DCM SHRIRAM

Improving Energy Efficiency

At

SFC Kota

K M Tandon, SFC, Kota

Manufacturing Facilities

	Plants / Products	Unit	Production Levels
Fertiliser	- Ammonia	TPD	700
	- Urea (& Neem Coated Urea)	,,	1200
	- Power	MW	35
Chlor Alkali	- Caustic Soda	TPD	325
	- Chlorine Liquefaction	,,	180
	- HCl	,,	175
Plastics	- Calcium Carbide	TPD	340
	- PVC Resin	,,	200
Cement		TPD	1200
Power		MW	100
Shriram Polytech - PVC Compounds		TPD	60
Fenesta - Window and Door profiles		TPA	5000

We also have a 250 TPD SSP plant at Chittorhgarh

Energy in Ammonia and Urea production is used in many forms

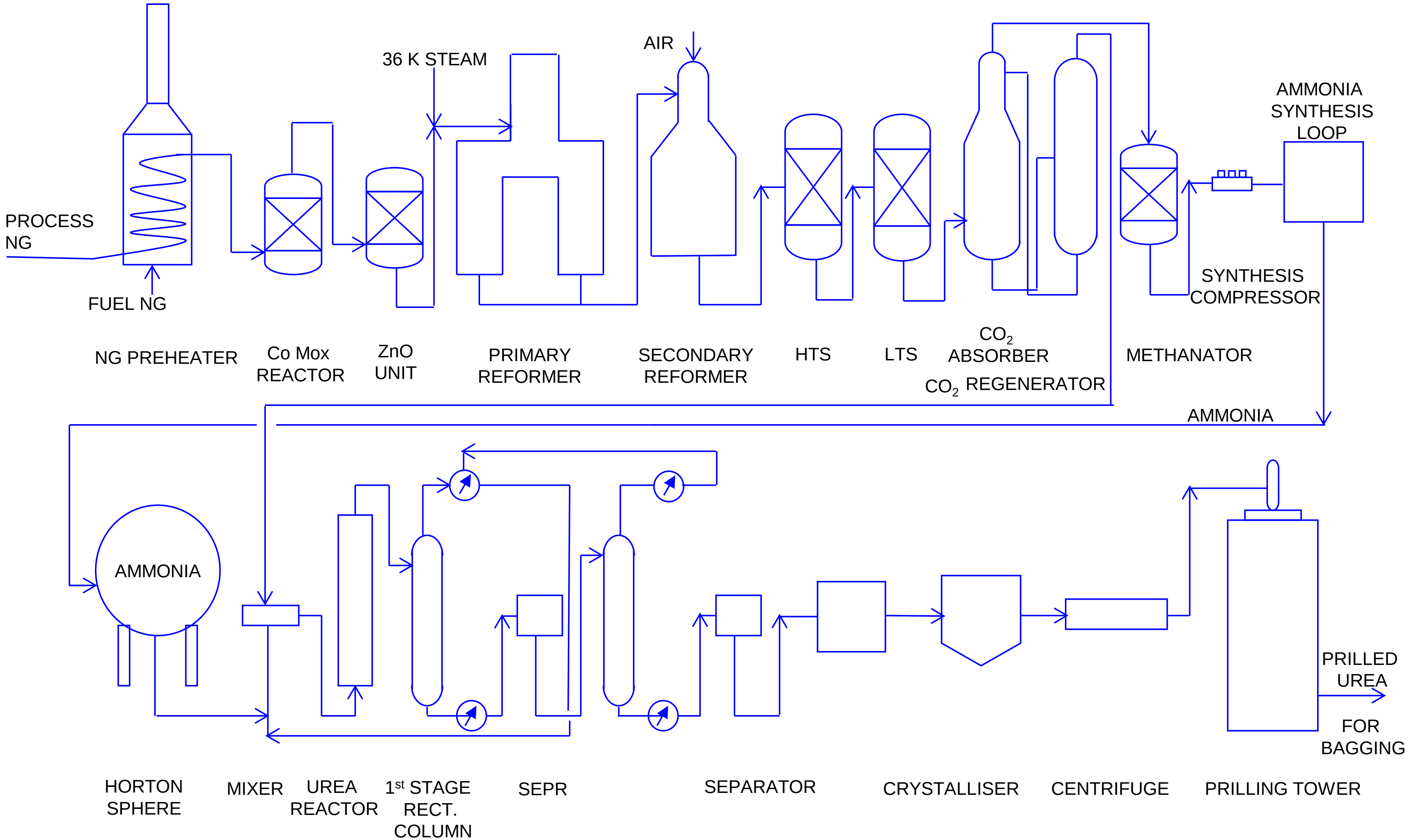
Natural gas

Other fossil Fuels

Steam

Compressed air

Schematic Flow Diagram



Salient features of plant at SFC Kota

- Ammonia Plant

  - SynGas Compressors (3 Nos.) and CO_2 Compressors (3 Nos.) are of reciprocating type and motor driven

  - No steam turbines in Ammonia & Urea Plant in normal operation
    - No 100 K Steam network in plant

  - 35 MW Power imported from coal based power plant
    - 35% of total energy consumption for Urea production coming from coal
    - Higher energy consumption due to coal use but at lower cost

  - High syn loop pressure of 325 Kg/cm2g

  - Two Hortonspheres of 1000 MT each for NH_3 storage at 7 Kg/cm2g

Salient features

- Urea Plant

  - Conventional total recycle process with two Urea reactors in series
  - Crystallisation route in place of evaporation route
    - Better, premium product quality
  - Induced Draft Prilling Tower with scrapper at bottom
  - Fluidised Prill Cooler installed in 1992 for cooling and dust removal
  - No Urea Bulk storage. Maximum storage capacity of 10,000 MT
  - Single Control room for Ammonia and Urea plants

Productivity enhancement in Fertiliser plants has been possible through

Steady and reliable operation

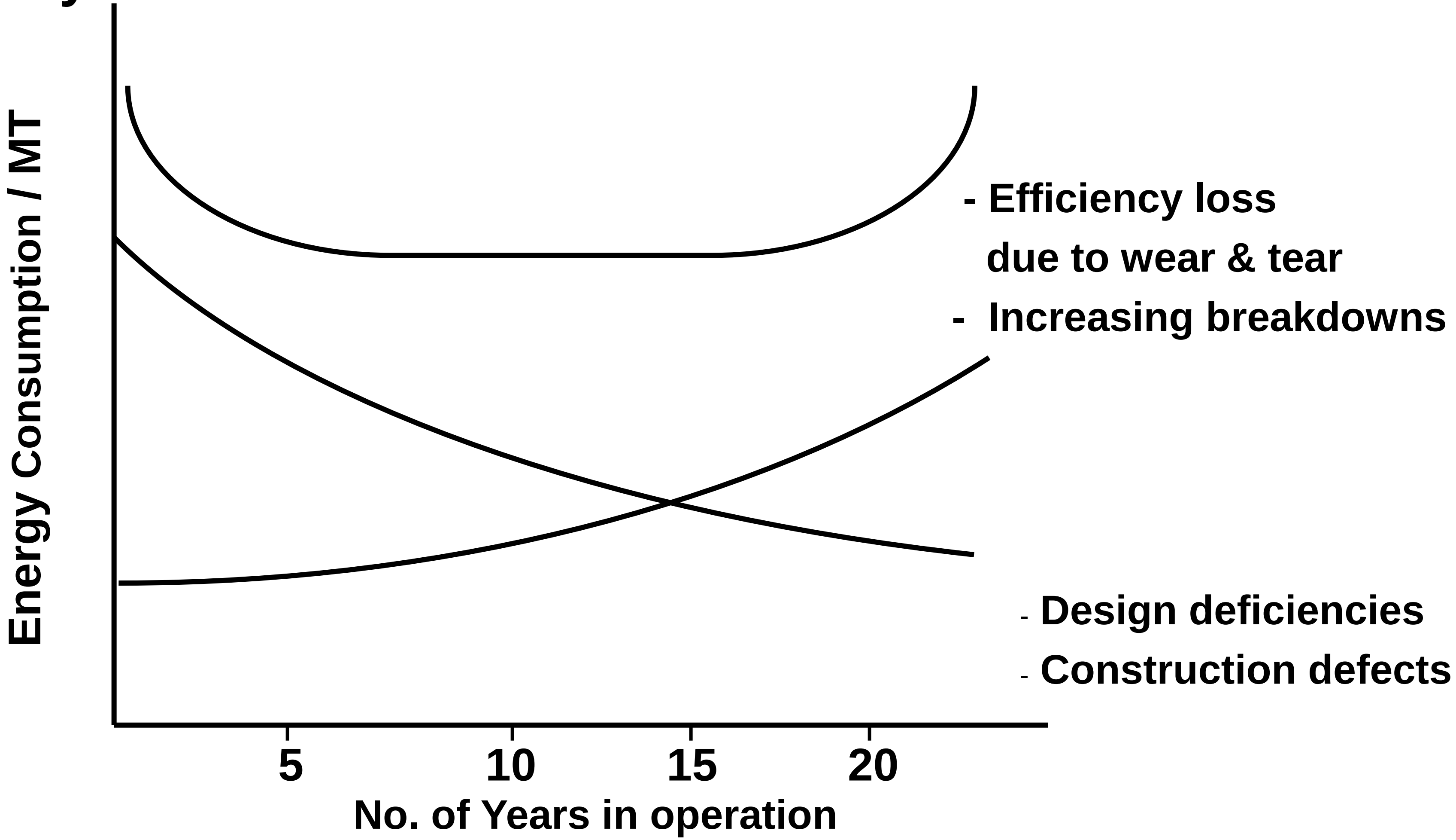
Modern maintenance practices

Modern commercial processes based on IT and relational data bases

Training and engagement of the workforce

Opportunities for energy saving

Approach to Energy Consumption of plant over its lifecycle : bath – tub curve



Opportunities for energy saving

Challenge / opportunity :

- To reverse the impact of efficiency loss due to aging

Approach adopted at SFC

- Incorporating latest technical advances
- Increasing capacity utilization
- Continuous review of plant performance
- Engineering improvements
- In-house design and fabrication
- Systemic approach to Energy Management

Approach adopted at SFC

- Incorporating latest technical advances
- **Increasing capacity utilization**
- **Continuous review of plant performance**
- **Engineering improvements**
- **In-house design and fabrication**
- **Systemic approach to Energy Management**

Approach adopted at SFC

- Incorporating latest technical advances

1981	:	Change in Absorber packing from Ceramic Intallox saddle to Poly proplyene to SS Pall rings
1983	:	Upgrade of Reformer tube material from HK 40 to IN519 and to HP Nb Modified (2000)
1985	:	Installation of cryogenic PGR from Air Liquide
1992	:	Change of MOC of blade of Cooling Tower ID Fans from Al to FRP
1991/92	:	Centrifugal Carbamate pump from Sunstrand in Urea plant
1992	:	S-200 axial design Converter Basket
1994	:	Pinch Analysis of Ammonia Plant
1996	:	High Efficiency trays in Urea Reactor
1997	:	Indigenous Advanced Control System for Ammonia plant

Approach adopted at SFC

2006	:	Feedstock change from Naphtha to Natural Gas. Modification done in the plant to make it capable of using both naphtha and natural gas in any proportion
2006	:	Ammonia Plant Process control instrumentation also changed from pneumatic to DCS
2013	:	Urea Plant process control instrumentation changed from Pneumatic to DCS
2014	:	Advance Process Control System for Ammonia Plant
2015	:	Commissioning of Benfield (CO_2 Removal) system revamp

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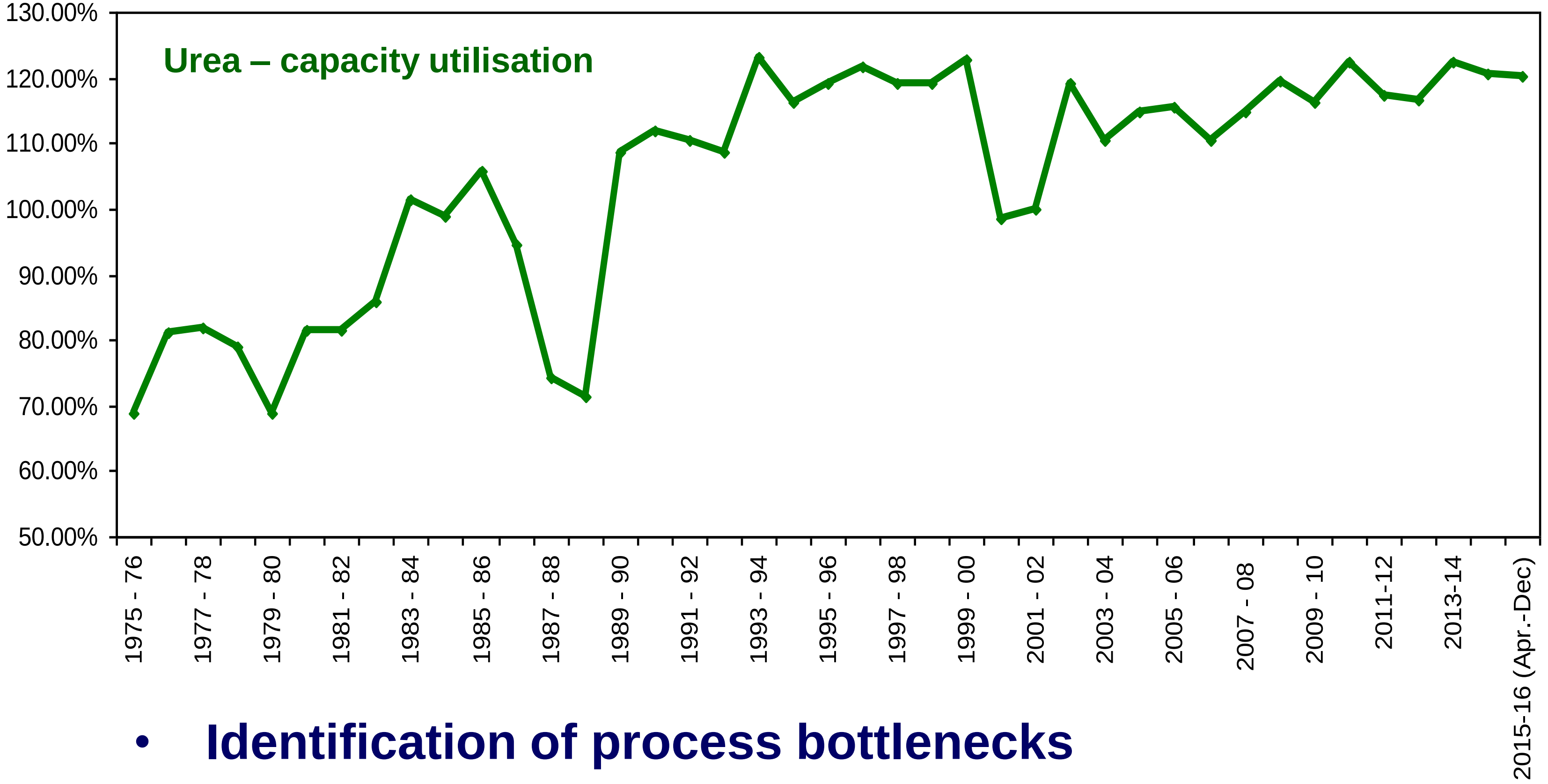
Approach adopted at SFC

➢ **Increasing capacity utilization**



- **Identification of process bottlenecks**
- **Systematic equipment replacement to improve reliability**
- **Reduction in trips and breakdowns**

Approach adopted at SFC

- Identification of process bottlenecks e.g.

  - Presently, Process air supply is bottleneck during summers

  - Reason of low supply identified as high pressure drop in 1st stage intercooler and high motor winding temperature

  - Steps undertaken to boost supply during summers:

    - Air from 1st stage discharge partly cooled in intercooler of old air compressor and re-injected in 2nd Stg suction

    - Chemical cooling of intercoolers done in 2011

    - Injection of 300 Nm3/hr excess air in Instrument Air Compressors in 2nd stage suction in 2011

    - Discharge of Winding Cooler opened to atmosphere to increase velocity and reduce temperature

Approach adopted at SFC

- Systematic equipment replacement to improve reliability

  - Energy consumption strongly related to equipment health
  - Exhaustive NDT undertaken during turnarounds involving ~ 350 mandays and covering entire plant
  - Based on results, rolling Equipment plan prepared
  - Critical equipment replaced or installed in last 15 years :

    - For example, in Reforming Section:
      - ✓ NG Pre-heater and outlet piping, Reformer Tubes, Inlet headers, Outlet pigtails, branch collector, common collector (partly), No2 RG Boiler , Steam NG Coil, Air Coil, Steam Coil, Comb. Air Heater, ID & FD Fan, burners

    - New HTS, Converter Basket, No1 Ammonia Separator, BFW Preheater, Lean Soln Cooler, SS Re-tubing of Syn Water Cooler

    - Crankcase of 2 Syn Gas Compressors, New Process Air Compr, all pump rotating assemblies, New Letdown Compr

Approach adopted at SFC

- Incorporating latest technical advances
- Increasing capacity utilization
- **Continuous review of plant performance**
- Engineering improvements
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Approach adopted at SFC

- Constantly reviewing plant performance
  - Significant changes in plant since inception
    - 700 TPD Ammonia / 1200 TPD Urea being produced from plant originally designed for 450 TPD Amm / 700 TPD Urea
    - Cost of Naphtha : Rs 180/T in 1969 v/s Rs55,000/T in ‘06
  - Plant and equipment performance needs to be constantly studied for optimising energy consumption
  - Interventions required in following areas
    - Modifications in operations of equipment
    - Equipment & piping replacement to decrease ΔP
    - Redesign of boilers and exchangers

Approach adopted at SFC

- Incorporating latest technical advances
- Increasing capacity utilization
- Re-look into original design of equipment
- **Engineering improvements**
- In-house design and fabrication
- Systemic approach to Energy Management

Approach adopted at SFC

➢ Engineering Improvements

- Better leakage class of vent valves in CO_2 Regenerator and Reformer
- Putting Primary Reformer temperature on cascade with Fuel NG flow control valve
- Replacing air bubbler type level indicators with radar type, thereby saving power consumption in Instt. Air Compressor
- Improving power factor of 415V system by adding capacitor bank
- Replacing aged motors with higher efficiency motors – eg HP BFW pump motor
- Operating Variable pockets for fine controlling the capacity of Syn Gas Compressors

Approach adopted at SFC

- Incorporating latest technical advances
- Increasing capacity utilization
- Re-look into original design of equipment
- Engineering improvements
- **In-house design and fabrication**
- Systemic approach to Energy Management

Approach adopted at SFC

➢ Modifications in operations of equipment

- Example - 1

- Off gas from Letdown drum was being compressed from 24 Kg/cm2g to 42 Kg/cm2g to mix with Purge Gas

- With Naphtha operation, NH_3 was being removed from Purge Gas in Water Scrubber at 40 Kg/cm2g pressure

- With PGR stopped after NG use, it was decided to take out purge from loop at 25 Kg/cm2g and operate scrubber at 24 Kg/cm2.

- Letdown compressor discharge pressure reduced leading to power saving of 35 kW

- Lower Scrubber pressure enabled feeding water from HP BFW pump leading to stoppage of Water Scrubber pump drawing 12 kW

Approach adopted at SFC

➢ Modifications in operations of equipment

- Example - 2
- In Product CO_2 Cooler, a direct contact cooler, circulating water loop with dedicated Cooling Tower was installed
- In place of circulating water, Cooling water was used as once through with outlet water cooled in Dedicated Cooling Tower and fed to Urea CT
- Circulating Pump stopped leading to power saving of 35 kW
- Example - 3
- Originally, air from Centrifugal Blower was being used to convey Urea crystals to top of Prilling tower
- In 1974, roots blowers were installed to supply higher flowrate at higher discharge pressure and centrifugal blower stopped
- In 2011, one roots blower was operated in parallel to centrifugal blower leading to power saving of 20 kW

Approach adopted at SFC

- Incorporating latest technical advances
- Increasing capacity utilization
- Re-look into original design of equipment
- Engineering improvements
- In-house design and fabrication
- **Systemic approach to Energy Management**

Approach adopted at SFC

- Systemic approach to Energy Management
  - Separate Technical Service/ Process Engg Deptt.
  - Well laid out Energy Policy for outlining the approach
  - Continuous data collection and analysis
    - Heat & Mass Balances
    - Catalyst performance
    - Boiler heat transfer coefficients
    - Normalised Pressure drops
    - Efficiency of rotating equipment
  - Daily specific material consumption through SAP
  - Weekly energy consumption figures reviewed by Top Management
  - Continuously identifying and implementing energy saving schemes

Approach adopted at SFC

- Equipment & piping replacement to decrease ΔP

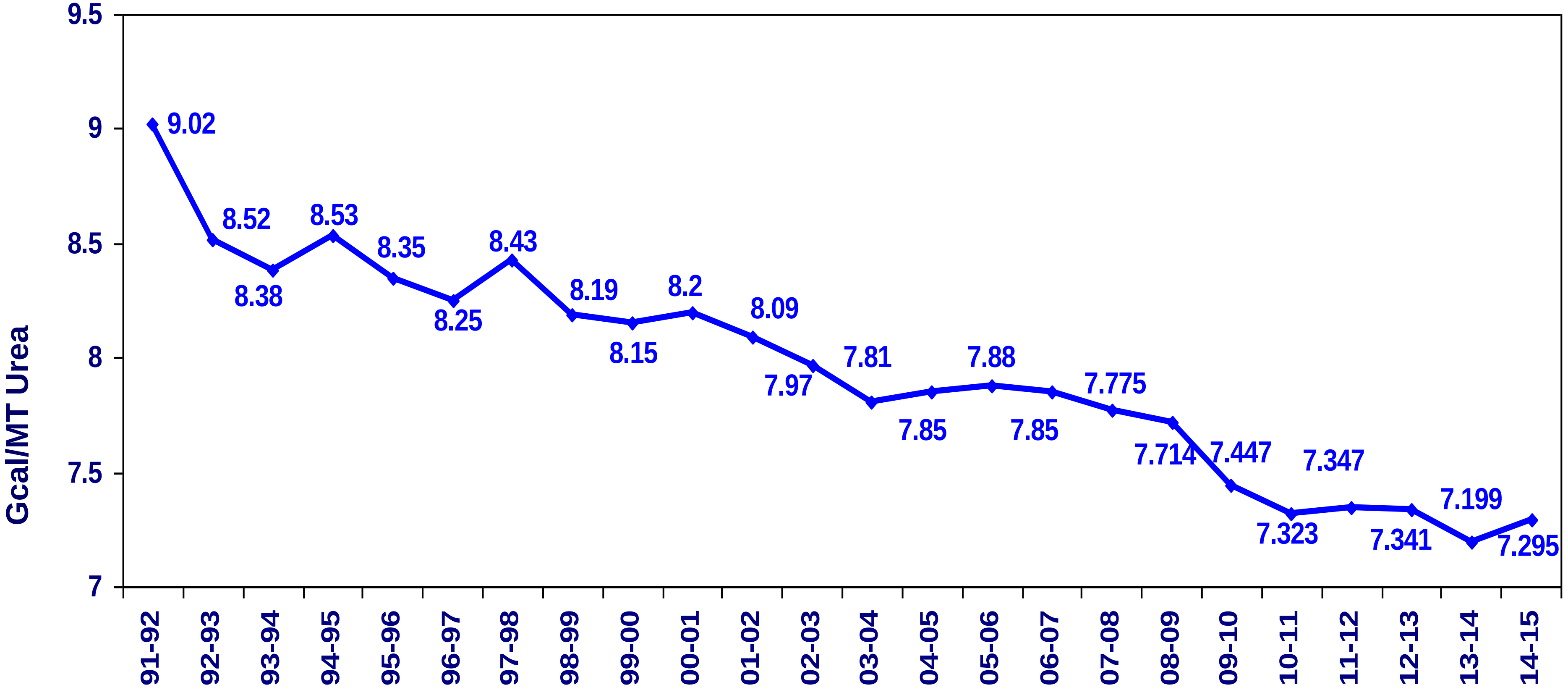
  - In HTS, ΔP at SOR was 0.9 Kg/cm2g
  - New, similar HTS was installed parallel to existing HTS leading to reduction in ΔP to 0.25 Kg/cm2 at SOR in 1998
  - Catalyst life increased from earlier 4 years to current 10 years
  - ΔP across Deaerator feed heater due to two phase flow was reduced by adding same design equipment in parallel in 1998
  - Line size of circulation gas for start up was increased from 2” to 3” for higher flowrates and faster startups in 2011

- Redesign of boilers and exchangers

  - New larger capacity Lean Solution Cooler was installed for cooling HPC Solution going to top of absorber

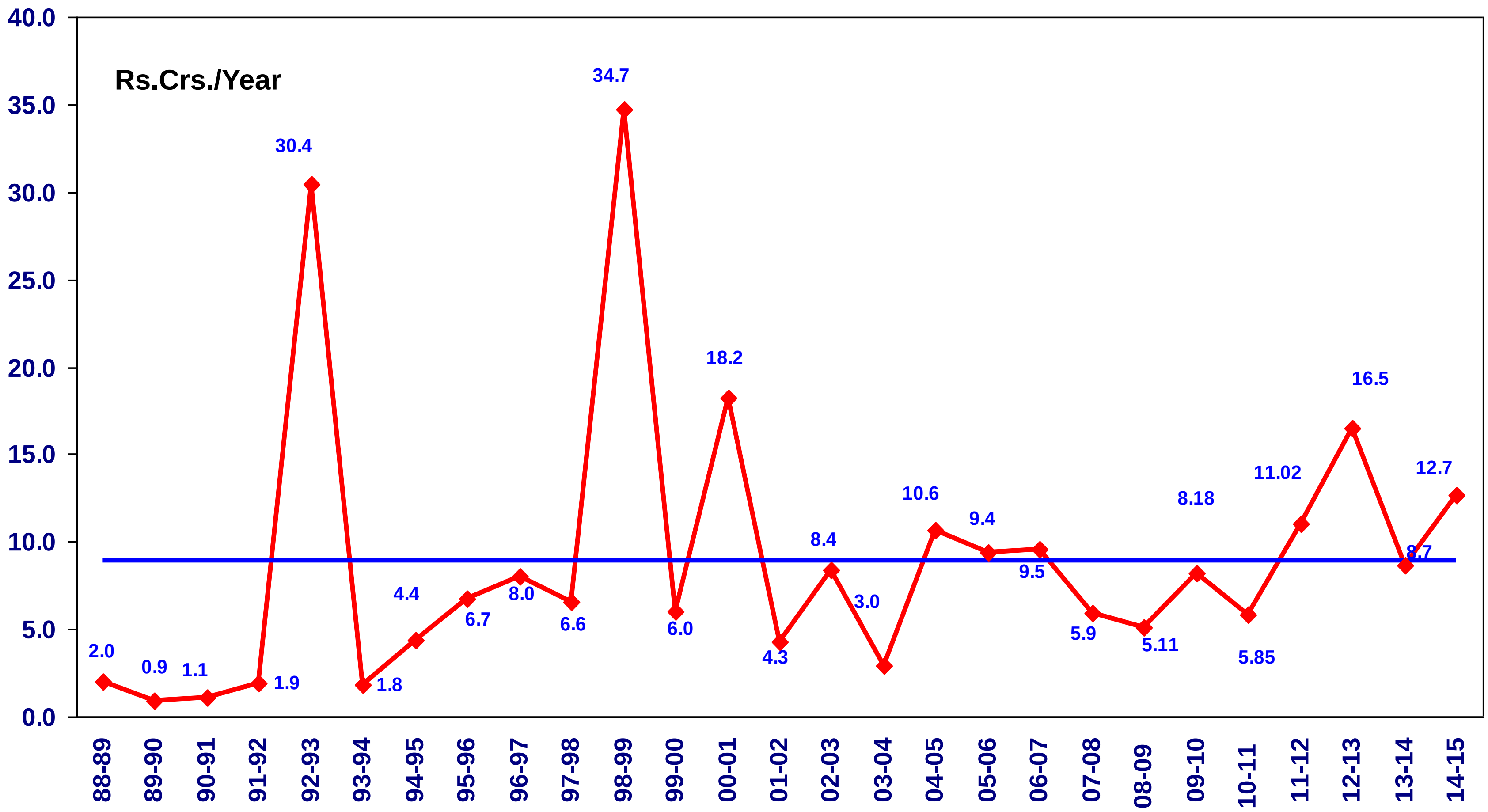
Energy performance of the plant

- Through a systematic effort to optimize operations, the energy consumption has been reduced significantly



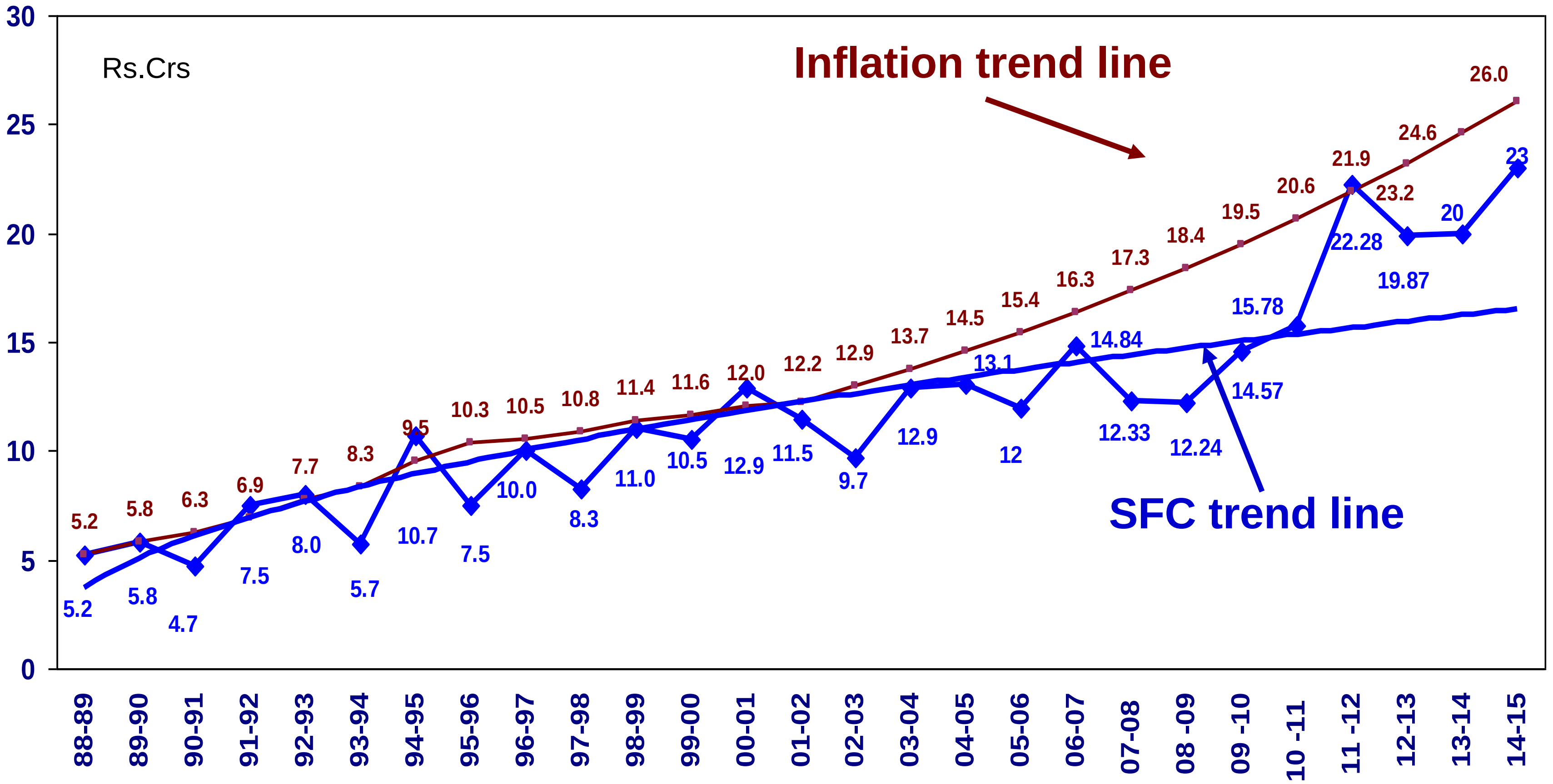
Achieving Energy Saving with min. Cost

➢ **Capital Expenditure**



Achieving Energy Saving with min. cost

➢ **R & M cost trend below inflation rate - Reduction in real term**



Thank you

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