

and Commercial

Part 1.

Lead In The Atmosphere In Association with Certain Industrial Operations.

the Operations of interest, located in the San Francisco and Los Angeles areas, included the blending of gasoline with antiknock compound containing tetramethyllead, the filling of tank trucks with such gasoline at refinery loading racks, the filling of barrels with gasoline, the testing of the gasoline by various methods (distillations etc) in refinery laboratories, and the dispensing of the gasoline at filling stations.

The environmental conditions associated with these operations, with respect to the concentration of lead in the atmosphere to which workmen might be exposed, are being investigated systematically in a program of sampling and analysis. *Two previous requirements,* *provided the nature of* ~~There being two refineries,~~ one in each area, ~~the~~ two sets of operations ~~are being subjected to~~ investigation. In addition, twenty-one gasoline service stations were included, ten in the San Francisco area and eleven in the Los Angeles area. These stations were selected on the basis of the large quantities of gasoline dispensed and their geographic distribution within the two cities.

Obtain some clue to
In order to ~~determine~~ the impact, if any, of the use of tetramethyllead upon the *level of lead concentrations in the atmosphere* general environment ~~of the~~ metropolitan areas, *as compared with the results of observations made prior to its use,* systematic ~~observations~~ *observations* are being made of the concentrations of particulate lead present in the air at one station in each city. The sampling sites were

to represent
selected ~~as being representative of~~ general conditions *near the* ~~of the approximate~~
centers of the downtown commercial areas of each city.

Procedures

The same sampling equipment and procedures for collecting the samples are being used in the environs of the two cities, all tests being conducted by technical personnel of the two major suppliers of tetramethyllead, *in accordance with procedures agreed upon in advance. The representatives of but one of the* ~~each of these~~ suppliers *are* responsible for carrying out the sampling program in a single area. *There is an inevitable degree of variability in the performance of the tests and also in the characteristics of the sites of sampling in the two cities. Several variables will be communicated and to the extent that they seem worthy of note.* Organic lead is being determined by means of specially designed

equipment furnished by one of the suppliers. In initial tests, four cubic feet of air ~~were~~ *are* drawn through the collecting equipment at the rate of 0.5 cubic feet per minute. However, as a result of an investigation of the chemical properties of vaporized tetramethyllead, it was found advisable to reduce the rate of sampling to 0.25 ~~cubic feet per minute~~ *cubic foot per minute* and to use two iodine scrubbers in series. The lead retained in each scrubber is being determined directly in the field, and the sum of the two values is being recorded as the *quantity of* organic lead ~~content~~ per cubic foot of air.

The rate of sampling at the service stations is the same as that used in the other test areas, except that the total volume of air sampled

is 8 cubic feet. Before air enters the iodine scrubbers, it passes through a millipore filter, which removes the particulate lead from the air. The concentration^{of} of organic lead ^{is} ~~are~~ determined directly in the field, while the millipore filters are shipped to ^{The Veterans Laboratory in} Cincinnati for the analysis of their content of inorganic lead.

^{levels of} The concentration~~s~~ of ~~the~~ particulate lead compounds in the atmosphere ~~over the~~ commercial centers of Los Angeles and San Francisco are being determined by the analysis of material collected on glass-fiber filter webs ^{used} ~~placed~~ in Staplex high volume samplers. The material from about ^{Cubic meters} 2000 ~~of~~ of air is being removed from the air by each filter during each 24 hours of sampling. The filter webs are being shipped to Cincinnati for analysis.

The following frequencies of sampling are being employed:

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1. Blending plants and loading racks are visited every other week.

2. Other samples in refineries (from ~~laboratories~~ and barrel filling operations) are being collected as

opportunities present themselves in connection with ^{the active} ~~the~~

^{performance of} the operations. These samples are being analyzed only for their content of organic lead.

3. Each filling station is being visited ^{not sampled} two times per month. These samples are analyzed for their content of both inorganic and organic lead compounds. ~~Samples of~~

4. ^{San M.D.} particulate material from the general atmosphere are being collected every other day and are being analyzed for their content of inorganic lead. *(Adequate evidence has demonstrated the existence of the source of some lead in the atmosphere of San Francisco.)*

Results:

Results:

results of the environmental survey as indicated herein,
The findings in this report derive from ~~only these~~ samples

collected up to February 2, 1961 in San Francisco, and up to February 9, 1961 in Los Angeles.

Tables 1 and 2 give the mean concentrations and the frequencies of occurrence of certain ranges of concentration of lead in the air at the various locations in the refineries of the two areas. In Tables 3, 4 and 5 are summarized the results of the analysis of samples collected at the filling stations in San Francisco, Los Angeles and Bakersfield. The levels of concentration of lead in the atmosphere in commercial centers in the two cities are compared in Table 6.

Discussion:

General Comments:

~~In the following discussion, and~~ ^I in all of the tables except

Table 6, the concentration of lead is expressed in micrograms of lead per

Because of the design and calibration of the equipment employed,
cubic foot of air. ~~For comparison with the threshold limit of~~ *lead conversion*
there to the more familiar expression of micrograms
~~200 micrograms of lead per cubic meter of air, as generally advised in~~

this value
~~industrial practice,~~ it is necessary to multiply ~~this value by the factor~~ 35.3,
the number of cubic feet in a cubic meter of air.

As may be seen from the data in Tables 1 and 2, the highest
levels of concentration of organic lead ~~are present~~ *are present* in the air when the
domes of the tank cars ~~are first opened for connection to the lines leading~~ *are first opened for connection to the lines leading*
into which the cars are transferred and blended.
to the weigh-tank. A much higher average level of concentration at this

location was reached in San Francisco than in the same location in the Los
Angeles area. The concentrations fluctuate considerably, depending upon the
condition of the valve connections, *to the point of connection* and on ~~how soon~~ *how soon* air sampling is started.

~~It is believed that~~ the higher average concentration of lead in the air
at the dome of tank cars in the blending area of the San Francisco refinery
are regarded as being ~~are~~ *the position of the* due to the fact that ~~the~~ *the* sampling was started as the dome was being opened
the and connections were being made, ~~to the weigh.~~ In Los Angeles, ~~in many cases,~~
initially, however,
sampling was started, only after connections to the weigh-tank had been made.

The two sets of concentration are representative, therefore, of two different
periods of periods of exposure at the dome of the car. The ~~peak~~ *peak* concentration of 35
micrograms per cubic foot, equivalent to 1235.5 micrograms per cubic meter of

air, was obtained in association with a leak in the dome of the tank car

containing the antiknock compound. The actual exposure of the operator under these

circumstances is negligible, since he ^{makes prompt use of his} ~~wears an~~ approved canister respirator

~~at such a time.~~

fluid into the dome

Other operations in the process of ~~blending~~ ^{mixing antiknock compound with gasoline} do not, ~~tend generally~~

~~as a rule,~~ ^{as a rule,} ~~contaminating~~ ^{used in the blending, not so they} the air within the building ~~(at the weigh tank) or in the~~

~~outside air of the area immediately adjacent to the blending area, as an~~ ^{extent to be hazardous.} Nevertheless, air outside of the blending building

in the San Francisco area contained lead ~~at higher level~~ than that within the

building at the weigh tank ~~itself.~~ The reason for this was not immediately

~~apparent~~ but it may have been due to the direction of air current, ~~together~~

with the location of the tank car or the position of the vent, during the

unloading operation.

The levels of ~~the~~ concentration of lead in the air at the

loading racks were generally in good agreement in the two areas. Average

concentrations on top of the trucks were 0.64 and 0.85 micrograms per cubic

foot, respectively, at the San Francisco and Los Angeles sites. At the Los

Angeles operations, the average concentration at ground level was slightly

higher than that at the top of the truck. The reason for this is not ~~entirely~~

~~clear~~ ^{self-evident} but it is not

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found at ground level at the loading rack in the San Francisco area.

The Air ~~has been~~ ^{was} sampled during the filling of barrels with gasoline containing tetramethyllead on only three occasions. *(The filling of barrels with any kind brand of gasoline is not a frequent operation)* Organic

lead could not be detected in the air during any of these periods. Twenty samples collected in the chemical laboratory were also negative. A ~~trace~~ trace of organic lead was present in the air of the inspection laboratory at the wharf (locally designated as the "long" wharf) ~~in Richmond.~~

Small quantities of lead are being found in the air at filling stations. In the San Francisco area, the total lead averaged 0.26 micrograms per cubic foot ($9.2 \text{ microgram/M}^3$). Of the total lead, 43 percent, or 0.11 microgram per cubic foot ($3.9 \text{ microgram/M}^3$), was inorganic, and 0.15 microgram per cubic foot ($5.3 \text{ microgram/M}^3$), or 57 per cent, was inorganic in nature. In the Los Angeles area the total lead in the air at the filling stations averaged 0.132 microgram per cubic foot (4.7 microgram/ M^3). The inorganic lead constituted 64 per cent of the total lead present ($0.085 \text{ microgram/ft}^3$), equivalent to 3.0 micrograms per cubic meter of air. The organic lead averaged 36 per cent of the total, being 0.045 microgram per cubic foot, or 1.6 microgram per cubic meter, of air.

At one station in Bakersfield, where 19 samples have been

collected to date, the average total ^{collected} lead concentration was 0.28 microgram per cubic foot of air, equivalent to 7.9 micrograms per cubic meter. Inorganic lead averaged 70 per cent of the total, or 5.5 microgram per cubic meter.

The higher average concentration of organic lead in the air ~~at~~ ^{at} the filling stations in San Francisco as compared to those in Los Angeles, is due to ^a differences ^{in the manner of obtaining the samples} in sampling. In Los Angeles, ^{the} air is being sampled near the fueling islands, but not in the immediate vicinity of the gasoline pumps. In San Francisco, the intake of the sampler ^{has been} was located at

approximately the same level as the ~~filler~~ ^{with} opening of the fuel tank of the car, ^{at a distance of} and about two feet from the opening. ^{The samples obtained in} In the case of San Francisco, ^{which were obtained} therefore, ^{higher concentrations of organic lead than those in the} the level portrays ~~the maximum severity of the exposure to which~~ ^{air to which the attendants are likely to be subjected in the ordinary performance} an attendant might be subjected if he remained at such a point during the

entire period of fueling. ^{of these duties, it may be that the samples taken in Los Angeles have tended} In Los Angeles, the levels are averaged out to ^{to portray somewhat lower levels of exposure than those which may occur at times,} take into account other duties performed by the attendant. ~~The two~~

^{This is, of course, a matter of judgment, and therefore it is just as well that the two} sets of data ^{therefore} supplement each other in ^{presenting} that they present certain variable possibilities for exposure to vaporized tetramethyllead at service stations.

Lead in the General Urban Air:

The average concentration of inorganic lead in the air ~~at~~ ^{at} the

general sampling station in

~~commercial center~~ of Los Angeles (5.3 microgram/M³) is approximately

three times as great as that in the air of the ~~commercial center~~ *corresponding station* (1.9

microgram/M³) *in* of San Francisco. The average ~~concentrations found during~~ *values obtained in*

the present investigation ~~are of interest, when compared with the average~~ *may be compared*

~~values~~ of 5.2 microgram/M³ and 2.4 micrograms/M³, found in Los Angeles and

San Francisco, respectively, in 1954 by Chambers and associates (Chambers,

L.A., Foter, M.J., and Cholak, J. "A Comparison of Particulate Loadings in

the Atmospheres of Certain American Cities), Proc. 3rd Natil. Air Poll.

Symp., Pasadena, Cal., April 18-20, 1955; 24-32). Additional information

dealing with the impact of the increased use of motor fuels on community

air pollution may be gained by comparing the average concentration of

5.3 microgram/M³, as observed in the present investigation, with that of

6.75 micrograms/M³, as found in August to November of 1954 in Los Angeles.

(Cholak, J., Schafer, L.J., Yeager, D.W. and Kehoe, R.A., Chap. 8, "The

Nature of the Suspended Matter, Report #9, An Aerometric Survey of the Los

Angeles Basin Aug. - Nov., 1954, N.A. Renzetti, Editor, Air Pollution

Foundation 1955).

increases in the numbers of motor vehicles and in fuel consumption, which have
The ~~current levels of concentrations~~ *are of interest in that the*
~~than incidental interest~~, *since the trend suggested by these*
~~trend~~ is contrary to predictions based on ~~simple~~ calculations from contemplated

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been given nationwide publicity. The results of the current investigation

while limited to a single central station in each city, appear to demonstrate

gain something in potential significance, in their lower relationship
~~the existence of a trend which corresponds to that observed in Cincinnati,~~
to the earlier results. Because of the consistency of this trend clearly, stable
~~Ohio. Data collected in Cincinnati from 1946 through 1959 have shown~~
by the data collected in Cincinnati from 1946 through 1959.

~~that the trend in the concentration of lead in the atmosphere was downward.~~

to decrease in the lead content of the atmosphere.
Several factors were responsible for ~~this trend~~, including the building
in the basin of Cincinnati, including an overall reduction of smoke, the building
of expressways, the expansion of populations into the outlying area, and the

opening up of the basin of the city, all of these tending to increase the

dilution of ~~the~~ contaminants. (Cholak, J., Schafer, J.L. and Sterling,

T.D., The Lead Content of the Atmosphere. To be published in Journal of

the Air Pollution Control Association.)

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