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AGGREKO PROCESS SERVICES

# An approach to temporary revamps

**REFCOMM**<sup>®</sup>  
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▪ *Massimo Capra*

▪ *[massimo.capra@aggreko.nl](mailto:massimo.capra@aggreko.nl)*

## APS TARGETS



- **Process Efficiency Enhancement:** VDU vacuum recovery
- **Mitigation of Seasonal impact on Utilities conditions:** FCC Dense Air application
- **Temporary Revamps to cope with short term market opportunities:** Isomerization de-butanizer
- **Recovery Projects:** Enhancing Heat transfer in fouled Heat Exchangers
- **Risk Management:** Engineered recovery plan for aged capital assets
- **Improved Time Schedule of Turnarounds or reduce the scope**

## Revamps through Leased Engineered Temporary Solutions

### Engineered

Solutions are engineered on customer requirements in order to ensure Critical Success Factors

- ❑ Project Design Package
- ❑ Safe Commissioning and Operations
- ❑ Participation to HAZOP and MOC
- ❑ Compliance with Customers' Technical Standards
- ❑ Environmentally compliant solutions
- ❑ Predictable performances
- ❑ Reliability of equipment
- ❑ Full Automation and Monitoring

### Temporary

Temporary solutions are for temporary problems or short term market opportunities

- ❑ Seasonal utilities conditions changes
- ❑ Seasonal production peaks
- ❑ Fouling of heat transfer equipment
  - ❑ High outlet CW temperature
  - ❑ Poor quality of CW
  - ❑ Temporary outage of Cooling Tower system
- ❑ Environmental problem
  - ❑ Effluents temperature too high for disposal
  - ❑ Biological plant working at too high temperature
- ❑ Test for new process conditions
- ❑ Resolve Capital Investment Challenges

### Solutions

Aggreko Process Services offers solutions to problems, in the following areas:

- ❑ Process Enhancement
  - ❑ Condensation improvement
    - ❑ CDU
    - ❑ VDU
    - ❑ FCC Main Fractionator
    - ❑ WGC
    - ❑ De-Butanizer
  - ❑ FCC Dense Air
  - ❑ Gas Turbine Dense Air
  - ❑ Run Down and PA Cooling
  - ❑ Waste Water Cooling
- ❑ Turn Around Solutions
  - ❑ Flare-less Steam Out
  - ❑ Columns Air Cooling
  - ❑ Reactor Cooling
    - ❑ Water flood
    - ❑ H<sub>2</sub> circulation
  - ❑ Confined Spaces and Equipment aeration
  - ❑ Utilities supply CW, Electrical Power
  - ❑ Intermediate Product Cooling
- ❑ Risk management
  - ❑ Contingency plans to prevent utilities disruption
    - ❑ Chillers
    - ❑ Cooling Towers
    - ❑ Generators
- ❑ Emergencies

# PROJECT STEPS



<u>APS Project Route</u>					
<u>Identify</u>	<u>Define</u>	<u>Design</u>	<u>Execute</u>	<u>Operate</u>	<u>Optimize</u>
		Order	Detailed Engineering	Training	After-Action Report
Preliminary Analysis	Letter of Intent and NDA	Definition of Project Deliverables	Certifications	Maintenance	Verification of Performance, Reliability, Safety, Environmental Compliance
Technical response	Customer Commitment on a Scoping Study	HazOp Assistance	Project Planning	Optimization	
Cost Estimate	Commercial Proposal	MOC	Installation	De-Commissioning	Optimization and Improvements for the future
		Detailed Process Design	Commissioning		

# Process Enhancement :

## Increasing Amine system $H_2S$ and $CO_2$ recovery efficiency

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# THE CORROSION-EROSION PROBLEM

**MEA: Primary Amine**

- High scrubbing efficiency
- High regeneration temperature
- High Corrosion rate

**DIPA: Secondary Amine**

**MDEA: Tertiary Amine**

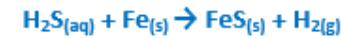
**Heat Stable Salts (HSS) below 1%wt**

Formed by Strong Acids reacting with amines or by high H<sub>2</sub>S load:

- formation of (NH<sub>4</sub>)HS which penetrates the FeS layer
- HSS inactivates amines
  - Water /Polysulphides wash of acid gases
  - Reclaiming operation

1-5 ppm as total suspended solids effectively guards against corrosion-erosion process

**Amine solution surface tension drops as suspended FeS conc. increases: this increase amine entrainment and liquid foaming**



**Wet H<sub>2</sub>S Corrosion produces atomic H which permeates steel inducing high pressure**

- Hydrogen blistering
- Hydrogen Induced Cracking
- Sulphide Stress Cracking

SSC

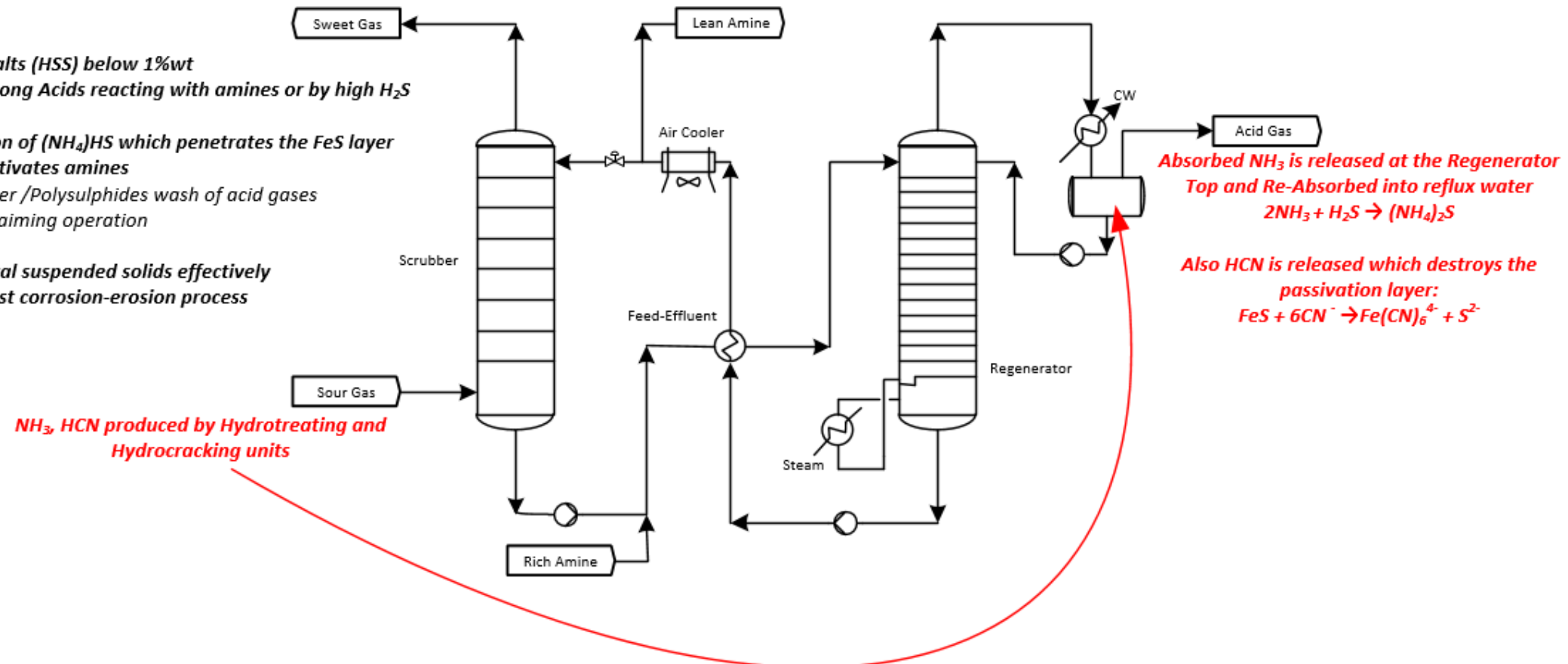
SCC

Concentration cell Corrosion

Inter granular Corrosion

HIC

Galvanic Corrosion



**Absorbed NH<sub>3</sub> is released at the Regenerator Top and Re-Absorbed into reflux water**  
 $2\text{NH}_3 + \text{H}_2\text{S} \rightarrow (\text{NH}_4)_2\text{S}$

**Also HCN is released which destroys the passivation layer:**  
 $\text{FeS} + 6\text{CN}^- \rightarrow \text{Fe}(\text{CN})_6^{4-} + \text{S}^{2-}$

- ❑ Corrosion due to wet  $\text{H}_2\text{S}$  is very fast on bare metal
  - ❑ Reduced as passivation layer builds-up
  - ❑ Accelerated by presence of  $\text{CO}_2$  or high TSS
- 
- API 945 includes recommendations to limit velocities:
    - ✓ Lean Amine to max 3 m/s
    - ✓ Rich Amines to max 1.5 m/s

### **Poor scrubbing and regenerator efficiency** caused by:

- Fouling of column internals
- Fouling of reboiler

### **Excessive foaming in amine solution** causes:

- Amines in regenerator drum
- Condenser corrosion
- Amines in sweetened gas

### **Fouling of lean amine lines and cooling equipment:**

- Increased lean amine temperature to scrubber
- Reduced acid gas removal efficiency



- ❑ Try to increase amine circulation rate: which worsen the problems

Often with:

- ❑ Scrubber / Regenerator already close to maximum loading

RESULT:

Cut upstream unit throughput : huge economic losses

### **FACT:**

Reducing lean amine temperature to scrubber is crucially important  
This restores acid gas removal efficiency

### **AGGREKO SOLUTION:**

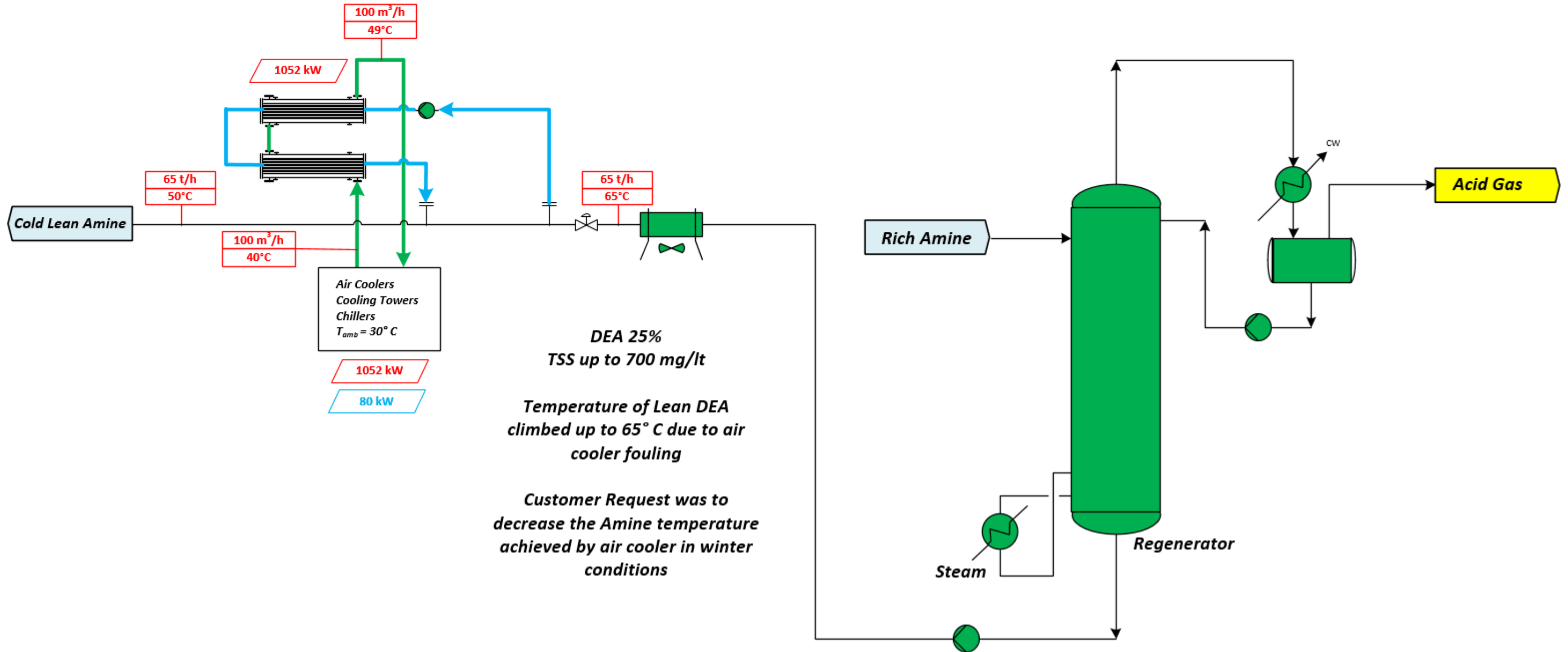
Provide supplemental cooling of lean amine stream

### **METHODOLOGY:**

Insert Aggreko HX in recirculating loop  
Aggreko's methodology requires no unit shutdown; causes no disturbance  
Aggreko cooling towers or refrigerated chillers provide supplemental cooling



# EXAMPLE OF A PROJECT ON DEA



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