Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes

Between 1997 and 2003, NYSDOH undertook a study of the occurrence of volatile organic chemicals in the indoor air of homes that heat with fuel oil. The study included basement, living space and outdoor samples from approximately 100 homes, tested during both heating and non-heating seasons. Most of the more than 600 samples collected in the study were analyzed for 69 individual compounds. A summary report will present the results to help characterize commonly found concentrations of these 69 compounds in the indoor and outdoor air of residential settings heated with fuel oil.

The study is comprised of single family homes heated with fuel oil. With the exception of New York City, homes from across the state were included in the study, with the majority of the homes being located near the Albany area. Prospective residences were required to have no past oil spills, no hobbies or home business that regularly use products containing VOCs, and no recent activities utilizing products that contain VOCs (painting, staining). A pre-sampling inspection was conducted in each home and included completing a building questionnaire to gather building information such as age, basement characteristics, heating and ventilation parameters, location of fuel oil tank, garage placement, etc. and an inventory of products that might be sources of indoor VOCs. A listing of the products and their ingredients if available were entered on the inventory form and the product containers were screened with a photoionization detector (PID) and the PID readings were recorded on the inventory form.

Sampling was performed in a manner consistent with the New York State Department of Health's August 2001 Indoor Air Sampling and Analysis Guidance. Samples were collected in 6-liter pre-cleaned, evacuated whole air canisters prepared and analyzed at the NYSDOH's Wadsworth Center laboratory. The samples were analyzed in accordance with EPA Method TO-15 utilizing a Tekmar® AutoCan® concentrator / Agilent® 6890/5973 GC/MSD analytical system. The method detection limits for all compounds except hexachlorobutadiene are 0.25 micrograms per cubic meter. The method detection limit for hexachlorobutadiene is slightly higher at 0.43$\mu g/m^3$.

Summary statistics of the data from the study are provided in table 1. The dataset exhibits a lognormal distribution typical of environmental data. Ordered statistics include the 25^{th}, 50^{th}, 75^{th} and 90^{th} percentile values. Also included are calculated values for the upper fence for each compound. The upper fence is a calculated value, 1.5 times the interquartile range (difference between the 25^{th} and 75^{th} percentile values) above the 75^{th} percentile value. The upper fence is a boundary used for identifying the presence of outliers in the data. All of the values calculated for the lower fence were negative and are not included in the table. In order to develop the descriptive statistics, randomly generated numbers between 0.00 and 0.25 were substituted for levels below the laboratory detection limit of 0.25 micrograms per cubic meter. Therefore, **any value below 0.25 is not a real detected concentration**. All of the values are adjusted to 2 significant figures.

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Summary of Indoor and Outdoor Levels of Volatile Organic Compounds from Fuel Oil Heated Homes in NYS, 1997-2003

All Results are Micrograms Per Cubic Meter

Chemical	Indoor							Outdoor						
	N	ND(%)	Lower Quartile	Median	Upper Quartile	90th Pctl	Upper F	N	ND(%)	Lower Quartile	Median	Upper Quartile	90th Pctl	Upper F
1,1,1-TRICHLOROETHANE	406	37.2	0.18	0.38	1.4	3.5	3.1	203	59.6	0.13	0.22	0.38	0.6	0.76
1,1,2,2-TETRACHLOROETHANE	406	97.3	0.067	0.14	0.2	0.23	0.39	203	99.5	0.06	0.13	0.18	0.23	0.36
1,1,2-TRICHLOROETHANE	406	96.1	0.068	0.13	0.2	0.24	0.41	203	99.0	0.056	0.12	0.18	0.22	0.38
1,1,2-TRICHLOROTRIFLUOROETHANE	406	40.6	0.18	0.61	1.1	1.8	2.5	203	43.3	0.16	0.61	1.1	1.8	2.4
1,1-DICHLOROETHANE	406	99.5	0.061	0.12	0.19	0.23	0.38	203	100.0	0.073	0.13	0.18	0.22	0.34
1,1-DICHLOROETHENE	406	98.0	0.064	0.12	0.19	0.23	0.38	203	100.0	0.073	0.13	0.19	0.23	0.37
1,2,3-TRIMETHYLBENZENE	406	39.7	0.16	0.39	1.1	2.7	2.6	203	75.9	0.094	0.18	0.25	0.54	0.48
1,2,4-TRICHLOROBENZENE	406	79.8	0.084	0.16	0.24	3.0	0.46	203	83.7	0.079	0.15	0.23	2.3	0.45
1,2,4-TRIMETHYLBENZENE	406	10.6	0.78	2.0	4.4	11	10	203	49.3	0.15	0.29	1.0	2.2	2.4
1,2-DIBROMOETHANE	406	99.3	0.066	0.13	0.19	0.23	0.37	203	99.5	0.054	0.12	0.21	0.24	0.44
1,2-DICHLOROBENZENE	406	78.8	0.085	0.15	0.24	0.78	0.48	203	82.8	0.072	0.15	0.22	0.66	0.44
1,2-DICHLOROETHANE	406	99.0	0.058	0.23	0.19	0.22	0.38	203	99.5	0.074	0.15	0.2	0.22	0.4
1,2-DICHLOROPROPANE	406	97.8	0.065	0.14	0.2	0.24	0.39	203	97.0	0.073	0.14	0.19	0.23	0.38
1,2-DICHLOROTETRAFLUOROETHANE	406	86.2	0.08	0.14	0.21	0.63	0.42	203	83.3	0.086	0.16	0.23	0.56	0.44
1,3,5-TRIMETHYLBENZENE	406	25.9	0.24	0.64	1.7	3.8	3.9	203	66.5	0.094	0.19	0.44	0.83	0.96
1,3-DICHLOROBENZENE	406	78.8	0.073	0.15	0.24	0.66	0.49	203	85.2	0.068	0.16	0.23	0.48	0.46
1,4-DICHLOROBENZENE	406	66.3	0.10	0.19	0.54	1.3	1.2	203	81.3	0.062	0.14	0.23	0.66	0.49
2,3-DIMETHYLPENTANE	406	33.3	0.18	0.59	2.1	7.9	5	203	69.0	0.094	0.2	0.41	1.4	0.88
2,4-DIMETHYLPENTANE	406	34.7	0.18	0.57	1.9	7.7	4.5	203	65.5	0.097	0.19	0.49	1.1	1.1
ACETONE	406	1.2	12	21	46	96	97	203	1.0	4.3	8.0	14	41	29
ALPHA-PINENE	406	16.7	0.5	1.7	4.9	17	12	203	57.1	0.12	0.22	0.61	2.6	1.4
BENZENE	406	2.7	1.2	2.2	5.7	15	13	203	3.9	0.86	1.5	2.6	5.2	5.2
BROMOMETHANE	406	77.3	0.094	0.17	0.24	0.58	0.46	203	80.8	0.077	0.15	0.24	0.47	0.48
CARBON TETRACHLORIDE	406	45.1	0.16	0.34	0.68	0.87	1.5	203	48.3	0.14	0.31	0.68	0.81	1.5
CHLOROBENZENE	406	99.5	0.065	0.12	0.19	0.23	0.38	203	100.0	0.061	0.12	0.19	0.23	0.38
CHLOROETHANE	406	90.9	0.074	0.13	0.2	0.25	0.39	203	93.6	0.068	0.15	0.21	0.24	0.42
CHLOROFORM	406	52.7	0.12	0.24	0.54	1.4	1.2	203	81.3	0.069	0.14	0.23	0.44	0.47
CHLOROMETHANE	406	44.3	0.15	0.67	2	3.3	4.8	203	44.8	0.12	0.78	2.0	3.3	4.8
CIS-1,2-DICHLOROETHENE	406	94.1	0.068	0.14	0.2	0.24	0.39	203	99.0	0.068	0.14	0.2	0.23	0.4
CIS-1,3-DICHLOROPROPENE	406	98.3	0.07	0.12	0.2	0.24	0.4	203	99.5	0.067	0.14	0.19	0.22	0.38
CYCLOHEPTANE	406	39.9	0.16	0.52	1.3	3.1	3	203	70.4	0.072	0.16	0.36	0.8	0.79
CYCLOHEXANE	406	30.0	0.21	0.79	2.9	9.1	6.9	203	63.5	0.1	0.2	0.62	2.2	1.4
DICHLORODIFLUOROMETHANE	406	47.5	0.14	0.87	5.6	15	14	203	46.8	0.12	2.2	5.1	7.7	13
d-LIMONENE	406	16.7	0.61	3.1	9.3	25	22	203	71.4	0.077	0.18	0.39	1.5	0.86
ETHYL ALCOHOL	230	1.3	40	210	610	1600	1500	115	1.7	3.8	9.0	17	67	37
ETHYLBENZENE	406	13.3	0.43	1.1	2.8	7.3	6.4	203	50.2	0.14	0.25	0.61	1.2	1.3
ETHYLCYCLOHEXANE	406	37.2	0.16	0.41	1.3	2.7	3	203	78.3	0.083	0.16	0.24	0.6	0.48
ETHYLMETHACRYLATE	230	96.1	0.077	0.13	0.2	0.24	0.38	115	100.0	0.062	0.13	0.18	0.22	0.35
HEXACHLOR0-1,3-BUTADIENE	406	76.1	0.084	0.17	0.25	4.8	0.5	203	80.8	0.079	0.16	0.23	2.4	0.46
ISO-OCTANE	406	31.3	0.2	0.61	2.6	7.3	6.2	203	64.5	0.12	0.2	0.42	1.4	0.87
ISOPRENE	406	10.6	0.78	2	4.3	8.2	9.6	203	53.2	0.14	0.24	1.0	3.1	2.3
ISOPROPYLBENZENE	406	65.5	0.095	0.19	0.39	0.88	0.83	203	88.7	0.085	0.15	0.22	0.29	0.42
M,P-XYLENE	406	12.3	0.52	1.5	4.7	12	11	203	50.2	0.13	0.25	0.69	2.2	1.5
METHYL ELTHYL KETONE	406	12.8	1.2	2.5	5.4	12	12	203	24.1	0.29	1.1	2.3	5.0	5.2
METHYL ISOBUTYL KETONE	406	41.9	0.14	0.39	0.98	3	2.2	203	69.5	0.089	0.17	0.33	0.98	0.69
METHYLCYCLOHEXANE	406	27.6	0.23	0.68	1.9	6.3	4.4	203	67.5	0.1	0.19	0.4	0.84	0.85
METHYLENE CHLORIDE	406	20.7	0.38	1.4	6.3	22	15	203	44.8	0.14	0.31	0.87	2.3	2.0
METHYLMETHACRYLATE	230	89.6	0.077	0.16	0.22	0.33	0.43	115	97.4	0.059	0.12	0.18	0.24	0.37
METHYL-tert-BUTYL ETHER	406	25.4	0.25	0.94	5.3	18	13	203	39.9	0.17	0.36	1.2	5.8	2.8
n-BUTYLBENZENE	406	54.9	0.11	0.23	0.49	1.2	1.1	203	82.8	0.078	0.15	0.24	0.38	0.47
n-DECANE	406	8.4	1.4	2.8	7	18	15	203	29.6	0.23	1.1	2.2	3.3	5.0
n-DODECANE	406	20.0	0.42	1.5	3.9	10	9.1	203	45.8	0.14	0.49	2.1	5.8	5.0
n-HEPTANE	406	4.2	1	2.8	7.7	19	18	203	28.6	0.22	0.53	1.3	3.6	3.0
n-HEXANE	406	11.1	0.63	1.7	6.5	19	15	203	32.5	0.2	0.49	1.1	2.9	2.5
n-NONANE	406	16.3	0.37	1.3	3.6	9.6	8.4	203	63.1	0.11	0.2	0.42	1.2	0.89
n-OCTANE	406	20.9	0.33	0.89	2.3	4.2	5.2	203	55.2	0.12	0.23	0.65	1.6	1.5
n-PROPYLBENZENE	406	51.0	0.13	0.25	0.69	1.8	1.5	203	88.2	0.06	0.14	0.21	0.34	0.44
n-UNDECANE	406	15	0.57	1.8	5.7	14	13	203	49.8	0.14	0.26	0.77	2.4	1.7
O-XYLENE	406	16.0	0.39	1.2	3.1	7.9	7.2	203	54.7	0.11	0.22	0.74	1.8	1.7
sec-BUTYLBENZENE	406	56.9	0.11	0.22	0.55	1.2	1.2	203	77.3	0.085	0.16	0.24	0.49	0.47
STYRENE	406	42.4	0.15	0.3	0.68	1.3	1.5	203	75.4	0.091	0.17	0.25	0.51	0.48
tert-BUTYLBENZENE	406	57.1	0.12	0.22	0.6	1.8	1.3	203	85.2	0.085	0.16	0.23	0.38	0.44
TETRACHLOROETHENE	406	44.3	0.13	0.34	1.2	2.9	2.7	203	70.9	0.087	0.18	0.34	0.81	0.72
TETRAHYDROFURAN	230	73.9	0.089	0.17	0.32	3.3	0.67	115	94.8	0.043	0.11	0.2	0.23	0.44
TOLUENE	406	2.2	4.2	9.9	25	59	56	203	2.5	0.68	1.4	3.3	8.4	7.2
TRANS-1,3-DICHLOROPROPENE	406	100.0	0.067	0.12	0.18	0.22	0.35	203	100.0	0.061	0.12	0.19	0.22	0.38
TRICHLOROETHENE	406	81.0	0.088	0.17	0.23	0.48	0.44	203	89.7	0.063	0.15	0.21	0.27	0.44
TRICHLOROFLUOROMETHANE	406	7.1	1.3	3.1	5.5	17	12	203	31.5	0.19	1.1	2.6	4.0	6.2
VINYL CHLORIDE	406	99.3	0.063	0.13	0.2	0.23	0.39	203	99.5	0.067	0.15	0.21	0.24	0.42

N:Total Number of Samples **ND(%):% of Nondetected** **Upper Fen:1.5 times the interquartile range (75th - 25th) above the 75th percentile value**

Values less 0.25 were randomly generated for calculating descriptive statistics, and do not represent actual detected concentration.