ENERGY CONSERVATION EFFORTS IN AMMONIA-UREA FERTILIZER PLANTS

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Introduction: Fertilizer Industry and Community development

- Nitrogen fertilizers contributes to producing close to 50 % of the food grown world wide.

- Fertilizers production consumes about 2 % of the world's total energy on an annual basis.

- About 97 % of the nitrogen fertilizers are derived from synthetically produced ammonia.

- The ammonia production is an energy-intensive process, that accounts for 80 % of the total energy required for production of urea.

Ammonia as an energy –intensive

- Economically, natural gas is the main hydrocarbon feed stock used in ammonia synthesis, i.e., the processes that use less natural gas per unit of Ammonia contributes to a significant reduction in the production costs.
- Environmentally, the energy-efficiency improvements led to a reduction in the generated CO_2 emissions from both process and fuel combustion results, that saves environment.

Minimize energy Consumption and/or maximize production capacity.

- According to latest surveys, the average net specific consumption for modern plants approaches 5.9-7 Gcal/mt NH_3, but still some plants at the figure of 8-13 Gcal/mt, based on age, capacity and technology.

Alexandria Fertilizers Company -Introduction

- Alexfert was established in October 2003 on the coast of Abu Qir bay, south Mediterranean of Alexandria, Egypt.
- Commissioned by August 2006.
- Consisted of:

Ammonia Plant
1200 MTPD

Urea Plant
1925 MTPD

Utilities Section

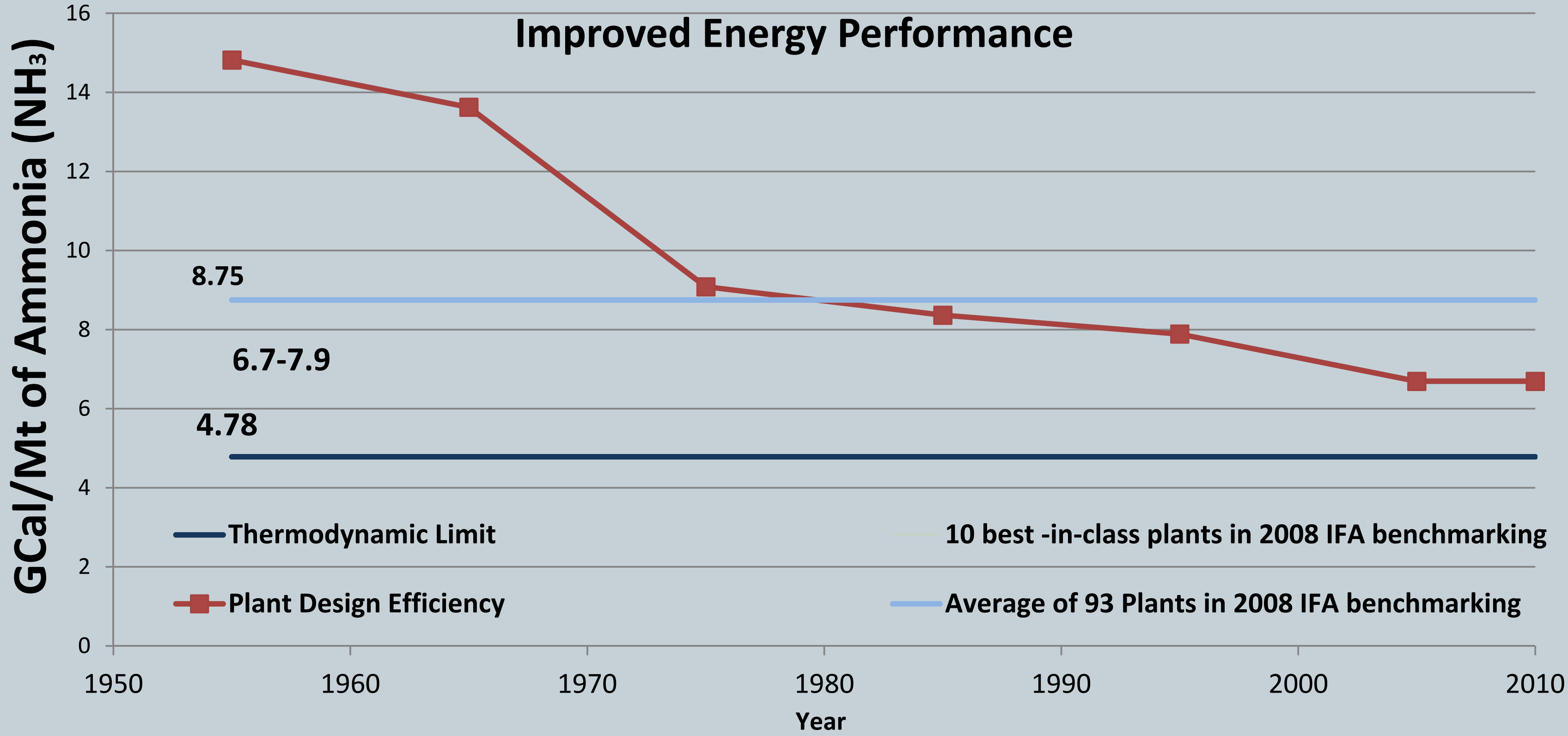
Ammonium Sulphate Plant
720 MTPD

Alexfert Policy

- To continually improve the process execution, and resources management including the energy conservation.
- Based on that, the plants establishment comprising the use of latest proven technologies, while continual efforts aims in improving and optimizing the energy consumption issues.
- Design Net Specific Consumption is 7.2 Gcal/MT Ammonia.

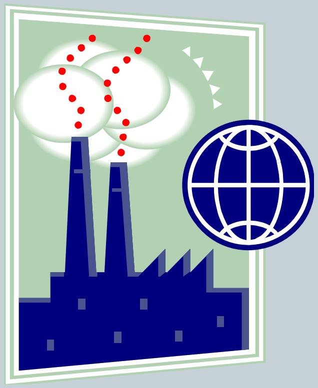
Energy Conservation in Fertilizer Plants

- Energy Improvement in the fertilizer plants over years:

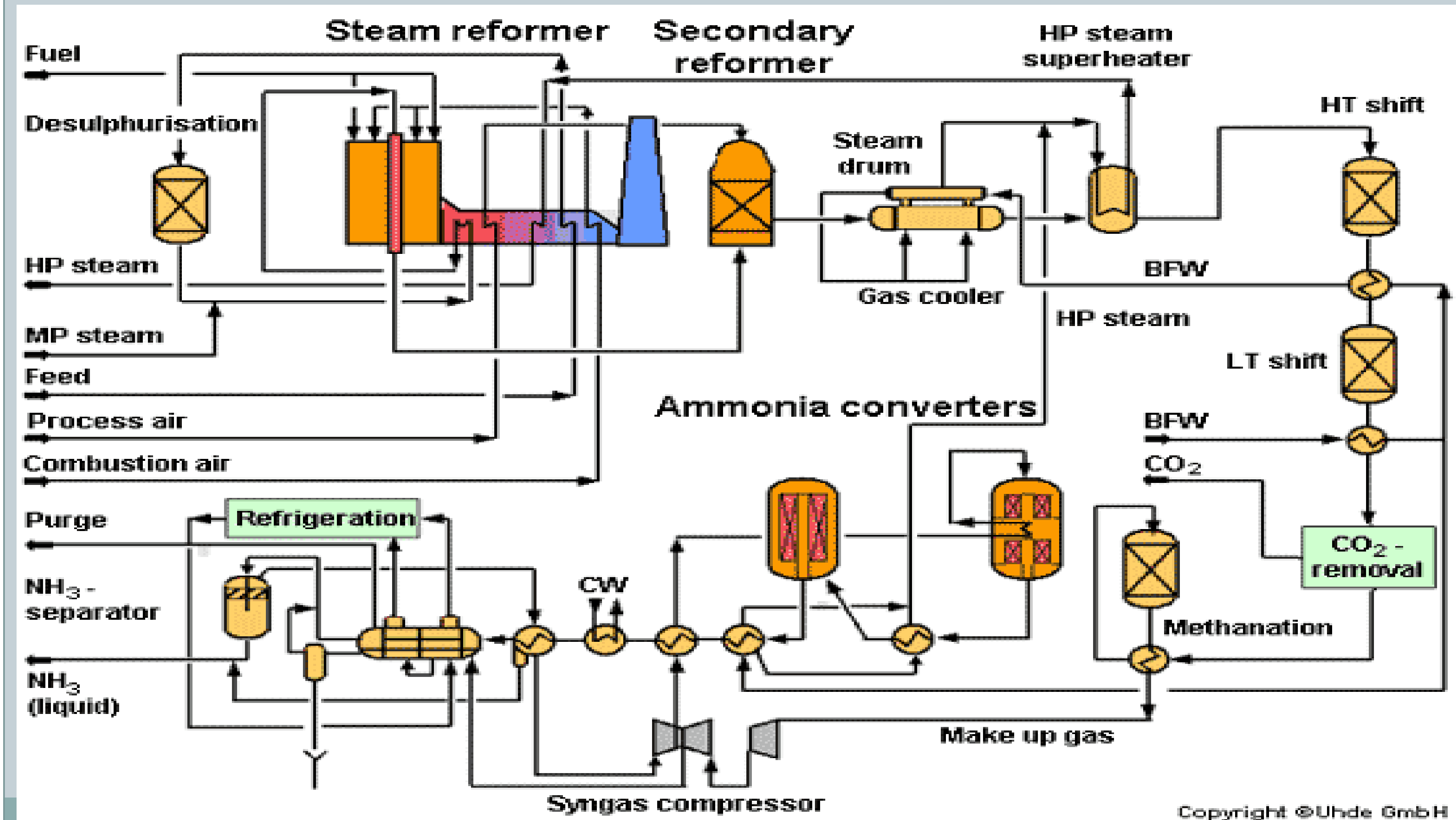


General guide for developments and opportunities: Ammonia Plants

- Developments runs simultaneously with the idea of revamping or modifying the existing units for the ease of increasing their efficiencies, maximizing economics, or eliminating bottlenecks to match with modern technologies and reduce energy consumption so as to remain competitive.



Ammonia Plant



Energy Conservation Opportunities-Ammonia Plant

- Reforming section:

1. Modern reformer tubes "Better Metallurgy, Box Design, catalyst packing, Burners"
2. Utilization of excess heat in flue gases "additional coils".
3. Installing pre-reformer "reduce firing duty for primary ref."
4. Reduction of Steam to Carbon ratio for reforming process.
5. Short loading catalyst in secondary reformer for better combustion and lowering pressure drop.

Reforming Section

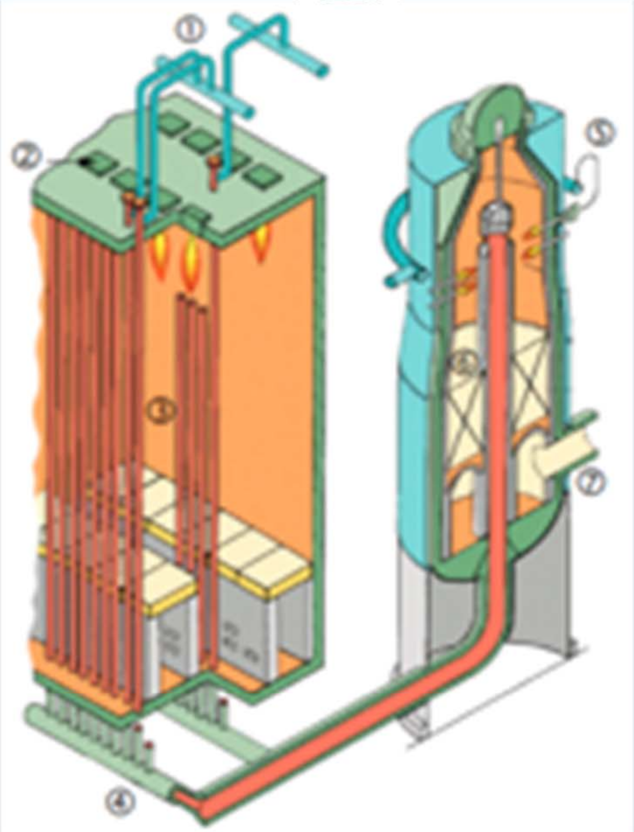


Figure 1 – A primary reformer radiant section and a secondary reformer (IPTS/EC, 2007).
1) Inlet manifold, 2) burners, 3) reformer tubes, 4) outlet manifold, 5) process air inlet, 6) catalyst bed and 7) gas outlet

Energy Conservation Opportunities-Ammonia Plant

- CO shift converters:

1. Better design exit nozzles “improves pressure drop”.
2. Gas radial flow.

- CO_2 removal unit:

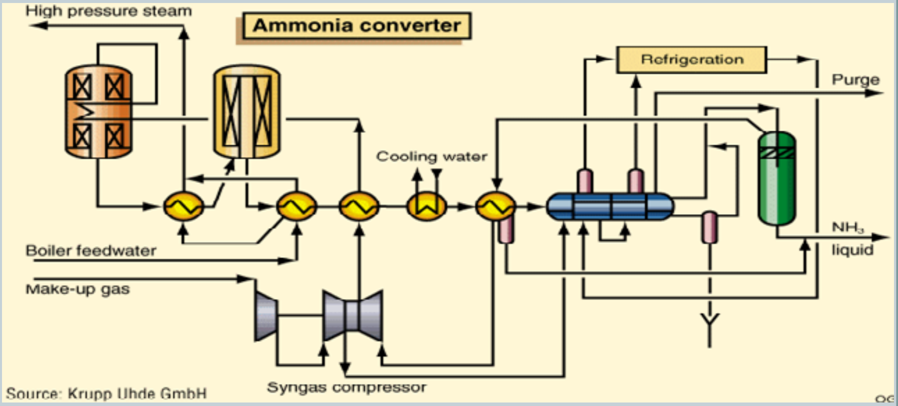
1. Packing selection for absorption and stripping columns.
2. Selecting proper activator.
3. Replacement of single stage flash drum to multi-stages one.
4. Hydraulic turbine.

Thus, improve absorption efficiency per extracted CO_2, decrease steam requirements.

Energy Conservation Opportunities-Ammonia Plant

- Methanator and synthesis gas suction:

1. Drying of the synthesis gas allows the gas to fed directly to converter instead of synthesis loop before separator.
2. Chilling of make-up synthesis gas reduces synthesis gas compressor power by 9 % per 30 °C “increase plant rate”.



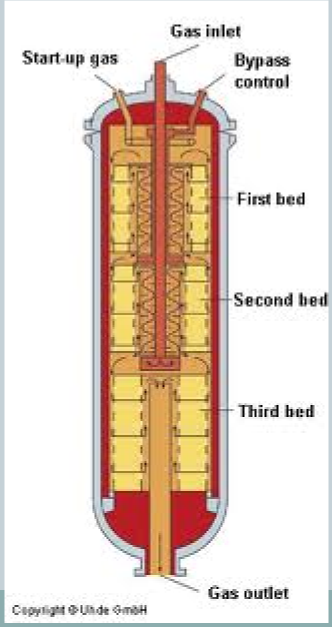
Energy Conservation Opportunities-Ammonia Plant

- Ammonia Synthesis:

1. Modifying the ammonia converter basket aiming in enhancing the flow direction “axial to radial or axial-radial”.
2. Proper design for waste heat recovery from synthesis gases exit converter “excess heat recover & improve heat duty of ammonia refrigeration cycle”.

- Purge gas recovery:

Selective recovery of ammonia and hydrogen from the purge gas “hydrogen to synthesis & ammonia productivity improved”



Energy Conservation Opportunities-Ammonia Plant

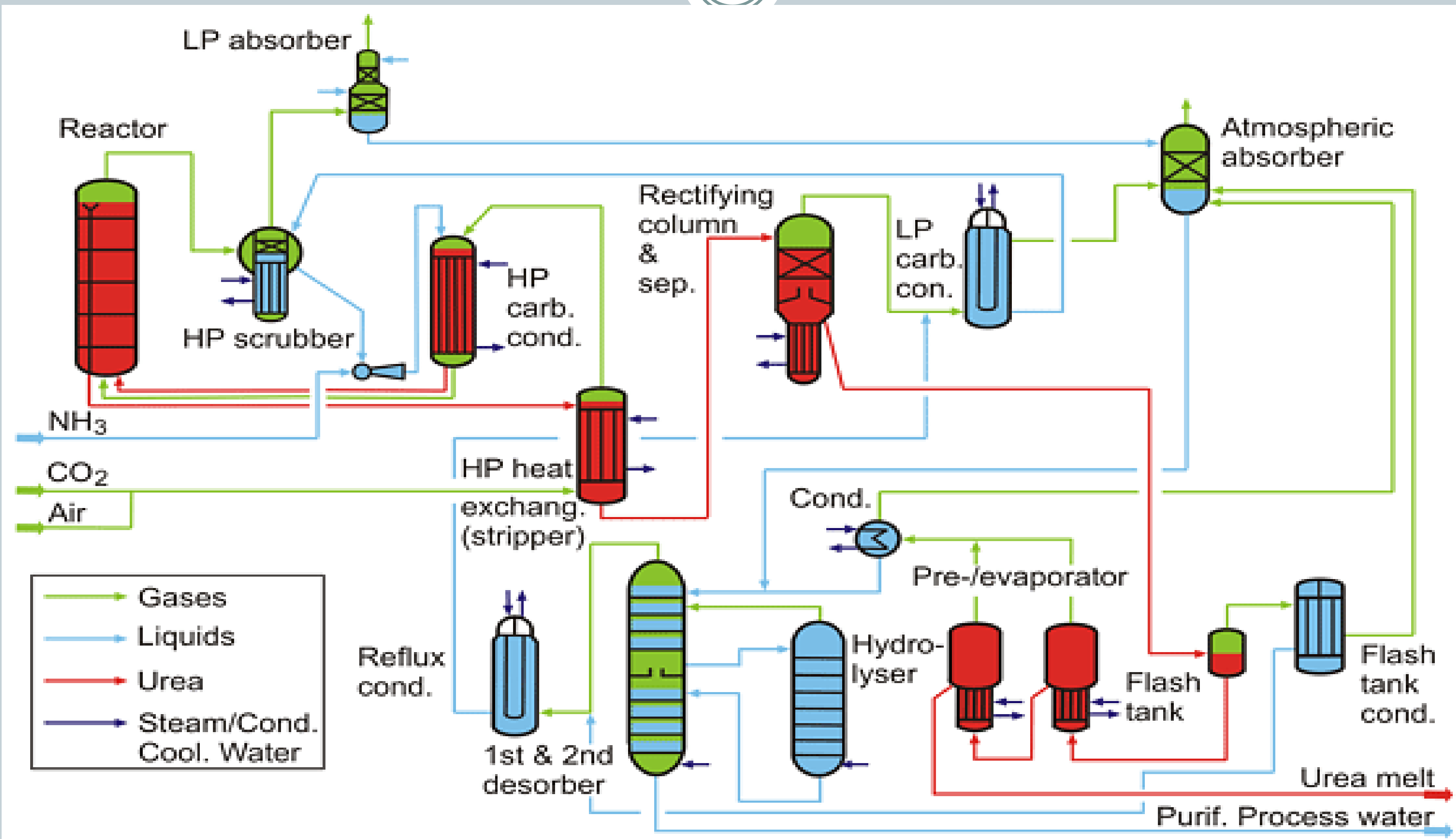
- Catalyst used:

Use of higher activity catalyst with lowest pressure drop & high conversion rates improves the productivity and energy needs.

- Steam system:

Effective control of leaked points from steam system vents as well as application of the modern control systems, all of which improves the process efficiency and saves energy.

Urea Plant



LP absorber
Reactor
Atmospheric absorber
Rectifying column & sep.
LP carb. con.
HP scrubber
HP carb. cond.
NH3
CO2
Air
HP heat exchang. (stripper)
Cond.
Pre-/evaporator
Gases
Liquids
Urea
Steam/Cond. Cool. Water
Reflux cond.
1st & 2nd desorber
Hydro-lyser
Flash tank
Flash tank cond.
Urea melt
Purif. Process water

Energy Conservation-Urea Plant

- High Efficiency Urea Reactor Trays.
- Installation of ammonia pre-heater to urea plant.
- Heat Recovery from vapors in Recycling and Evaporation Units.
- Urea Hydrolyzer.
- Product cooling with Chilled Ammonia.

Energy Conservation-Utilities Plant

- Using Modern Water Treatment Techniques, e.g. R.O. Units.
  - Saving chemicals, power and environment.
  - Ability to Operate cooling water systems with the minimum necessary blowdown streams, saving power, and environment.

Energy Conservation Opportunities-General

- Advance process Control.
- Variable frequency Drives.
- Load Management Systems.
- Change of Pumps and fans drives from steam turbine to electric motors.
- Use of Energy Efficiency Lighting systems.

Conclusions

- The energy conservation philosophy is an essential for ammonia/urea manufacturing competition taking into account:

1. Energy Conservation as a target led to Power Saving, Environmental Care, Cost Reduction, Performance Improvement.
2. Continual increase in the scarce energy resources prices pulls manufacturers to reduce energy consumption.

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Thanks.