

Data Limitations

These VOCs were selected for analysis because they are commonly found at low levels in outdoor and indoor air, routine analytical procedures were readily available and many have been shown to be constituents of fires. Other VOCs and semivolatile organic compounds have been found in the smoke from fires and can be expected near the site and in the smoke plume as well. Different sampling techniques are required for these compounds.

Public Health Implications

Although the highest levels of VOCs were found in samples from the plume at the WTC debris pile, these results are not likely to represent the potential exposure of the residents. Residents are unlikely to be in the plume at the debris pile where they could be exposed to these levels for any length of time. Therefore, the sampling results for areas potentially affected by the plume (i.e., at downwind locations) but not at the debris pile are more relevant for evaluating potential exposure to the residents. The levels of some of the chemicals in the plume measured at the debris are elevated and exceed typical background ranges, and recovery and emergency workers should take precautions to limit their exposure to emissions from the plume.

The levels of VOCs at the upwind sites (75 Park Place and 225 Rector) are within the range of typical background levels.

The air concentrations of VOCs at the downwind site (140 Broadway) were generally greater than those measured upwind (75 Park Place and 225 Rector) and typical background concentrations. However, none of the WTC-related chemicals measured at 140 Broadway exceed both typical background levels and air comparison values except benzene, chloromethane and styrene. Based on the available information, exposures to these chemicals from the plume are unlikely to last more than one year. Thus, in addition to typical background levels, the concentrations of the chemicals measured at 140 Broadway are evaluated with health comparison values for air based on noncancer effects and exposure durations of less than one year (e.g., acute (up to two weeks) and intermediate (up to one year) air comparison values).

None of the chemicals detected above background at 140 Broadway exceed intermediate or short-term air comparison values except benzene. The average and highest levels of benzene at 140 Broadway are slightly above typical background and are near the intermediate comparison value for this chemical. This comparison value for benzene is about 90 times lower than the exposure level that caused mild neurological effects in mice exposed regularly for 30 days.

The benzene air concentrations at 140 Broadway (as well as typical background concentrations of benzene) exceed the health comparison value for benzene in air based on carcinogenic effects following long-term exposure. The cancer comparison value is the air concentration associated with an increased lifetime cancer risk of one-in-one million (10^{-6}). Because the estimated duration of exposure is at most one year, and because elevated levels are unlikely to persist for extended periods of time (e.g. the fires will be put out and the wind direction will periodically change), community exposures are not expected to result in cancer risks that are appreciably

increased over those resulting from background exposure. These estimated cancer risks do not exceed one-in-ten thousand (10^{-4}), above which actions are usually taken to reduce exposure.

The average levels of chloromethane and styrene also exceed background and their air comparison values based on cancer effects and long-term exposure. Again, based on the low potential for long-term exposure to elevated levels, this is not expected to result in an appreciable increased cancer risk, but one similar to the risks resulting from exposure to background levels.

Limitations of Health Assessment

The primary limitation of this assessment is that the list of VOCs measured may not be completely representative of the emissions from the fires and recovery activities at the World Trade Center site. The available analytical methods cannot include all of the numerous combustion products that can be generated from the fires, which, in addition to the measured VOCs, could affect air quality and public health. Some chemicals that are known to be produced by fires (e.g. aldehydes, acrolein) and are strong respiratory irritants were not measured.

When odors are present, it is not unusual for some people to experience short-term effects such as respiratory irritation and effects such as headaches and dizziness. These effects tend to diminish once exposure to the odors is stopped, and usually do not result in long-term health consequences. Some people are more likely to experience these effects than others.

Conclusion

The results of the monitoring suggest that the levels of some VOCs in the plume at the debris pile are significantly elevated above typical background levels, and workers at the site should take precautions to limit their exposure. For the VOCs that were measured, the air concentrations outside the work area are not a significant health concern. However, the elevation above background levels of some VOCs indicates that combustion products may be contributing to symptoms of eye, nose and throat irritation that have been reported in workers and residents in the WTC neighborhood. Based on the current results and the expected mitigation of VOC emissions from the site in the future by controlling the fires, continued monitoring for the VOCs sampled is not necessary at this time. It may be useful to assess VOC concentrations again once the fires are controlled to ensure that other recovery activities are not a continuing source of VOCs in the community.

References

Peter S.J. Lees. 1995. Combustion products and other firefighter exposures: A state of the art review. *Occup. Med.* 10:691-706.

VOC Results 09-28.doc
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Summary of Outdoor Air Samples Collected at the World Trade Center Disaster Area
All Results are Parts Per Billion by Volume

Analyte	75 Park Place									Parc Place at 225 Rector						140 Broadway						WTC Plume SPM	Outdoor Background ¹	
	Roof Above 14th Floor			10th Floor		Street			Roof Above 24th Floor			Street			Roof Above 52nd Floor			Street			EPA ¹		NYSDOH ²	
	M	A	E	M	A	M	A	E	M	A	E	M	A	E	M	A	E	M	A	E				
DICHLORODIFLUOROMETHANE	0.6	0.6	0.6	0.7	0.6	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.8	1.1	1.1	0.8	0.6	0.7	1.2	0.32 - 0.35	<0.2	
CHLOROMETHANE	1.0 PL	1.0 PL	1.0 PL	1.0 PL	1.0 PL	1.0 PL	1.0 PL	1.0 PL	1.0 PL	1.0 PL	1.0 PL	1.0 PL	1.0 PL	1.0 PL	2.8	1.2	1.0 PL	3.2	2.4	1.7	58	0.6 - 0.7	0.24 - 0.63	
BROMOMETHANE	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.9	0.05 - 3.1	<0.3	
CHLOROETHANE	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	2.7	NA	<0.2	
ETHYL ALCOHOL	4.7	1.9	3.6	3.5	4.1	10.1	9.6	4.7	2.6	2.1	3.8	2.1	1.3	2.0	3.7	5.0	4.3	9.6	3.7	4.6	32	NA	<0.5 - 0.9	
TRICHLOROFUOROMETHANE	0.4 PL	0.4 PL	0.4 PL	0.4 PL	0.4 PL	0.4	0.4	0.4	0.4 PL	0.4 PL	0.4 PL	0.4 PL	0.4 PL	0.4 PL	>133	>133	>133	4.8	0.6	1.6	1.7	0.19 - 0.21	<0.18	
ISOPRENE	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	2.5	NA	NA	
ACETONE	1.3	0.9	1.1	1.4	2.2	1.2	1.5	1.3	1.2	1.0	1.7	1.4	1.0	1.2	4.0	7.6	4.6	3.2	2.9	2.6	59	ND - 2.83	NA	
METHYLENE CHLORIDE	0.6 PL	<0.6	<0.6	0.6 PL	0.6 PL	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	2.2	8.4	3.2	<0.6	0.6 PL	<0.6	0.6 PL	0.3 - 1.8	0.14 - 1.1	
METHYL-tert-BUTYL ETHER	0.6 PL	0.6 PL	0.6 PL	0.6 PL	0.6 PL	1.2	0.6 PL	0.8	0.6 PL	0.6	1.4	0.6 PL	0.6 PL	0.6 PL	0.6 PL	0.6 PL	0.6 PL	0.6 PL	0.6	0.6 PL	0.6 PL	0.6 PL	NA	<0.3
n-HEXANE	0.6 PL	<0.6	<0.6	0.6 PL	0.6 PL	0.6 PL	<0.6	2.3	0.6 PL	<0.6	0.6 PL	<0.6	<0.6	<0.6	0.6 PL	0.6 PL	<0.6	0.6 PL	0.6 PL	0.6 PL	3.7	0.83 - 2.95	0.1 - 0.5	
METHYL ETHYL KETONE	<0.7	<0.7	<0.7	<0.7	0.7 PL	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	0.7 PL	<0.7	<0.7	1.0	1.3	0.8	0.7	0.7	0.7 PL	25	ND	NA	
TETRAHYDROFURAN	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	<0.7	0.7 PL	<0.7	<0.7	<0.7	<0.7	<0.7	3.4	NA	NA	
n-HEPTANE	<0.5	<0.5	<0.5	<0.5	0.5 PL	<0.5	0.5 PL	<0.5	<0.5	<0.5	0.5 PL	<0.5	<0.5	<0.5	0.5 PL	<0.5	<0.5	0.5 PL	0.5 PL	0.5 PL	3.4	0.35 - 0.82	NA	
BENZENE	0.7 PL	0.7 PL	0.7 PL	0.7 PL	0.7 PL	0.7 PL	0.7 PL	0.7 PL	0.7 PL	0.7 PL	1.0	0.7 PL	0.7 PL	0.7 PL	5.0	2.2	0.7	5.7	5.0	3.1	88	0.6 - 3.3	0.3 - 1.5	
METHYLMETHACRYLATE	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5 PL	<0.5	<0.5	0.5 PL	0.5 PL	0.5 PL	13	NA	NA	
METHYL ISOBUTYL KETONE	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	NA	NA	
n-OCTANE	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.4 PL	<0.4	<0.4	<0.4	0.4 PL	<0.4	2.4	0.16 - 0.76	NA	
TOLUENE	0.7	0.5 PL	0.5 PL	0.8	2.0	1.1	0.7	1.2	0.5 PL	0.5 PL	1.3	0.6	0.5 PL	0.5	4.0	2.7	1.2	4.2	3.7	2.5	64	0.16 - 5.21	0.3 - 1.5	
TETRACHLOROETHENE	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.4 PL	<0.4	<0.4	<0.4	1.5	0.4 PL	<0.4	0.1 - 0.9	0.1 - 0.5
n-NONANE	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.4 PL	<0.4	<0.4	0.4 PL	0.4 PL	<0.4	3.2	0.14 - 0.61	NA	
CHLOROBENZENE	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.4 PL	<0.4	<0.4	0.4 PL	0.4 PL	<0.4	1.1	ND - 0.31	<0.4	
ETHYLBENZENE	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5 PL	<0.5	0.5 PL	0.5	<0.5	<0.5	<0.5	3.0	0.9	0.5 PL	3.2	2.5	1.6	46	0.2 - 1.2	0.1 - 0.6	
m,p-XYLENE	<0.5	<0.5	<0.5	<0.5	0.5 PL	0.5 PL	0.5 PL	0.5 PL	<0.5	0.5 PL	0.5 PL	0.5 PL	<0.5	<0.5	0.5 PL	<0.5	<0.5	0.5 PL	0.5 PL	0.5 PL	3.2	1.0 - 6.5	0.2 - 1.2	
o-XYLENE	<0.5	<0.5	<0.5	<0.5	<0.5	0.5 PL	<0.5	0.5 PL	<0.5	<0.5	0.5 PL	<0.5	<0.5	<0.5	0.5 PL	<0.5	<0.5	0.5 PL	0.5 PL	0.5 PL	6.5	0.2 - 1.5	0.2 - 1.1	
STYRENE	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5 PL	<0.5	<0.5	<0.5	1.9	0.5 PL	<0.5	1.9	1.8	1.1	75	ND - 0.31	<0.24	
ALPHA-PINENE	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.4	0.023 - 0.264	NA	
ISOPROPYLBENZENE	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	1.1	0.4 PL	<0.4	0.9	0.9	0.5	13	ND	<0.0	
n-DECANE	<0.3	<0.3	<0.3	<0.3	<0.3	0.3 PL	0.3 PL	<0.3	<0.3	<0.3	<0.3	0.3 PL	<0.3	<0.3	0.3 PL	<0.3	<0.3	0.3 PL	0.3 PL	0.3 PL	2.6	0.05 - 0.68	NA	
n-PROPYLBENZENE	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.4 PL	<0.4	<0.4	<0.4	<0.4	<0.4	2.5	0.08 - 0.26	<0.0	
1,3,5-TRIMETHYLBENZENE	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	2.0	0.04 - 0.51	<0.2	
1,2,4-TRIMETHYLBENZENE	<0.4	<0.4	<0.4	<0.4	<0.4	0.4 PL	<0.4	<0.4	<0.4	<0.4	<0.4	0.4 PL	<0.4	<0.4	0.4 PL	0.4 PL	<0.4	0.4 PL	0.4 PL	<0.4	2.9	0.57 - 1.51	<0.2	
d-LIMONENE	<0.4	<0.4	<0.4	<0.4	<0.4	0.4 PL	<0.4	<0.4	<0.4	0.4 PL	0.4	<0.4	<0.4	<0.4	0.4	0.4	0.4 PL	<0.4	<0.4	<0.4	0.6	NA	NA	
1,2,3-TRIMETHYLBENZENE	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	1.4	NA	NA	
1,4-DICHLOROBENZENE	<0.5	<0.5	<0.5	<0.5	<0.5	0.5 PL	1.0	0.5 PL	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	ND - 0.2	0.1 - 0.6
n-UNDECANE	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.3 PL	<0.3	<0.3	0.3 PL	0.3 PL	<0.3	2.9	ND - 0.82	NA	
n-BUTYLBENZENE	<0.5	0.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.0	ND	<1.8	
n-DODECANE	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.3 PL	<0.3	<0.3	0.3 PL	0.3 PL	<0.3	3.7	ND - 0.41	NA	

M - morning (~6-8AM)
A - afternoon (~2-4PM)
E - evening (~6-8PM)

NA - Not Available
ND - Not Detected

Samples were collected by Summa canisters (EPA Method TO-14) for a 2-hour period, the plume sample was a 25 second grab sample. Samples were analyzed by the Wadsworth Center for Labs and Research.

¹The United States Environmental Protection Agency Volatile Organic Compounds Database (EPA) is a compilation of indoor and outdoor data from studies across the United States published in 1988.

²The New York State Department of Health Database (NYSDOH) is a summary of indoor and outdoor air sample results in control homes collected and analyzed by the NYSDOH from 1989 through 1995.

³The levels are the 25th percentile to 75th percentile, (middle half), of the data from the EPA and NYSDOH databases.

< Means less than. The number following this symbol (<) is the lowest level the laboratory test can reliably measure (detection limit). If there is a "<" before any number, then the chemical was NOT detected in the sample.

[PL] - Present, but less than the level indicated.