

(See Chemical Bulletin Nos. 1, 6)

INTRODUCTION

The use of lead in the Monsanto plant in Everett, Massachusetts has been discussed in recent years and their plan was to the new plant being constructed using lead throughout. However, during its production, the new plant was using very little lead. The company had expected 9% lead in its equipment but in homogeneous equipment but failures of the air-liquid interface have demonstrated the use of lead there.

The breakage factor of Duriron and high cost of replacement compared to lead results in 14 hour lead lined pumps being favored over Duriron. Lead valves are generally satisfactory except where plug valves of lead were replaced out by alum crystals. Lead valves with Duriron plug and seat have replaced those formerly all lead units.

Lead and brick combinations in the alum plant were in use prior to the 1930 fire which destroyed company records. These were one course of acid resistant brick over 12 and 15-lb. lead which have given this long service only with extensive leakage and loss of solution. Catch pans of steel, lead and brick have been built under some units to return this leakage to the system.

Forty pound steam pressure as handled in this plant has been too much for 1-in., 9 lb. lead coils to stand over two years. Dissatisfaction has been great as a result of this poor service from lead steam coils.

a. INTRODUCTORY HISTORY

(See Chemical Bulletin Nos. 1, 6)

The Monsanto plant in Everett, Massachusetts was ravaged by fire in 1930 and all plant records prior to that date were destroyed. The equipment for processing, bauxite to alum survived with some slight damage. The chemical engineer in charge indicated there had been a great trend away from the use of lead in their processing equipment. This was later borne out in evidence, as the local lead suppliers and distributors, who said they had to deal with a great deal of business in this plant, practically every day of the year, and the use of lead was being a bother. The plant engineers have even seriously considered the use of silver coils in place of lead despite the large investment.

One of the tanks is 15 ft. deep.

and is

the other is 18 ft. deep.

The tanks are not permitted through one of the large physical tanks and in many of the processes other than those other materials are stored. The process have allowed additional consideration for lead. One of the tanks is lined with a special process and known only as "B" and is used in the process of lead and lead compounds. Because of a tank being used in the process of lead and lead compounds, the tanks are lined with lead and lead compounds. The tanks are lined with lead and lead compounds and are used in the process of lead and lead compounds.

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b. DESCRIPTION OF MATERIALS

The dilution liquor, weak enough to be stored in wooden tanks, "A" is obtained from the tanks, is then pumped through lead pipes to the reaction tanks "B" where it is mixed with the lead and lead compounds. The tanks are used for the storage of lead and lead compounds. The tanks are used for the storage of lead and lead compounds. The tanks are used for the storage of lead and lead compounds. The tanks are used for the storage of lead and lead compounds.

The strong solution is diluted sufficiently to give good settling of the undissolved matter. After settling, the clear solution is pumped to the clear liquor tank "D" for concentration and is then allowed to stand overnight in flat steel floorpans. The solidified whitecake is broken up, ground to powder, and bagged for shipment. Washings from the undissolved matter are pumped from "D" to the dilute alum tanks "C" where it is stored until dilution liquor is required in the reaction tanks to make up the next batch. The waste solids are discarded after thoroughly washing to remove all alum.

c. DESCRIPTION AND PERFORMANCE OF MATERIALS

(1) Reaction Tanks

The alum reaction tanks "A" (or "making tanks") are in the form of an ellipse with diameters 23 and 18 ft. These two tanks, 15 ft. deep, are lined with 12-lb. lead on the sides and 15-lb. lead on the bottom. There are no straps, the lead being hung over the sides of the tank, edges burned together, and in one reaction tank one course of 4-in. acid resistant brick acts as a support. The other tank lining is the same except for an additional layer of brick over the bottom and 4 ft. on the side wall. The extra course of brick was installed in 1942 and there have been no repairs made since that time, which the plant engineers say is not considered as yet sufficient time to judge the worth of the extra layer of brick. Cambria brick is used with Penn Chlor cement.

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In 1930, there was a fire in one of the clear liquor tanks at "Tank" No. 1. In 1930, there was a fire in one of the clear liquor tanks. The fire was caused by a leak in the lead lining of the tank. The lead lining was damaged and the fire spread to the other tanks. The fire was extinguished and the tanks were repaired. The lead lining was replaced and the tanks were put back into service. The fire was a serious one and it was a warning to the company. The lead lining is a very important part of the tanks and it must be kept in good condition. The fire was a reminder that the lead lining is not invulnerable and it must be checked regularly. The fire was a reminder that the lead lining is not invulnerable and it must be checked regularly.

Below both settling tanks there are two pans of steel, 12-14 in. in diameter. There is also a drip pan for the lead lining. The pan has a steel coil in it to prevent the strong alum liquor from solidifying if allowed to cool. While 16 years seems like long length of service, dissatisfaction is high because of continuous leakage and loss of solution. Drip pans "E" under the clear liquor tank and the two reaction tanks catch the leakage. While under the settler tanks "B" and dilution liquor tanks "C" leakage is allowed to run into the dirt and gravel floor.

Four short, sturdy antimonial lead paddle blades 1-1/2 in. thick are rotated near the bottom of the tanks by means of a long lead covered steel shaft connected by gears with a motor atop the tank. Each paddle blade has its own lead covered steel supporting rib. Some damage has been done to the lead tops of the tanks by vibration from the gears. Mountings for one of the gear units have recently been altered to eliminate vibration. The motors and gear housing had been mounted directly on the channel iron supports for the lead tops.

2. Alum Settler

The alum settler tanks have the same 12-14 in. lead linings with one course of acid resistant brick as was in use at the time of the 1930 fire. These six tanks are 21 ft. in diameter and 8 ft. deep with a lead steel coil in each to prevent the strong alum liquor from solidifying if allowed to cool. While 16 years seems like long length of service, dissatisfaction is high because of continuous leakage and loss of solution. Drip pans "E" under the clear liquor tank and the two reaction tanks catch the leakage. While under the settler tanks "B" and dilution liquor tanks "C" leakage is allowed to run into the dirt and gravel floor.

One large leak was visible on one of the alum settler tanks and had been in process for 3 or 4 years. It had penetrated the brick and lead lining and cut a large swathe through the steel tank. This breakthrough, roughly 5 ft. high by 18 to 24 in. wide, had been filled by the muddy alum solution which had solidified upon cooling. Periodically, the solution breaks through and liquid alum spurts through to the gravel floor. Sand is thrown in the break and the alum solution soon cools, crystallizes out of solution and fills the gap for another month or two until the next break occurs.

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3. Clear Liquor Tank

The steam-jacketed evaporator known in the plant as the clear liquor tank is rectangular in shape, 20 ft. wide, 7 ft. deep and roughly 18 ft. long. It is lined with brick. Lead on the inside and outside lined on the bottom with a brick lining. Stumps were used for this, but for safety considerations and better sealing in the bottom to have more uniformity, the firm has to stand 1/2 in. aluminum plate lining the bottom and sides of the tank bottom. The stumps were in good condition at the time of the tank and it was said they had not been replaced every two years. These were of 1/2 in. 241. Lead pipe under valves, and pressure. A continuous 1/2 inch pipe is bent on the steam jacket and to 6 inches below. It is possible for more than 10 gal steam to be applied by a personnel cover or from steam leak in the coils steam jacket on the floor of the tank. The tank lining was said to last only 4 years and leakage began after 6 months operation. Leaks occurred where the steam jacket, no stumps being used. A small stack vents the clear liquor tank and has served since 1942 with no repairs.

Experimental sections of various materials have been tried for the top of the clear liquor tank with transite and cyprus giving good service. The heaviest lead sheet tried for the top was 3-lb. lead which sagged. Heavy tops became brittle and formed large cracks in six months time. Top sections of Saron failed the same way in slightly less time. Cyprus and transite have done well and are still undergoing test.

4. Performance of Valves and Pumps

Lead lined valves of the Hills McKenna type are generally used in this plant and are well liked. Lead valves with a Duriron seat and plug (1) have given excellent service in controlling outflow of liquor from the reaction tanks "A" and the clear liquor tank "D". Lead valves originally tried here failed when a piece of grit or alum crystal slipped between the plug and the seat. This foreign particle would cause a deep gouge in the lead seat and plug but by making these two parts of the high hardness material, Duriron, has eliminated this trouble. The 8-in. rubber hose (2), through which is removed 50 of the 60 tons of alum in one batch is the means of eliminating a large valve. The hose is directed manually into one of three openings which in turn lead to the alum settler tanks.

Duriron and LaBour lead lined pumps are used in this plant for pumping liquid alum. The lead lined pumps are preferred for several reasons. There is no salvage value from the Duriron and the Duriron housing is easily broken while in use or even when being installed. The Duriron spindle replacement was said to cost \$70.00 and the LaBour replacement only \$35.00.

5. Pipe

Lead pipe is used extensively in this plant to handle the acid alum solutions. Little or no trouble is encountered although sludges and crystals, as well as hot and cold clear solutions are handled daily. The only exception to this is the 8-in. rubber hose which is used with distribution boxes in place of several large lead valves.

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4. OTHER MATERIALS USED1. Hareg

Top cover for the clear liquor tank was at one time made of Hareg which lasted only six months. The material became brittle and large cracks developed.

Hareg equipment is molded from a mixture of a special acid-cured asbestos and a synthetic phenol-formaldehyde resin. Tensile strength is only 8500 psi. max. and compressive strength is greater, about 6,000 to 10,500 psi., depending on the grade. The material is never used for heat transfer because of its low thermal conductivity (0.333 to 0.607 BTU/in. ft./°F./inch of pack) and it is claimed to withstand continued or intermittent temperatures as high as 2450 °F. Hareg is claimed to have good resistance to mineral acids, hydrofluoric acid and is not recommended in any grade for use with chromic acid, nitric acid, strong sulfuric (over 50%), sodium hypochlorite, acetone, aniline, pyridine, bromine, iodine or mono and dichlor benzene.

2. Transite

Transite was also tried as a portion of the top of the clear liquor tank and very good service was reported. A transite test section, after 18 months service as part of a reaction tank top was reported as "better than lead." A 6-lb. lead roof section had sagged in that same period.

Transite (c) is made of asbestos fibres and cement united under hydraulic pressure into dense, unslatted, monolithic sheets possessing great strength and rigidity. It is weatherproof, corrosion resistant and requires no painting to preserve it. It may be obtained in various sizes, corrugated or flat. Johns-Manville, the manufacturers, claim it actually strengthens and toughens with age and that it is generally regarded as the outstanding fireproof, corrosion-resistant building sheet on the market today. The sheet material is often used for flues and Transite pipe may be used for stacks and ventilators.

3. Saran

Sections of Saran were also tried as top cover for the clear liquor tank and failed in the same length of time as did the Hareg. Failures were in the same manner, through brittleness and cracking.

High resistance to a wide variety of chemicals make the Saran resins prominent in the field of thermoplastics. Saran is a vinylidene chloride-vinyl chloride copolymer combined with suitable plasticizers and pigments. Chemical resistance is rated as excellent for acetic acid, 10%, glacial; ferrous sulfate 15%; hydrochloric acid 10, 35%; nitric acid 10%; concentrated oleic acid, sulfuric acid 10, 30, 60%; and sulfurous acid 5%. It is rated good for nitric 65% and fair for sulfuric 90%.

(c) Swets Catalogue File, 1941.

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Saran's two good features:

- a. Easily fabricated,
- b. Excellent chemical resistance.

Saran's two bad features:

- a. Very low thermal conductivity.
- b. Useful temperature range is low.

Max. for continuous exposure 160-200° F.

Max. for intermittent exposure 160-200° F.

CONCLUSIONSA. Reaction Tanks

- 1. Continual leakage from 12-15-lb. lead, brick (one course) linings across lead service to be regarded as unsatisfactory. This is borne out by the use of drip pans to catch leakage loss.
- 2. An additional layer of brick lining would lower temperatures and allow longer life.
- 3. Present double brick layer is too new to judge performance.

B. Settlers

- 1. Good length of service obtained from 12-lb. lead and one course brick as all six have lining in use since 1930 fire. Leaks have occurred which eventually require repairs, but by self sealing with help of some sand thrown in, it is possible to continue use for several years before repairs are required.

C. Clear Liquor Tanks

- 1. Lining—Life of lining is said to be 4 years. It is hung from the top without straps and no bricks. The corners pull out and frequently require redressing. Four years life of lining is excessively short.
- 2. Steam Coils—Two years of life, said to be maximum obtained from steam coils, is very short. As 40-lb. steam is used in coils, failures must result from excessive pressures. These could be outgrowth of vapor locks in the line or result from excessive steam pressures being used unknowingly.
- 3. Top—Heaviest lead top tried was 3-lb. Failed by sagging. Haves and saran tops became brittle and failed. Cyprus and transite, have been good in short test.

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Saran's two good features:

- a. Easily fabricated.
- b. Excellent chemical resistance.

Saran's two bad features:

- a. Very low thermal conductivity.
- b. Good temperature range is low.

Max. for continuous exposure 120-130° F.

Max. for intermittent exposure 150-160° F.

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3. Present double brick layer is too new to judge performance.

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D. Pumps & Valves

1 a. Lead lined LaTour pumps are preferred over Duriron because Duriron's replacement housing costs twice that of lead.

b. Duriron is too easily broken and there is no seal on valves from the broken parts.

2 a. Lead lined Mills-McKenna type valves are extensively used in this plant and well liked.

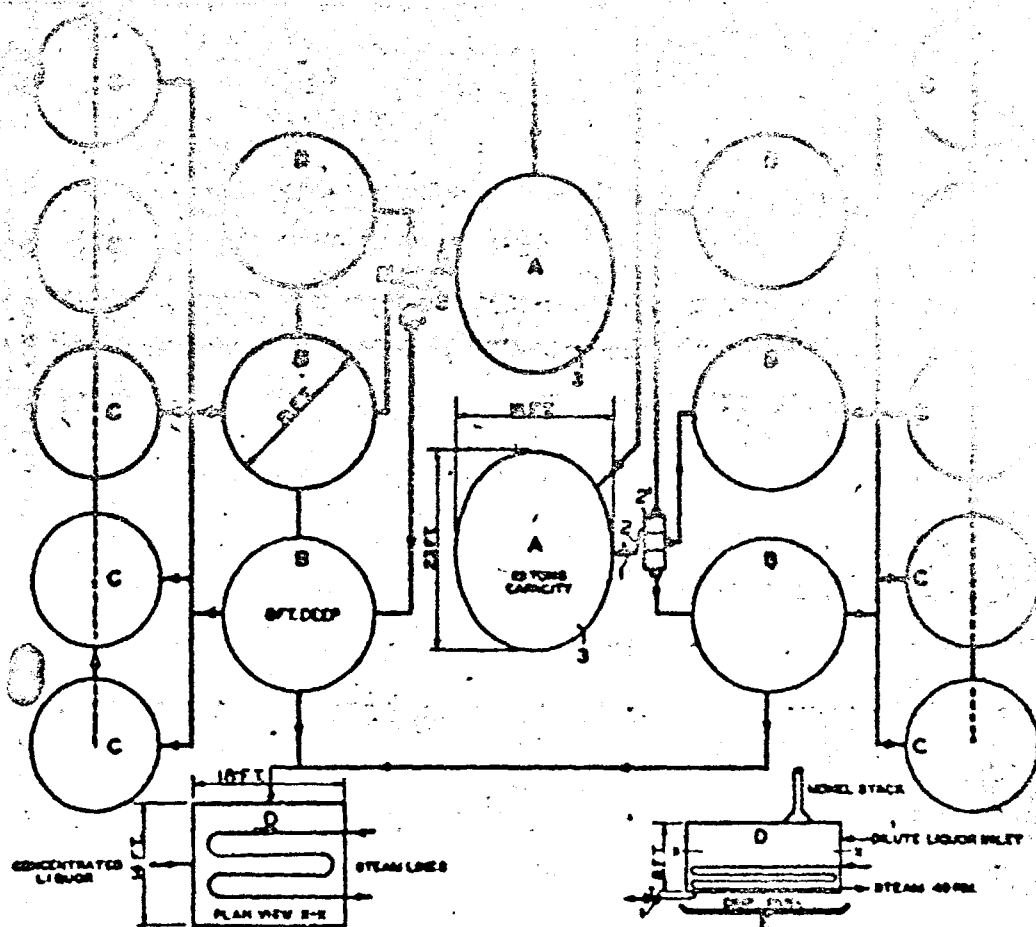
b. Lead valves, Duriron seat and plug replaced exclusively by lead lined units where hard crystals are encountered.

c. Use of 8-in. rubber hose eliminates one large valve at steam liquor exit from reaction tank.

E. Pipe

1. With exception of rubber hose mentioned above, piping is all lead. No particular trouble has been encountered in handling alum solutions either hot or cold.

2. Lead steam lines are generally satisfactory except in the clear liquor tank.



- (A) ALUM. BOIL OR MAKE TANK STEEL, LEAD & BRICK LINED
 BOTTOM - 15 LB. LEAD
 SIDES - 12 LB. LEAD
 ONE TANK BRICK LINED, BOTTOM & SIDE, ONE COURSE
 CAMBRIA BRICK, OTHER TANK BOTTOM LINED, TWO
 COURSES BRICK, SIDES, TWO COURSES UP 4 FT ONE
 COURSE TO TOP
 TOP 6 LB. 00% TELLURUM LEAD - TRANSITE, BEING
 TESTED
- (B) ALUM. SETTLERS STEEL TANK, 12 LB. LEAD LINING,
 BOTTOM & SIDES, ONE COURSE BRICK

NOTE: ALL PIPES, OF VARIOUS LEAD SIZES, EXCEPT #2

- (C) DILUTE ALUM. TANKS CYPRUS
 (D) CLEAR LIQUOR TANK
 BOTTOM, 15 LB. LEAD NO STRAPS, NO BRICK,
 SIDES, 12 LB. LEAD NO STRAPS, NO BRICK,
 TOP, 3 LB. LEAD OTHER MATERIALS TESTED
 HAVEG, SEAN, TRANSITE
- (E) DRAINING STEEL, LEAD & BRICK,
 1. LEAD VALVE, DURIUM SCATH PLUG,
 2. RUBBER HOSE, HAND CONTROLLED TO
 DIRECT FLOW TO 3 DISTRIBUTION BOXES
3. AGITATOR ON TOP OF BOIL TANK, LEAD,
 COVERED PADDLE & SHAFT.

DR. H.M. CHURCH JR.

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ALUM. PROCESSING TANK
 CHEMICAL PULLETS
 NO. 12