

EFFECTS OF HANDLING ETHYL.

DR. M. COPLANS' REPORT.

WORKER ENGAGED IN FUEL TEST.

DEFINITE TRACE OF LEAD IN SYSTEM.

Below we publish the first section of the medical report on the effects on health of tetraethyl petrol. The headlines and the cross-headlines throughout the report are our own.

By DR. MYER COPLANS, D.S.O.

The following summarises the medical reports on the two mechanics who have been employed in connection with the *Daily Mail* tests on ethyl petrol by the Research Association of British Motor and Allied Manufacturers in attendance upon the stationary engine trials (exhaust gases and deposits) and the examination of the medium-powered and light family cars and motor-cycle.

With their consent, these mechanics have been subjected to independent medical examinations weekly, with particular reference to the signs of the action of lead. They have also been examined by their own private doctors. Their exposure to handling ethyl petrol and its products of combustion as motor fuel was in the ordinary nature of their employment. There was no additional exposure, nor have these men been made the subject of personal experimentation of any description.

Their exposure to this special fuel commenced on January 15 and terminated on March 31, 1923. Their first medical specialist examination took place on February 14 and was repeated thereafter at regular intervals.

Both these men are aged about 25 and single.

MECHANIC A.

Changes in blood: Hemoglobin content (red colouring matter) which was 93 per cent. on February 14, diminished to 90 per cent. on March 13.

Presence of lead: On each of three occasions when he was examined for signs of lead ingestion or lead absorption, lead was definitely discovered to be present in the bowel content to the extent of not less than 1 part in 10,000.

The report by his private doctor on April 2 states that he has somewhat increased blood pressure: 138-185.

MECHANIC B.

Changes in blood: Hemoglobin content, which was 92 per cent. on February 10, diminished to 89 per cent. on March 15. At no time was there any sign found of lead ingestion or lead absorption.

The report by his private doctor on April 5 is that the patient shows slight pallor.

With reference to these reports, the information furnished to me on April 5 by the Director of the Research Association under whose immediate direction and observation these mechanics remained throughout the period of the tests, is as follows: Mechanic A has been handling the ethyl petrol in the engine, whereas Mechanic B has been in attendance and very little exposed to personal contact.

of these mechanics and to protect their health the periodic medical examinations were not only justified but would have to be maintained had their exposure to the action of leaded petrol been continued. In short, it would have been necessary to continue to keep them under medical observation, inasmuch as one of them had shown repeatedly that not only had he been exposed to an industrial lead risk but also that, at a comparatively early stage, he was already ingesting slight quantities of lead.

Spectroscopic examination with photographic record was employed on every occasion for the purpose of detection of the presence of lead. Positive and unmistakable records were obtained.

Portions of the outer clothing worn by these two mechanics at their work while employed in these tests have been submitted to me for analysis with the following results:—

MECHANIC A.

Workshop overall: 4 small pieces taken—one from each sleeve and one from each forepart (chest).

Total weight of material examined: 26.4 grams (nearly one ounce).

Lead tetraethyl present per gram = .0015 milligrams.

Total lead present per gram = 11.3 milligrams.

MECHANIC B.

Workshop overall: 4 pieces taken (as for Mechanic A).

Total weight of material examined: 21.63 grams (3 ounces).

Lead tetraethyl present per gram = .005 milligrams.

Total lead present per gram = 12.4 milligrams.

Cloth cap: Portion examined 11.3 grams.

Lead tetraethyl present per gram = .005 milligrams.

Total lead present per gram = 4.6 milligrams.

These results confirm the fact of exposure to lead.

The laundry to which garments so stained are sent should ordinarily be notified of the lead risk in handling such material, more particularly by laundresses.

INDEPENDENT ANALYSES.

The following analyses are the results of examination of samples of materials furnished me by the Research Association for the purpose of independent investigation.

Ethyl Petrol: 9 samples received for examination. Average content per sample of lead tetraethyl = 0.1566% by weight or 1 part in 638 (by weight).

Stationary Engine: Samples furnished for analysis:

Sample A.—Used oil ex crankcase.

Total ash 0.13%

Lead in sample 0.12%

The ash therefore contained 90% of lead.

The amount of ash obtained was not sufficient to permit of the determination of the nature of the lead compounds present.

Sample B.—Sludge ex crankcase.

Total ash 5.69%

Lead in sample 2.66%

The ash therefore contains 46.76% of lead (largely lead bromide or lead chloride).

Sample C.—Sample of deposit.

Lead content 25.46%, containing either lead bromide or chloride.

HANDLING THE MATERIALS.

The following information is furnished by the Director of Research Association with reference to these materials:

A has been drawn out and in this case can only be removed by scooping it away with the fingers.

C is the sample of deposit (from cylinders) and need not be touched by the fingers, although there are many mechanics who certainly would touch it.

In regard to the accompanying table dealing with the medium-powered car, the small bulk of sample available or the percentage of lead present rendered it difficult to determine the actual composition of lead compounds present, but by analogy with similar previous tests it may be assumed that a large proportion of the lead present (about 50 per cent.) is combined with bromine, at least as far as the deposits are concerned.

MEDIUM-POWERED CAR.

Information Furnished by Research Association.

Quantity	Lead Found Grams	%	Quantity of Sample Grams	Lead Found Grams	%	Quantity of Sample Grams	Lead Found Grams	%
Crankcase Oil ...	3,100 ccs.	9.075	189	.23	.12	202	.106	.062
Washings ...	350 "	0.2245						
Sludge ...	24.068 gms.	0.4534						
		0.0626						
Outside of Block and crankcase ...	52 ccs.	0.202	12.1	.1	0.8			
Inlet manifold acid washings ...	250 "	0.106						
*Inlet valves ...	4.072 gms.	0.7225						
*Exhaust valves ...	1.925 "	0.5245						
*Pistons ...	15.884 "	1.2705						
*Cylinder Heads ...	53.740 "	10.8						
*Spark Plug ...	1.104 "	0.354						
Exhaust manifold acid washings ...	2,500 ccs.	4.706	189 gr.	.52	g/100 cc.	46	g/100 cc.	
*Exhaust pipe scrapings (powd'ry black deposit) ...	43.5 gms.	11.680	175 ccs.	2.7	27.3	3.05	30.5	
Exhaust pipe acid washings ...	1,500 ccs.	0.1268						
Exhaust pipe final scrapings ...	13.5 gms.	1.925						
*Silencer and tail pipe (powd'ry black deposit) ...	201.0 "	26.0						
*7 items total:	221.255 gms	51.4416	16.01	41.4	7.36	17.77	6.972	14.64

Taking the ratio of total lead to lead bromide in the above figures as 100:82.5, and applying this to the data furnished by the addition of the seven items (deposits), the total lead found, viz., 51.44 grams, corresponds with 42.430 grams lead bromide, this being a percentage of 13.2 of the total amount.

The total amount of lead bromide assumed to be present in the seven deposits is, therefore 42.439 milligrams.

MOTOR CYCLE.

Analyses of Samples received from Research Association.

Quantity received (Grams)	Total Lead present Grams	Lead Non-volatile (Bromide) % (wt.)	Lead Volatile (Chloride) % (wt.)
Crankcase Oil ...	37.1	0.28	0.07
Chain sprocket washing - approx. benzol - large amount of dark brown sediment	40.0	0.06	0.24
Wipings (dirty oily rag)	18.08	0.34	1.88
Deposits from piston and head (black granular powder)	9.3	2.3	24.7

LEAD POISONING.

The interpretation of the foregoing analyses must be based partly on the vast clinical and industrial experience, and partly on the experimentation with animals, as recorded by a number of authorities in whom this country has been singularly rich, viz., Sir Thomas Oliver, Sir Kenneth Goadby, Sir Thomas M. Legge, and Mr. G. Duckering, in regard to industrial lead poisoning, and

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More recently, a literature peculiar to the experimental study of ethyl petrol has grown up in the United States, while another literature has arisen in this country by reason of the lead treatment of cancer (Blair Bell), coupled, as it now is, with the certainty of rapid identification of lead in minute quantities by means of spectroscopic examination.

There is, moreover, a vast literature upon the subject of plumbism generally, a compilation having been published in 1922 (in German) citing some 3,000 references.

DANGER TO WOMEN.

The records prove that so minute a quantity as half a milligram of soluble lead consumed daily regularly, and without intermission, as a contamination of drinking water, causes outbreaks of lead poisoning among the exposed population, women being peculiarly affected. With regard to lead dust, the experience of the English authorities cited above (Legge and Duckering) places the figure at 2 milligrams per day in the case of persons exposed to industrial risk. (In this connection lead dust signifies dust containing compounds of lead.)

Even so, women and young persons are so susceptible to this form of poisoning that their employment in certain lead industries has had to be prohibited by legislative enactments in a large number of countries, including Great Britain.

The fineness of division of the particles of the dust, as emitted from the exhaust pipe of motor-cars, is another factor affecting its poisonous nature. The more finely divided particles find their way into the lung more easily than the coarser particles.

Inhalation of lead-contaminated dust in industrial lead exposure is considered to be a hundred times more dangerous than any other method of exposure (skin, swallowing), and the experience of industrial lead poisoning is that 90 per cent. of all cases are considered to be due to inhalation of fine particles of compounds in the form of fine dust.

FINE DUST FROM EXHAUST.

The question of this fine lead dust in the discharge from a motor exhaust of a car using ethyl petrol on the public thoroughfares necessarily concerns the public generally, for the tests conducted by the Research Association of British Motor Manufacturers state that of the lead supplied in the petrol 80.4 per cent. was discharged into the atmosphere. In the case of the motor-cycle, the figures for the light family car and the medium-powered car being 75 per cent. and 83.8 per cent. respectively.

In the case of the stationary engine under test, it is stated that as the engine became warmed up, and as the load increased, the lead content in the exhaust gases rose to 60.2 per cent. of the lead supplied in the petrol. It is shown that if all the lead in the petrol were emitted in the exhaust gases there would be, under average conditions, 94 milligrams of lead per cubic metre of exhaust gas; but even assuming that 30 per cent. only of the lead is being emitted as a reasonable average, this would mean 28 milligrams of lead per cubic metre of exhaust gas.

OF GRAVEST CONCERN.

It is important to bear in mind that each and every car using ethyl petrol in a public thoroughfare is emitting this quantity of lead into the atmosphere, and the conditions in narrow streets with tall buildings in the neighbourhood of traffic blocks, or in vehicular tunnels, becomes a matter of the gravest concern in this densely populated country.

The question of carbon monoxide which may be present in the exhaust gases to the extent of 5.5 per cent., or even greater, does not present any new factor for consideration, for there is no

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greater quantity of this rapidly poisonous gas discharged from the exhaust of a car using ethyl petrol than occurs with any other kind of petrol.

Carbon monoxide, being a gas, rapidly diffuses away into the surrounding atmosphere in open thoroughfares and may be readily assisted to do so by natural ventilation in garages or closed-in spaces. But with lead dust, as it exists in motor exhaust of an engine using ethyl petrol, the problem is entirely different.

CUMULATIVE DANGER.

In industrial enterprises the removal of lead dust can only be effectively achieved by powerfully driven fans or suction apparatus. In garages, tunnels, or open spaces this dust, which is of a heavy nature, tends to hang in the atmosphere within the breathing level of man.

Some of it will deposit on the ground only to be raised again as fresh dust by other passing vehicles, and thus a vicious circle of accumulation and disturbance of lead dust is set up. Some of this dust will accumulate in low-lying places, such as areas, cellars, garage pits, and on the walls and windows of adjoining houses.

It is known that lead dust, being of a sticky nature, will, in the presence of slight moisture, tend to adhere to the surface on which it deposits. From the ground will result surface pollution of water supplies if the dust contains compounds of a water-soluble nature.