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REPORTS OF INVESTIGATIONS

BUREAU OF MINES - - NOVEMBER, 1920 - - DEPARTMENT OF INTERIOR

ANALYSES OF AIR FROM BURNING BUILDINGS.

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At the annual meeting of the International Association of Fire Engineers at Kansas City, Mo., in June, 1919, the Bureau of Mines offered to cooperate with municipal fire departments for the purpose of obtaining information regarding composition of the air in burning buildings. (Katz, S. H., Statement made at Convention of International Assoc. of Fire Engineers: Fire and Water Eng., vol. 66, July 16, 1919, pp. 129-30, also Fireman's Herald, vol. 78, July 12, 1919, pp. 48.) The gas-mask laboratory of the Bureau's experiment station at Pittsburgh sent vacuum bottles for taking samples to fire chiefs in twenty-five cities, who had signified their intention to aid in this work. It was hoped to obtain one hundred or more samples, because statistics in quantity are necessary for drawing reliable conclusions concerning the likelihoods of encountering irrespirable gas in burning buildings. Thus far, eleven samples have been received by the laboratory. Results of analyses and pertinent data regarding these samples are given in the accompanying table.

Eight of the eleven samples contained no carbon monoxide; seven of the eight were taken above the ground level and one below ground. One sample taken above ground contained 0.03 per cent carbon monoxide, and this quantity is not dangerous to breathe for a limited time. Of the three samples taken below ground, one contained no carbon monoxide; the other two contained 0.10 and 0.35 per cent, respectively. This indicates that in a burning building, the hazard from carbon monoxide is much greater below the ground level. The cause undoubtedly lies in the poorer ventilation that is usually found in cellars or basements. Abundance of ventilation provides the necessary air for complete combustion, or if incomplete combustion does occur, the carbon monoxide generated by the fire is greatly diluted with fresh air and swept away by the current. It may be noted that the highest proportion of carbon monoxide was found in a cellar where a fire was burning among piled cases. The difficult access of air to the burning parts facilitated the formation and liberation of carbon monoxide. The smoke here was very light and no difficulty was experienced in breathing. Some of the air containing dense smoke showed little change from normal air by analysis. Thus the density of smoke or the irritation and difficulty it causes in breathing are no indication of the presence of poisonous gas. None of the samples shows important deficiencies in oxygen.

It is hoped that in time more air samples from burning buildings will be analyzed in order to extend the little information given here. Especial credit is due the men who, in the turmoil and anxiety that accompanies efforts to subdue fires, and with possible danger to themselves, have been able to take the samples. - U. S. Bureau of Mines, Reports of Investigations.

DATA ON SAMPLES OF ATMOSPHERES FROM BURNING BUILDINGS.

(Normal air contains carbon dioxide, 0.03 per cent; oxygen, 21.93 per cent; nitrogen, 79.04 per cent by volume.)

Sampler	City	Date	Building	Location of fire	Character of fire	Time		Location of taking sample	Ventilation of sampling location	Density of smoke	Action on gases on the senses	Gas analyses, per cent by volume					Laboratory No. of sample	REMARKS
						Fire probably started	Sample taken					CO ₂	O ₂	CO	Other combustible gases	N ₂		
Patrol Lt., George Groves	New York, N. Y.	7-19-19	3-story brick factory	1st., 2nd., and 3rd. stories	-----	3:50 A.M.	4:30 A.M.	2nd-story hallway, 4 feet above floor	Open window and skylight	Heavy	-----	0.06	20.91	0.00	0.00	79.03	11331	
Patrol Supt., Jas. O. Schwank	do	7-19-19	do	do	-----	3:50 A.M.	4:30 A.M.	do	do	do	Difficult to breathe	0.20	20.64	.03	.01 methane	79.12	11332	
Patrol Lt., Soren B. F. Berulson	do	7-23-19	Brick hotel being razed, 5-stories, basement and subbasement	Center of basement	Woodwork, beams and flooring burning	9:09 A.M.	9:15 P.M.	Three feet from front door, 6 feet above floor	Open doors	Heavy black, from building material	Could stay inside only short time	.71	20.21	.10	.02 methane	78.96	11326	Sample probably contained outside air from door, 3 ft. away. 0.10 per cent would be dangerous to work in very long, even if smoke permitted.
Chief S. F. Hunter	Springfield, Ohio	7-26-19	One-story brick, storage and repair garage	Center of building	Automobile rags, oil, gasoline	11:45 A.M.	11:50 A.M.	One foot from floor near burning rags	Open door	Very smoky near rags	Not difficult to breathe	.14	20.83	.00	.03	79.00	11329	Sample taken near floor, shows only slight contamination of air; at higher levels more contamination might exist.
Patrol Supt., Jas. O. Schwank	New York, N. Y.	7-30-19	Five-story brick cold storage plant	From basement thru light shaft to roof	Pans of fat over boiler in basement	6:48 P.M.	7:30 P.M.	Center of 1st story 6 feet above floor	Windows open	Noticeable	Difficult to breathe	.05	20.93	.00	.00	79.02	11327	Ammonia fumes were noticeable.
Patrol Supt., Jas. O. Schwank	do	8-3-19	Brick and stone warehouse 5 stories basement and subbasement	Rear of basement	Confined to cases containing whiskey in bottles	11:10 P.M.	11:15 P.M.	Center of basement, 5 feet above floor	Open windows and elevator shaft	Light	Strong whiskey fumes	1.57	19.77	.35	.08 alcohol	78.23	11833	CO content is high, but no smoke or gas, which caused no difficulty in breathing accompanied it.
Patrol Lt., Soren S. F. Berulson	do	12-16-19	Brick and stone 7-story office building	Center of cellar, extending thru floor of 1st story	Old furniture and woodwork	11:16 A.M.	11:25 A.M.	Stairway to cellar, 6 ft. above cellar floor near center	Small grating and hoist shaft leading to street	Heavy Black	Very difficult to breathe	.34	20.76	.00	.02 methane	78.88	11832	Dense smoke prevented sampler descending further into cellar.
Chief A. Neuenschwander	Louisville, Ky.	12-19-19	-----	-----	-----	-----	-----	-----	-----	Very dense	-----	.06 1.67	20.85 19.17	.00 .00	.11 .13	78.98 79.03	11834 11835	Taken in a room in very dense smoke. After the fire, tobacco, sulphur, rags, & pitch were found. The sampler wore a mask.
Patrol Supt. J. O. Schwank	New York, N. Y.	6-14-20	Brick building, 5 stories and cellar	Third story extending to fifth story	Building contained dry colors and dye stuffs	10:58 P.M.	11:10 P.M.	Third story in adjoining building	Closed room	Noticeable	Difficult to breathe	.28 .36	20.68 20.57	.00 .00	.04 .04	79.00 79.03	13004 13005	The air contained fumes from chemicals.