[illegible]

[illegible] lead armor [illegible] in the since [illegible] service with very little trouble from such breakage.

Erosion of lead in separator units has resulted in the use of [illegible] steel plates and ribs in the area of initial contact. The remaining lead lining in separators gives excellent service as do the auxiliary units which are lead lined.

A. INTRODUCTORY HISTORY

In a steel plant of moderate size such as at Inland, there is not sufficient coking of coal to [illegible] an excessive flow of coke oven gas and [illegible] of three [illegible] units are in use at any one time. [illegible] 5 to 6 million cu. ft. of gas per day which is a much smaller volume of [illegible] in the [illegible] plant (see [illegible] Bulletin No. [illegible] where [illegible] per day [illegible] is the [illegible]. This is, of course, [illegible] greater [illegible] 1,000,000 cu. ft. of gas handled daily by the [illegible] Coke and Chemical [illegible]

The process of passing the coke oven gas through [illegible] sulfuric [illegible] of hard [illegible] sulfate [illegible]

[illegible] the place of lead [illegible]

B. DESCRIPTION AND PERFORMANCE OF CURTIS UNITS

Three saturator-separator units have been in use at this plant since 1936. The saturators are in the shape of a large oval 10 x 20 ft. and are roughly 18 ft. high. As shown in the drawing, the heavy lead cracker pipes are supported 4 ft. from the bottom of the unit. Upon installation, the saturators and separators were completely lined with 3/8 in. chemical lead. One of these was relined in 1938 and another in 1947 with 3/8 in. tellurium lead. However, in 1946, when it became necessary to reline the third saturator, which apparently received less severe use, 5/8 in. chemical lead was used in place of tellurium lead. Some repairs are required periodically in areas damaged by the abrasive effect of crystals which form and drop to the bottom of the saturator. These crystals are drawn off through a slurry pump and some abrasion was encountered at the throat of the pump suction. These units are all operating to date with a 50% increase in capacity over previous years. An important factor is the use of a Cottrell precipitator to remove 60-70% of the tar. However, there is still sufficient tar remaining to clog up the pumps and this would certainly be enough to have some protective effect for the lead linings.

The original cracker pipes are still in use in these three saturators. These are made of 1 in. lead, stand about 18 in. high and are roughly the same width. Continuous rows of slots 7 in. high by 1 9/16 in. wide allow the gas to pass through the dilute sulfuric acid liquor. The liquid level is 39 in. above the cracker pipe slots. Gas enters the cracker pipe through two 24 in. cast iron nozzles. There has been no trouble with slots breaking off nor has there been any trouble with the cracker pipe except for its great weight (approximately 8 tons). The supports for the cracker pipe are 6 in. wide, steel covered with 3/4 in. chemical lead and there has been extrusion trouble at the points of support. To correct this the weight of pipe should be distributed over larger areas of support which apparently was an oversight in the original design. Perhaps a square plate or strip of 6 or 10% antimonial lead (or stainless) would act as a means of distributing the weight over a greater area and thus prevent the extrusion of lead from between the cracker pipe and its steel supports.

After bubbling through sulfuric acid, the gas passes through a lead lined upper portion of the saturator known as the surge tank, and then through a cast iron outlet nozzle, 35 in. wide. Upon entering the separator, the gas is whirled around and down past a central tube through which it finally passes upward and out of the unit. In its rotary motion about this central tube, the acid particles are flung outward where they contact the outer lead lining, flow down the sides to a drain, and then return to the saturator.

Trouble occurs at the first point of impingement of the acid particles on the lead lining which becomes eroded. Vertical ribs of hard lead have been installed to absorb this initial impact of the acid particles. These failed, however, and the Dietsel Lead Burning Company suggested the installation of 40 in. square plates of 18-8 stainless steel which have been very satisfactory and probably will prevent the complete replacement of lead here. Here is a possible use for the abrasive resistant lead product known as "plumbalum."

C. DESCRIPTION AND PERFORMANCE OF KIN UNITS

Three additional saturator-separator units were said to have been built in August, 1945, of different design. These new saturators are 25 ft. high and 18 ft. 9 in. in diameter. The bottom and sides of the saturator are lined with 3/16

in. chemical lead covered by one course of acid resistant brick. The sloping top of the saturator is lead lined with support obtained by straps. Gas entry to the upper chamber is shown at the right of Drawing No. 2. As dry gas only is in contact with the metal here, there is no need for lead lining. Passing down through the eight vertical stainless steel tubes (18-8) the gas bubbles through the acid liquor where ammonia is absorbed to form the hard ammonium sulfate crystals. Through steel pipes in the center of each cracker pipe fresh (concentrated) acid is added.

The crystals form and collect at the bottom of the saturator and are drawn off through lead pipes to the slurry feed tank where the crystals are separated from the acid liquor. An agitator in the lower portion of the saturator keeps the acid in circulation. Here the brick lining over the lead prevents abrasion from the agitation of the hard ammonium sulfate crystals.

The wet gas bubbles into the surge chamber and flows up a 5 ft. diameter lead lined steel pipe 14 ft. high. A horizontal lead lined steel pipe 3 ft. 6 in. in diameter conducts the coke oven gas to the separator where acid particles are thrown out against the sides as described above. Both sides of the separator exit tube and the inner wall of the separator are said to be lined with 1/4 in. lead. The gas outlet tube is lined with 3/16 in. lead.

A lead pipe returns drip acid to the saturator as shown. Acid from the overflow weir and return acid from the slurry feed tank are fed into a distribution pot and returned to the saturator as shown.

It is claimed a power saving is brought about through the use of stainless steel cracker pipes by means of a decrease in gas pressure required to drive the coke oven gas through the system. In the units using lead cracker pipes there is a 39 in. difference between the liquid level and the upper edge of the cracker pipe slots. This difference in height of liquid through which the gas must be forced is reduced to 18 in. in units using stainless steel cracker pipes. This was said to change the pressure head required from 80-100 to 20-25 m.m. of mercury. This is an important power saving but, if the gas flow is kept the same, just why there is this difference in head when using lead or stainless is still not clearly brought out. However, the Koppers engineers state that when the gas flow is greatly increased then stainless steel cracker pipes show their superior resistance to abrasion.

CONCLUSIONS

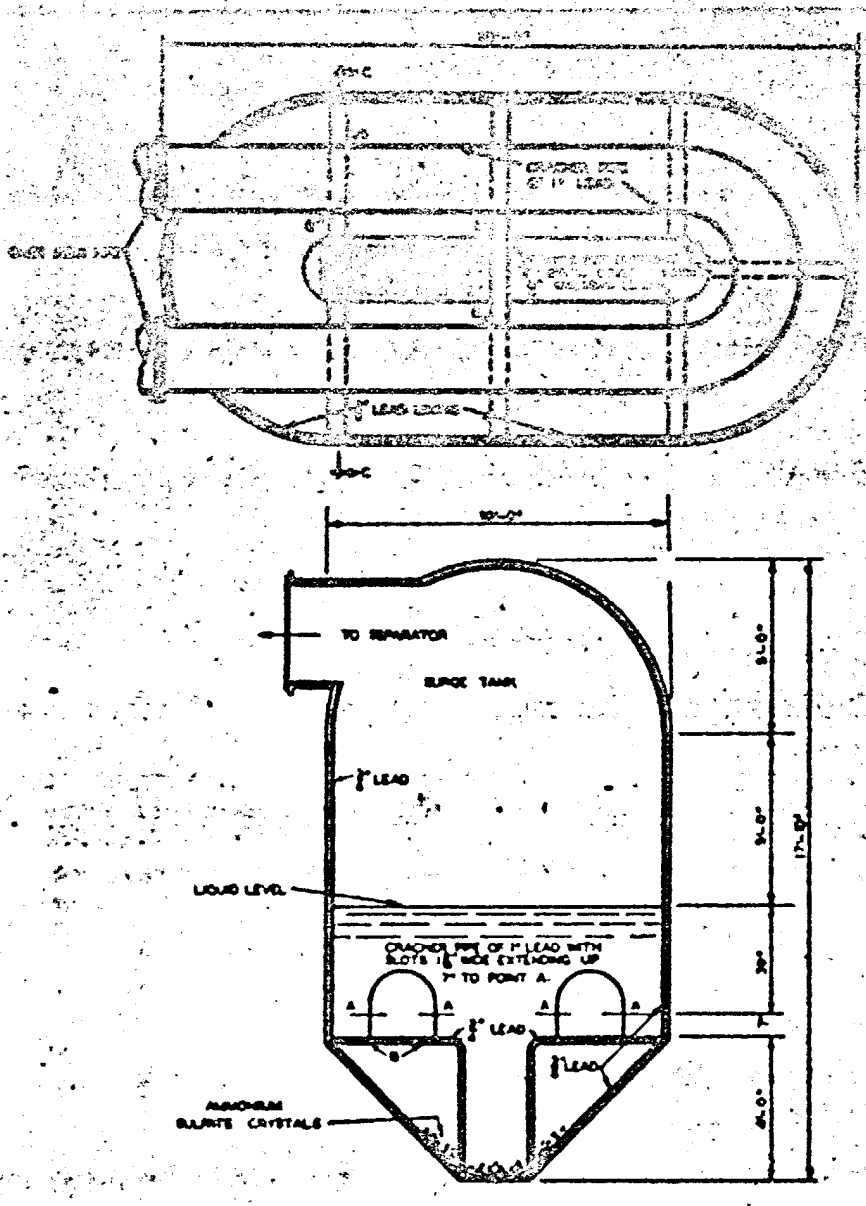
1. In saturators handling moderate quantities of gas, lead linings have given fairly good service but there is a general trend toward stainless steel and other materials.

2. Saturators, lead and brick lined and using stainless steel cracker pipes, have given excellent service since their installation in 1943. Saturators of this type should give excellent service even though the gas flow were greatly increased.

3. Extrusion of lead from beneath lead cracker pipes due to their great weight is an original design fault rather than a lead failure, however, lead is blamed.

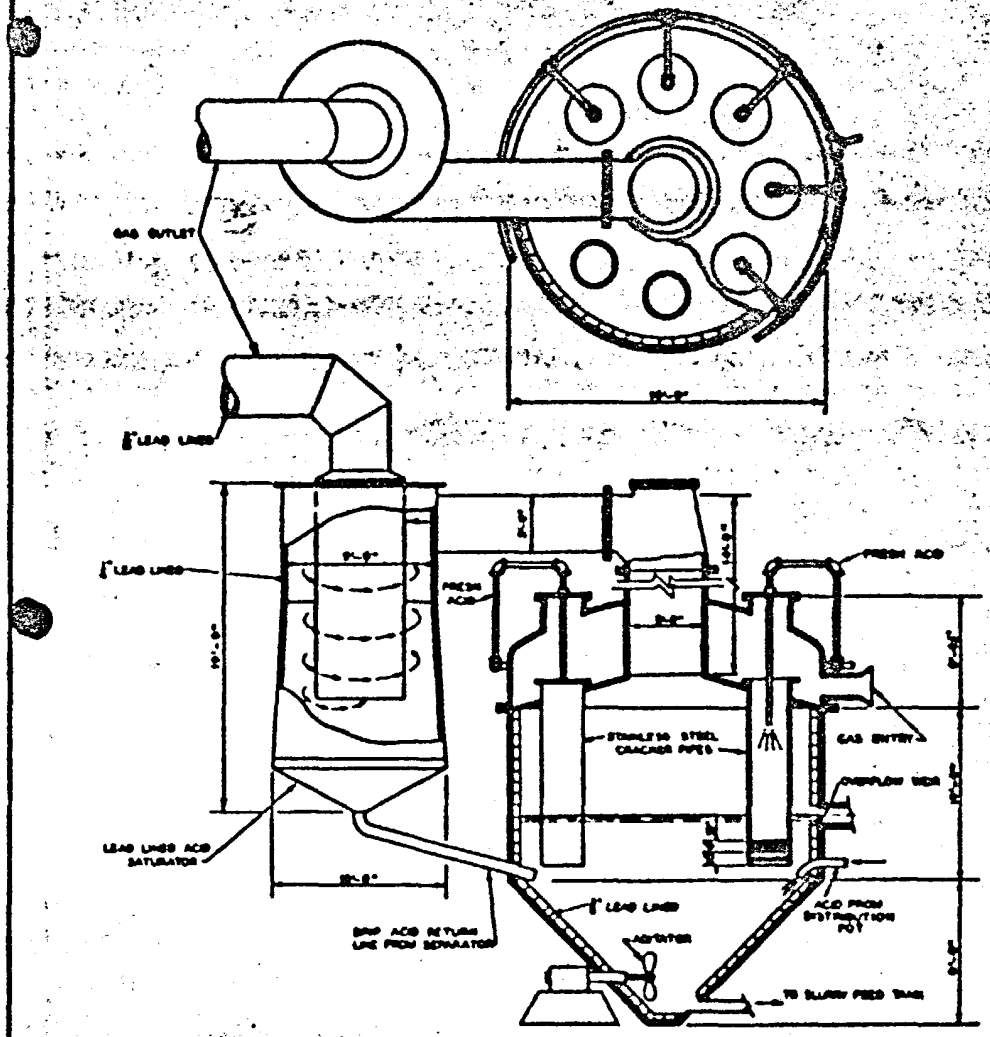
4. Cracker pipes of stainless steel are being successfully used and, it is claimed, result in an important power saving by reducing the pressure required for gas propulsion.

5. In acid separators there has been trouble from erosion of lead in the area of impingement of acid particles on the lining. This has been overcome by using a stainless steel plate in the area of erosion which allows lead to serve with satisfaction throughout the rest of the separator.



OLD SATURATOR

DRC NO. 1 BY PRODUCT COKE BY H.M. CHURCH MAY 8, 1947	LEAD INDUSTRIES ASSOCIATION 420 LEXINGTON AVE N.Y. 17 N.Y.	INLAND STEEL COMPANY CHEMICAL BULLETIN NO 18



NEW SATURATOR

DRG NO 2 BY PRODUCT COKE BY H M CHURCH MAY 8, 1947	LEAD INDUSTRIES ASSOCIATION 420 LEXINGTON AVE N Y 17 N Y	INLAND STEEL COMPANY CHEMICAL BULLETIN NO 18