ENERGY IMPROVEMENT PROJECT OF AMMONIA AND UREA PLANTS

NEED FOR THE PROPOSED PROJECTS

MCF intends to do energy improvement revamp of existing Ammonia / Urea plants. The revamp is necessitated due to recently announced new urea GOI policy No. 12012/1/2015-FPP dated 25-05-2015 on Urea. All Ammonia/Urea manufacturers are mandated to improve their energy norms to particular levels by 2018-19 to keep themselves in black. The norms prescribed for MCF vintage is 6.5 Gcal/t of urea. As the operation profitability depends only on energy and payment of all subsidy costs are energy dependent, it becomes necessary for manufacturers like MCF to bring down energy norms to best achievable industry levels to continue operation.

The existing Ammonia and Urea plants are running efficiently and scope for energy improvement is seen due to vintage of plants.

REVAMP PROCESS: AMMONIA PLANT

The plant is currently operating with naphtha as feed and fuel and operates at about 700 MTPD with an energy consumption of around 9.6 GCal/t ISBL (inside battery limit). In the revamping process the production of the ammonia plant will be increased to 900 MTPD with a decrease in the energy consumption to around 8.0 Gcal/t ISBL. The revamped plant will use RLNG / NG as the feed and fuel. The plant is already converted to take Natural gas as feed and fuel. The revamping process will include the following modifications.

Revamp details.

a) Reformer section:
In the reformer section in the convection side two coils will be added. One is for preheating the NG before it enters the fired heater and the other is to heat the NG and the steam before it enters the primary reformer. This will increase the inlet temperature to the primary reformer thereby bringing down firing and the heat flux in the tubes. This calls for the replacement of the cross over line and the inlet pig tails. It also calls for replacement of some of the coils in the super heater section and replacement of the tubular combustion air heater with a plate heat exchanger. The temperature to stack will be brought down to less than 140°C versus the current value of 170°C.
b) CO₂ removal section:
The current CO₂ removal section with UOP consisting of a single stage regeneration consumes around 1100 Kcal/Nm³ of CO₂. Whereas going forward using the GV low heat two stage regeneration the regeneration energy can be brought down to around 700 Kcal/Nm³ of CO₂. It calls for an additional regenerator operating at very low pressure (1.05 kg/cm²) and the current one to operate at close to 2.0 Kg/cm². In addition to this a blower will be required to boost the CO₂ from the low pressure regenerator. The CO₂ will be available to the urea plant at 1.40 kg/cm² compared to the current value of 1.25 Kg/cm².

c) Compression section:

i. Synthesis gas compressor
The option is to go ahead with a completely new set of compressor and turbine eliminating the motor altogether.

ii. Air compressor
The new compressor purchased for the gas conversion project along with the existing compressor will be adequate for the revamped requirements.

iii. Refrigeration compressor
To optimize the load on the refrigeration compressor, additional high pressure ammonia chiller, an interstate cooler and a parallel flash drum will be added.

iv. Synthesis section:
Based on the option selected for the synthesis compressor revamp the loop will operate at 240 kg/cm² or 185 kg/cm² with or without the additional converter. The modalities for the same are being worked with the process licensor. An additional converter of a single bed with intercooler with catalyst volume of 30m³ will be required to increase the per pass conversion. This converter will be a cold walled design operating in series with the existing S200 converter of HTAS design. Additional BFW heater is provided for heat balance.

d) MP stripper:
Process condensate from the plant will be stripped using a medium pressure stripper. But the condensate so produced can be used as a make up to the de-aerator thereby bringing down the water requirement.
For increasing the capacity of the urea plant to 1560 MTPD, KRES / HTER system will be required to meet the CO₂ demand.

**REVAMP OF UREA PLANT**

Main objectives of the revamp are:-

a) Reduce HP steam consumption in HP stripper - using Stamicarbon low energy concept to achieve 550 - 600 kg/t (38 bar A & 400° C).

b) Capacity expansion from 4,29,000 t/y to 5,69,400 t/y.

c) Reduction in particulate matter to atmosphere from Prill tower fans – install Granulation Plant.

d) To improve the quality of the prilled Urea product.

**STAMICARBON Revamp Technology**

The revamp concept is targeting the below:

1. Increasing the current plant capacity from 4,29,000 t/y to 5,69,400 t/y.

2. Reduction of the extraction steam consumption from the current consumption from 850 kg/ton to about 550-600 kg/ton (400°C, 38 bar)

**Process retrofit concepts to fulfil the revamp objectives**

In the synthesis section the existing high pressure falling film carbamate condenser is replaced by a pool reactor/condenser which integrates reaction volume and efficient condensation operating at an N/C ratio of about 3 and a pressure of about 145 bar, generating LP steam (4 bar). The choice between pool condenser with existing reactor or a completely new pool reactor will be done in the study phase together with the client. The function of a MP decomposer heater is integrated into the pool reactor/condenser by direct heat exchange to a second tube bundle inside this pool reactor/condenser. Liquid from the stripper is sent to this additional tube bundle. To avoid flooding of the stripper part of the liquid from the reactor is bypassing the stripper and sent directly to this bundle.

Additional heat integration is achieved by using the heat of condensation from the gas of this integrated MP decomposer to evaporate water from the urea solution in the evaporation section in the pre evaporator. The rest of the downstream sections remain essentially unchanged, if no additional requirements are formulated from the side of the client. It is assumed that these sections like the low pressure recirculation, evaporation, condensation and prilling have sufficient
margin to handle the new higher plant capacity or do require only small adjustments. The additional required $\text{CO}_2$ compression capacity is added in the form of a medium pressure compressor which introduces $\text{CO}_2$ to the medium pressure section if insufficient compression capacity is available at present.

**ENVIRONMENTAL MANAGEMENT**

There will not be any increase in pollution load due to increase in production. This is achieved by the energy improvement schemes which will be implemented in the plant. The total firing in the primary reformer will be lower resulting in reduction of fuel consumption. Also there will be reduction in steam and power requirement for the plant.

In addition there is going to be power generation using a STG. All this is possible only because of the improvements going to be achieved with the revamp. There is no additional liquid effluent generation from the plant. The plant will remain zero liquid effluent discharge plant.

It is proposed to replace the present low pressure stripper with medium pressure (MP) stripper which will ensure removal of Ammonia from process condensate. The gases from the MP stripper will be carried by the steam going to primary reformer.

The effluent generated in the plant shall be treated in the existing effluent treatment facility and recycled back to the system.

The particulate matter (PM) from Urea prill tower emissions will come down from existing levels due to decrease in load on existing Prilling tower and introduction of granulation plant to take care of increase in capacity.

The emission of Particulate matter from the urea prill tower would be well within 150 mg/Nm$^3$. The expected emission level of particulate Matter from Granulation unit would be less than 50mg/Nm$^3$.

The Ammonia / Urea revamp project will not have impact on Environment as energy norms will improve further there by reducing the consumption norms on fuel resulting in reduction of emissions. The proposed project will not have any adverse impact on the existing environment.
as sufficient pollution control measures are incorporated in the process technology like medium pressure scrubber in ammonia and granulation plant for urea.

The additional trade effluent generated due to modernization shall be collected and treated in the existing waste water recovery system and urea hydrolyser stripper. The treated effluent will be reused in the cooling tower as make up water.