Reports

Mercury Vapor Concentrations inside Buildings

Abstract. *The concentrations of elemental gaseous mercury in several homes, offices, and laboratories in the Dallas area have been measured. The values are substantially higher than the ambient natural background concentration, about 3 nanograms of mercury per cubic meter of air in San Francisco, Dallas, and Washington, D.C.*

Various safe environmental concentrations of Hg have been specified by U.S. government agencies. The Department of Labor (*1*) has set the maximum tolerable Hg inhalation level to be 100 $\mu g/m^3$ for any exposure. The American Conference of Governmental Industrial Hygienists (*2*) has set the threshold limit value for a 40-hour workweek at 50 $\mu g/m^3$ for all forms of Hg except alkyl compounds and has set a limit of 10 $\mu g/m^3$ for skin contact. Information presently available (*3*) suggests that an ambient Hg concentration in the air below 1 $\mu g/m^3$ is sufficient to prevent illness due to the inhalation of Hg. In Russia (*4*) the maximum 8-hour exposure limit has been set at 10 $\mu g/m^3$, with the recommended environmental concentration of Hg not to exceed 0.3 $\mu g/m^3$ for a 24-hour exposure period.

Using a fine-mesh Au screen (2.5 cm in diameter) which has a 29 percent Hg collection efficiency at an air flow rate of 0.13 m^3/min, I have measured elemental atmospheric Hg concentrations in a variety of buildings. Air sample volumes have ranged from 0.62 to 0.006 m^3. Transfer of the Hg has been made from the collection screen to a secondary Au screen in the gas-flow column, which is ahead of the double-beam atomic absorption system (2537-Å Hg line), at a flow rate of 0.000034 m^3/min to ensure the measurement of elemental Hg and to remove any confusion caused by the measurement of organic debris. The double-beam cell was 61 cm long. The system was cali-

Table 1. Mercury concentrations inside various buildings in the Dallas area as compared with the ambient background concentrations in Washington, D.C., San Francisco, and Dallas (1 ng = 10^{-3} μg).

Location	Date	Mercury concentration (ng/m^3)	Remarks
Home 1, study	9 Dec. 71	68.2	Home 1 painted with latex-base paint, March 68
Home 1, bedroom 1	9 Dec. 71	66.5	
Home 1, living room	9 Dec. 71	69.0	
Home 1, den	9 Dec. 71	70.0	
Home 1, bedroom 2	9 Nov. 71	139	Repainted with latex-base paint, July 71
Home 1, bedroom 2	9 Dec. 71	130	
Home 1, bedroom 3	9 Dec. 71	92	
Home 1, bedroom 4	9 Nov. 71	78	
Home 2, living room	9 Dec. 71	164	Painted with latex-base paint, March 71
Home 3, bedroom	9 Dec. 71	159	Painted with latex-base paint, July 71
Home 4, living room	9 Dec. 71	148	
Home 4, bathroom	9 Dec. 71	141	
House 5, bedroom	10 Dec. 71	103	
Home 6, bedroom	10 Dec. 71	262	New home, painted with latex-base paint 30 days before
Home 7, living room	29 Dec. 71	1560	New home, painted with latex-base paint 7 days before
Home 7, bedroom 1	29 Dec. 71	1560	New home, painted with latex-base paint 7 days before
Home 7, bedroom 2	29 Dec. 71	3070	
Home 8, bedroom	9 Nov. 71	12.9	Home paneled
Home 8, kitchen	9 Nov. 71	5.0	
Office building 1, room 1	9 Dec. 71	172	Painted with latex-base paint, June 70
Office building 1, room 2	9 Dec. 71	245	Painted with latex-base paint, June 70
Office building 1, room 3	9 Dec. 71	203	Painted with latex-base paint, June 71
Office building 1, room 4	9 Dec. 71	116	Paneled office
Office building 2, room 1	17 Dec. 71	183	
Doctor's room 1	13 Dec. 71	4950	Hg thermometer broken in the past
Doctor's room 2	13 Dec. 71	5680	Hg thermometer broken in the past
Doctor's room 3	13 Dec. 71	4550	Hg thermometer broken in the past
Dentist 1, room 1	23 Dec. 71	5550	Mixing area for Ag amalgam
Dentist 1, room 2	23 Dec. 71	5030	
Dentist 1, room 3	23 Dec. 71	4770	
Dentist 2, room 1	28 Dec. 71	1295	Inactive for previous 4 days
Dentist 2, room 2	28 Dec. 71	1135	
Dentist 2, room 3	28 Dec. 71	1160	
Hospital laboratory	13 Dec. 71	307	
Hospital ward	13 Dec. 71	336	
Chemical building, laboratory 1	14 Dec. 71	930	At laboratory sink
Chemical building, laboratory 2	14 Dec. 71	592	At laboratory desks
Chemical building, office	14 Dec. 71	398	Office away from laboratory
Washington, D.C.	2 Feb. 72	3.25	Potomac River at Key Bridge
San Francisco	19 Jan. 72	3.14	8 km south of San Francisco on the beach
Dallas	11 Jan. 72	3.38	16 km southwest of Dallas

brated by inserting measured volumes of Hg vapor at known temperatures. The sensitivity per measurement is ± 0.02 ng of Hg for one standard deviation, or about ± 0.05 ng of Hg per cubic meter of air for natural background measurements and approximately ± 1 percent for all measurements.

Mercury concentrations significantly higher than those in the natural environment have been measured in the home, office, and laboratory environments. The Hg concentration in the confined atmosphere of homes and offices is dependent upon the type of paint used and the length of time that has elapsed since the room was painted. Mercury concentrations in homes 3 years after painting with latex-base interior paint containing diphenyl mercury dodecenyl succinate to prevent fungus growth (Hg compounds dissociate to release elemental Hg) have averaged 0.07 $\mu g/m^3$. Wood-paneled and nonpainted rooms exhibit much lower Hg concentrations. Doctors' and dentists' examination and treatment rooms show Hg concentrations greater than 5 $\mu g/m^3$, an indication that the cleanup of spilled Hg was incomplete. Table 1 indicates the concentrations of Hg in the atmosphere in various locations.

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References

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Atmospheric Sulfur: Its Effect on the Chemical Weathering of New England

Abstract. *The present acidity and sulfur content of the upland streams of New England can be accounted for on the basis of the rainout and washout of sulfuric acid from the atmosphere. In spite of this excess acid flux over the New England landscape, the rate of cationic denudation of upland watersheds is relatively low.*

The Northeast for some time has been characterized by an excess deposition of sulfur from the atmosphere (*1–3*). This sulfur originates largely from the combustion of fossil fuels (New England is immediately downwind from the major industrial centers of the United States) (Fig. 1). However, in the United States the extent and consequences of this form of pollution on the environment have only recently begun to be appreciated (*4*). In this connection a study of the effects of atmospheric sulfur on the chemistry of surface waters in the Northeast has been in progress since 1963 at the Hubbard Brook Experimental Forest in New Hampshire (*5*).

The rain and snow incident at Hubbard Brook (1963–1969) contained, on the average, 3.1 mg/liter of sulfate with an associated *p*H of 4.1. The *p*H values of individual weekly samples, however, have been as low as 3.0. Pearson and Fisher (*2*) have found that, over a 3-year period, rain and snow in the Northeast contain, on the average, 4.3 mg/liter of sulfate with an associated *p*H of 4.4. Contemporary precipitation, therefore, over much of New England is pervaded by 3 to 4 mg/liter of sulfate, mostly in the form of H_2SO_4, which is sufficient to lower the *p*H of ambient rain and snow to about 4.1 to 4.4. By comparison, geologically normal precipitation, that is, pure rainwater saturated with CO_2 at normal pressure, is much less acid, having a *p*H of only 5.7.

Table 1. Composition of the surface waters of the North Atlantic slope (in milligrams per liter) (*6*).

Component	Hubbard Brook (6-year average)	Maritime Provinces (average of 19 lakes)	New England (average of 66 tributary streams)	World average stream water
HCO_3	*	1.3	17	58.4
SO_4	6.40	5.8	6.9	11.2
Cl	0.64	6.4	2.8	7.8
NO_3	1.14		0.8	1.0
Ca	1.58	1.7	5.7	15.0
Mg	0.39	2.7	1.2	4.1
Na	0.92	4.2	2.6	6.3
K	0.23	2.5	0.7	2.3
Al or Fe†	0.24		0.2	0.7
SiO_2	4.16		4.6	13.1
Total	16.15 *p*H 5.15	>24.6	42.5 *p*H 6.7	120 *p*H $\simeq$ 7

* Not detectable, on the average. † Hubbard Brook water contains aluminum and no iron; New England water and world stream water contain iron and no aluminum.

Table 1 gives data (6-year weighted averages) on the stream water chemistry in the Hubbard Brook area; also included are comparative average data on the river water of the world. The absence of bicarbonate in Hubbard Brook stream water is conspicuous and significant. The dominant anion in the Hubbard Brook stream water is sulfate; by contrast, the dominant anion in the rivers of the world is bicarbonate (*6*). Table 1 also gives the average composition of 66 nominally unpolluted tributary streams in New England. These streams drain a rather homogeneous terrain composed of igneous and metamorphic rocks with few limestones. Collectively, these waters show a rather constant sulfate content of about 5 to 7 mg/liter. These data also suggest a systematic increase in the bicarbonate content as the stream size increases.

If typical precipitation over the Northeast contains 3 to 4 mg/liter of sulfate and if a typical value for evapotranspiration over the same area is 50 percent (*7*), then the net precipitation disposed over this landscape should contain 6 to 8 mg/liter of sulfate, the amount actually observed in the upland waters of this region (Table 1). Thus, these data suggest that the present rate of sulfur rainout and washout from the atmosphere is sufficient to account for the present sulfate content of surface waters in New England, as Pearson and Fisher have also surmised (*2*).

In the incongruent solution of rocks and minerals by rainwater, that is, chemical weathering, hydrogen ion is the most important active agent. It is thought that over most of the world today and perhaps everywhere in the geologic past, carbonic acid has been the dominant source for the hydrogen ion (*8*). The interjection of a strong mineral acid such as H_2SO_4 or HNO_3 into a carbonic acid system would shift