[illegible]

(See Chemical Bulletins Nos. 1, 6)

[illegible]

The use of lead in the Monsanto plant in Everett, Massachusetts has [illegible] decreased in recent years until their alum unit is the only remaining [illegible] using lead throughout. Ferrous sulfate is produced [illegible] using very little lead. The company-designated [illegible] acid [illegible] in homogeneous equipment but failures at the air-liquid interface have eliminated the use of lead there.

The breakage factor of Duriron and high cost of replacement [illegible] to lead results in La Bour lead lined pumps being favored over Duriron. [illegible] valves are generally satisfactory except where plug valves of lead [illegible] out by alum crystals. Lead valves with Duriron plug and seat have replaced these 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 Bulletins 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 has been a great trend away from the use of lead in their processing equipment. This was later borne out in [illegible] as the local lead suppliers [illegible], who said they used to send [illegible] and burners to this plant practically every day of the year [illegible] dwindled to about [illegible] a month. The plant engineers have even seriously considered the use of silver coils in place of lead despite the large [illegible].

LIA09820

[illegible]

[illegible] not permitted through [illegible] of the large [illegible] and in many of the processes other than [illegible] other materials [illegible] have allowed widespread [illegible] for lead. One of the [illegible] by a [illegible] process and known [illegible] and lead equipment. [illegible]

[illegible] produces 10 tons per day of ferrous sulfate by the [illegible] method. A [illegible] small amount of lead is used which was said to be [illegible] well.

b. [illegible]

Alum dilution liquor, weak enough to be stored in wooden tanks, "C" is [illegible], is then pumped through lead pipe to the reaction tanks "A" [illegible] strong (60° Be) sulfuric acid. Three steam coils are used to bring the temperature to 170° F., at which point finely ground bauxite is added. An [illegible] digestion period then follows with temperatures around 240° F. Agitation is accomplished by lead paddle wheels at the lower end of a long lead covered shaft driven by a motor on top of the tank. The batch is diluted and the temperature lowered by the addition of more dilution liquor from the wooden tanks. At the end of the 10-hr. batch cycle the tank is nearly full and the batch temperature is at or above 170° F. The hot liquor is then run off through a lead valve (1), with a Duriron seat and plug via an 6-in. rubber hose (2), into three lead lined distribution boxes (2') and then by lead pipes to the three alum settler tanks "B."

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 "B" 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 resistent 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.

[illegible] of [illegible] lead was [illegible] placed on the [illegible] lining was [illegible] the 1930 [illegible] had an [illegible] on the bottom and lower [illegible]

[illegible] there are drip pans of steel, 12-lb. [illegible] There is also a drip pan [illegible] The pan has a steam coil [illegible] until it can be pumped [illegible] the production [illegible] A steel stack, lead lined, [illegible] each reaction tank. An overflow port of steel, lead, and [illegible] construction located near the top of the reaction tanks allows excess liquid to flow off to waste.

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-lb. 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 steam 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.

3. [illegible]

The [illegible] evaporator known in the plant as the clear liquor tank is rectangular in shape, [illegible] ft. wide, 7 ft. deep and roughly 18 ft. long. It is lined with [illegible] lead on the sides and [illegible] lead on the bottom with no brick lining. Straps were [illegible] by [illegible] by crystallization and broke [illegible]. As the liquor is [illegible] from [illegible] to about [illegible] pieces [illegible] the tank bottom. The [illegible] were in [illegible] of the tank and it was said they had to be replaced every ten years. These were of [illegible] lead pipe [illegible]. A [illegible] is kept on the steam return line to determine leaks. It is possible for more than [illegible] steam to be applied by a personal error or from vapor lock in the coils [illegible] on the floor of the tank. The tank lining was said to last only 4 years and leakage [illegible] after 6 months operation. Leaks occurred where the seams split, no straps being used. A [illegible] stack vents the clear liquor tank and has served since [illegible] with 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. Haveg tops became brittle and formed large cracks in six months time. Top sections of Saran 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.

4. OTHER MATERIALS USED

1. Haveg

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

Haveg equipment is molded from a mixture of a special acid-digested asbestos and a synthetic phenol-formaldehyde resin. Tensile strength is only [illegible] 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.[illegible] to 0.607 BTU/sq. ft./°F/hour/inch of path) and it is claimed to withstand continued or intermittent temperatures as high as 265° F. Haveg is claimed to have good resistance to mineral acids, hydrofluoric acid and is not recommended in any grades 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 (*) is made of asbestos fibres and cement united under hydraulic pressure into dense, unlaminated, 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 Haveg. 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 95%.

(*) Sweets Catalogue File, 1941.

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-[illegible]° F.
Max. for intermittent exposure 1[illegible]-[illegible]° F.

CONCLUSIONS

A. Reaction Tanks

1. Continual leakage from 12-15-lb. lead, brick (one course) linings cause 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. Haveg and saran tops became brittle and failed. Cyprus and transite, have been good in short test.

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D. Pumps & Valves

1 a. Lead lined LaBour 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 salvage value from the broken parts.

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

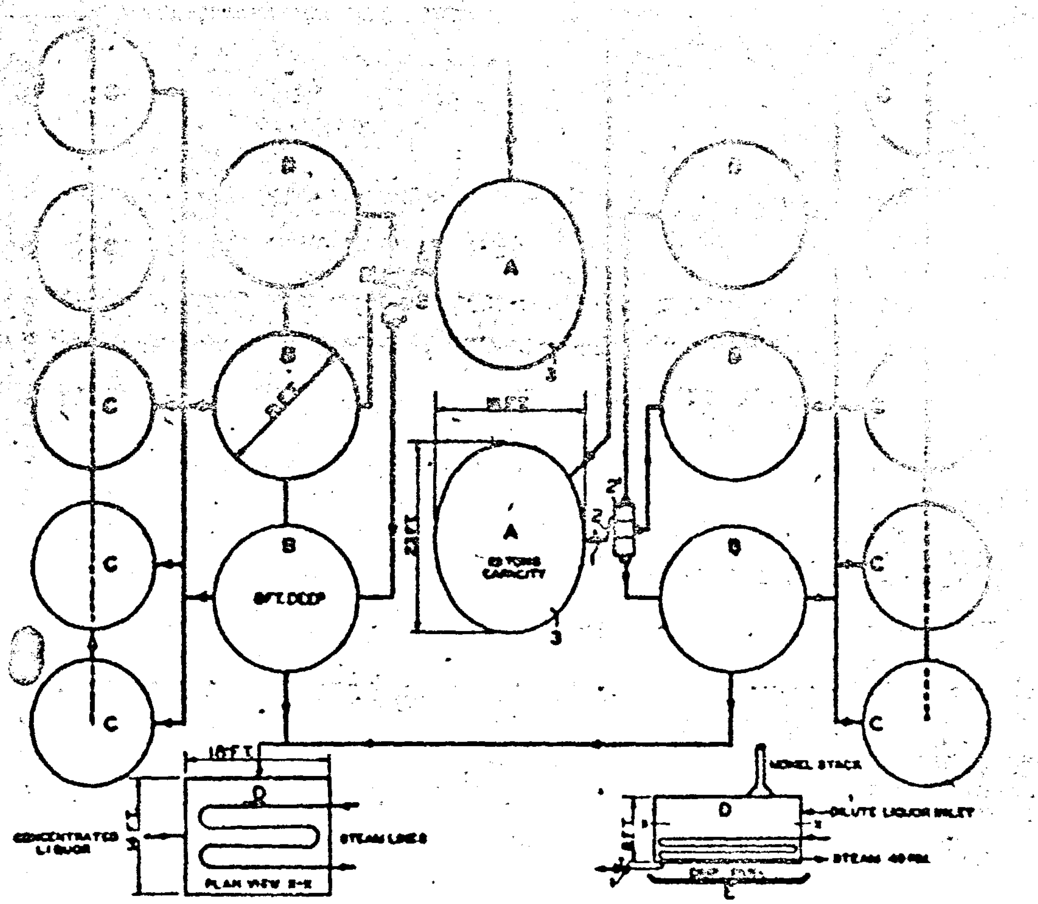
b. Lead valves, Duriron seat and plug replaced completely by lead lined units where hard crystals are encountered.

c. Use of 8-in. rubber hose eliminates one large valve at alum 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.



Ⓐ ALUM BOIL OR MAKE TANK STEEL, LEAD & BRICK LINED
BOTTOM - 15LB. LEAD
SIDES - 12LB. LEAD
ONE TANK, BRICK LINED, BOTTOM & SIDE, ONE COURSE CAMBRIA BRICK, OTHER TANK BOTTOM LINED, TWO COURSES BRICK, SIDES, TWO COURSES UP 4FT ONE COURSE TO TOP
TOP 6LB. 0.06 TELLURIUM LEAD - TRANSITE BEING TESTED

Ⓑ ALUM SETTLERS STEEL TANK, 12LB. LEAD LINING. BOTTOM & SIDES, ONE COURSE BRICK

NOTE ALL PIPES, OF VARIOUS LEAD SIZES, EXCEPT *2

Ⓒ DILUTE ALUM TANKS CYPRUS

Ⓓ CLEAR LIQUOR TANK
BOTTOM, 15LB. LEAD NO STRAPS, NO BRICK.
SIDES, 12LB. LEAD NO STRAPS, NO BRICK.
TOP, 3LB. LEAD OTHER MATERIALS TESTED HAVEG, SARAN, TRANSITE

Ⓔ [illegible] STEEL, LEAD & BRICK.
1 LEAD VALVE, DURIRON SEAT & PLUG.
2 RUBBER HOSE, HAND CONTROLLED TO DIRECT FLOW TO 3 DISTRIBUTION [illegible]
3 AGITATOR ON TOP OF BOIL TANK, LEAD COVERED PADDLE & SHAFT.

BY: H.M. CHURCH JR. FEB. 3, 1947	LEAD INDUSTRIES ASSOCIATION 420 LEXINGTON AVE. NEW YORK CITY, N.Y.	ALUM PROCESSING TANKS CHEMICAL BULLETIN NO. 10