

On the Absorption of Tetraethyl Lead Out of Lubricating Oil

A brief report of experimental observations carried out to determine the general magnitude of the potential hazard of lead absorption among persons who may handle lubricating oil containing small amounts of tetraethyl lead

by

Robert A. Kehoe

In consideration of the fact that a distributor of lubricating oil has expressed a wish to purchase tetraethyl lead from the Ethyl Gasoline Corporation for use in the preparation of a special lubricating oil, it has seemed desirable to investigate various aspects of the potential health hazards which may be hypothecated as an outgrowth of the addition of tetraethyl lead to motor lubricants. The problem which is the subject of discussion and experiments herein, has to do only with the absorption of tetraethyl lead out of lubricating oil. This problem has been investigated by methods similar to those which were employed to determine the extent of the absorption of tetraethyl lead out of gasoline.

Experimental Methods

Healthy full grown rabbits were selected. After a brief period of observation in order to establish the healthiness of the animals, they were prepared for the experimental procedure by clipping the hair from their fore legs. On successive days, each animal was held with a fore leg dipped in a known concentration of tetraethyl lead in oil, (Stanavo, Viscosity 120, as supplied by Standard Oil Company of Ohio), for a period of half an hour. After the exposure, the skin of the animal was cleansed as thoroughly

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which the skin was generously coated with white paraffin oil in order to prevent undue injury from its contact with the kerosene. The viscosity of the oil and its tendency to spread beyond the treated area, as well as the necessity for gentle handling of the animals, militated against the complete cleansing of the skin. Thus a certain skepticism existed with regard to the quantitative removal of the lead-oil solution. The data will demonstrate that such skepticism was fully justified. Nevertheless, since such technical difficulties could confidently be expected to bring about high results, rather than low, it was believed that such errors as might occur would be on the side of an increased severity in the test conditions.

The animals were fed in the usual manner and kept under observation. Necropsies were performed soon after the death of animals that died in the course of the experiment. Certain surviving animals were killed at suitable times and examined for pathological changes. The tissues of the animals were analyzed to determine their lead content by means of methods which we have employed previously in similar experiments on the absorption of lead out of leaded gasoline.

Experimental Observations

I. Three rabbits were subjected to contact with oil containing 10 per cent of tetraethyl lead by volume. Rabbit #388 was so subjected on 2 successive days. He became ill and died on the second day after the second period of contact, further manipulation having been suspended because of his apparent illness.

Rabbit #387 was subjected to such periods of contact on 5 successive days. He was only slightly ill until the day after the fifth period of contact, at which time further contacts were discontinued. The animal

KE 0003482

sickened and died three days after the last (fifth) period of contact.

Rabbit #386 became ill with intercurrent sinusitis and otitis during the course of the experiment, after having been subjected to three periods of contact. The experimental manipulations were suspended, the animal recovered, and is apparently well at present. (Two and a half months after the last period of contact.)

The analyses of the tissues, carried out in such a way as to differentiate alimentary lead from that in the remainder of the carcass, appear in Table 1. Attention is directed to two points in the data; (a) the gross amounts of lead found in the tissues are small as compared to those found in the tissues of an animal subjected to similar contact with a 10 per cent solution of tetraethyl lead in gasoline (after 3 half-hour periods of contact with such gasoline, a rabbit was found to have 36.46 mgs. of lead in its tissues); (b) the amounts of lead are especially high (Cf. Rabbit #387) in the alimentary tract, indicating that the animals swallowed lead in licking the grease cream from their contaminated skins, as they were seen doing regularly after being returned to their cages. It seems apparent, therefore, that the oil was absorbed more slowly through the skin of the animals from this oil than it had been from gasoline. Additional evidence that this was the case is derived from the fact that one out of three animals survived, while all three of the rabbits previously reported as having been subjected similarly to contact with gasoline containing 10 per cent tetraethyl lead, died as the result of three such contacts.

II. Three rabbits were subjected to a corresponding type of contact with oil containing 1 per cent of tetraethyl lead in oil. This experiment, considered as of more significance than that previously described, was carried out over a longer period of time. Thirty periods of contact of half an hour

KE 0003483

each, ~~the experiments~~ were carried out. On account of the evidence of lead ingestion obtained in the first set of observations, more time and attention was given to cleansing the skin after each period of contact. After the period of contact, thirty-first / the animals were killed, and their tissues were prepared for analysis by separation in accordance with the list shown in Table 2. The skin was removed and discarded with the utmost precaution against contamination of the tissues beneath it. The other tissues were analysed in their entirety. The analytical results are recorded in Table 2. The amounts of lead found in the tissues are not greater than those which are found commonly in those of normal animals. One result (the heart of Rabbit #389) was aberrant, apparently the result of contamination of the sample either in process of preparation or in the course of the analysis. This result can be ignored entirely as irrelevant, since it is not possible that it could have been due to the absorption of lead during the experiment, in view of the otherwise negative findings. Attention should be called especially to the absence of lead in the tissues of the central nervous system.

Summary and Conclusions

(1) The foreleg of each of three rabbits was immersed in a ten per cent solution of tetraethyl lead in lubricating oil. One animal died as a result of two such immersions, each continued for half an hour on successive days; another died after five such periods of contact; another survived after three such periods of contact, despite a complicating intercurrent illness (an acute suppurative sinusitis and otitis). Analytical evidence indicated that a portion of the lead found in the bodies of the animals was the result of ingestion due to the practice of the animals of licking themselves after the

KE 0003484

lead found were considerably less than those which resulted from similar contacts of the skin with a 10 per cent solution of tetraethyl lead in gasoline.

(2) Similarly, three rabbits were subjected to contact, repeatedly, with a 1 per cent solution of tetraethyl lead in oil. The animals did not sicken, but remained healthy through the period of 6 weeks during which they were subjected to contact with the oil for half an hour per day on each of 30 days (5 days per week). Analyses of their tissues at the end of this period failed to disclose evidence that lead had been absorbed through their skin.

It is concluded that the rate of the percutaneous absorption of tetraethyl lead out of lubricating oil is materially less than that out of gasoline, and that no appreciable absorption occurs when the concentration of tetraethyl lead in the oil is equivalent to 1 per cent or less, by volume. The experiments have failed to yield evidence of the likelihood of the hazard of percutaneous absorption of lead among persons who may handle lubricating oil containing less than 1 per cent of tetraethyl lead.

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Table I

Lead in Tissues of Animals Subjected to Contact of Their Skin with Oil Co
10 per cent of Tetraethyl Lead

Tissues	Lead Found in Milligrams	
	Rabbit #387 5-half hour periods of contact Died 3 days after last period of contact	Rabbit #388 2-half hour periods of contact Died 2 days after last period of contact
Entire leg subjected to contact, including skin	0.40	
Intestinal tract and contents	11.10	
Remainder of carcass exclusive of skin	4.12	
Total lead found in tissues*	15.62	

* All the skin of the body with the exception of that on the leg subjected to contact was discarded.

Table 2

Lead in Tissues of Animals Subjected to Contact with Oil Containing 1 Per Cent
Tetraethyl Lead

Tissues	Lead Found in Milligrams	
	Rabbit #389	Rabbit #390
Kidneys	0.15	0.00
Liver	0.02	0.06
Spleen	0.00	0.00
C. N. S.	0.00	0.00
Muscle	0.03	0.03
Heart	1.17 *	0.00
Lungs	0.00	0.00
Bone	0.23	0.12
Intestinal Tract	0.34	0.34
Remainder	0.29	0.16
Total	1.06 **	0.71

* Obviously a contaminated sample

** Exclusive of the aberrant result