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May 6th, 1953

Dr. T.A. Boyd
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Detroit 2, Michigan

Dear Dr. Boyd:

Following your very instructive and entertaining talk at the Pittsburgh Chemists Club last night, I would like to have talked to you about the recovery of lead bromide from the spent TEL in automotive fuel consumed. I believe my thoughts to be provocative but can see no practical way to achieve a profitable recovery. The automobiles themselves, together with the winds that blow have done such a job of distribution that the prospects for recovery would seem akin to G.H. Lewis' probability of unscrambling an egg by scrambling it long enough.

We know that lead is, and will be the more so, in short supply. We also know the large amount of lead required to supply the national demand for TEL and the considerable amount of bromine required for ethyl fluid.

The thought occurs as to whether there are any sources where recovery of lead and bromine might be considered. Two sources which have intrigued me are as follows:

(1) Street sweepings in populous cities. Power sweeping is practiced in large cities and the refuse is presumably used for land-fill. The concentration of level bromide is certain to be very small, perhaps too small to warrant any work of extraction by leveling with hot water or by sublimation by heating. Classification processes involving air or water. Flotations might enter into a scheme of separation. The organic matter in sweepings although probably not near as high as it was in the horse and buggy days, presents a problem in any recovery scheme. It might well be that the recovery process would become one of producing a soluble insecticide for garden plants from extracting the cigars and cigarette butts. Bromine can, of course, be freed from lead bromide using sulfuric acid and several schemes are available for the recovery of lead as such.

(2) Exhaust gases from vehicular tunnels. Presumably electrostatic precipitation would give a concentrate of lead bromide which could be worked into lead and bromine as already indicated. I had thought this source would yield sizable amount of these elements but my calculations concerning the Holland Tunnel proved disappointing and dissuaded me from any thought of going into the business. Here they are:

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In 1940, 13,331,159 vehicles used the tubes
Tunnel is 1.6 miles long.
Assume 100% recovery of fumes. 18 miles per gallon gasoline.
2 ml. ethyl fluid per gal. 60% volume TEL, 40% ethylene bromide.

TEL sp.g. 2.00 mol. wt. 323.5
Et Br₂ sp.g. 2.18 mol.wt. 188.

<u>13,331,159 x 1.6</u>	=	1,170,000	gal. gasoline x 2	=
18		2,330,000	ml. ethyl fluid x .6	=
		1,400,000	gls. TEL x 2.00	=
		2,800,000	gms. TEL x 2.08	=
		1,800,000	gms. Pb. x 454	=
		4,000	lbs. Pb.	=
		2,330,000	ml. ethyl fluid x .4	=
		930,000	ml. Et Br ₂ x 2.18	=
		2,180,000	gms. Et. Br ₂ x 160	=
		1,860,000	gms. Br ₂ x 454	=
		4,000	lbs. Et. Br ₂	=

On this basis, two tons of lead and two tons of bromine might be recovered per year, which is hardly a sizeable amount.

It has been estimated that the usage of lead for anti-knock is 10% of the total lead usage. It is about 1-1/4 million tons per year. If evenly distributed over the area of the continental United States, it would amount to approximately 1/2 ton per square mile or 1 1/2 lbs. per acre. While there will be much higher depositions in populous areas (one can arrive at a figure of 5-tons per square mile for the District of Columbia), I doubt.

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if these figures can be obtained with any accuracy because of the dist. effect of winds. The fumes from American automobile exhausts, I believe since penetrated in some degree, the jungles and deserts of all continents and both polar regions. Much of the lead salt fumes is no doubt washed into the streams by rains, and, as with all mineral matter possessing a degree of solubility, the lead salts must eventually concentrate in the

Of course, one might postulate each motorist recovering his bit of lead salts by some collecting device attached to the exhaust system and a collection system to round up the whole tonnage. This is hardly practicable for a number of reasons.

I thank you for having the patience to hear me out in this matter, (as you have read this) and I would be interested in knowing what you, and any others with much experience in this field, think.

Very truly yours,

Edwin W. Shand
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