METHODS OF DISPOSING OF SLUDGE FROM LEADED GASOLINE STORAGE TANKS

The first case of lead intoxication, as a result of work within a leaded gasoline storage tank, occurred in 1932. At that time, the source of lead was thought to be the sludge in the bottom of the tank and this assumption proved to be correct. Therefore, it became necessary that the sludge be disposed of by a method which would avoid harmful effects both from skin contact or inhalation of its vapors after removal from the tank. The immediate solution was the burial method of disposal.

This procedure required the necessary space, the digging of pits and covering the partially filled pits with soil. The method was accepted without question until relatively recently. Within the past several years, inquiries have been made by a number of oil companies asking for an alternate method of sludge disposal. The requirement for an alternate method arose primarily in those refineries which found that the space available for sludge pits was being exhausted. The difficulty was increased because we had no knowledge of when the sludge might become innocuous, so that the area could be used once again. There have been many assumptions made concerning this time factor, but insufficient supporting data have been available.

Some effort has been made to solve the problem of the time required for the reduction of organic lead in buried sludge but the efforts have not been rewarding. The principal difficulty was that every time arrangements were made for the sampling of sludge for its original lead content, the sample was so low in organic lead content that it was not good experimental material. It was suggested that we produce our own concentration of TEL in sludge in order to have an adequate sample for study. However, there was evidence to show that added TEL did not behave like "naturally" occurring TEL in terms of disappearance of the compound. Added TEL was found to be more readily vaporized than that which was found as a result of its accumulation under stored gasoline. We had guessed (and there was some evidence to support the conjecture

[illegible] was finally [illegible] as being out of proportion [illegible] attached to it.

For these reasons, it became desirable to develop a second method of disposal. After considerable thought and experimental effort had been devoted to the problem, Ethyl Corporation believed that it was in a position to [illegible] a new method. Initial use was to be on a trial experimental basis.

The procedure became known as the "Weathering Method." It consists of [illegible] the sludge in layers not to exceed three inches in thickness, the [illegible] roping off and isolation of the area covered by sludge and the posting of [illegible] that the area is hazardous. The sludge remains untouched for a minimum [illegible] of thirty days. Under the experimental program the weathered sludge has [illegible] for organic lead at [illegible] days. When the concentration of [illegible] was found not to exceed [illegible] weight (20 p.p.m.), the sludge was [illegible].

[illegible] degree of [illegible] confidence in the method has been [illegible] persons but [illegible] always to be expected when a change or a new [illegible] particularly when it concerns health and safety. Some of this [illegible] from some degree of misinterpretation of our own attitude toward [illegible].

[illegible] is one of great importance in the understanding of the sludge [illegible] program should first be clarified:

(1) In this discussion, reference is made to only one component of sludge - namely organic lead compounds. No other materials have been considered even though other components may be health hazards.

(2) It is necessary to think of the dangers of the vapors that arise from sludge under two quite different sets of conditions; namely, in closed or relatively closed spaces, on the one hand, and in open unrestricted spaces, on the other.

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e safety of the method depends on the original dispersion of organic lead ...orizes and the great dilution which occurs when it is not in a confined space.

Three questions must be considered in judging the safety of this method of ...dge disposal:-

(1) What are the risks which arise from the sludge when it is spread freshly with its maximum content of organic lead?

(2) Does weathering in reality reduce the organic lead content to a level that makes it completely non-hazardous and suitable for handling as ordinary waste material?

(3) What is the period of time required for reasonable complete vaporization?

The risks involved in handling sludge as it comes from the tank are the same as the handling of sludge when put into a pit for burial. There is no reason to believe that any significant absorption of lead has ever occurred as a result of the ordinary and proper removal of sludge from tanks. The potential problems that exist are those of absorption of organic lead through the skin from contact with the sludge and the inhalation of lead vapors arising from the sludge.

Although there are no direct experimental data to prove or disprove the probability of absorption of organic lead through the skin from contact with sludge, experience makes it possible to develop certain comparisons. Many observations have been made of men who have worked on tank entry and tank cleaning jobs. In some instances, (definitely against regulations) men have worked wearing clothing contaminated with sludge, have worn leather shoes and have had their hands and other skin areas covered with sludge. Although no determinations were made to measure possible lead absorption, these workers have never shown symptoms from this type and degree of exposure.

The occasional cases of lead intoxication that have occurred as a result of work in leaded gasoline storage tanks have always been demonstrated to be the result of absorption by inhalation while within the tank. Therefore, in every case it has been demonstrated that absorption was a result of either a failure to use proper

[illegible] failure of that equipment.

[illegible] confined skin application of gasoline containing concentrations in considerable excess of those found ordinarily in gas[illegible] and no appreciable absorption of lead has been found.

[illegible] series of [illegible] samples of sludge taken from leaded gasoline storage tanks in 1955-59, the mean organic lead content was found to be 0.011% and the range was from [illegible]% to 0.1565%. These samples were largely from unwashed sludge. There were only three results which were at a level of 0.10% or greater and these three results must be regarded as exceptional. The maximum allowable concentration of tetraethyl lead in gasoline is about 0.2% by weight. Although the careless handling of sludge and contact with it are definitely not condoned, it is highly unlikely that, with even a minimal degree of care and cleanliness, significant absorption will occur from skin contact with sludge even before reduction of its organic lead content.

The degree of hazard that might exist from the inhalation of vapors arising from the fresh spread sludge has probably been confused with the hazard produced by the entrainment of its vapors in confined spaces. It requires only astonishingly small concentrations of organic lead in sludge to produce distinctly dangerous concentrations of organic lead in the air above it when the sludge and air are confined and sufficient time is allowed for vaporization to occur. However, an almost totally different set of conditions exist after sludge is spread in the open.

By the time sludge is spread its organic lead content is usually reduced. This comes about principally by a considerable degree of removal which occurs as the tank is washed and the sludge is flushed with water from pressure hoses. After the sludge is spread there is no opportunity for the concentration of organic lead to build up in the overlying air and even in still air dispersion alone provides for an increasing dilution of the vapors away from the sludge surface.

Theoretically it has been shown that the concentration of TEL in a volume of still air over a solution of TEL in gasoline (3 ml TEL/gal gasoline) drops off very rapidly. In a period of 18.4 hours the concentrations of lead in a column of still air over this interface would be 134,000 micrograms per cubic foot at a distance of 1 ft. The concentration of lead drops to 33,300 micrograms per cubic foot at a level of 4 feet above the surface and to 8,380 micrograms/cu. ft. at a level of 6 feet above the surface. Application of formulas from which these figures have been derived have not been applied to vaporization from sludge because of many unknown factors.*

In practice, it is known that the concentration of TEL in the air 1 foot above the interface of sludge and air is very low even initially. No concentration over 4 micrograms per cubic foot has ever been found in the air above freshly spread sludge. There does exist a report of a result of 20 micrograms per cubic foot (that was obtained by others) at a level of 1 foot above a spread of sludge reported to have a concentration of TEL of 0.1%. Even at the concentration of 20 micrograms per cubic foot at 1 foot above the sludge it can be assumed that at normal breathing level of 4 to 6 feet the concentration would not exceed 4 micrograms per cubic foot. Therefore, we had assurance that, with ordinary care, there is no hazard to be expected from sludge spread for weathering even before any vaporization has taken place.

In order to determine the question concerning the vaporization that takes place in practical applications, a field investigation was conducted where samples of sludge were taken from 36 test areas when sludge was first spread for weathering and again

*These figures are mentioned not because there is any relationship between the magnitude of the concentrations but to illustrate the reduction of concentration in relation to distance.

at the end of a 30-day period. These experimental spreads were made over a considerable geographic distribution as far south as Louisiana and Texas and as far north as New York State and New Hampshire. The tests were made during all calendar weather periods. At the end of a 30-day period all of the weathered sludge samples except four were reduced to a concentration of organic lead of 0.002% or less. Two of these four exceptions were found to contain 0.006% organic lead and two were found to contain 0.004%. In one instance where 0.006% was found in 30 days, an additional exposure of 14 days reduced the organic lead concentration to 0.001.

Temperature is the most influential factor in vaporization but extremely high temperatures are not required. At freezing temperatures little or no vaporization occurs and it is advised that days of freezing temperature be excluded from the 30-day weathering requirement. Of the 36 weathered samples 6 were reduced to zero % organic lead. If zero results should be required, additional time over the 30-day period will attain this result.

Conclusions:-

1. The handling of sludge as it is taken from the tank and spread on the ground is no more hazardous than the handling of sludge when it is dumped into a pit.
2. The presence of sludge spread over the ground in thin layers creates no hazard if ordinary precautions are taken to avoid contact with the sludge and the vapors arising from it.
3. A 30-day period of weathering (exclusive of days of freezing temperatures) reduces the organic lead content sufficiently for all restrictions to be removed and to allow disposal or treatment as any ordinary waste.
4. There are advantages in the weathering method over the burial method insofar as finality of the problem is concerned and insofar as availability of more and more disposal sites are concerned.