

INSTALLER LEAD PROTECTIVE DIVISION

October 17, 1947

SECRET

This report covers a study of pickle tanks at the American Iron and Steel Company.

The first Goodrich "Triflex" pickle tank was installed at Akron in 1932 and are still performing well today. They have been the only rubber lined tank covers which have lasted after about four years service.

Failure of lead and brick lining combinations came about by the contraction of lead under pressure of the expanding brick lining. So great were the temperatures were used which caused the brick lining to expand beyond the point at which it would contract, bringing extensive pressure on the inner lead lining. The rubber people were aware of this source of trouble to both lead and brick 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 "Triflex" 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 Lorain, Ohio, (electrical steel), Butler, Pa. (sheet, strip and railroad wheel castings), Ashland, Ky. (blast furnace and sheet mill), and in Baltimore, Md., stainless steel is made in the former Rustless Steel Co. plant which is now a branch of Armco. This report is based on the overall experience of the Armco engineers in all the above plants, but with particular reference to practices in the Middletown plant.

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b. PROCESSING

Strip steel mill strip coils (formerly the individual sheet transfer and then the coils through the various tanks for the processing of the strip) are cut out, the strip is run through a roller mill which produces the required flatness and processing time.

The sulfuric acid bath was formerly maintained at 12-14% concentration, but more recent practice developed by the American Iron and Steel Institute has raised the bath concentration to 18-20%. The bath is maintained at 12-14% concentration from the 13 rollers between the 1st and 2nd rollers. The concentration has been increased to 18-20% from the 1st roller to the 13th roller.

The oxide and dirt pickled from the strip steel react with the acid to form a solution of iron sulfate called "coppering." 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 coppering 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 Arco 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 lining 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. 5-1/4 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 others 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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4. REPAIRS OF MATERIALS

1. Lead - The rubber tanks, constructed of wood and lead lining, were used for a number of years, lined with lead and held in position by a wooden frame. The lead lining was found to be defective in many places and the removal of the lead lining was required.

The Department also on several occasions found and corrected the use of concrete in the tanks which was found to be defective. The concrete which is used for the original lining of the tanks is made by the process of the brick and the lead cannot be removed by any means. The brick and actually one of the first from between the brick and concrete lining wall.

2. Brick - The change was made using steel tanks lined with 1/2 in. "Triflex" about 1932. Drawing No. 1 and with two courses (total of 1 in.) of resistant brick. Two rubber lined tanks of this type installed in 1932 have given good service to date. As these tanks are installed in a granite excavation they have not been available for inspection but performance 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 because filled with the plasticized sulfur cement which was not 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 Araco 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 Araco 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 Araco engineers.

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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 proved 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 two ways which was given to the lead linings.

4. "Triflex" covers have failed in four years time from the hot (210°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 Aruco maintenance men.

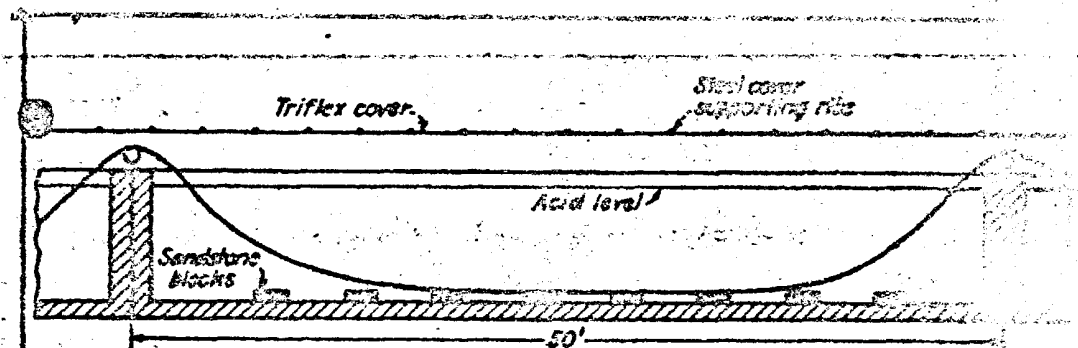
6. "Triflex" linings installed in granite excavations with resulting excellent performance indicate that the expansion cushions serve very well even where there is little possibility of thermal change in the supporting medium.

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.

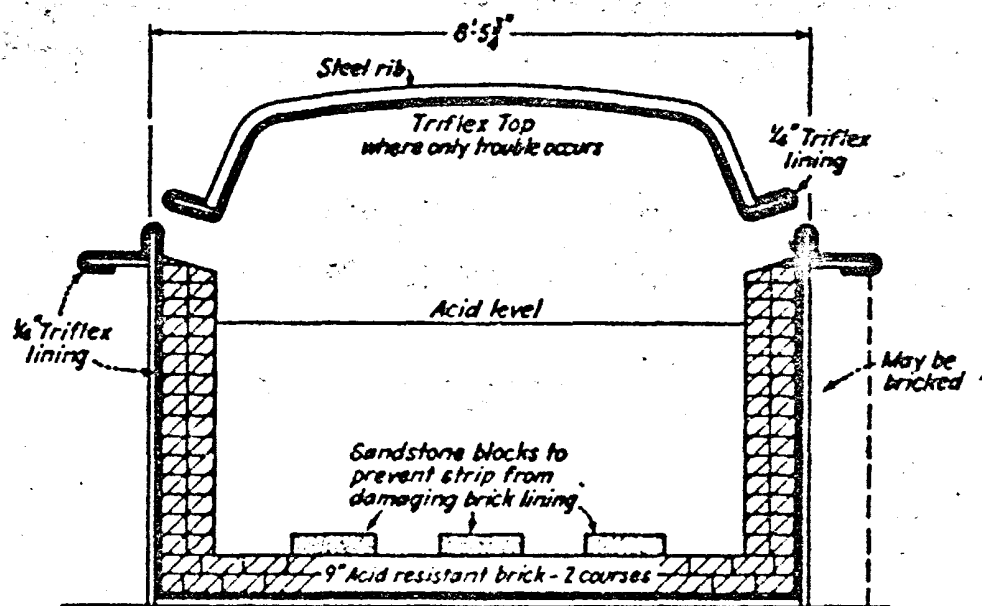
1. Any lead chamber process plant is proof that lead can do the job of pickle tank covers.

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



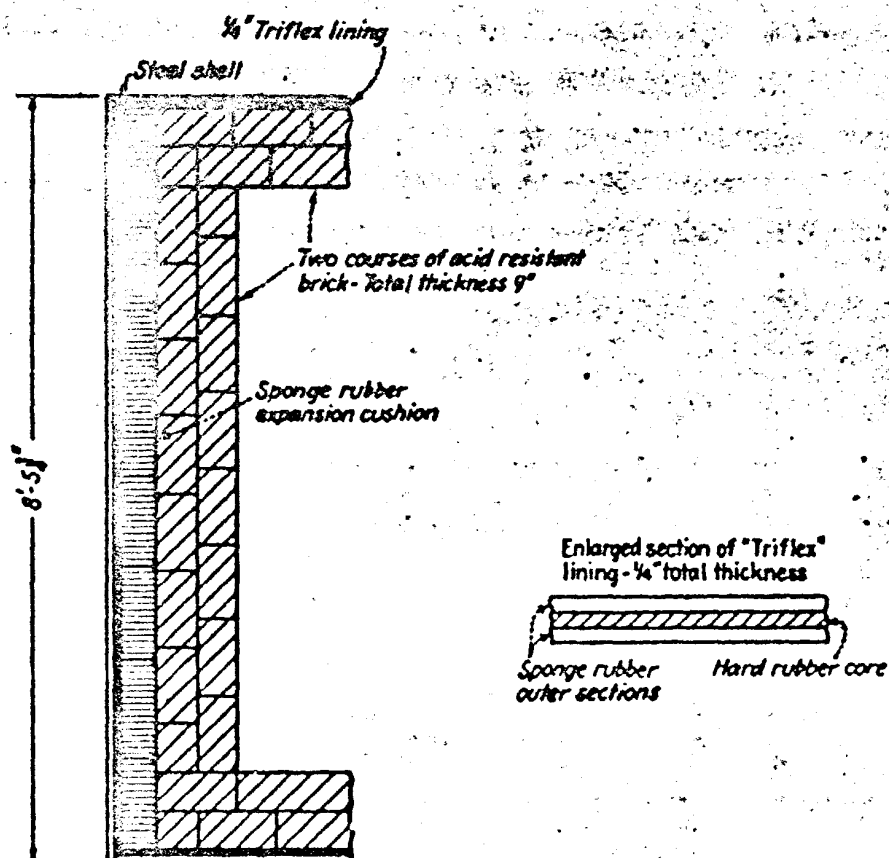
CROSS SECTION OF ARMCO PICKLE TANKS

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PICKLE TANKS

LEAD INDUSTRIES ASSOCIATION
420 Lexington Ave., New York, 17, N.Y.

Drawing No.1
by H. M. Church, Jr.

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PLAN VIEW OF END CONSTRUCTION
ARMCO PICKLE TANKS

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Drawing No. 2
by H. M. Church, Jr.

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