

R O U G H

PROGRESS REPORT

Cal. Research, X-105A Project

Phase I

Establishment of Base Line Levels
Resulting From the Use of Chevron
Gasoline (1.7 ml. TEL per gallon)

This investigation with commercial gasoline (1.7 ml. of TEL) was undertaken to determine base line levels of the concentration of atmospheric lead for comparison with concentrations to be determined in subsequent investigations with a special blend of fuel containing 3 ml. of TEL/gallon and with a blend containing 3 ml. of X-105A. During this initial study, designated as Phase I, concentrations of lead in the air were determined at the loading racks in Richmond (B) and the North Side Sales Yard in San Francisco (C) and at the fueling islands in the garage of the Yellow Cab Company (D) and at the corner of Turk and Jones Streets,

Summary and Conclusions

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The average concentration of total lead in the air^{of} the garage, calculated for 35 samples collected at the fueling islands, was 20 micrograms per cubic meter of air and ranged from 0 to 53 micrograms per cubic meter of air. These concentrations do not consider one extremely high value of 530 micrograms of lead per cubic meter

of air in a sample collected
~~sampled~~ at 4:30 p.m. on May 6, 1959. When this concentration
is included in the calculation, the average concentration during
the period of fueling with Chevron gas was 34.3 micrograms per
cubic meter, a value approximately 1/7 the threshold limit currently
acceptable for industrial practice.

Approximately 25% of the total lead in the air was found
to be particulate in nature. The average daily concentration of
particulate lead as determined from the analysis of the dust deposited
hourly on the tapes of an A.I.S.I. smoke sampler was 5.2 micrograms
per cubic meter. This concentration is lower than the daily
average concentration in the outside air of a downtown area of
Los Angeles during the period August - November of 1954.

Concentrations of carbon monoxide were all below the
threshold limit of 100 ppm, the average concentration being only
11 ppm. The maximum concentration was 40 ppm.

The average temperature in the garage during the test
period was 60° F. and ranged from 52° F. to 72° F. Ventilation in
the garage was good during this period, the air velocity throughout
the area being approximately 90 feet per minute. The air velocity

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was less than 15 feet per minute. During the night, the average velocity of the air in the garage was approximately 50% of that observed for the daylight hours.

Procedures

The concentration of lead in the atmosphere was determined with the Ethyl Lead-In-Air Analyzer at the loading racks in Richmond and the sales yard in San Francisco and at the fueling islands in the garage. During this investigation, samples were collected in the garage only during the periods of maximum activity, which were said to occur between 3:00 p.m. and 5:00 p.m. and between 11:00 p.m. and 2:00 a.m. The lead-in-air analyzer determined essentially the total lead present in the air by including the organic lead and some or most of the particulate lead. The portion of the total lead due to particulate matter present in the atmosphere of the garage was determined at certain times by equipping the lead-in-air analyzer with a sampling head in which a millipore filter could be placed. The millipore filter removed the particulate matter so that only gaseous organic lead vapors reached the scrubber of the analyzer.

A continuous record of the particulate matter present in the atmosphere of the garage was obtained by operating an A.I.S.I. smoke sampler continuously during the period of this test. In this equipment, air at a known rate was filtered through a paper tape and the small quantities of dust deposited on the tape were then analyzed to determine the fluctuations in the concentration of particulate lead in the air during each hour of the period of investigation.

On each day that the air was monitored at any of the three locations, a record was kept of the dry bulb temperature and of the air velocities at the sampling sites. In addition, the concentrations of carbon monoxide in the atmosphere of the garage were determined with the NBS carbon monoxide indicator tubes. The millipore filters and the paper tapes of the A.I.S.I. smoke sampler were mailed to the Kettering Laboratory for analysis. Lead was determined by the dithizone method used routinely in the Laboratory.

Results

The concentrations of lead in the air at the breathing zone of the loader during the time that he was stationed at the

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loaded with Phase I gasoline are summarized in Table 1. Dry bulb temperatures during the periods of sampling are also listed.

A summary of the concentration of lead, ~~as was~~ determined with the lead-in-air analyzer at the fueling island in the Yellow Cab garage during the periods of maximum activity, is given in Table 2 along with the temperature, carbon monoxide and air velocity data.

The concentrations of organic and particulate lead present in the air, as determined by the analysis of material separated by the train sampler, are recorded in Table 3 for the individual tests which were undertaken to determine the partition between gaseous and particulate lead.

Table 4 gives the daily average and range of concentration of particulate lead which were determined from the analysis of the samples of dust collected on the tapes of the A.I.S.I. smoke sampler during each hour of the test period. The daily average and range of the Coh value, an empirical measurement of the soiling property and concentration of the dust are also recorded in Table 4. Table 5 records the average and range of concentration of Coh units and of particulate lead for each hour of the period of this investigation.

Discussion

The exposure of operators to lead during the blending of Chevron gasoline (1.7 ml. TEL per gallon) was not determined since the fuel came from regular blended stock.

Loading Areas - The concentrations of lead at the breathing zone of the loader while he worked at the dome of the tank truck were all satisfactory and indicated a minimum of exposure to lead during the intermittent loading of tank trucks with Phase I fuel (Table 1). The highest concentration was 53 micrograms of lead per cubic meter of air, approximately 1/4 the threshold limit.

Yellow Cab Garage - The concentration of lead in the air of the fueling islands during periods of peak activity averaged 34.3 micrograms/M³ and ranged from 0.0 to 530 micrograms per cubic meter. When the latter value was omitted from the calculation, the average and maximum concentrations of lead were 20.0 and 53 micrograms/M³ respectively. The high concentration of 530 micrograms of lead per cubic meter of air could have been due to the presence of gasoline mist or to the trapping of a large particle of particulate lead in the analyzer. The air was contaminated at this level for only a brief period of time since a sample taken

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one-half hour later was found to contain only 35.3 micrograms of lead per cubic foot of air.

The particulate matter in the air averaged 24.3% of the total lead found to be present (Table 3). A comparison of the average total lead in the samples recorded in Table 3 with the average concentrations of lead recorded in Table 2 would appear to indicate that the lead-in-air analyzer traps 90% or better of all of the lead present in the air.

Particulate lead was present in low concentrations in the dust removed from the air of the garage by the tapes of the A.I.S.I. smoke sampler. The daily average for the entire period was 5.2 micrograms per cubic meter, a concentration that was less than the daily average concentration of 6.75 micrograms per cubic meter of air obtained for a downtown station in Los Angeles during the period August-November of 1954 (Cholak, J., Schafer, L. J., Yeager, D. and Kehoe, R. A.: Report on the Nature of Suspended Matter, Report for Air Pollution Foundation, Los Angeles, Calif., July 1, 1955).

The relationship between the concentrations of lead and of particulate matter, as indicated by the empirical "Coh" unit is shown graphically in Figure 1. It may be seen that the fluctuations in the patterns of the concentration of lead and of the Coh values are similar in nature. The peaks in this figure bear no relationship to the times of peak activity noted above. The dust spots on the tapes could not always be related to a definite time period because of frequent power failures and some inadequacies in marking the tapes daily. The graph is presented only to show the general relationship between the Coh values and the concentrations of lead and it is hoped that improvements instituted in marking the tapes and more continuous operation of the samplers will show a better coincidence between peak lead and Coh values and the periods of greatest activity in the garage.

The concentrations of carbon monoxide in the garage were satisfactory, there being only one concentration of 40 ppm and one of 25 ppm. All other concentrations were in the 10 ppm range (Table 2). The dry bulb temperature during the period of this test averaged only 60° F. and ranged from 52-72° F. The average and

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were approximately 5° lower than was the case during the daylight hours.

Measurement of air velocities within the garage indicated satisfactory ventilation, the average air velocity for the period being approximately 90 feet per minute. Air velocities ranged from an average low of 15 feet per minute to a high of 350 feet per minute. The lowest air velocities were measured on May 5 and 6. The highest concentration of lead (530 micrograms per cubic meter) occurred at 4:30 p.m. on May 6 when the air in the garage was very calm, the air velocity being less than 15 feet per minute.

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Table 1

Concentrations of Lead in the Air at the
Loading Racks While Tank Trucks Were Being
Loaded With Chevron Gasoline

Identification	Number	Micrograms Lead/M ³ of Air		Temperature °F	
		Average	Range	Average	Range
<u>Richmond (B)</u>					
At dome of tank truck	5	21.0	0-53	68	62-72
At ground level	4	14.1	0-353	70	68-72
<u>North Side Sales Yard, San Francisco</u> (C)					
At dome of tank truck	4	4.3	0-17.7	56.5	50-64
At ground level	1	0.0	-	69	

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Table 5

Average Concentrations of Total Lead, Temperature, Carbon Monoxide and Velocity of Air Movement in the Garage, While Commercial Grade Fuel Containing 1.7 ml. TEL Per Gallon Was Used During Period of April 29 - Noon, May 12, 19

Time	Micrograms Pb/ M ³ of Air			Temperature °F			Carbon Monoxide PPM		
	Number	Average	Range	Number	Average	Range	Number	Average	Range
2:00-3:00 p.m.	1	0.0	-	1	62	-	1	0.0	-
3:00-4:00 p.m.	7	21.4	0-35.3	9	64	58-72	2	17.5	10-
4:00-5:00 p.m.	6	106.0	0-530.0	9	64	57-72	4	7.5	0-1
	5	21.0	0-35.3*						
5:00-6:00 p.m.	4	22.0	0-35.3	7	63	57-71	2	25.0	10-
6:00-7:00 p.m.				2	68	68, 68	2	0.0	-
8:00-9:00 p.m.				2	56	54, 58	1	0.0	-
9:00-10:00 p.m.	1	0.0	-	1	62				
10:00-11:00 p.m.	3	17.7	0-35.3	4	56	54-61	2	10.0	0-1
11:00-12:00 M.	4	35.3	17.7-53.0	6	57	53-61	1	25.0	-
12:00 M.-1:00 a.m.	6	17.7	0.0-35.3	8	57	52-61			
1:00-2:00 a.m.	4	14.2	0.0-17.7	6	54	52-58			
Average	35	20.0	0.0-53	55	60	52-72	15	11.0	0.0
	36*	34.3	0.0-530#						

*Concentration of 530 micrograms excluded from calculation

Table 3

Concentrations of Organic, Particulate
and Total Lead in the Air at the Fueling
Islands of the Yellow Cab Garage

Time	Date	LIA	Particulate Lead	Total Lead	Per Cent Particulate Matter in Total
3:45 p.m.	4-29-59	35.3	8.8	44.1	20.0
5:00 p.m.	4-29-59	17.7	3.5	22.2	15.7
11:00 p.m.	4-29-59	17.7	7.6	25.3	30.0
1:00 a.m.	4-30-59	17.7	0.0	17.7	0.0
1:00 a.m.	5-2-59	17.7	0.0	17.7	0.0
5:30 p.m.	5-4-59	0.0	1.8	1.8	100.0
12:45 p.m.	5-5-59	17.7	0.0	17.7	0.0
11:30 p.m.	5-6-59	35.3	12.4	47.7	26.0
5:15 p.m.	5-8-59	17.7	7.6	25.3	30.0
10:30 p.m.	5-8-59	0.0	4.2	4.2	100.0
3:45 p.m.	5-11-59	17.7	13.4	21.1	63.5
Average		17.3	5.4	22.7	24.3

Table 4

Daily Average and Range of Concentration
of Coh Units and of Particulate Lead in
the Yellow Cab Garage

Date	Time	Coh/1000 Feet of Air		Micrograms Lead/ Cubic Meter of Air	
		Average	Range	Average	Range
4-28-59	7:00 p.m.-12:00 M.	2.10	1.24-3.92	6.9	6.3-8.8
4-29-59	12:00 M. -12:00 M.	2.84	0.20-9.68	6.3	2.5-27.3
4-30-59	12:00 M. -12:00 M.	2.02	0.20-4.88	4.0	1.8-8.6
5-1-59	12:00 M. -12:00 M.	2.53	0.36-4.22	2.7	<1.2-9.8
5-2-59	12:00 M. -12:00 M.	2.13	0.36-4.64	3.5	1.5-9.2
5-3-59	12:00 M. -12:00 M.	2.12	0.20-9.20	4.2	1.9-10.5
5-4-59	12:00 M. -8:30 A.M.	3.30	1.06-5.78	9.5	2.0-18.3
5-4-59	4:00 P.M.-12:00 M.	2.3	1.06-6.06	6.0	2.9-16.0
5-5-59	12:00 M. -12:00 M.	2.23	0.20-6.06	3.6	1.5-10.5
5-6-59	12:00 M. -12:00 M.	3.25	0.86-7.84	6.2	2.1-15.7
5-7-59	12:00 M. -12:00 M.	3.20	0.20-8.16	6.8	1.8-18.3
5-8-59	12:00 M. -12:00 M.	1.74	0.36-2.54	4.6	1.9-6.1
5-9-59	12:00 M. -12:00 M.	2.60	0.20-6.80	6.8	2.3-25.0
5-10-59	12:00 M. -12:00 M.	2.03	0.20-4.22	5.4	2.5-14.3
5-11-59	12:00 M. -12:00 M.	2.34	0.20-8.16	6.7	2.8-24.0
5-12-59	12:00 M. -12:00 N.	3.13	0.20-8.30	5.6	3.1-16.0
5-28-59	7:00 P.M.)	2.45	0.20-9.68	5.2	<1.2-27.3
5-12-59	12:00 N. }				

Table 5

Average and Range of Concentration of Coh Units and Of
Particulate Lead for Each Hour During the
April 28 - Noon, May 12, 1959

Time	Coh/1000 Feet of Air		Micrograms Lead/ Cubic Meter of Air	
	Average	Range	Average	Range
12:00 M.-1:00 A.M.	2.50	0.86-5.78	4.8	2.1-18.3
1:00 A.M.-2:00 A.M.	2.50	1.06-3.60	6.2	2.1-7.0
2:00 A.M.-3:00 A.M.	2.10	0.70-3.54	4.4	1.5-7.0
3:00 A.M.-4:00 A.M.	2.48	1.78-3.60	4.1	1.5-6.3
4:00 A.M.-5:00 A.M.	1.49	0.20-3.40	3.6	2.0-5.5
5:00 A.M.-6:00 A.M.	1.30	0.20-4.22	4.6	1.4-14.0
7:00 A.M.-7:00 A.M.	2.46	0.20-4.42	4.5	2.3-10.5
8:00 A.M.-8:00 A.M.	3.36	0.86-7.06	7.8	1.4-20.0
9:00 A.M.-9:00 A.M.	4.75	0.20-9.68	9.8	1.2-27.3
9:00 A.M.-10:00 A.M.	3.67	0.86-7.84	7.4	3.9-14.7
10:00 A.M.-11:00 A.M.	4.37	1.64-7.69	7.8	3.4-25.0
11:00 A.M.-12:00 N.	2.36	0.36-8.16	5.4	1.6-18.3
12:00 N.-1:00 P.M.	2.42	0.36-7.84	5.2	1.6-15.0
1:00 P.M.-2:00 P.M.	2.02	0.52-3.40	4.9	2.3-6.5
2:00 P.M.-3:00 P.M.	2.15	0.36-3.78	5.0	2.3-6.5
3:00 P.M.-4:00 P.M.	1.78	0.20-4.42	4.2	0.6-9.5
4:00 P.M.-5:00 P.M.	2.40	0.20-6.06	5.1	0.6-16.0
5:00 P.M.-6:00 P.M.	2.38	0.20-4.10	4.1	1.5-6.7
6:00 P.M.-7:00 P.M.	1.85	0.20-3.16	4.0	2.1-6.7
7:00 P.M.-8:00 P.M.	2.20	1.06-3.16	4.1	2.1-7.0

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Time	Coh/1000 Feet of Air		Micrograms Lead/ Cubic Meter of Air	
	Average	Range	Average	Range
8:00 P.M.-9:00 P.M.	1.73	0.20-3.40	3.7	1.9-7.0
9:00 P.M.-10:00 P.M.	1.61	0.20-3.78	3.4	1.7-6.0
10:00 P.M.-11:00 P.M.	2.07	0.86-4.10	3.3	1.2-6.4
11:00 P.M.-12:00 M.	2.98	1.06-9.20	4.2	1.5-14.3

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Figure I

Relationship between Concentration of Sulfate Matter (Colloid) and particulate lead ($\mu\text{g}/\text{m}^3$) during period April 29 - May 12, 1959



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