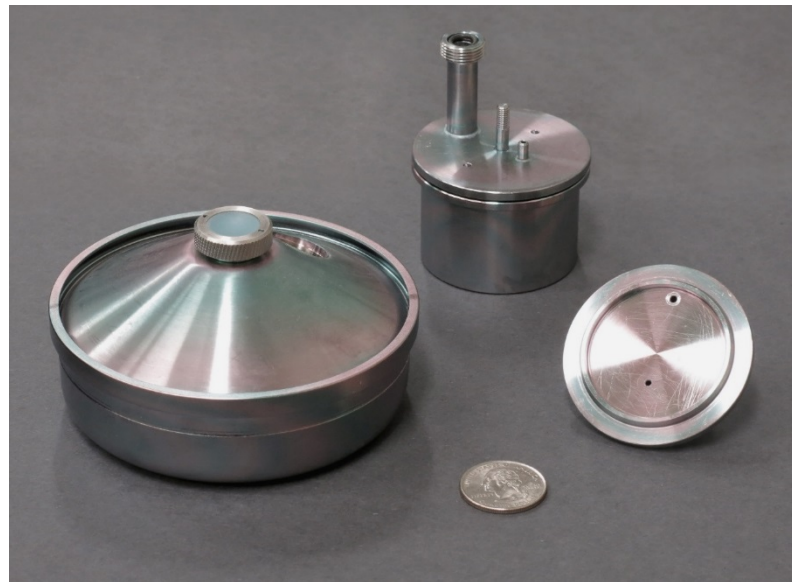


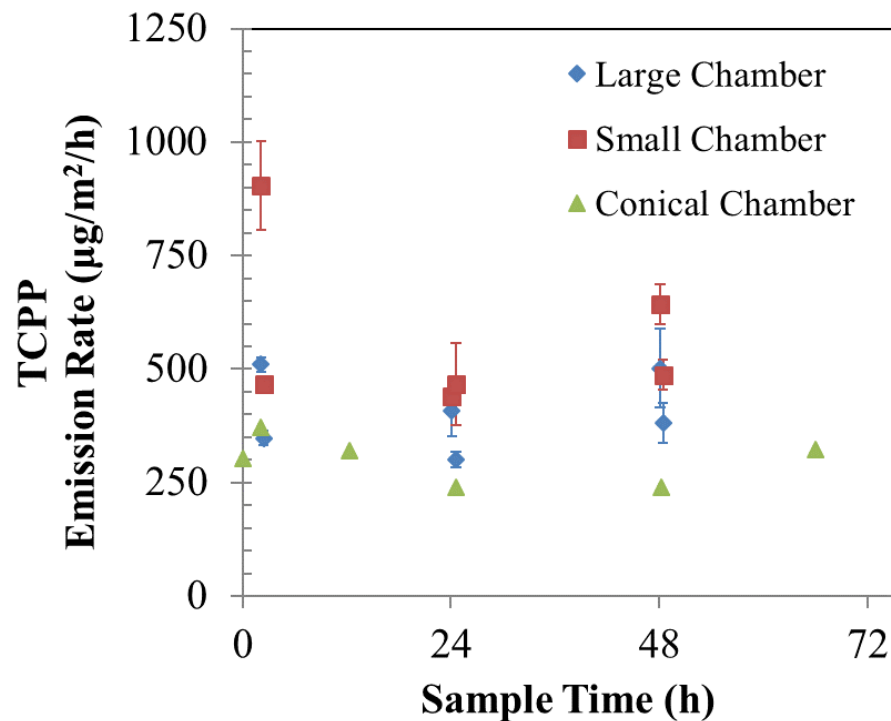
Comparison of Emissions from Spray Polyurethane Foam using Different Micro-Chamber Systems



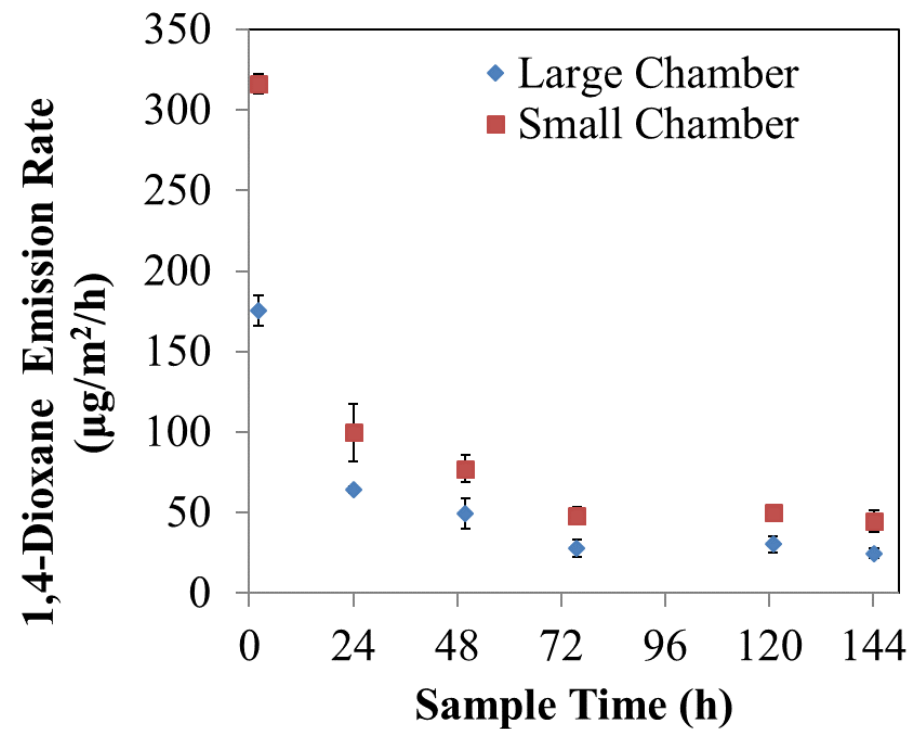
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ASTM WK40293 - Results

Open Cell



Closed Cell



People don't inhale emission rates!

Objective

ASTM subcommittee D22.05 is developing a standard method to characterize vapor phase emissions from Spray Polyurethane Foam (SPF) using micro-chamber systems. This study aims to examine whether chemical emission rates from SPF using three different size micro-chamber systems are comparable.



Figure 1: Two commercial micro-chamber systems.

Background

Spray polyurethane foam (SPF): SPF insulation improves building energy efficiency by reducing both conductive and convective heat losses through the building envelope.

Produced on site by mixing: methylene diphenyl diisocyanate, flame retardants, catalysts, blowing agents, and polyols.

Collaborative efforts: ASTM subcommittee D22.05 is developing methods to characterize vapor phase emissions from SPF using micro-chamber systems.

Methods

Chambers Investigated:

- Emissions from SPF were tested in three micro-chamber systems of different chamber sizes (Table 1, Figure 2) for open cell SPF and two different chamber sizes for closed cell.
- Flow rates were targeted to have similar area specific airflow rates for each chamber. Flows were measured with a bubble flow meter.
- Temperatures were set to 35 °C for each chamber system prior to each experiment by inserting a NIST traceable thermocouple into chambers filled with water.
- The six small and four large chambers were manually sampled. The single conical chamber was automatically sampled by the GCMS system.



Figure 2: Small and conical micro-chamber. (250 mL Conical version shown).

Table 1: Chamber Parameters.

Chamber Description	Volume (mL)	Projected Foam Surface Area (cm ²)	Area Specific Airflow (m ³ m ⁻² hr ⁻¹)
Small	44	16	1.10
Large	116	33	1.07
Conical	1000	65	1.08

SPF:

- The same SPF was tested in each chamber simultaneously.
- The SPF skin was removed from the open cell samples, but not the closed cell samples.

Results

Open Cell Data: Emissions from open cell SPF were tested in three different micro-chamber sizes (Table 2, Figure 3).

Table 2: Average and standard deviation for chamber parameters for open cell SPF.

Chamber Description	Flow (mL/min)	Temperature (°C)	Number of Samples (n)
Small	24 ± 0.7	35.7 ± 0.7	5
Large	48 ± 1.2	35.7 ± 0.7	3
Conical	106 ± 8.2	35.3 ± 0.1	1

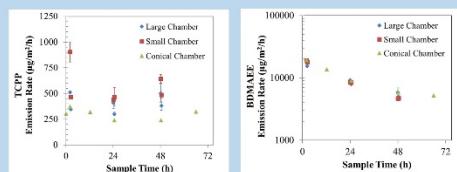


Figure 2: Comparison of emission data from three chambers for open cell SPF. BDMAEE figure is on a log scale. Uncertainty bars show standard error.

- For closed cell,** the average 1,2-dichloropropane emission rates were not statistically different for the two chamber sizes, while the average emission rates of 1,4 dioxane were statistically different at all sampling times.
- For open cell,** the average BDMAEE emission rates from all three chamber sizes were similar. For TCPP inter-sample variability in TCPP data was greater than between chamber type variability. Average conical TCPP concentrations were lower than the other chambers.

Closed Cell Data: Emissions from closed cell SPF were tested in two different micro-chamber sizes (Table 3, Figure 4).

Table 3: Average and standard deviation for chamber parameters for closed cell SPF.

Chamber Description	Flow (mL/min)	Temperature (°C)	Number of Samples (n)
Small	24 ± 0.8	34.5 ± 0.2	5
Large	46 ± 2.6	35.4 ± 0.3	3

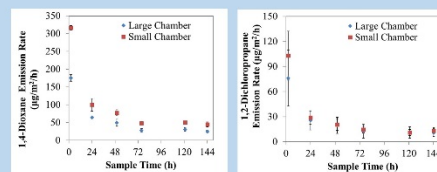


Figure 3: Comparison of emission data from two chambers for closed cell SPF. Uncertainty bars show standard error.

Implications

- Chamber type should be reported when reporting data.
- All data is comparable within a factor of two.
- Inter-sample variability in TCPP data is greater than between chamber type variability. Repeatability in TCPP data for different sample volumes not consistent for manually sampled chambers.
- Automated conical chamber can only run one sample at a time limiting statistical comparisons.

Disclaimer

Certain trade names or company products are highlighted above to adequately specify the experimental equipment used. In no case does such identification imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the equipment is the best available for the purpose.