

HYDROGEN SAFETY WORKSHOP

Sulphur Conference 2014

Introduction

- Design
 - Things to consider when modifying/maintaining the plant
- Detect
 - How do you know there is an issue
- React
 - Do you know how to respond if an issue is detected

Design

- Acid Coolers, Economizers and other metallic components can be a source of Hydrogen.
- Absorption Towers will always have a place where gas can accumulate
- Since we need this equipment, what can be considered during design or operation to minimize the impact of a problem.

Acid Coolers

- Corrosion on acid side creates Hydrogen
 - Weak acid in acid system
 - Leak of cooling water into acid side
- Acid Pressure > Water Pressure
 - Correct at plant start – Is it still true today?
 - What about heat recovery coolers?
 - Abnormal operation – Filling or Acid Pump shutdowns
- Coolers are getting larger, what about the drains?
 - Consider installing a larger drain nozzle/piping
 - Do you have a vent valve to speed up drainage
 - Where is the acid / water drained to

Acid Coolers



4400 MTPD plant
70" Shell ID
4800 gal Acid
2000 gal Water



800 MTPD plant
36" Shell ID
1400 gal Acid
640 gal Water

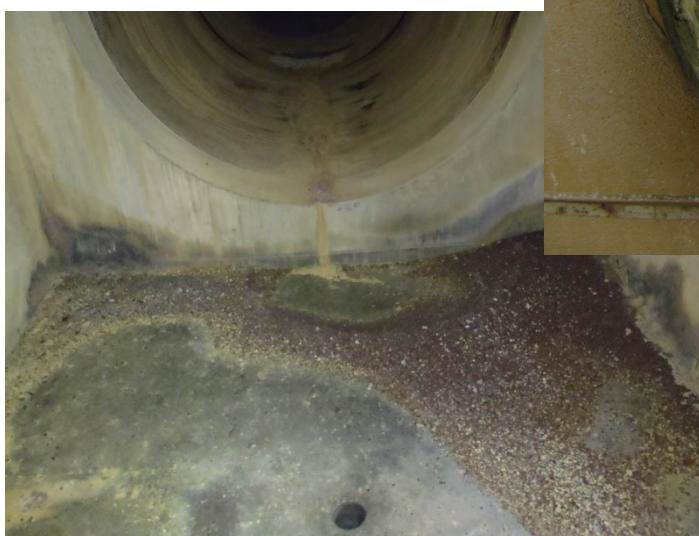
Acid Coolers

- Maintenance
 - Plugged tubes can hold water after washing
 - Washing can leave residual water behind in shell
 - Consider drain location and/or slope
 - Remember to drain the expansion joint
 - Is there a procedure to check for water prior to filling
- Leak response
 - Can you easily test the CW to confirm a leak?
 - Can you isolate the water side in case of a leak?
 - Can you easily access the drains/vents
 - Consider quick connect blind flange on water side

Economizers

- Water Pressure >> Gas Pressure
 - A leak will always force water into the gas
 - SO₃ in the gas will form acid once water enters gas side
 - Weak acid rapidly corrodes the finned tubes → HYDROGEN
 -  Water in the gas also dilutes the acid in the towers
- Have you considered draining the economizer?
 - It is a dry system - I don't need a drain.....
 - Small bottom drains are easily plugged with scale
 - Are drains inspected/cleaned every shut down?
 - Is there a location for the liquid to drain to

Economizers



Sulfate / Scale build-up can
easily block a drain

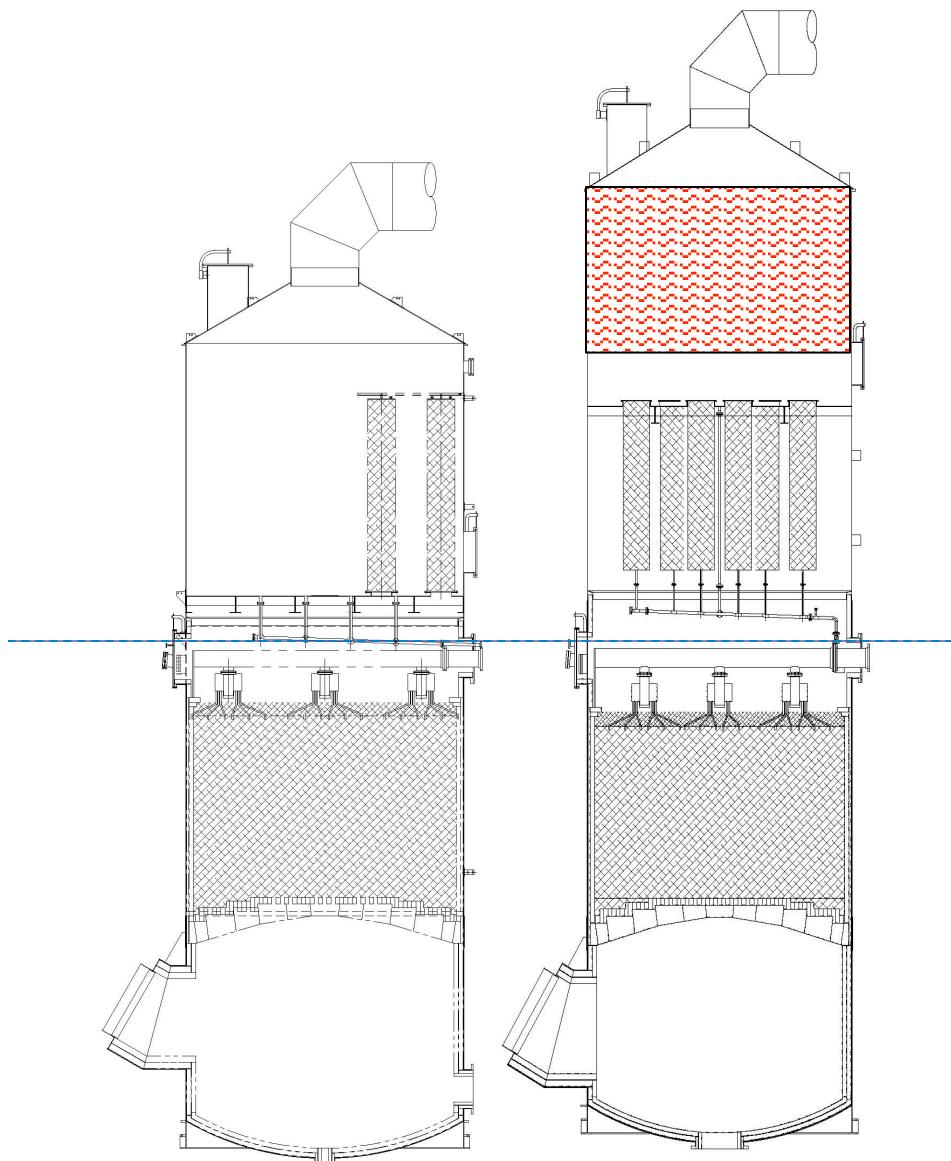
Economizers

- Water Pressure > Gas Pressure
- Have you considered draining the economizer?
- Economizer Piping
 - Check valve to prevent reverse flow from Boiler
 - Can you fully isolate the water side
 - Bypass – The boiler may need water during cooling down

Absorption Towers

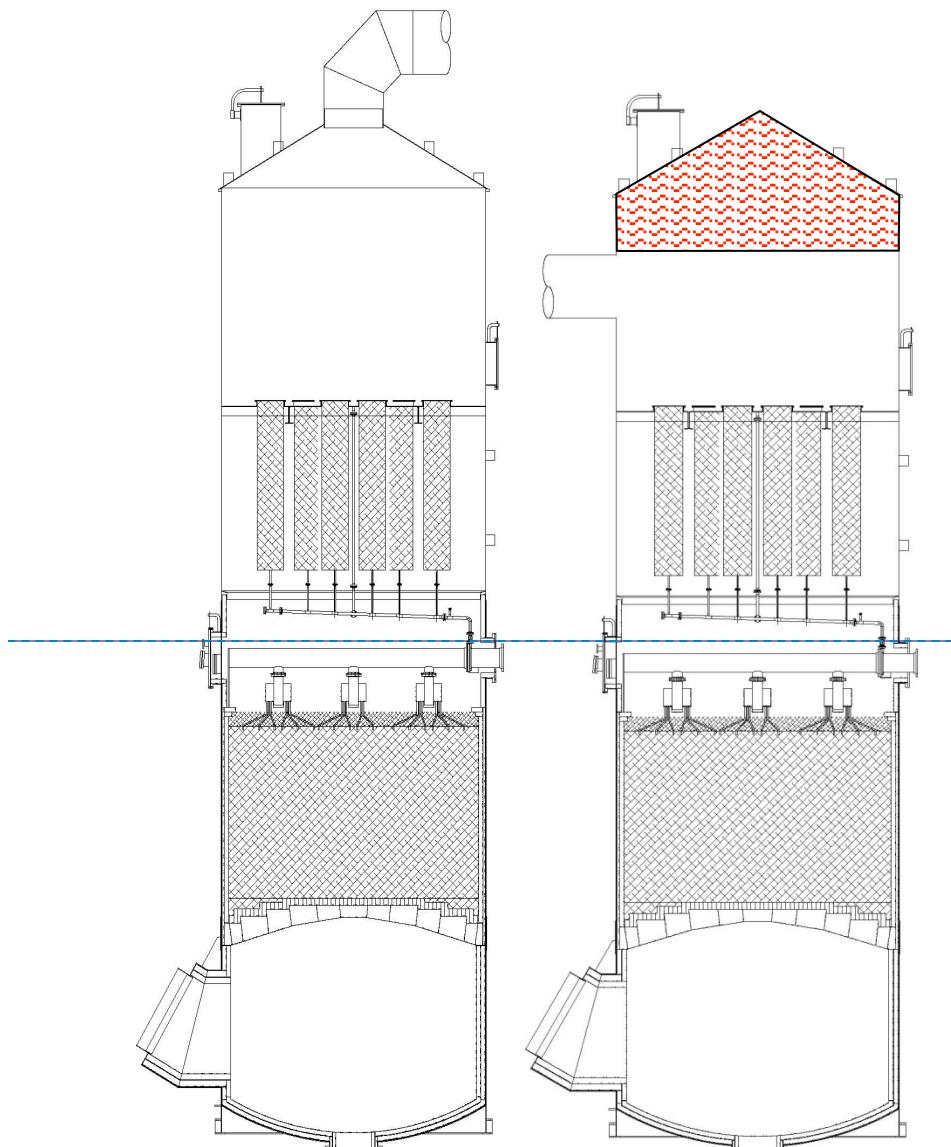
- Decisions have to be made at design stage
 - Alloy tower vs Brick Lined towers
 - Corrosion potential for alloy towers is higher

Absorption Towers



- Consider minimizing vapour space
 - Standing candles vs. hanging candles

Absorption Towers



- Consider minimizing stagnant gas space
 - Top gas outlet vs. side gas outlet

Absorption Towers

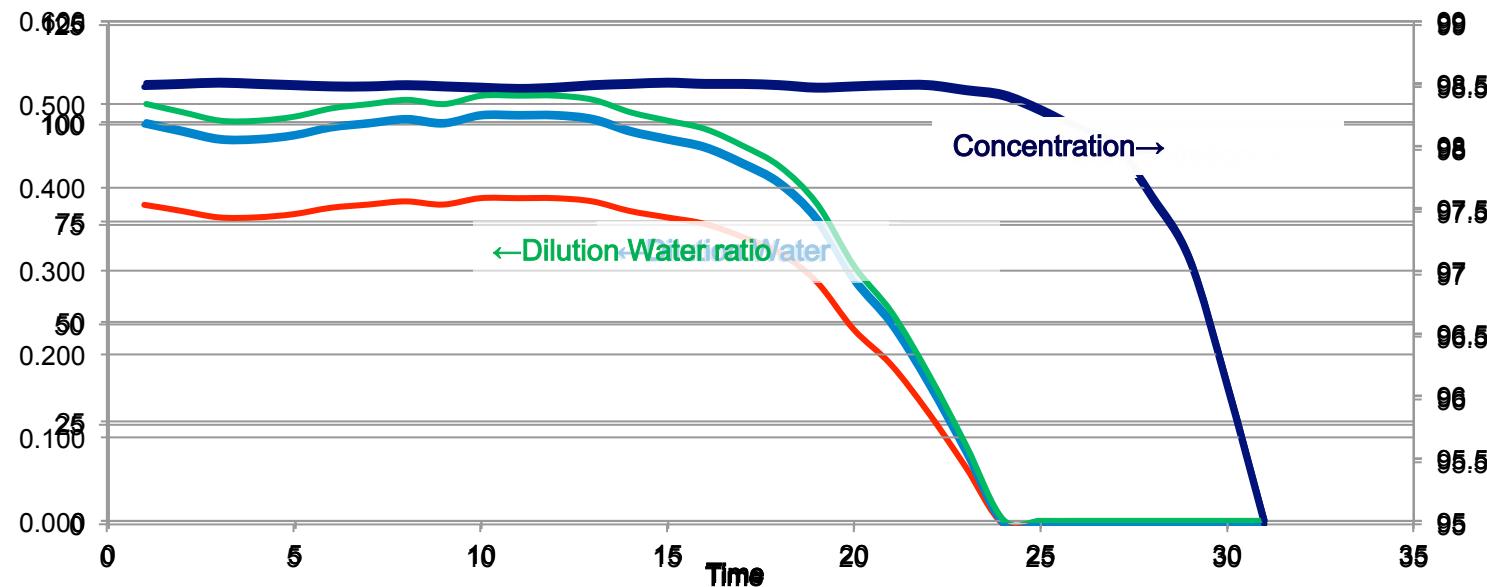
- Decisions have to be made at design stage
 - Alloy tower vs Brick Lined towers
 - Consider minimizing vapour space
 - Consider minimizing stagnant gas space
 - Consider how to remove Hydrogen from tower
 - Purging (Air / Nitrogen)
 - Venting

Detect

- Early warning of a problem is vital
- Analyzers on water returns – 1 per cooler
 - Need easy access to sample point to confirm alarm
 - Maintenance of pH probes is often overlooked
 - Conductivity can be used to confirm a pH alarm
- Acid Cooler Temperatures
 - Consider measuring Acid and Water side temperatures
 - May already exist on Anodic protection system
- Anodic Protection Systems can help
 - Changes/fluctuations in current/voltage can indicate a problem before a leak develops
 - Supplier can help analyze unusual operation

Detect (2)

- Monitor the Acid Plant Water Balance
 - Most leaks start small
 - Compare dilution water flow vs. acid production/sulfur feed
 - Easy to implement on DCS – can be trended
 - Can be used for alarm or interlock



React

- Fail to plan = Plan to Fail
 - Do your procedures cover these events?
 - Write procedures for each event you can foresee
 - Do your operators get any practice?
 - If you don't practice will they know what to do?
 - How are new operators trained?
 - Does management support the operators?
 - Does your equipment get practice?
 - Ensure Bypass / Isolation valves still move
 - Are drains / drain piping cleared at every shutdown

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