[redacted]

October 27, 19[redacted]

METALLIC LEAD PRODUCTS DIVISION

[redacted]

SUMMARY

This report covers a study of pickle tanks at the American [redacted]

The first Goodrich "Trifles" pickle tank [redacted] Armco in 1932 and are still performing [redacted] the rubber lined tank covers which have begun to fail after about [redacted] service.

Failure of lead and brick lining combinations came about by the [redacted] of lead under pressure of the expanding brick lining. [redacted] temperatures were used which caused the brick lining to expand [redacted] at which it would contract, bringing excessive pressure on the inner [redacted] ing. The rubber people were aware of this source of trouble to both [redacted] ber linings when covered by brick and installed sponge rubber expansion cushions at the ends of the tanks to take up the brick expansion.

Another point in favor of rubber is the course of instruction in repair and maintenance of "Trifles" rubber lined tanks given at Akron to two Armco maintenance men who are now at hand for any repairs required.

Pickle tanks of lead and brick construction could be installed using the sponge rubber expansion cushion as it has been used by the rubber people to eliminate trouble from brick expansion and contraction.

a. INTRODUCTORY HISTORY

Pickle tanks have been lead lined from the beginning of the steel industry when steel sheets or parts were first dipped in dilute sulfuric acid to remove oxide scale and dirt. Lead lined wooden tanks were used at first, followed by steel or concrete tanks lined with lead and oftentimes with a brick lining for further protection. In recent years, rubber lined tanks with a brick inner lining for further protection for the rubber have made inroads on this once secure market for lead sheet.

In Middletown, Ohio, the American Rolling Mill Co. has its general offices, research laboratories, and operates a fabricating plant as well as the much larger sheet and strip mill known as the East Works. Blast furnaces and coke plant are in nearby Hamilton, Ohio, and other plants are located in [redacted] Ohio, (electrical steel), Butler, Pa. (sheet, strip and railroad wheel [redacted]), Ashland, Ky. (blast furnace and sheet mill), and in Baltimore, Md., [redacted] steel is made in the former Rustless Steel Co. plant which is now a [redacted] of Armco. This report is based on the overall experience of the Armco [redacted] in all the above plants, but with particular reference to practice in the Middletown plant.

b. [illegible]

[illegible] steel mills stitch coils (formerly the individual sheets) together [illegible] through the various baths [illegible] the strip is run through a [illegible] for the acid pickling [illegible].

The sulfuric acid bath was formerly maintained at [illegible] F, but more recent practice [illegible] has raised the bath temperature to [illegible] [illegible] concentration has been increased to 12-15% from the former concentration of [illegible].

The oxide and dirt pickled from the strip steel react with the acid to form a solution of iron sulfate called "copperas." If this solution of iron sulfate is permitted to reach 25% of the bath, it will precipitate out of solution and become deposited on the tank bottom making removal very difficult. Operations are carried out to dump the tanks about once a week when the copperas content has reached 20%. It is the custom in the steel mills to "go down" every Saturday night for clean up, repairs, roll changes, etc.

c. EQUIPMENT DESCRIPTION

In 1932, the first two rubber lined pickle tanks were installed at the Armco plant in Middletown, Ohio. These two tanks are sunk in granite excavations and have not been available for inspection.

This Goodrich rubber lining is trade named "Triflex" by reason of its three sections. There is an inner layer or core of hard rubber covered on both sides with soft rubber. The rubber linings throughout are 1/4 in. in total thickness.

Additional "Triflex" rubber lined pickle tanks were built and they are all serving today after 10 to 14 years service. Dimensions of a typical pickle tank are: depth 4 ft., width 8 ft. 5-3/4 in., and total length 200 ft. The tank is divided into four sections for different acid concentrations and for the end section to serve as a wash tank.

With the exception of the first two tanks, the [illegible] have been constructed on I beams for general accessibility. The shell of the tank is of steel covered with the "Triflex" rubber lining just as lead would be applied, and then two courses of acid resistant brick make an additional lining of 9 in. Sandstone blocks are placed at intervals on the floor of the tank to take the bulk of the abrasion from the strip. The brick lining extends above the acid level and a top of "Triflex" rubber covers the entire tank and is supported at intervals by steel ribs.

Construction at the end of the tank is similar; however a sponge rubber expansion cushion is placed between the "Triflex" rubber lining and the acid resistant brick. A sulfur and graphite bonding compound is used as a brick binder. Several courses of brick are laid with small blocks of the bonding compound separating the brick at the proper distance. The plasticized sulfur cement is heated until molten and poured into the spaces between bricks where, upon cooling, it becomes a firm solid binder.

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6. [illegible] OF MATERIALS

1. Lead — [illegible] pickle tanks, constructed of wood and lead lined, [illegible] lined with lead [illegible] [illegible] giving trouble [illegible] [illegible] the resulting [illegible] on the brick lining.

The [illegible] to [illegible] the [illegible] and [illegible] use of [illegible] temperatures would [illegible] [illegible] original [illegible] pressure by the brick upon the lead caused [illegible] by [illegible] lead [illegible] the [illegible] and actually out of the tank from between the brick and [illegible] [illegible] wall.

2. Rubber — The change was made using steel tanks lined with [illegible] flex" shown in Drawing No. 1 and with two courses (total of 9 in.) of [illegible] resistant brick. Two rubber lined tanks of this type installed in [illegible] in 1932 have given good service to date. As these tanks are [illegible] granite [illegible] they have not been available for inspection but [illegible] is based on the amount of the copperas product formed which indicates good service after 16 years. Two other tanks, 200 ft. in length, were installed in 1936 and are also serving in a very satisfactory manner to date. Other tanks installed at later dates have also held up well.

The rubber lined tanks have given trouble in two cases, namely, the "Triflex" top and at the ends of the tanks. As can be seen from drawing No. 2, sponge rubber expansion cushions were placed at the ends of the tank which allowed the sidewall brick more room for expansion than in the previous construction wherein lead was used as a lining. The cracks between sections of sponge rubber became filled with the plasticized sulfur cement which was hot poured between the courses of brick and in behind the brick. The molten sulfur compound upon cooling will crystallize and harden forming a good bonding material. However in the cracks between sponge rubber sections these crystals formed so many little daggers pointed toward the "Triflex" lining, that under usage and pressure these sulfur crystals punctured the "Triflex" lining causing leakage at the ends of the tanks. The repair work was done in the same fashion, but a sheet of coarse paper was placed over the sponge rubber before laying the brick and pouring the sulfur. This effectively prevented the formation of crystal daggers in the joints of the sponge rubber and no further trouble has been had at the tank ends.

Only other source of trouble has been with the "Triflex" tops which have faced the hot acid vapors without the help of a brick lining. These have given good service up to four years and then leaks occur. Mr. J.J. Healy of the Armco Engineering Department would like to install lead covers but has apparently been outvoted. The "Triflex" cover is supported by steel ribs as also shown in drawing No. 2.

When repairs are required two Armco maintenance men have been trained to do the work just as they would handle other plant repair jobs. These two men were given their instruction in rubber lined tank repair work at the Goodrich plant. This practice had obviously made a big impression on the Armco engineers.

CONCLUSIONS

1. Lead linings have failed due to expansion-contraction troubles with the brick inner lining.

2. Lead has been replaced by "Triflex" rubber lining which has served well for 10-11 years.

3. Sponge rubber expansion cushions have undoubtedly been the major factor in preventing the high pressure of the expanding brick from working on the rubber the same effect as was given to the lead linings.

4. "Triflex" covers have failed in four years time from the hot (212°F) acid fumes.

5. The high cost and delay of importing leadburners for repair work has been eliminated with the rubber lining and the course in repair work given by the Goodrich people at their plant to two Anaco maintenance men.

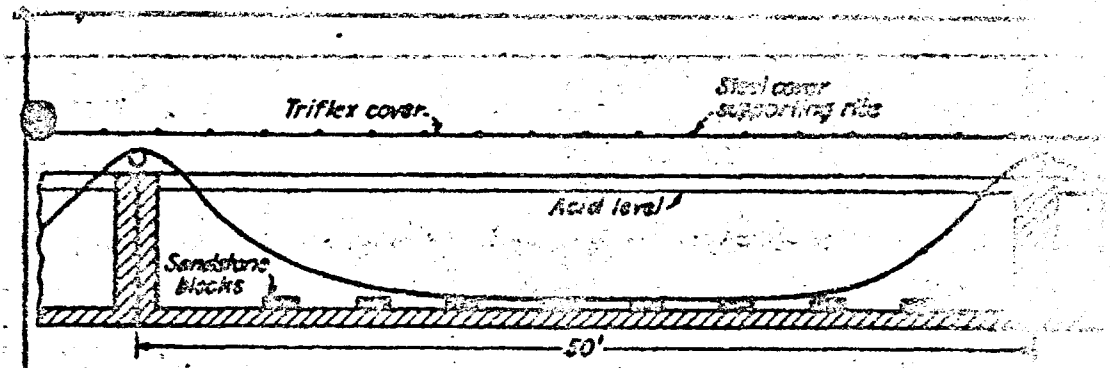
6. "Triflex" linings installed in granite excavations with resulting excellent performance indicate that the expansion cushions serve very well even where there is little possibility of thermal change in the supporting medium.

There is a chance for lead to prove its worth here in replacing the "Triflex" rubber covers which have failed in four years' time. The engineering department is to some extent divided as to what material to use and this is a chance for lead to regain some of its lost ground.

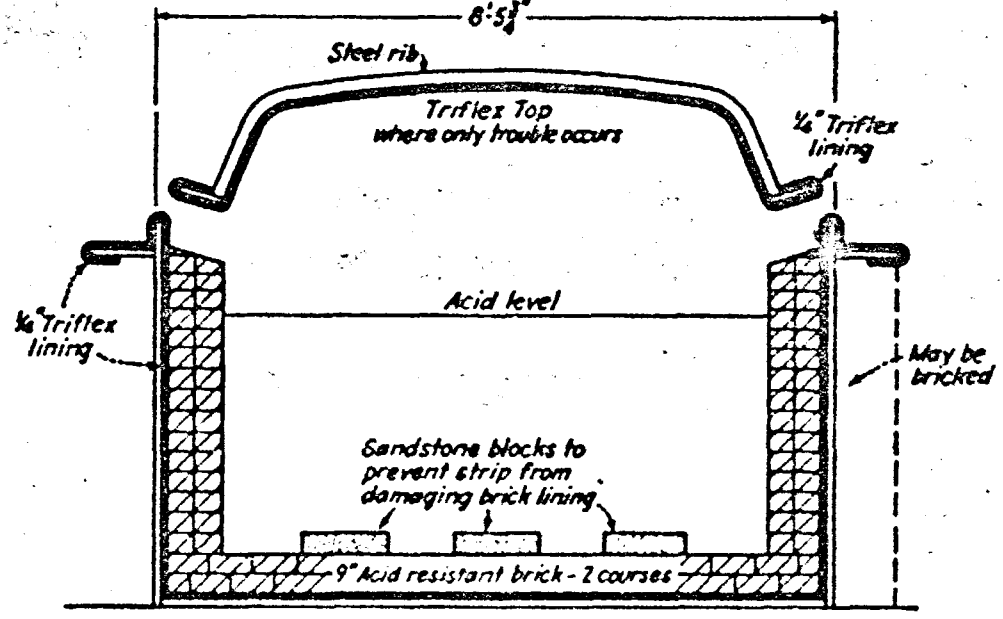
1. Any lead chamber process plant is proof that lead can do the job of pickle tank covers.

2. The use of sponge rubber (or other material) expansion cushions could be combined with brick and lead lined tanks to take up the brick expansion and prevent the extrusion of lead and subsequent leakage.

3. It would be well to investigate the expansion effects of whatever cement was to be used as a brick binder, as it is conceivable that the cement could equal the amount of expansion due to the brick alone.

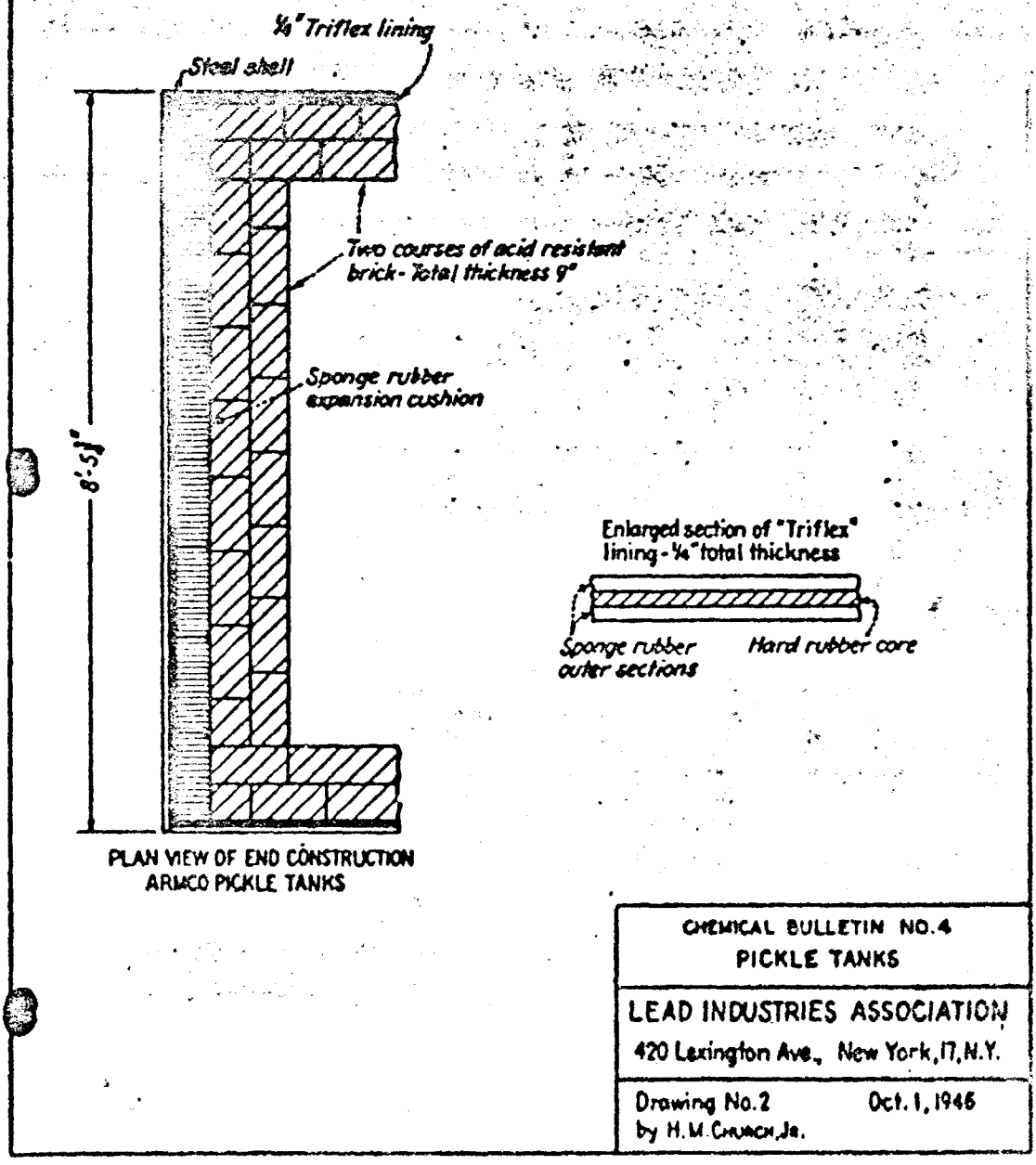


LONGITUDINAL CROSS SECTION OF ARMCO PICKLE TANKS



CROSS SECTION OF ARMCO PICKLE TANKS

CHEMICAL BULLETIN NO.4 PICKLE TANKS
LEAD INDUSTRIES ASSOCIATION 420 Lexington Ave., New York, 17, N.Y.
Drawing No. 1 Oct. 1, 1946 by H. M. Church, Jr.



PLAN VIEW OF END CONSTRUCTION
ARMCO PICKLE TANKS

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Drawing No. 2 Oct. 1, 1946
by H. M. Church, Jr.