LIA09767

LEAD INDUSTRIES [illegible] ASSOCIATION
[illegible]
NEW YORK [illegible], N.Y.

[illegible] LEAD PRODUCTS [illegible] August [illegible]

[illegible]:

"Lead lined acid [illegible] a [illegible]", [illegible] tration plant [illegible] 19 years of [illegible] the lead and [illegible] linings are being [illegible]

Six [illegible] ft. deep with a [illegible] 20-lb. lead strapped [illegible] obtained by heat of reaction. [illegible] service in the five dilution tanks [illegible] tanks at Baltimore are holding up well with a [illegible] lining.

Complete depreciation was assumed for the boiling tanks to be [illegible] years, yet in one to two years' time maintenance cost had become [illegible]. There is no objection to the use of lead by the waterworks engineer except for mechanical fatigue resulting from temperature changes causing bulges and sagging.

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a. **INTRODUCTORY HISTORY**

Alum has been a useful chemical since ancient times. The Egyptians used it in certain medical preparations and the Romans used it to fireproof their siege machines. Alums are used in water treatment and in dyeing but are being replaced by aluminum sulfate, which has a greater alumina equivalent per unit weight. The word alum or filter alum is often used to denote aluminum sulfate which may be used in water treatment, in the textile industry, as mordant for dyes, and pharmaceutically in dilute solution as a mild astringent and antiseptic for the skin. Small amounts are used in sizing of paper and in making some baking powders, but most important is water clarifying which consumes 65% of all aluminum sulfate produced.

Large scale water treatment may take one of several forms depending on the condition of the water supply. Pure chlorine may be added to destroy any bacteria present when the natural water is clear. Filtration through slow sand filters and subsequent treatment with chlorine is often practiced where there is suspended matter present. Treatment with aluminum sulfate (or ferrous and ferric sulfate), filtration, and subsequent treatment with chlorine is often required. As most of our natural waters are basic the addition of aluminum sulfate causes the formation of aluminum hydroxide as a colloidal dispersion throughout the water. This coagulates slowly and, as it settles, carries down any suspended matter present, including bacteria and many absorbed coloring materials.

b. [illegible]

In the [illegible] to [illegible] diluted to [illegible] is [illegible] to [illegible] (Alg[illegible] [illegible] and Alabama and [illegible]

Agitation [illegible] covered stirrers or, [illegible] by an air blast. [illegible] of the [illegible] which builds up to [illegible] procedure is to have one or two reaction tanks which [illegible] combined temperature and corrosive action and several [illegible] which may or may not be lead lined.

In Baltimore the reaction is run not more than once a day while at the Dalecarlia plant in Washington, D.C., they often run two batches per day and claim a slightly higher temperature. The batch is cooled for three hours at one degree per minute.

For uses other than water treatment the concentrated liquor may be poured into flat pans to be cooled and completely solidified. The solid cake is then broken and ground to size for shipment.

c. EQUIPMENT DESCRIPTION

In the Baltimore filtration plant on Hillian Road there are six steel tanks (see first drawing), 15 ft. in diameter and 17 ft. in overall depth. The circular tanks have a hemispherical bottom with a 7-1/2 ft. radius which is not generally regarded as easy to fabricate or line. A shallow "V" bottom is far easier to construct, less difficult to repair, and allows a better lead installation. Three of these tanks are used for dilution and are lined with a bitumastic enamel which is a product of the Wailes Dove-Hermiston Corporation, Westfield, New Jersey. The other three tanks are lined with 20-lb. lead with vertical straps every 36 in. These straps merge toward the center, terminating at the outer edge of a circular lead plate 3 ft. in diameter.

At the Dalecarlia filtration plant in Washington, D.C., there are six 10,000 gal. tanks, 12 ft. in diameter, all lined with lead until recently when lead was torn out of the boiling tank and replaced by an acid resistant brick. In the brick lined tank Pyroflex No. 100 cement was used and an asphalt lining was applied to the steel. For better bonding the asphalt was warmed before the placing of each brick. Three coats of primer were applied before the final coat of pitch. The hemispherical bottom of the tank was double lined with two courses of four inch brick and the side walls were of one course, six inches thick. For outlets, lead pipe has been replaced with ceramic tubing. Vertical straps, 15 in. apart had been installed in all six tanks. The lead linings were not wrapped over or secured at the top except by the upper end of the vertical straps.

c. EQUIPMENT [illegible] (CONTINUED)

The 60° [illegible] is stored in three long cylindrical steel tanks in the basement. [illegible] are installed [illegible] and 3 in. Duriron [illegible] lead lined [illegible]. [illegible] are also used on the [illegible] pipe line from the [illegible].

d. DETAIL [illegible]

The history of [illegible] in Washington and [illegible] are closely parallel. In [illegible] and error efforts have been [illegible] their first plant construction in [illegible]. The first installation in the [illegible] plant was with [illegible] lead [illegible] 8 ft. apart. The tops were [illegible] and the eight lead sections were carried to the [illegible] of the tank where they were cut in orange peel pattern. The bottom consisted of a circular disc of lead, 3 ft. in diameter, with a heavy lead casting over the outlet to serve as a valve seat.

In 1932, 12 lb. lead was installed with horizontal straps as shown in the second drawing. These straps were no more effective than the previous arrangement as they buckled and sagged with repeated heating cycles. The bottom construction retained the arrangement of eight straps converging toward the central disc.

The first drawing shows the last attempt that was made in 1938 to make lead linings give reasonable service in alum boiling tanks. Vertical straps were installed 36 in. apart with 20 lb. lead lining left unfastened at the top.

e. PERFORMANCE OF LEAD

The leakage has occurred only around the lower edges of the vertical straps in the two reaction tanks. These two tanks were said to require as much maintenance as all the rest. The lead lining expands with heating and does not contract, leaving a buckled area of disturbed or "crazed" metal which is probably more readily corroded. The buckling movement of the lead would also tend to weaken the weld metal at the edge of the straps. The expanded metal shows up in the cylindrical portion of the tank as wrinkles and bulges between the straps; however, there is no leakage in this area. Leaks occur only in the bottom area and are always along a seam of welded metal. There is no question of failure through abrasive or chemical action on the lead itself.

The first installation in 1927 of 10-lb. lead using only eight vertical straps failed, but was continued in use with excessive maintenance for five years. The Washington tanks were 12 ft. in diameter and the straps for joining the eight sheets of lead were well over 4-1/2 ft. apart.

The combination of 12-lb. lead with horizontal straps installed in 1932 failed in a year's time. Excessive sagging occurred in the sheet lead just above the horizontal straps and many of the bulges became too large to dress back into place. These had to be cut out and a new seam burned in. There were even horizontal cracks in the lead.

c. PERFORMANCE OF LEAD (CONTINUED)

The 1935 installations has served to date only under various straps and with constant repair. Vertical straps 18 in. apart were far from satisfactory as the lead [illegible] the straps would creep [illegible] the temperature change of approximately 100° F. [illegible] lead was tried during this period and was said to be [illegible] satisfactory.

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CONCLUSIONS

Conclusions pertaining only to the Washington and Baltimore water works have been reached as follows:

1. Lead linings with certain combinations of straps have failed in the acid alum reaction tanks.

2. Lead has been replaced by brick in the reaction tanks.

3. Bitumastic linings are giving good service in three dilution tanks in the Baltimore plant while lead linings are serving the same function in a satisfactory manner in the Washington plant.

4. The brick lining recently installed in the Washington reaction tank has an excellent appearance, but it is too early to judge the worth of its service.

Lead has a black eye at these two plants and probably others for failing to do the job. Actually it has not been given a proper test. If straps had been tried at a distance of 24 in., undoubtedly the increased length of service of the lead lining would more than offset the cost of additional straps.

It is planned in Washington to build a new filtration plant about 1950. Designs for the alum tanks incorporate a shallow "V" bottom and show a brick lining with no mention of lead (see third drawing).

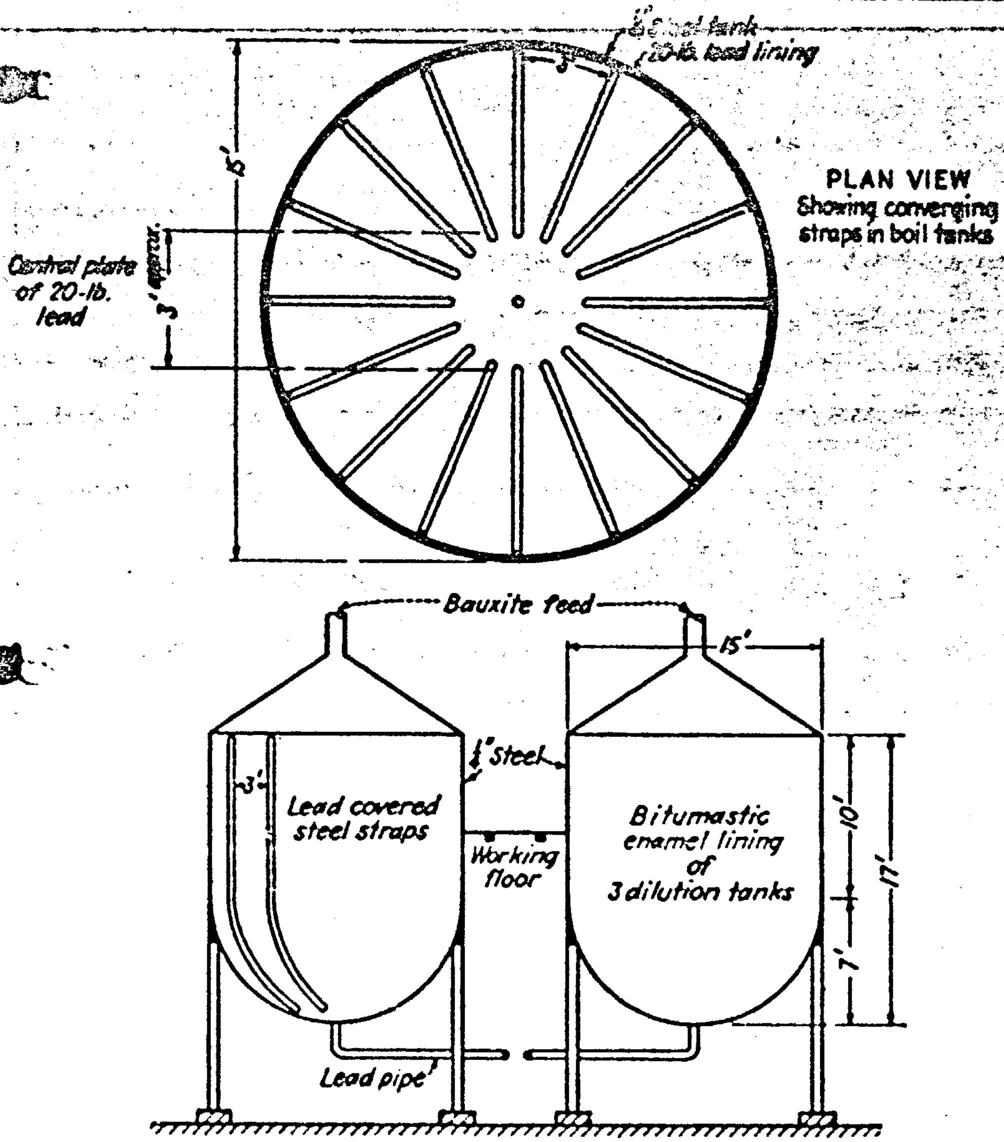
Future bulletins hope to point out the advisability of using lead and brick combinations. Advantages would include:

1. Eliminate the need of using straps for support as the brick lining would prevent the lead from bulging outward.

2. Depending upon local conditions, it might be possible to use a lighter lead inner lining.

3. Abrasive protection would be furnished for lead.

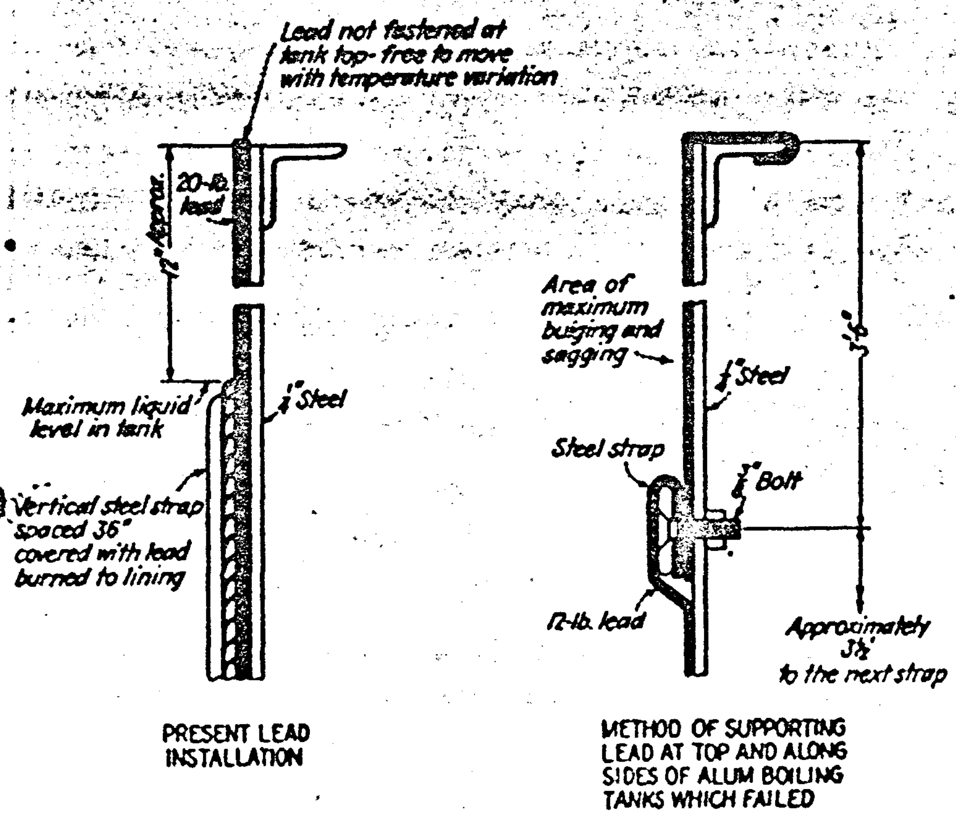
4. Thermal effect of brick as insulation would allow lead to be used at higher temperatures.



PRESENT ALUM TANK
INSTALLATION IN BALTIMORE
Lead lining of boil tanks
to be replaced by brick

LEAD INDUSTRIES ASSOCIATION
420 LEXINGTON AVE., NEW YORK, 17, N.Y.

CHEMICAL BULLETIN NO. 1
ACID ALUM REACTION TANKS
DATE: JULY 23, 1946



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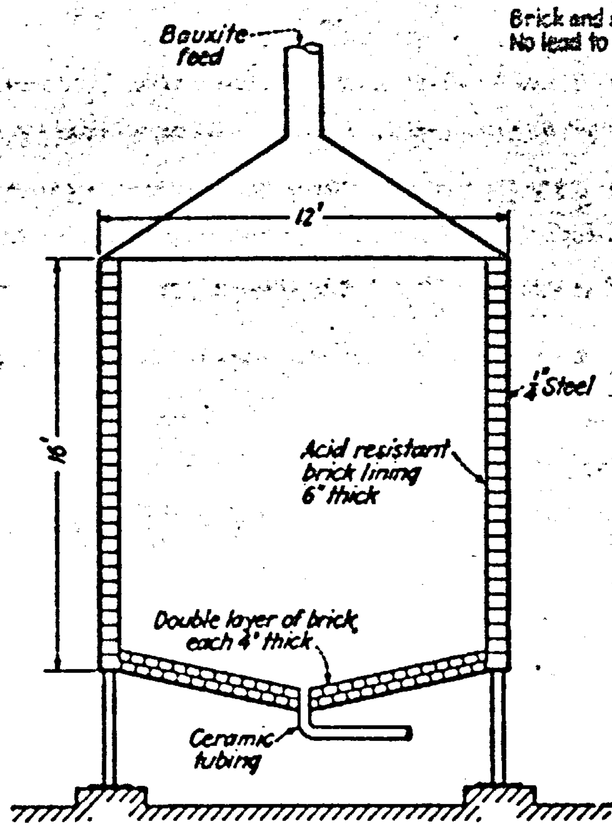
LIA09773

PROPOSED DESIGN FOR BOILING TANK IN FUTURE (1950) WASHINGTON FILTRATION PLANT

Brick and steel only
No lead to be used



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