trends.

Every emission factor has an associated emission factor rating (EFR) code. This rating system is common to EETs for all industries and sectors. They are based on rating systems developed by the United States Environmental Protection Agency (USEPA), and by the European Environment Agency (EEA). Consequently, the ratings may not be directly relevant to Australian industry. Sources for all emission factors cited can be found in the reference section of this document. The emission factor ratings will not form part of the public NPI database.

When using emission factors, you should be aware of the associated EFR code and what that rating implies. An A or B rating indicates a greater degree of certainty than a D or E rating. The less certainty, the more likely that a given emission factor for a specific source or category is not representative of the source type. These ratings notwithstanding, the main criterion affecting the uncertainty of an emission factor remains the degree of similarity between the equipment process selected in applying the factor, and the target equipment process from which the factor was derived.

The EFR system is as follows:

A	-	Excellent
B	-	Above Average
C	-	Average
D	-	Below Average
E	-	Poor
U	-	Unrated

4.3 Fuel Analysis

Fuel analysis data can sometimes be used to predict emissions by applying mass conservation laws. For example, if the concentration of a pollutant or pollutant precursor in a fuel is known, emissions of that pollutant can be calculated by assuming that all of the pollutant is emitted, or by adjusting the calculated emissions using the control efficiency.

The *Combustion in Boilers* Manual details techniques for estimating emissions from a variety of fuels in a range of industrial boilers. The *Fuel and Organic Liquid Storage* Manual outlines techniques for estimating emissions from fuel storage operations. Dry cleaners who also operate commercial laundries or other auxiliary processes may need to obtain these additional Manuals when estimating emissions from boilers and fuel storage activities.

4.4 Mass Balance

A mass balance identifies the quantity of a substance going in and out of an entire dry cleaning facility, process, or piece of equipment (ie. individual dry cleaning machine). Emissions can be calculated as the difference between input and output of each listed substance or compound. Accumulation or depletion of the substance within the equipment should be accounted for in your calculation.

A mass balance is an appropriate and relatively easy technique to use in estimating emissions of Perc or white spirit from a dry cleaning facility: total emissions per year equal the amount of solvent purchased, minus the amounts of solvent collected by a solvent recycler and hazardous waste hauler.

5.0 Emission Estimation

5.1 Using Emission Factors

An emission factor is a tool that is used to estimate emissions to the environment. In this Manual, it relates the quantity of substances emitted from a source to some common activity associated with those emissions. Emission factors are obtained from US, European, and Australian sources and are usually expressed as the weight of a substance emitted multiplied by the unit weight, volume, distance, or duration of the activity emitting the substance, (eg. kilograms of Perc emitted per tonne of clothes dry cleaned).

Emission factors are used to estimate a facility's emissions by the application of Equation (1):

$$E_{kpy,i} = [A * OpHrs] * EF_i * [1 - (CE_i / 100)] \quad (1)$$

where :

$E_{kpy,i}$ = emission rate of pollutant i, kg/yr
A = activity rate, t/hr
OpHrs = operating hours, hr/yr
EF_i = uncontrolled emission factor of pollutant i kg/t
CE_i = overall control efficiency for pollutant i, %

Note: If a controlled emission factor is used from Table 2, then CE_i becomes zero.

Example 1 illustrates the application of Equation (1) using the emission factors provided at Table 2.

Example 1 - Using Emission Factors

Table 2 shows 0.3 kg of Perc are emitted for each tonne of clothes cleaned from the washer/dryer/still/muck cooker from a well-controlled dry cleaning operation. Assume the dry cleaner averages 0.5 tonnes of garments per hour and operates for 1 500 hr/yr.

EF_{PERC} = 0.3 kg/tonne
A = 0.5 tonnes clothes/hr
OpHrs = 1 500 hr/yr
CE_i = 0

$E_{kpy,PERC}$ = A * EF_i * OpHrs * [1 – 0/100]
= 0.5 tonne/hr * 0.3 kg/tonne * 1 500 hr/yr
= 225 kg Perc/yr

At the time of publication of this Manual, accurate information on emissions in Australia is being collected and collated but is not yet available. Australian derived emission factors will be available as soon as practicable. In the interim, queries could be directed to the state branches of the Dry Cleaning Institute of Australia (DIA).

Table 2. Solvent Loss Emission Factors for Dry Cleaners

Solvent Used (Process Used)	Source	Emission Factor [a]	
		Typical System (kg / tonne)	Well-Controlled System (kg / tonne)
Petroleum / White Spirit (transfer process)	Washer / Dryer [b]	180	20 [c]
	Filter Disposal		
	Uncooked (drained)	80	ND
	Centrifuged	ND	5 - 10
	Still Residue Disposal	10	5 - 10
	Miscellaneous [d]	10	10
Perchloroethylene	Washer / Dryer / Still / Muck Cooker	80 [e]	0.3 [c]
	Filter Disposal		
	Uncooked muck	140	ND
	Cooked muck	13	5 - 13
	Cartridge filter	11	5 - 11
	Still Residue Disposal	16	5 - 16
	Miscellaneous [d]	15	10

Source: USEPA *AP-42*, September 1985.

[a] Factor units are in terms of weight of solvent emitted to air per weight of clothes cleaned (capacity x loads). Emissions are to air only.

[b] Different materials in wash retain a different amount of solvent (synthetics, 10kg / 100kg; cotton, 20kg / 100kg; wool 30kg / 100kg; leather, 40kg / 100kg)

[c] Emissions from washer, dryer, still, and muck cooker are passed collectively through a carbon adsorber.

[d] Miscellaneous sources include fugitives from flanges, pumps, pipes, and storage tanks, and fixed losses such as opening and closing dryers, et cetera.

[e] Uncontrolled emissions from washer, dryer, still, and muck cooker average about 8kg / 100kg. About 15 percent of solvent is emitted from the washer, 75 percent from the dryer, and 5 percent each from the still and muck cooker.

ND = no data.

Table 3 provides a percentage breakdown of the media to which emissions occur, again based on US data, while Table 4 provides weight percentages of xylenes and toluene (NPI-listed substances) contained in white spirit.

Emissions may also be estimated by determining the amount of solvent consumed at a facility (see Section 5.4). Assuming that all solvent is eventually evaporated to the atmosphere or lost to wastewater, an emission factor of 1 000kg per tonne of solvent consumed can be applied. This emission amount can then be multiplied by the emission media distribution percentage (from Table 3) to determine total emissions to air and total emissions to water.

Table 3. Weight Percentage Emissions of Perc and White Spirit from Dry Cleaners

Emission Media	Emission Media Distribution (%)
Air	99.985
Wastewater	0.015
Hazardous Waste	ND

Source: Queensland Department of Environment and Heritage, 1998.
ND = no data

5.2 Speciating White Spirit Emissions

Where facilities utilise white spirit as the solvent, the facility operator will need to list and report emissions of the two listed NPI components - toluene and xylenes - separately. Equation (2) illustrates the calculations to be used, and Table 4 provides weight percentages of both toluene and xylenes in dry cleaning white spirit.

$$E_{kpy,i} = \Sigma Q * (Q_i / 100) * 1\,000 \quad (2)$$

where:

$E_{kpy,i}$ = emissions of white spirit component i (xylenes or toluene), kg/yr
ΣQ = total amount of white spirit solvent used, tonne/yr
Q_i = weight percent of component i in white spirit, %
1 000 = conversion factor, kg/tonne

The application of Equation (2) is illustrated by Example 2.

Example 2 - Estimating Emissions from White Spirit

From purchasing and stock records, a dry cleaner calculates white spirit purchases at 18 tonnes during the reporting year. It is assumed that all component solvents evaporate at the same rate. Emissions of toluene and xylenes are calculated using the white spirit VOC speciation profile from Table 4 and Equation (2).

$$E_{kpy,Toluene} = \Sigma Q * (Q_i / 100) * 1\,000$$
$$= 18 * (0.5 / 100) * 1\,000$$
$$= 90 \text{ kg toluene/yr}$$

$$E_{kpy,Xylenes} = \Sigma Q * (Q_i / 100) * 1\,000$$
$$= 18 * (18.3 / 100) * 1\,000$$
$$= 3\,294 \text{ kg xylenes/yr}$$

Table 4. VOC Speciation for White Spirit

Species	Weight Percentage
Toluene	0.5
Xylenes	18.3

Source: Victorian Environmental Protection Authority, 1996.

5.3 Using Sampling Data

For Estimating Emissions to Air

Because vent or other outlet testing is relatively uncommon for Australian dry cleaners, emissions test data for these facilities are generally only available in the form of Perc monitoring results conducted by the industry for compliance with Worksafe Australia Exposure Standards for Atmospheric Contaminants in the Workplace Environment. This data may be used in conjunction with exhaust system flow rates to calculate dry cleaning solvent emissions from a room, floor, or building. Equation (3) is used to calculate these emissions.

$$E_{kpy,i} = (FR * 3\,600 * OpHrs * C_{it} * 0.0858 * M_i) / 1 * 10^6 \qquad (3)$$

where:

- $E_{kpy,i}$ = emissions of VOC or PM_{10} species i, kg/yr
- FR = flow rate through exhaust ventilation system, m^3/sec
- 3 600 = conversion factor, sec/hr
- OpHrs = exhaust system operating hours, hr/yr
- C_{it} = concentration of VOC or PM_{10} species i, ppmv
- 0.0858 = molar volume of gas at 20 °C, mole/m^3
- M_i = molecular weight of VOC or PM_{10} species i, kg/kg-mole
- $1*10^6$ = $1*10^6$ m^3/million m^3
- ppmv = parts per million by volume

Example 3 illustrates the application of Equation (3).

Example 3 - Using Sampling Data

This example shows how Equation (3) is used to calculate fugitive emissions of Perc from a building where dry cleaning activities are being conducted. The following data is given:

- the building exhaust flow rate (FR) is 10.1 m^3/sec
- the exhaust system operates for 7 920 hr/yr, OpHrs
- occupational hygiene data indicates that the concentration of Perc in the building (C_{it}) is 0.1 ppmv
- the molecular weight of Perc (M_i) is 165.83 kg/kg-mole

Perc emissions are then calculated as follows:

$$E_{kpy,PERC} = (FR * 3\,600 * OpHrs * C_{it} * 0.0858 * M_i) / 1 * 10^6$$
$$= (10.1 * 3\,600 * 7\,920 * 0.1 * 0.0858 * 165.83) / 1 * 10^6$$
$$= 410 \text{ kg Perc/yr}$$

For Estimating Emissions to Water

Because of the significant environmental hazards posed by emitting toxic substances to water, most facilities emitting NPI-listed substances to waterways are required by their relevant State or Territory environment agency to closely monitor and measure these emissions. This existing monitoring data can be used to calculate annual emissions by the use of Equation (4).

$$E_{kpy,i} = C_i * V * OpHrs / 1\,000\,000 \qquad (4)$$

where:

$E_{kpy,i}$	=	emissions of pollutant i, kg/yr
C_i	=	concentration of pollutant i in wastewater, mg/L
V	=	hourly volume of wastewater, L/hr
OpHrs	=	operating hours per year for which data apply, hr/yr
1 000 000	=	conversion factor, mg/kg

In applying Equation (4) to water emission calculations, monitoring data should be averaged, and only representative concentrations used in emission calculations. The total emissions of a listed substance should equal the amount used during the year, minus the amount emitted to atmosphere, minus the amounts destroyed in on-site treatment or transferred off-site for disposal by another facility. In estimating emissions of Perc and other dry cleaning solvents to water, it is particularly helpful to first estimate the amount emitted to atmosphere proceeding to individual water emission estimates, as this will provide a useful reference point.

5.4 Using a Mass Balance

The mass balance approach requires the totalling of all Perc and/or white spirit received at the dry cleaning facility, and then subtracting all the known losses or transfers of the materials off-site, such as in hazardous waste materials. The difference is assumed to have been emitted to air and/or water. The quantity received, and the quantity of materials lost or used, should be for the same time period, typically 1 July to 30 June (the NPI reporting year).

Equation (5) can be used for calculating emissions using the mass balance approach.

$$E_{kpy,i,} = Q_r - Q_p - Q_{rec} - Q_w - Q_i \quad (5)$$

where:

$E_{kpy,i,}$ = emissions of Perc or white spirit species i, kg/yr
Q_r = quantity of Perc or white spirit species i that is received as raw material, kg/yr
Q_p = quantity of Perc or white spirit species i that is retained in the cleaned clothes or garments (1%), kg/yr
Q_{rec} = quantity of Perc or white spirit species i that is recovered on-site by all methods (such as solvent recovery), kg/yr
Q_w = quantity of Perc or white spirit species i that is contained in all wastes (such as wastewater, sludge, drum residue) generated during the NPI reporting year, kg/yr
Q_i = quantity of Perc or white spirit species i that remains on-site in the raw material inventory or stock list, kg/yr

Example 4 illustrates the application of Equation (5).

Example 4 - Using a Mass Balance

This example shows how total Perc emissions for a dry cleaner can be calculated using Equation (5). Data given is as follows:

- During the reporting year, a dry cleaner purchases 10 000 kg of Perc (Q_f).
- The amount of Perc contained in the facility's stock inventory at the end of the reporting year (Q_i) is 1 500kg.
- The amount of Perc retained in cleaned garments (Q_p) is 1% of the total volume consumed. Q_p = 1 / 100 * (Q_r-Q_i)
  = 1 / 100 * (8500)
  = 85 kg
- The amount of Perc that was recovered by the facility's distillation system (Q_{rec}) is 1 000kg.
- Based on waste composition analyses, the amount of Perc in waste transferred off-site, and wastewater discharge rates, the facility estimates that the amount of Perc found in all wastes generated during the year (Q_w) is 500kg.

Emissions of Perc are calculated as follows:

$$E_{kpy,PERC} = Q_r - Q_p - Q_{rec} - Q_w - Q_i$$
$$= 10\,000 - 85 - 1\,000 - 500 - 1\,500$$
$$= 6\,915 \text{ kg Perc per year to atmosphere}$$

6.0 Control Technologies

Control technologies for dry cleaners include the use of add-on controls, such as refrigerated condensers and carbon absorbers, to capture and reduce emissions from dry cleaning machines. Emission control is also achieved through changes in operational practices to reduce fugitive emissions and worker exposure. The Dry Cleaning Institute of Australia's Code of Practice and associated training program set out recommended practices for the safe handling of Perc for use by the industry.

6.1 Perchloroethylene Facilities

Industrial dry cleaners usually have efficient recycling and recapture systems. Solvent recovery is particularly necessary in Perc plants due to the high cost of perchloroethylene. As shown in Figure 1, recovery is effected on the washer, dryer, still, and through the use of condensers, water/solvent separators, and carbon adsorption units. Typically, solvent in the carbon adsorption unit is desorbed with steam, then condensed, separated from the water, and returned to the pure solvent storage tank on a daily basis. Residual solvent emitted from treated distillation bottoms and muck is not recovered.

Currently in Australia, there are Perc exposure limits that govern the level of exposure of employees to the solvent, and these limits are shown in Table 5. These OH&S regulations indirectly affect the emissions of Perc by ensuring that dry cleaners consider the recommended work practices contained in the industry's code of practice. In the absence of workplace sampling data, these concentration values can be used to estimate emissions of Perc to atmosphere through the application of Equation (3) (see Section 5.3).

Table 5. Exposure Limits for Perchloroethylene

Type of Limit	Vapour Concentration (ppm)	Notes
NOHSC[a] Exposure Standard		
8-hour TWA	50	8 hours per day (40 hours per week)
15-minute STEL	150	Should not be exceeded in any 15 minute period - the 8-hour TWA must still be met

Source: Dry Cleaning Institute of Australia, 1998.

[a] National Occupational Health and Safety Commission (Commonwealth).

6.2 White Spirit (Petroleum) Facilities

There are only very few petroleum facilities in operation, and they represent only a very small percentage of industry turnover. Generally, these operations have not employed major solvent recovery programs because of the low cost of petroleum solvents and the fire hazards associated with collecting vapours. Some emission control, however, can be obtained by maintaining all equipment (eg. preventing lint accumulation or solvent leakage), and by using good operating practices (eg. not overloading machinery). Both carbon adsorption and incineration appear to be technically feasible controls for petroleum facilities, but costs are high and the size of the average facility makes these techniques prohibitive.

7.0 References

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