

Report on Gaseous Detonation and Control
with reference to Lead

Roberts, Surgeon.



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TREASURY DEPARTMENT

UNITED STATES
PUBLIC HEALTH SERVICE

ROSEBANK
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Surgeon General, U.S. Public Health Service,
Washington, D.C.

FILE B. L. J.

Sir: (Through Chief Medical Officer, Ellis Island, N.Y.)

I have the honor to report that I have accomplished the purpose of the following Bureau telegram to the Chief Medical Officer:

DIRECT SURGEON NORMAN ROBERTS ATTEND MEETING AMERICAN CHEMICAL SOCIETY RUMFORD HALL FIFTY TWO EAST FORTY FIRST STREET NEW YORK CITY NOVEMBER TEN EIGHT PM REPORT ON ADDRESS BY THOMAS MIDGLEY GASEOUS DETONATION AND ITS CONTROL PERIOD SERVICES INTEREST IS IN POSSIBLE POISONOUS EFFECTS OF LEAD COMPOUND IN GASOLINE

Midgley has sought to increase the efficiency of gasoline as a fuel for internal-combustion engines. To this end he has sought to compress the air-vapor mixture (before the combustion stage in the cycle) beyond the present practicable limits. To this end he has sought a chemical substance which, when added in small amounts to the gasoline, would prevent the combustion of the highly-compressed explosive mixture from assuming a violent or detonating character, this tending to destroy the motor. In chauffeur's language, he has tried to increase the mileage of gasoline by adding to it an "anti-knock" substance.

Midgley found that the best and indeed practically the only worth-while anti-knock substance was tetra-ethyl-lead, $Pb(C_2H_5)_4$, a hitherto little-known metallo-organic liquid freely soluble in and volatile with gasoline. Tetra-ethyl-lead in concentrated form is described as a heavy, mobile liquid, smelling like witch hazel. As a vapor, it irritates the eyes and nose. As a liquid, it irritates the skin of the hands. If improperly manipulated, it can produce lead poisoning. But as an antiknock, it is required in the proportion of only 3 cubic centimeters to the gallon of gasoline; and such a mixture can be handled in any reasonable way without toxic effects.

When this lead-containing gasoline is burned in a motor-cylinder, the lead is converted into a solid inorganic form. It

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would naturally be supposed that the exhaust would contain finely-divided particles of some lead compound; and this free evacuation of the lead is a necessity for the practical continuous use of the fuel in a motor. But Midgley states that thus far in his experiments no lead has been demonstrable in his exhaust gas. On the contrary, it all seems to cling to the walls of the combustion chamber, imparting to the "carbon" a grayish appearance, attacking the nickel of the spark-plug points, and necessitating unduly frequent cleanings and replacements inside the cylinders. Midgley is experimenting with other compounds which, added to the gasoline, will obviate this drawback, and will cause the lead to scavenge out with the other waste products.

The presence of lead in the exhaust will (when the process has advanced to this stage of development) add another poisonous constituent to the carbon monoxid already present in the exhaust gases. Moreover, lead as a poison is cumulative. Hence the public-health question arises: Will the use of lead for this purpose cause lead poisoning in those breathing the exhaust gases? The probable answer, according to Midgley, is No; and for the following reason:- Owing to the carbon monoxid present in all automobile and similar exhaust gases, there must be free ventilation in all spaces into which these gases escape, if the air of these spaces is to be breathed. Experiments preliminary to the construction of the Lower-Manhattan-Jersey-City vehicular tunnel show that the highest reasonably-safe concentration of carbon monoxid is about 0.01 of 1 percent, this proportion being breathable, without demonstrable harm, for as much as four hours every day indefinitely. Even if all automobiles using the vehicular tunnel used this lead-containing gasoline, and even if all the lead in the gasoline were discharged into the air of the tunnel, the concentration of lead in the air of the tunnel would still be too low to produce any toxic effect whatever. In other words, the more toxic substance, carbon monoxid, would probably prevent the absorption of the less toxic substance, lead, even under the most unfavorable conditions known to exist, in spite of the more cumulative character of the lead. This, however, is theory only; and Midgley says that he would welcome co-operation and extend facilities for toxicologic investigation if desired.

COMMENTS BY ROBERTS.

There are available, here and now, no figures showing the actual total amount of accumulated lead necessary to cause chronic human plumbism, nor the amount of lead which, after being ingested in small quantities, the human body is able to get rid of day after day, without causing undue strain on the organs of elimination. As an estimate, the human body would probably require a rather large amount of lead, over one gramme at the least, to saturate it to a harmful degree; and it could get rid of only a small amount not over about 5 milligrammes, each day. A fair-sized car, working properly on Midgley's lead-containing gasoline would consume say 3 or 4 gallons daily and discharge into the air about 7 gramme

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of lead. If as much as one-one-thousandth of the total exhaust were absorbed by any one man, day after day, he would probably accumulate lead and ultimately be poisoned. But as no such proportion of the total exhaust is ever breathed by anyone day after day, the possibility of lead poisoning from this source is to be regarded as remote.

It would nevertheless seem advisable if practicable to detail a competent Service representative to study the effects of this lead-containing exhaust, suitably diluted with air, on animals. If Midgley's work is commercially successful, as seems likely considering its nature and the financial standing of the parties interested, large quantities of lead-containing gasoline will soon begin to be used as motor fuel; and even if such turns out not to be the case, the toxicologic facts obtainable would be of permanent value.

I desire to acknowledge Mr. Midgley's courtesy to me personally and ^{as} a Service representative, in explaining and amplifying the points of his address in which the Service is most interested.

Respectfully,

Norman Roberts

Surgeon.

Respectfully forwarded:

W. A. Ziehl

Surgeon,

Chief Medical Officer.