

Project Report

Volatile Organic Compound Measurements Upwind and Downwind of Alpine Cabinet Company, Timnath, CO

Prof. Jeffrey L. Collett, Jr., (collett@atmos.colostate.edu)

Dr. Arsineh Hecobian, (arsineh@colostate.edu)

November 29, 2018

Whole air sampling was conducted using 2L stainless steel canisters to evaluate the VOC emissions from the Alpine Cabinet Company in Timnath, CO. The staff at Timnath collected 10 canisters during a period of five days (10/29/2018 to 11/02/2018). Each day, 2 canisters were collected, one upwind of the Alpine Cabinet Company and another downwind. The staff responsible for sample collection reported location, date and time of sample collection, and notes on the meteorological conditions during sample collection. The log-sheet for collected samples is included at the end of the report. Figure 1 is a map of the locations and dates of the measurements discussed in this report.



Figure 1. Locations of sample collection marked by sample collection date. Circles indicate upwind samples and squares indicate downwind samples.

At the conclusion of the sample collection period, canisters were delivered to the laboratories at CSU's Atmospheric Science Department to measure the concentrations of a suite of VOCs using a multi-channel Gas Chromatograph Flame Ionization Detector Mass Spectrometer (GC-FID-MS). Wind direction speed data for the time of measurements were reported by Timnath staff while collecting samples and verified from Weather Underground's Timnath Ranch station (KCOTIMNA3) at the times of reported sample collection. Wind direction information confirmed the downwind/upwind designation for sites. Wind speeds varied from 0-9 miles per hour. The VOC data analyzed in whole air samples are listed in Table 1.

Table 1: Sampling dates and concentrations of VOCs. All values are reported in parts per billion (ppb).

Date and Time	Designation	Benzene	Toluene	Ethylbenzene	m+p-Xylenes	o-Xylene	Acetone	Isopropanol	Methyl Ethyl Ketone (MEK)
10/29/18 10:15	Downwind	0.33	0.69	0.12	0.44	0.15	2.47	2.93	0.49
10/29/18 10:22	Upwind	0.28	0.40	0.14	0.71	0.23	3.23	3.52	0.54
10/30/18 10:10	Downwind	0.12	0.26	0.05	0.22	0.07	1.82	3.66	0.22
10/30/18 10:01	Upwind	0.11	0.23	0.03	0.11	0.03	1.96	4.54	0.17
10/31/18 10:52	Downwind	0.10	0.09	ND	0.04	0.01	1.38	ND	0.16
10/31/18 10:55	Upwind	0.11	0.11	0.02	0.08	0.02	1.65	0.39	0.23
11/1/18 10:56	Downwind	0.06	0.04	ND	0.02	ND	ND	ND	ND
11/1/18 11:01	Upwind	0.05	0.05	ND	ND	ND	1.24	ND	0.11
11/2/18 11:40	Downwind	0.27	2.38	0.05	0.20	0.07	3.19	ND	0.59
11/2/18 11:25	Upwind	0.21	0.27	0.03	0.12	0.03	2.12	0.52	0.40

For each day, the values measured upwind concentrations were subtracted from those measured downwind to evaluate any enhancements observed in downwind locations. The results are shown in Table 2. All positive enhancements in VOC concentrations are shaded in.

Table 2: Differences in concentrations of VOCs between upwind and downwind locations sampled on the same day.

Date and Time	Benzene	Toluene	Ethelbenzene	m+p-Xylenes	o-Xylene	Acetone	Isopropanol	Methyl Ethyl Ketone (MEK)
10/29/2018	0.05	0.28	-0.02	-0.27	-0.08	-0.76	-0.59	-0.05
10/30/2018	0.01	0.03	0.02	0.10	0.03	-0.14	-0.88	0.06
10/31/2018	-0.01	-0.02	ND	-0.04	-0.01	-0.26	ND	-0.08
11/1/2018	0.00	-0.01	ND	ND	ND	ND	ND	ND
11/2/2018	0.05	2.11	0.02	0.08	0.03	1.06	ND	0.20

Based on notes from Timnath staff during sample collection, on 11/2/2018 the sample collected downwind was influenced by heavy traffic in the area. This is noted in the observed enhancement in toluene concentrations which are emitted from fresh vehicular exhaust.

A comparison of the range of VOCs enhanced during this project, governmental threshold values for acute and chronic health-based reference levels, and typical ranges of concentrations reported in peer reviewed publications are presented in Table 3. References for publications can be found at the end of the report.

Table 3: Summary of the results from measurements compared to acute and chronic health-based values and concentrations from other published studies. All concentrations are reported in parts per billion (ppb).

	Timnath Enhanced Concentration Range (including background) (ppbv)	Health-protective criteria values	Typical Published Conc. (ppbv)
Acetone	3.19	26000 acute ⁷ 13000 chronic ⁷	1-17 (forested-urban) ^{1,2}
Isopropanol	No enhancement	1312 acute ⁸ 2870 chronic ⁸	7-44 Urban ³
MEK	0.22-0.59	20000 acute ⁷ 1695 chronic ⁷	0.1-2900 ^{4,5}
Ethylbenzene	0.05	20000 acute ⁷ 230 chronic ⁷	1-20 ⁴
Xylenes	0.07-0.22	1700 acute ⁷ 23 chronic ⁷	0.1-1000 ^{4,6}
Toluene	0.26-2.37	2000 acute ⁷ 1327 chronic ⁷	0.4-1600 ^{4,6}
Benzene	0.12-0.33	180 acute ⁷ 9.39 chronic ⁷	0.4-4.5 ⁹

References:

1. Villanueva I. et al., Biogenic emissions and ambient concentrations of hydrocarbons, carbonyl compounds and organic acids from ponderosa pine and cottonwood trees in rural and forested sites in Central New Mexico, *Atmos. Environ.*, (38), 249-260, (2004).
2. Granby K. et al., Urban and Semi-rural observations of carboxylic acids and carbonyls, (31), 10, 1403-1415, (1997).
3. Nguyen H. T. et al., Atmospheric alcohols and aldehydes concentrations measured in Osaka, Japan and in Sao Paulo Brazil. *Atmos. Environ.*, (35), 3075-3083, (2001).
4. Swarthout R. F. et al., Volatile organic compound distributions during the NACHTT campaign at the Boulder Atmospheric Observatory: Influence of urban and natural gas sources. *J. Geophys. Res. –Atmos.*, (118), 10614-10637, (2013).
5. California Environmental Protection Agency, Air Resources Board, <https://www.arb.ca.gov/adam/toxics/sitelists/meksites.html>, Last accessed: (2018).
6. Air Resource Specialists, City of Fort Collins Data Summary Report (H₂S and VOC), (2013).
7. McMullin T. et al., Exposure and health risks from volatile organic compounds in communities located near oil and gas exploration and production activities in Colorado (U.S.A.). *Int. J. Environ. Res. Public Health*, 15 (7), (2018).
8. Provisional Peer-Reviewed toxicity values for isopropanol, <https://cfpub.epa.gov/ncea/pprtv/documents/Isopropanol.pdf>, Last accessed: (2018).
9. Ambient Concentrations of Benzene, <https://cfpub.epa.gov/roe/documents/BenzeneConcentrations.pdf>, Last accessed: (2018).

Sample Collection Log-sheet

Canister #	Location	Date/Time	Operator	Notes
0613	4980 5th Ave (downwind)	10/29/18 10:15	SB	No smell evident Normal conditions Wind 0mph Complaint location
0831	5105 Sugar trail (upwind)	10/29/18 10:22	SB	No smell evident Normal conditions Wind 3mph SE Complaint location
2120	Field behind alpine cabinet W of RRT (downwind)	10/30/18 10:10	SB	Light snow spatters No smells detected Wind 5mph E
1824	5200 4th Ave (upwind)	10/30/18 10:01	SB	light snow spatters No smells detected Wind 5mph E
1728	4125 main street, south side by railroad tracks (downwind)	10/31/18 10:52	SB	Very faint scent 37 deg F Normal conditions Wind SW 4mph
0725	4117 main street, northeast corner of street (upwind)	10/31/18 10:55	SB	No scent Normal weather Wind SW 4mph
1314	Field directly SE of RRT and CO Feed and Grain (downwind)	11/1/18 10:56	SB	Very slight chemical odor detected Wind NW 9mph
1932	Far west end of Walt Weiss (upwind) Ball Field, directly northwest of Timnath Elementary	11/1/18 11:01	SB	No smells detected Wind NW 9mph
2515	4005 Main St., West side of street (downwind)	11/2/18 11:40	SB	Heavy traffic. No odor detected Wind S 7mph
2317	4212 Main, East side of street (upwind)	11/2/18 11:25	SB	No odor detected Wind S 7mph