VENT SAMPLING REPORT
EMERSON POWER TRANSMISSION
ITHACA, NEW YORK
SITE NO. 755010
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REVISED

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Contents

1 Introduction

WSP Environment & Energy, on behalf of Emerson and its subsidiary, Emerson Power Transmission (EPT), prepared this report describing the procedures and results of the sampling conducted of selected exhaust vents of sub-slab depressurization systems (mitigation systems) installed in structures in the South Hill neighborhood to the north of the EPT facility in Ithaca, New York. The sampling was conducted to evaluate emission concentrations and mass emission rates of chlorinated volatile organic compounds (VOCs) that may be present in the exhaust gas stream. The scope of the sampling was consistent with the Vent Sampling and Analysis Work Plan (April 7, 2008) which was approved by New York State Department of Environmental Conservation (NYSDEC) and York State Department of Health (NYSDOH) on April 29, 2008. The work plan was prepared and executed in accordance with requirements outlined in the July 13, 1987, Consent Order (Index # A7-0125-87-09) entered into by NYSDEC and EPT. The results of this sampling were used to assess the potential for ambient air impacts associated with operation of vapor mitigation systems installed in structures in the South Hill neighborhood.

Section 2 of the report presents background information including a description of the EPT site, an overview of the indoor air sampling sub-slab mitigation program, and a summary of the objectives of the vent sampling. This is followed by a description of the vent sampling program and procedures in Section 3. Results of the sampling are presented in Section 4 followed by conclusions in Section 5.

This report corrects the emission calculations for volatile organic compounds (VOCs) presented in the initial report dated September 23, 2008, which were based on incorrect conversion factors. Specifically, the values reported for stack emission concentrations (microgram per cubic meter [µg/m^3]) should have been divided by a factor of 1,000,000 rather than 1,000. In addition, the metric conversion factor for converting the measured stack flow rates from cubic feet per minute (ft^3/min) to meters cubed per second (m^3/s) should have been 0.0004719 versus the 0.004719 that was utilized. In total, the reported emission rates were thus overestimated by a factor of 10,000. Table 3 has been revised to reflect the correct emission rates.

2 Background

2.1 SITE LOCATION

The EPT facility is located at 620 South Aurora Street in Ithaca, New York. The facility comprises approximately 110 acres within the City of Ithaca and the Town of Ithaca in Tompkins County. There are over 30 buildings and structures on the site that encompass approximately 800,000 square feet. The area surrounding the facility is mostly residential. The South Hill community is to the north-northwest of the EPT site and is bordered on the north and west by Six Mile Creek, to the south by the EPT facility, and to the east by South Aurora Street.

2.2 OVERVIEW OF INDOOR AIR SAMPLING AND SUB-SLAB MITIGATION

Since 2004, Emerson and EPT have conducted an extensive sampling program to evaluate and address the potential for intrusion of VOC vapors to indoor air in the South Hill community. To date, sampling has been conducted in 104 structures and has involved concurrent sampling of indoor air on the first floor and basement level and collecting a soil gas sample below the basement slab of structures. In addition, outdoor (ambient) air samples were collected in the vicinity of homes being sampled on a particular day to establish ambient conditions. All sampling activities have been conducted in accordance with the approved work plan for Phase V Indoor Air Sampling, dated October 26, 2006, the approved general work plan for indoor air sampling, dated September 23, 2005, and the NYSDOH's Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006. In accordance with NYSDOH guidance, two rounds of sampling have been completed in the majority of the 104 structures within the study area. All sampling results have been evaluated based on the NYSDOH Soil Vapor/Indoor Air Matrix.

In March 2006, EPT and Emerson informed residents of the South Hill community of its voluntary offer to mitigate homes in which trichloroethylene (TCE) was detected in the basement or first floor indoor air samples at or above a concentration of 0.8 µg/m^3 in at least one sampling event. This threshold is substantially below the state guidance level of 5.0 µg/m^3 for TCE. Mitigation involves installing one or more extraction points beneath a structure from which soil vapor is withdrawn and released to the atmosphere through a vent stack. Each mitigation system is engineered specific to a structure so that a negative pressure is developed below the slab relative to the interior of the structure. Following installation, testing is performed to verify that the mitigation system is operating as designed. As of the end of 2007, mitigation systems have been installed in over 30 structures in the South Hill community.

2.3 VENT SAMPLING OBJECTIVES

Vent sampling was conducted to assess the actual mass emission rates of potentially site-related VOCs (1,1,1-trichloroethane, 1,2-dichloroethane, cis-1,2-dichloroethene [DCE], methylene chloride, tetrachloroethylene, trans-1,2-DCE, TCE, and vinyl chloride). The objectives of the sampling were to quantify actual emission rates of these VOCs and evaluate the potential for ambient air impacts associated with operation of vapor mitigation systems installed in the South Hill community. The mass emission rates were then compared to the 1.0 pound per hour (lb/hr) control requirements stated in 6NYCRR Part 212.

3 Sampling Program

3.1 SAMPLE LOCATIONS

Samples were collected at three properties designated by NYSDEC: properties 61, 87, and 97B. These properties were selected to provide a representative range of potential emission rates from the mitigation systems. Initially, property 78 was selected for sampling. However, based on the fact that the vent stack for the mitigation system could not be safely accessed by a ladder or scaffolding WSP requested an alternative property (61) for vent sampling. NYSDEC reviewed the access issue and agreed to the request.

3.2 SAMPLE METHODOLOGY

For the three properties tested, each vent was sampled in triplicate (three samples per vent). Each sample was collected sequentially over a 60-minute period. For purposes of quality control, a duplicate sample was collected in conjunction with one of the three triplicate samples collected from two of the vents (i.e., a total of two duplicate samples) at properties 61 and 97B. All three properties were sampled on July 8, 2008. A copy of the field notes recorded during the sampling event is included in Appendix A.

As part of the sampling, air flow characteristics (velocity, dry bulb temperature, wet bulb temperature) were measured to allow for mass emission rates to be calculated for each vent. Each vent stack has a 4-inch inside diameter.

One test port was installed (drilled) into each stack at least 32 inches (8 diameters) downstream of the fan. The downstream distance from the test port to the nearest flow disturbance was greater than two diameters in all cases. Flow rate measurements and sample collection were performed at each test port. Velocity measurements were recorded as 90 percent of the centroid value, with each sample collected at one point near the centroid of the stack.

The flow rate of exhaust gas through the vents was measured with a TSI VelociCalc hot wire anemometer. The anemometer was calibrated by the manufacturer within 12 months prior to the sampling. Dry bulb and wet bulb temperatures were measured using the thermocouple function of the TSI VelociCalc. No water condensation was observed during sample collection.

The gas samples were collected from the vent stacks in certified 6-liter SUMMA® canisters using certified sample trains. Sample gas was extracted through a short segment of new Teflon tubing connected to a dedicated single use certified flow regulator, which regulated the sampling flow rate so that each sample could be collected over a 60-minute period. The tubing and regulator were purged with sample gas before the sample collection was initiated.

Prior to sample collection, all sampling lines (tubing) were evacuated. To ensure no leaks are present during sampling, each connection was leak checked in the field using visual techniques. The sampling flow rate was calibrated to achieve a slight vacuum in the canister at the end of the sampling period. The initial and final vacuums were greater than 25 inches of mercury (in. Hg) and 1 in. Hg, respectively, and were recorded for each sample.

The canisters were delivered to Columbia Analytical Services in Simi Valley, California, for analysis via EPA Method TO-15 using selective ion monitoring mode (SIM) for the eight target compounds. The SIM mode was selected over the SCAN mode because it provides better resolution and sensitivity. The detection limits for these compounds were approximately 0.15 µg/m^3. The sample hold time for Method TO-15 is 30 days and the samples for the vent study were analyzed well within this time frame.

3.3 MITIGATION SYSTEM OPERATION

During the sampling event, the mitigation systems were operated in accordance with the engineering protocols established in the draft Operation, Maintenance, and Monitoring Plan (May 2007). Prior to the proposed vent sampling, the mitigation system was inspected. The vacuum at each sub-slab and sub-membrane suction point was checked and recorded. Each of the properties sampled had systems operating with a vacuum reading within ± 0.25" H_2O of their respective commissioned values (defined as the standard operating parameters, such as vacuum and pressure, that are established when the mitigation system is initially installed). Consequently, no adjustments were necessary for the ventilation systems that were sampled.

4 Results

This section provides the results of the sampling as well as the calculated emission concentrations and mass emission rates of the target compounds identified in Section 2.3.

4.1 ANALYTICAL RESULTS

The gas samples collected during this project were analyzed for the site-specific target compounds (Table 1; Appendix B). In general, the majority of samples had constituent concentrations below the laboratory's method detection limit. For TCE the detected concentrations ranged from 4.5 to 10.0 µg/m^3 and for tetrachloroethylene detected levels ranged from 0.51 to 7.8 µg/m^3.

4.2 SAMPLING EVENT CONDITIONS

The work plan detailed the operating parameters that were to be maintained during the course of the sampling event. For each mitigation system, the appropriate operating pressure was attained throughout the sampling. The vent stack operating parameters measured during the sampling are provided in Table 2. For flow measurements, the values provided in Table 2 are 90 percent of the monitored centroid value, as prescribed in the work plan. No deviations were encountered during the sampling event.

4.3 MASS EMISSION RATES

Utilizing the gas analytical results for each property (Table 1) and vent operating parameters (Table 2), mass emission rates were calculated for each vent stack. WSP incorporated the methodology provided in the vent stack sampling work plan (Appendix C). The average TCE emission rates ranged from 1.23 x 10^{-6} to 3.31 x 10^{-6} lb/hr with a maximum value of 3.49 x 10^{-6} lb/hr. The highest individual compound measured was tetrachloroethylene, which had average emission rates of 1.85 x 10^{-7} to 3.60 x 10^{-6} lb/hr throughout the sampling with a maximum emission rate of 3.84 x 10^{-6} lb/hr.

The total emission rate of all VOCs sampled was also calculated. The average total emission rates ranged from 1.88 x 10^{-6} to 7.99 x 10^{-6} lb/hr with total maximum values ranging from 2.23 x 10^{-6} to 1.10 x 10^{-5} lb/hr. A summary of mass emission rates is provided in Table 3.

5 Conclusions

5.1 VENT STACK SAMPLING

The sampling of vent stacks at properties 61, 87, and 97B was performed under conditions consistent and in compliance with the work plan as no operational deviations were experienced during the sampling event. All sample canisters were operated, handled, and stored in accordance with the quality assurance/quality control provisions of the work plan.

5.2 MASS EMISSION RATES

Utilizing the operating parameters obtained at each property and the analytical results of each sample collected, average and maximum mass emission rates were calculated for the target compounds identified in the work plan, as well as total VOCs. The resulting calculations demonstrate that none of the vent stacks exhibit mass emission rates at or near the 1.0 lb/hr mass emission rate whereby NYSDEC would require controls. Individual and total mass emission rates for the site-related VOCs where one-tenth or less than the NYSDEC control emission rate. The results of the vent stack sampling in combination with the results of the focused ambient air sampling work conducted in July 2008 indicate that the emissions from mitigation systems are not a source of concern for TCE and PCE in the ambient air in the South Hill community

Tables

Table 1

Vent Stack Sample Data (a)
Emerson Power Transmission
Ithaca, New York

	Property 61				Property 87			Property 97B			
Sample ID:	**61VS-1**	**61VS-2**	**61VS-2** (b)	**61VS-3**	**87VS-1**	**87VS-2**	**87VS-3**	**97BVS-1**	**97BVS-2**	**97BVS-2**	**97BVS-3**
Sample Type:			**DUP**							**DUP**	
Sampling Date:	**07/08/08**	**07/08/08**	**07/08/08**	**07/08/08**	**07/08/08**	**07/08/08**	**07/08/08**	**07/08/08**	**07/08/08**	**07/08/08**	**07/08/08**
VOCs (µg/m3)											
1,1,1-Trichloroethane	0.42	0.33	0.3	0.33	1.6 U	1.9 U	3.1 U	0.18	0.18	0.56	0.17
1,2-Dichloroethane	0.16 U	0.13 U	0.15 U	0.15 U	1.6 U	1.9 U	3.1 U	0.3	0.37	0.58	0.24
cis-1,2-Dichloroethylene	0.16 U	0.13 U	0.15 U	0.15 U	1.6 U	1.9 U	3.1 U	0.14 U	0.44	0.14 U	0.16 U
Methylene chloride	0.78 U	0.64 U	0.74 U	0.73 U	10	9.4 U	16 U	0.72 U	0.78 U	0.72 U	0.81 U
Tetrachloroethene	7.1	7.7	6.7	7.8	2.9	1.9 U	3.1 U	0.51	0.8	1.2	0.53
trans-1,2-Dichloroethene	0.16 U	0.13 U	0.15 U	0.15 U	1.6 U	1.9 U	3.1 U	0.14 U	0.16 U	0.18	0.16 U
Trichloroethene	6.7	7.1	6.1	7	6.3	4.5	10	5.1	5	4.8	5.2
Vinyl Chloride	0.16 U	0.13 U	0.15 U	0.15 U	1.6 U	1.9 U	3.1 U	0.14 U	0.16 U	0.14 U	0.16 U
Other VOCs (µg/m3)											
Acetone	NA	NA	15	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone	NA	NA	1.9	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	NA	NA	0.36	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	NA	1.6	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	NA	NA	1.9	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl acetate	NA	NA	1.3	NA	NA	NA	NA	NA	NA	NA	NA
2-Propanol (Isopropyl Alcohol)	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	NA	NA	9.9	NA	NA	NA	NA	NA	NA	NA	NA
Trichlorofluoromethane	NA	NA	1	NA	NA	NA	NA	NA	NA	NA	NA
m&p Xylenes	NA	NA	1.4	NA	NA	NA	NA	NA	NA	NA	NA

a/ DUP - duplicate sample NA - not analyzed
VOCs - volatile organic compounds
b/ This sample was analyzed for the entire list of VOCs

Table 2

Vent Stack Operating Parameters
Emerson Power Transmission
Ithaca, New York

Property	Stack Velocity (fpm)[a]	Volumetric Flow (cfm)[a]	Dry Bulb Temperature (^oF)	Wet Bulb Temperature (^oF)
61	1629	131	81.2	72.1
87	756	66	88.0	71.9
97B	747	65	82.7	71.2

a/ Represents 90 percent of centerline measurement;
fpm = feet per minute; cfm = cubic feet per minute.

Table 3

Mass Emission Rates
Emerson Power Transmission
Ithaca, New York

	Property 61				Property 87				Property 97B			
	Stack Concentration				Stack Concentration				Stack Concentration			
Compound	Avg. (ug/m^3)	Max. (ug/m^3)	Avg. (lb/hr)	Max. (lb/hr)	Avg. (ug/m^3)	Max. (ug/m^3)	Avg. (lb/hr)	Max. (lb/hr)	Avg. (ug/m^3)	Max. (ug/m^3)	Avg. (lb/hr)	Max. (lb/hr)
1,1,1-Trichloroethane	0.35	0.42	1.70E-07	2.07E-07	2.20	3.10	5.43E-07	7.65E-07	0.27	0.56	6.64E-08	1.37E-07
1,2-Dichloroethane	0.15	0.16	7.25E-08	7.87E-08	2.20	3.10	5.43E-07	7.65E-07	0.37	0.58	9.08E-08	1.41E-07
cis-1,2-Dichloroethylene	0.15	0.16	7.25E-08	7.87E-08	2.20	3.10	5.43E-07	7.65E-07	0.22	0.44	5.36E-08	1.07E-07
Methylene chloride	0.72	0.78	3.55E-07	3.84E-07	11.8	16.0	2.91E-06	3.95E-06	0.76	0.81	1.85E-07	1.97E-07
Tetrachloroethene	7.33	7.80	3.60E-06	3.84E-06	2.63	3.10	6.50E-07	7.65E-07	0.76	1.20	1.85E-07	2.93E-07
trans-1,2-Dichloroethene	0.15	0.16	7.25E-08	7.87E-08	2.20	3.10	5.43E-07	7.65E-07	0.16	0.18	3.90E-08	4.39E-08
Trichloroethene	6.73	7.10	3.31E-06	3.49E-06	6.93	10.0	1.71E-06	2.47E-06	5.03	5.20	1.23E-06	1.27E-06
Vinyl Chloride	0.15	0.16	7.25E-08	7.87E-08	2.20	3.10	5.43E-07	7.65E-07	0.15	0.16	3.66E-08	3.90E-08
Total Volatile Organics			7.72E-06	8.23E-06			7.99E-06	1.10E-05			1.88E-06	2.23E-06

a/ Represents 90 percent of centerline measurement;
fpm = feet per minute; cfm = cubic feet per minute.

Appendix A – Field Data Sheets

7/8/08

1250 Supply Runs

1450 Collect Flow Rate and Temperature Readings

ID 97B

Velo 830 Ft/min
Flow 0.3 ft³/min
DB 82.7 °F
WB 71.2

7/8/08

1455 Collect flowrate & temp.

ID: 87

Velocity: 840 (ft/min)
flowrate: 0.268 (ft³/min)
DB: 88.0 (°F)
WB: 71.9 (°F)

1507 Collect flowrate + temp.

ID: 61

Velocity: 1810 ft/min
flowrate: 146 ft³/min
DB: 81.2°F
WB: 72.1°F

1516 Install probe at ID: 61
No leaks present at junction btwn probe and stack! YAY!
No leaks present at tubing to probe interface.
No leaks present at tubing to can interface.

7/8/08

1524 61 VS070808-1 setup

1530 Mob to setup at ID: 97B

1537 Install probe at 97B.
No leaks at any of the 3 junctions.

1538 Mob to setup probe at ID: 87
No leaks at any of the 3 locations/junctions

1549 ~~Collect~~/Initiate sample
ID: 87VS070808-1
Can#: 02128
regulator: OA00415
Starting vacuum: 730 in Hg.

1550 Initiate sample
ID: 97BVS070808-1
Can: 02276
Reg: OA00655
starting vacuum: 30 in Hg

7/8/08

1600 Initiate sample: 0600
ID: 61VS070808-1
Can: 01204
Reg: OA00653
starting vacuum: 730 "Hg
Initiate

1604 ~~Set~~ ~~Setup~~ DW-1-PM on Columbia
Can: 02501
Reg: OA01029
Starting vac: 29.5 in Hg
Initiate

1602 ~~Setup~~: DW-2-PM1 on Hillview
Can: 00282
Reg: OA1010
Starting vac: 28 in Hg

~~Collect sample~~ rp
~~MH-9~~ rp
~~F~~ rp

1617 Collect sample DW-2-PM
Final Vac: 18 in Hg

1619 Collect sample DW-1-PM
Final vac: 5.5 in Hg

7/8/08

1420 Mob to police station.

1649 Collect sample
ID: 87VSO70808-1
Final vacuum: 7.5 in Hg
Photo: ✓

1703 Setup sample/initiate
ID: 87VSO70808-2
Can # 01482
Reg # OA00656
Starting vacuum: @ 7 30 in Hg

1703 Initiate 2nd sample at 87.
ID: 87VSO70808-2-MSD
Can: 01882
Reg: OA00674
Starting vacuum: >30 in Hg

1654 Collect sample
ID: 97BVSO70808-1
Final vacuum: 4 in Hg
Photo: ✓

7/8/08

1712 Initiate sample
ID: 91BVSO70808-2
Can: 002523
Reg: OA00102

1712 Starting vacuum: 28.5 in Hg
Initiate 2nd sample at 97B.
ID: 97BVSRO70808-2
Can: 00387
Reg: OA00671
Starting vac: 28 in Hg

-LATE-

1700 Collect sample
ID: 61VSO70808-1
Final vacuum: 7 in Hg
Photo: ✓

1727 Initiate sample
ID: 61VSO70808-2
Can: 00524
Reg: OA00661
Starting vacuum: >30 in Hg

1727 Initiate 2nd sample
ID: 61VSRO70808-2
Can: 01742
Reg: OA00665
Starting vac: 26 in Hg

7/8/08

1803 Collect sample 8TVS070808-2
Final vac: ~~20~~ np 6 in Hg
Photo: ~~no~~ yes

1803 Collect sample 8TVS070808-2 USD
Final vac: ~~24~~ np 7 in Hg
Photo: ~~no~~ yes

1805 ~~Col~~ Initiate sample
ID: 8TVS070808-3
Can # 00354
Reg# 0A00091
Starting vacuum: 27.5 in Hg

1812 Collect sample
ID: 97BVS070808-2
Final vac: 7 in Hg
Pic: yes

1812 Collect sample
ID: 97BVSR070808-2
Final vac: 4 in Hg
Pic: yes

7/8/08

1813 Initiate sample
ID: 97BVS070808-3
can: 02329
Reg: 0A00098
Starting vac: 730 in Hg

1823 Collect sample 6VS070808-2
Final vac: 0 in Hg
Photo: yes

1824 Collect sample ID: 6VSR070808-2
Final vac: 6 in Hg
Photo: yes
Turned off early b/c dup went to 0-

1826 Initiate sample
ID: 6VS070808-3
Can: 02670
Reg: 0A00756
Starting vacuum: 29 in Hg

1905 Collect sample
ID: 8TVS070808-3
~~Can~~ np Final vac: 7 in Hg
Photo: yes

7/8/08

1913 Collect sample [97BVS070808-3]
Final vac: 7 in Hg
Photo: yes

1926 Collect sample [61VS070808-3]
Final vacuum: 5 in Hg
Photo: yes

1927 Remove all probes. Mob to facility to drop off cans + supplies.

1955 WSL OFF SITE

7/9/08

Appendix B – Laboratory Data Package and QA/QC Review

Data Usability Summary Report
for Vent Stack Samples Collected near the EPT Site
Ithaca, New York
July 8, 2008

Introduction

This Data Usability Summary Report (DUSR) includes 11 air samples were collected on July 8, 2008, from three discrete vents attached to vapor mitigation systems installed in homes in the vicinity of the Emerson Power Transmission (EPT) site. The samples were analyzed by Columbia Analytical Services, Inc. of Simi Valley, California, for volatile organic compounds (VOCs), by U.S. Environmental Protection Agency (EPA) Method TO-15. The data were reviewed in accordance with the method and chain-of-custody criteria outlined in the National Functional Guidelines of Organic (October 1999) Data Review.

All holding times were met.

Volatile Organic Compounds

Eleven vapor samples were analyzed for VOCs by EPA Method TO-15. The data were reviewed for surrogate recovery, matrix spike/matrix spike duplicate (MS/MSD) recovery, blank contamination, instrument performance, calibration, and calculation criteria.

The reporting limits for sample 87VS070808-1 were elevated because the sample had to be diluted in order to get the analytes into the calibration range. The sample contained a relatively high concentration of propylene glycol. The WSP sampling team had used propylene glycol as a leak detector.

It was not necessary to qualify any of the VOC results.

Overall Assessment of the Data

The data presented are acceptable.

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Appendix C – Example Calculation for Emission Rate

Sample Calculations for Emission Rate

Following analysis by EPA Method 18, the analytical laboratory will provide a corrected organic concentration on a dry basis. This concentration must be applied to sampling event conditions to calculate a stack emission rate.

The concentration, provided in parts per million (ppm) or parts per billion (ppb), must then be converted to mass per volume using the following equation:

$$C_{c\ (g/m3)} = \frac{C_{c\ (ppm)}\, MW\ P_i}{R\ T_i\ (10^6)} \quad ; \text{where}$$

$C_{c\ (ppm)}$= Corrected organic concentration, dry basis (ppm);
$C_{c\ (g/m3)}$ = Corrected organic concentration, dry basis (g/m^3);
MW = Molecular weight of compound;
P_i = Pressure at time of sample collection, mm Hg;
R = Universal gas constant (0.0624 mm Hg-$m^3/{}^oK$-g mol);
T_i = Temperature at time of sample collection, ^oK

Using the mass per volume concentration in conjunction with the gas stack volumetric flow rate, the pollutant mass flow rate can be calculated as follows:

$$M_p = Q_s\ CF\ C_{c\ (g/m3)} \quad ; \text{where}$$

M_p = Pollutant mass flow rate (g/s);
Q_s = Stack gas flow rate (cfm);
CF = Conversion factor (cfm to m^3/s);
$C_{c\ (g/m3)}$ = Corrected organic concentration, dry basis (g/m^3)

Example: Calculate the equivalent emission rate for a stack under the following conditions:

$C_{c\ (ppm)}$= Trichloroethylene, 0.025 ppm;
MW = 131.4;
P_i = 761.84 mm Hg
R = 0.0624 mm Hg-$m^3/{}^oK$-g mol
T_i = 298 ^oK

1) Using the equation above, the measured concentration in units of mass per volume is:

$$C_{c\ (g/m3)} = \frac{(0.025\ ppm)(131.4)(761.84\ mm\ Hg)}{(0.0624\ mm\ Hg\text{-}m^3/{}^oK\text{-}g\ mol)(298\ {}^oK)(10^6)}$$

$$C_{c\ (g/m3)} = 1.346 \times 10^{-5}\ g/m^3$$

2) Incorporating the conversion equation (above), the pollutant mass flow rate can be calculated as follows:

Q_s = 60 cfm;
CF = 4.719 x 10-4 m^3/s/cfm;
$C_{c\ (g/m3)}$ = 1.346 x 10^{-6} g/m^3

M_p = (60 cfm)(4.719 x 10-4 m^3/s/cfm)(1.346 x 10^{-5} g/m^3)

M_p = 3.811 x 10^{-7} g/s