SL 001750

INTRODUCTION

~~At Lake Charles~~, liquid and gaseous chlorinated organic waste is burned in the Nos. 1, 2, & 3 incinerators. The exhaust gases from these incinerators are quenched and water-scrubbed for the removal of hydrogen chloride from the combustion gases in their respective primary scrubbers. At present, Nos. 1 and 2 scrubbers have Sabine River Water feed on a once-through basis with the aqueous effluent discharging to the Plant B sewer.

The No. 3 primary scrubber has a weak acid (17 wt.% HCl) recovery system, ~~and the~~ recovered weak acid is utilized for captive consumption and sale to Texas United Chemicals Company. During No. 3 incinerator shutdown periods, the in-plant consumers utilize the more expensive strong acid (31.5 wt.% HCl) in place of the No. 3 incinerator weak acid.

It is the objective of this report to present the evaluation of a weak acid recovery system installation on Nos. 1 and 2 primary scrubbers for operation during No. 3 incinerator outages.

DISCUSSION

The Waste Treatment Unit (WTU) processes the liquid bottoms from Plant B production units as well as the bottoms purchased from other VCM manufacturers on the Gulf Coast and recovers the carbon and chloride value for per-tri feedstock. The residual bottoms are stored in an incinerator liquid feed tank and incinerated in Plant B incinerators along with the gaseous waste generated by Plant B processes. The incineration of gaseous and liquid waste generates hydrogen chloride gas, water, carbon dioxide, and traces of chlorine. The combustion off-gases from each incinerator are scrubbed with water in the respective primary scrubbers. The residual gases are then scrubbed with cell liquor in the secondary scrubber to remove traces of HCl and chlorine. The effluent from the secondary scrubber is discharged to the Plant B sewer, while the scrubber gases are discharged to the atmosphere through a stack. At present, the effluent from Nos. 1 and 2 primary scrubbers is discharged to Plant B sewer and is neutralized with Plant A cell liquor.

The No. 3 primary scrubber was started up in 1979 and is specifically designed to cool the combustion gases and remove HCl from the gas stream. A two-stage packed absorption section design of the No. 3 primary scrubber was specially selected for the production of intermediate strength weak acid (15-17 wt.% HCl). The scrubbing medium in this scrubber is a combination of recirculated weak acid and make-up water. The product acid is level controlled out of the primary scrubber, while the recirculated acid is flow-controlled to the primary scrubber. The weak acid produced in the No. 3 primary scrubber is cooled and stored in a 21,000 gallon storage tank. From the 21,000 gallon tank, the acid is pumped to the North Rubber Line Storage (NRLS) tank (weak acid bulk storage capacity of 103 tons) and is distributed to weak acid consumers such as Silica Products, Plant A and C Brine Treatment, Foremate Destruction, pH control on Lake Charles Complex effluent, etc. The weak acid is also sold to Texas United Chemicals Company (TUCC) on a demand basis.

The No. 3 incinerator is shut down for reboiler cleanings on an 8-12 week frequency for one week. During No. 3 incinerator outages, the in-plant weak acid consumers are supplied with the more expensive muriatic acid (31.5 wt.% HCl). Also, due to limited storage capacity for the liquid bottoms, the

incineration of liquid bottoms and the Plant B gaseous waste has to be carried out in Nos. 1 and 2 incinerators.

Unlike No. 3 primary scrubber, Nos. 1 and 2 primary scrubbers do not have the facilities for acid recirculation and are not equipped with two-stage packed absorption sections. Hence, the effluent stream from these scrubbers contains only 0.3-1.2 wt.% HCl. At present, the aqueous effluent from Nos. 1 and 2 primary scrubbers is discharged to the Plant B sewer. It was recommended to evaluate the installation of the weak acid recovery system on Nos. 1 and 2 primary scrubbers.

Trane Thermal Inc., the vendor for the Nos. 1, 2, & 3 incinerator systems (including primary and secondary scrubbers), was supplied with the liquid and gaseous feed to the Nos. 1 or 2 incinerators during No. 3 incinerator shutdowns (see Table 1) and was requested to provide PPG with the viability of the recirculation scheme on the existing Nos. 1 & 2 primary scrubbers along with the primary scrubber process conditions with recirculation scheme. A copy of the reply from Trane Thermal is enclosed in the Appendix. Based on the information provided by the Trane Thermal Company, the recirculation system shown in Figure 1 was designed.

The combustion gases will enter the primary scrubber at 2300°F and will be quenched by the recirculated weak acid flowing downward through the distributor and the packed section. The recirculated acid will be fed through the existing water nozzle and the distributor. The recirculated acid flow will be controlled manually using a plug valve and will be indicated in the control room. The recirculation flow will be alarmed on low flow and will also trip the incinerator if it falls below 300 gpm.

The acid recirculation will reduce the Sabine River Water requirement from 500-600 gpm to 165 gpm. The make-up water flow will be controlled using a plug valve and will be indicated and low flow alarmed in the control room. The water will be sprayed through a cone spray nozzle above the packed section. The cone spray nozzle system's design and location will facilitate HCl removal from and cooling of the gases flowing to the secondary scrubber. The acid recirculation will be flow controlled using a plug valve while the product acid is level controlled to the existing No. 3 incinerator acid cooler. The acid cooler cools the weak acid to 120°F, and the cooled acid stream is sent to the weak acid collection tank. The weak acid tank can be bypassed in case it is out of commission during the outage, and the acid can be sent to the NRLS tank using the existing weak acid pumps. The existing drain nozzle on the scrubber will be used as pump suction. The pump has a low available NPSH and will require careful design for trouble-free operation.

Some of the important design considerations are discussed below:

1. The minimum installation cost for the system was the major guiding factor in the design along with safety and loss prevention. As a result, it was decided to install the recirculation system with only one pump and piping for only No. 2 primary scrubber. The piping for No. 1 primary scrubber and a spare pump may be installed at a later date if necessary. The No. 2 primary scrubber was chosen as it is the one operated the majority of the time during No. 3 incinerator outages.

2. The concentration of weak acid stored in the NRLS will change from 17 wt.% HCl to 10 wt.% HCl during No. 3 incinerator outages. In the past, concentration changes in the rubber-lined tanks have accelerated the deterioration of the rubber lining due to the removal of passive chloride film on the lining with the concentration change. Mr. Max Kincaid of B.F. Goodrich (the lining supplier) was contacted for evaluating the impact of acid concentration change from 17 wt.% to 10 wt.% every 2-3 months for one week period. He indicated that it should not be a cause for concern and any testing to determine the impact will require 2-3 years. Hence, it was decided to proceed with status quo. However, the NRLS may be bypassed, and the in-plant consumers can be supplied directly from the 21,000 gallon storage tank. Of course, this may require a delicate balancing of weak acid production and consumption.

3. The material of construction of the primary scrubber tower cone is 3/16" rubber lining on carbon steel. Trane Thermal has recommended that this lining be replaced with a brick, hard rubber, or semi-hard rubber lining. However, Operations personnel have indicated that the lining should be replaced only when it deteriorates and should not be in the scope of the present design. As indicated by Trane, the higher operating temperature of the exit gas and aqueous effluent (186°F vs. 120°F) should not present any other material of construction problems, as the safety shutdown system on the incinerator is designed to trip at 220°F.

4. Due to the limitation of the No. 2 primary scrubber design, only 90.7% of HCl feed will be recovered and 9.3% of HCl feed (521 lb/hr HCl) will be carried over to the secondary scrubber. This will require more cell liquor feed to the secondary scrubber for neutralization. The neutralization will generate 792,000 BTU/hr of energy. This energy will have to be dissipated as heat by using higher water flow to the secondary scrubber. It is recommended to increase the make-up water flow rate to the secondary scrubber to 40-50 gpm from the normal 30 gpm during the operation of the recirculation system and should be an SOP. This will limit the temperature rise in the secondary scrubber bottom to 40°F.

521 #/hr = .093 X
X = 5602 #/hr
-521
5081
60.9 TPD

5. The change in concentration of weak acid supply to the in-plant consumers is deemed to have little impact on their operation and will not require any capital expenses. If necessary, the 10 wt.% HCl weak acid can be blended with muriatic acid (31.5 wt.% HCl) and supplied to the in-plant consumers and/or TUCC.

6. The level in the primary scrubber will be controlled by the level control valve on the pump outlet. The level control valve will be designed to fail closed and will control the liquid level in the scrubber to avoid pump cavitation. It will also prevent the high level in the scrubber and the possible seepage of the liquid into the combustion chamber.

   A seal loop will be installed on the scrubber's emergency overflow nozzle. The seal loop will be designed such that the liquid level in the scrubber will be maintained to prevent seepage of liquid into the

combustion chamber and will act as back-up to the level control valve. The seal loop and the level control valve design are considered critical for the smooth operation of the incinerator. There will be low and high scrubber level alarms in the control room.

7. The weak acid concentration can be increased to a maximum of 13 wt.% HCl. However, this will result in higher HCl losses to the secondary scrubber and is not recommended.

8. It was suggested to install a larger incinerator liquid feed storage tank as an alternative to the recirculation system. The storage tank will provide a surge capacity for the waste bottoms during No. 3 incinerator shutdown, which will be incinerated when No. 3 incinerator was operating. However, this scheme will not provide for an alternative source of weak acid during No. 3 incinerator shutdown and may require neutralization of the excess weak acid generated after No. 3 incinerator start-up. Hence, this scheme was rejected.

   The P & I diagram (Figure 2) has been reviewed and approved by the Loss Prevention group personnel. The No. 3 incinerator safety shutdown system and No. 2 incinerator safety shutdown systems will be identical except that No. 3 incinerator will trip on a low liquid level in primary scrubber while No. 2 incinerator will not.

Economics

The capital cost for installing the recirculation system has been estimated at $150,000 (±10%). The ACT-grade economics evaluation for the project shows as 27% continuous IRR and 25% ROI. The basis for economics evaluation is presented in Table 2. The ROI will increase to 41% for an investment of $100,000. Please note that the Plant B ROI at $150,000 investment will be 170%.

It has been possible to reduce the capital cost for small jobs of this nature by lump sum job contract awards to outside contractors. An example that comes to mind is the installation of 4" anhydrous HCl pipeline between VCM I and VCM II. The estimated cost for the job using standard PPG estimation techniques was $160,000, while the contractor completed the job for $62,000. In today's competitive business environment, sub-contracting for this job may be an alternative worth exploring.

CONCLUSIONS

1. The installation of a weak acid recovery system as designed for No. 2 incinerator primary scrubber will result in annual savings of $74,830 in muriatic acid and neutralization liquor.

RECOMMENDATIONS

1. Obtain the lump sum bids for installing the weak acid recovery system as designed on No. 3 incinerator.

2. Install the weak acid recovery system if the corporate guidelines on IRR are met after evaluation of estimated capital cost reduction as suggested above or otherwise.

Author: D. B. Sheth Date: 12/10/85

Approved: Randall M. Hall Date: 12/11/85

Approved: R P. Byars Date: 12/19/85

APPENDIX

Figures

1 - No. 2 Primary Scrubber Recirculation Schematic

2 - No. 2 Primary Scrubber Recirculation Scheme P & ID

Tables

1 - Typical Analysis of Waste & Liquid Feed to No. 3 Incinerator

2 - Economics Basis for No. 2 Incinerator Acid Recovery System

Trane Thermal Letter

I suggest you contact M. A. Knight directly in order to expedite the information requested on maximum acid strength attainable and the pricing on packing and other revisions to the tower based on their recommendations.

Sincerely,

Frank Romano

Frank Romano
Product Engineer

tf

cc: J. A. Young & Assoc., Inc.
P. O. Box 15203
13918 Airline Hwy.
Baton Rouge, LA 70816
Phone: 504/293-7107

APPENDIX

Figures

1 - No. 2 Primary Scrubber Recirculation Schematic

2 - No. 2 Primary Scrubber Recirculation Scheme P & ID

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2 - Economics Basis for No. 2 Incinerator Acid Recovery System

Trane Thermal Letter

LD-2531/11

TRANE THERMAL
THE TRANE COMPANY
BROOK ROAD
CONSHOHOCKEN, PENNSYLVANIA 19428
(215) 828-5400 TELEX: 84-6484

July 22, 1985

PPG Industries, Inc.
P. O. Box 1000
Lake Charles, LA 70602

Attention: Mr. Dilip Sheth

Reference: Trane Thermal J.O. 7113

Gentlemen:

Confirming our telecon of July 12, 1985, I am enclosing information discussed on concentrating hydrochloric acid in your M. A. Knight tower.

The revised process conditions are as follows:

Make-Up Water Rate---------	82,379 lbs/hr.	(165 gpm)
Tower Recirculation Rate---	320,000 lbs/hr.	(610 gpm)
Tower Blowdown Rate--------	56,010 lbs/hr of 10% HCl	(107 gpm)
Gas Outlet Temperature-----	186°F	
% HCl Recovery------------	90.7%	

A heat exchanger on the tower recirculation line will not be required, assuming the tower make-up water is at ambient temperature. Maximum acid concentration attainable is 13%.

One area to be checked is the material of construction of the tower cone top. The tower cone top was originally supplied with a 3/16" rubber lining. I do not know whether this lining has been changed since 1972. Tower top linings were discussed with M. A. Knight and they recommenced either a brick, or hard, semi-hard rubber cone top lining. M. A. Knight has a local representative, Mr. Wayne LeBourgeois who can review this subject with you. Mr. LeBourgeois may be reached at 504/381-9342.

Sincerely,

Frank Romano

Frank Romano
Product Engineer

tf

SL 001758

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Subject to Protective Order
of 14th Judicial District Court
No. 91-1145

cc: J. A. Young & Associates, Inc
13918 Airline Hwy.
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