LEAD 2-ETHYLHEXOATE.

Lead 2-ethylhexoate (also called lead 2-ethylhexanoate, lead α-ethylcaproate, or lead "octoate") is the lead salt of 2-ethylhexoic acid.

(Its structural formula is:-

$$Pb\left[OOC-\underset{C_2H_5}{CH}-CH_2-CH_2-CH_2-CH_3\right]_2$$; this was given

incorrectly on the data sheet sent you by the Ministry of Supply).

It is a typical metallic soap (i.e. the salt of a metal and a fatty acid) and is insoluble in water, but soluble in certain organic solvents. It is not, in the strict usage of the term, an organolead compound, since its structure does not involve any Pb- C linkages, such as are present in tetraethyllead and in triethyl- and diethyllead salts. Also, it is hardly conceivable that it could produce true organolead compounds, by chemical reaction, either in vitro or in vivo. As a lead salt of an organic acid, it is analogous in many ways to lead salts of inorganic acids, such as lead chloride, which are ionic in nature; thus in ether, in which lead 2-ethylhexoate is soluble, it will tend to ionise as follows:-

$$Pb\,(O_2C - C_7H_{15})_2 \longrightarrow Pb^{++} + 2\left(O_2C - C_7H_{15}\right)$$

The methods which may be used for its preparation are also indicative of its salt-like nature:-

(1) $PbO + 2\,C_7H_{15}CO_2H \longrightarrow Pb(O_2C-C_7H_{15})_2 + H_2O$

(2) $PbCl_2 + 2\,NaO_2C-C_7H_{15} \longrightarrow Pb(O_2C-C_7H_{15})_2 + 2NaCl$

From a toxicological point of view, therefore, it can be predicted that it will resemble more closely inorganic lead compounds rather than organolead compounds such as T.E.L.

The high toxicity of T.E.L. can, as a first approximation at least, be attributed to (1) its volatility and (2) its fat or lipid solubility. Lead 2-ethylhexoate, reported to be a liquid, is not volatile, but decomposes on heating, probably to give mainly lead oxide and ketonic substances. Although it is soluble in organic solvents such as esters, and therefore would be expected to have a certain fat solubility, it is probable that this is of a much lower degree than that of T.E.L. Thus, S.B. Elliott in an article on driers and metallic soaps, (Encyclopedia of

Chemical Technology, Vol. 5, p. 204) states: "The metallic soaps are not nearly as fat soluble as the organo-metallic compounds; it is probable that this difference in fat solubility is the cause of the relatively low toxicity of metallic soaps when applied to skin surfaces. Lead oleate, for example, has been used medicinally as a plaster for treating various skin diseases, whereas the lead alkyl compounds are very toxic in contact with skin surfaces." Unfortunately, I have been unable to find any quantitative information on the solubility behaviour of lead 2-ethylhexoate, but I think it fairly certain that the above generalisation would apply to it.

On the basis of lack of volatility and lower fat solubility, therefore, it is predicted that the toxic hazard of lead 2-ethylhexoate is considerably less than that of T.E.L. The use of lead "plasters," such as lead oleate, in medicine is certainly of significance here; lead 2-ethylhexoate should be very similar in properties to lead oleate.

Elliot (loc.cit.) indicates that the main hazard involved in the use of metallic soaps is the accidental ingestion of such materials. Although lead 2-ethylhexoate is practically insoluble in water, it would be readily hydrolysed in the stomach to produce the soluble lead chloride.

It is possible that studies or evaluations of the toxicity and hazards of lead salts of fatty acids (i.e. lead soaps) have already been made. With respect to the latter, I have found a reference in "Chemical Abstracts" which may be relevant:

"Industrial Hygiene Observations on Driers" - Walter Meyer Farben - Chem. vol. 11., pp. 173-8 (1940) (Abst: Health hazards involved in the manufacture and use of the resinates, naphthenates, etc., of Pb, Mn, Co, Zu, etc. are reviewed with special attention to prophylactic methods).

It is quite likely that there are other papers in the voluminous literature on industrial lead poisoning and hazards which refer specifically to lead soaps, but "Chemical Abstracts" is not very informative on this point; some of those dealing with lead poisoning and hazards in the paint and varnish industry might be relevant.

In an article by E.P. Lang and F.M. Kunze (J.Ind.Hyg. Toxicol. vol.30, pp. 256-9 (1948), it is stated that skin (in rats) is more permeable to lead acetate (in aqueous solution) than to lead oleate (in petrolatum and oleic acid vehicles) and that it is much less permeable to lead arsenate (in a paste). These three substances are compared with T.E.L., and it is pointed out that with T.E.L. the entire organism becomes flooded with lead (e.g. kidney values are 10-20 times higher than with the other two compounds). On this basis, one might perhaps conclude that

(Contd).

lead-2-ethylhexoate (like lead oleate) is less dangerous than the very soluble (in water) lead acetate but more dangerous than the relatively insoluble lead arsenate. However, you will probably wish to examine the original paper, of which I have only seen the abstract.

I have remarked that lead 2-ethylhexoate is not volatile. On heating, however, it decomposes, the principal products being lead oxide and ketonic substances; some metallic lead may also be formed in this decomposition. It is quite probable that this decomposition presents a toxic hazard since an aerosol containing inorganic lead would be expected to be formed. It is known, for example, that lead linoleate (also a lead soap) evolves toxic lead fumes on heating (cf. Sax- "Handbook of Dangerous Materials," Reinhold, 1951). Also, in manipulations involving lead 2-ethylhexoate either as the pure liquid or in solution, toxic aerosols might readily be formed. In the manufacture of lead 2-ethylhexoate from lead oxide and 2-ethylhexoic acid, relatively high temperatures (up to 300°F) are involved, and there is also the possibility of lead-containing aerosols being produced here.

I am afraid this has rather rambled on and on, but I do hope it will be of some use to you. Certainly, one can conclude that lead 2-ethylhexoate is considerably less hazardous than T.E.L. However, because of its definite fat solubility, and in spite of some of the discussion above, it would be best, it seems to me, to regard it as potentially more dangerous than inorganic lead compounds commonly met with in industry.