TATA CHEMICALS LIMITED (FERTILIZER SBU)
Budaun (Uttar Pradesh)

Unit Profile

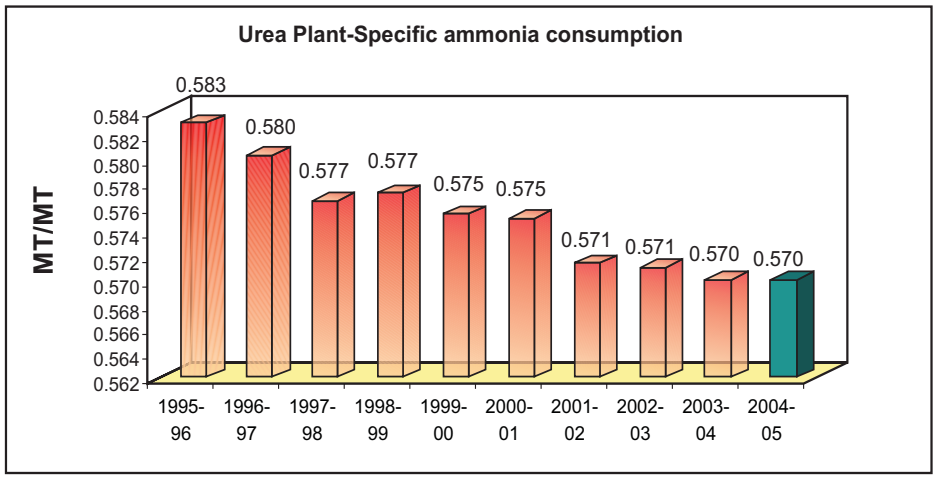
Tata Chemicals Limited (TATA CHEM) founded in 1939, is a part of TATA group of companies. TATACHEM comprises four SBU - Chemical-SBU, Fertilizer- SBU, Phosphate-SBU and Food Additive-SBU. The Tata Chemical Limited operates the largest and integrated inorganic chemicals complex in India at Mithapur which produces 35 basic chemicals of which soda ash is the major product. TATACHEM holds a predominant position as a leader in the soda ash industry. The inorganic chemical complex of TATA CHEM is the largest not only in India, but also in this part of the world and ranks among the most self-reliant, energy efficient and water efficient operations anywhere in the world .A pioneer and market leader in the branded iodised salt which has a highest purity in the country. The Phosphate- SBU has been acquired recently from HLCL and plant is located at Haldia which is one of the most energy efficient plant in India.

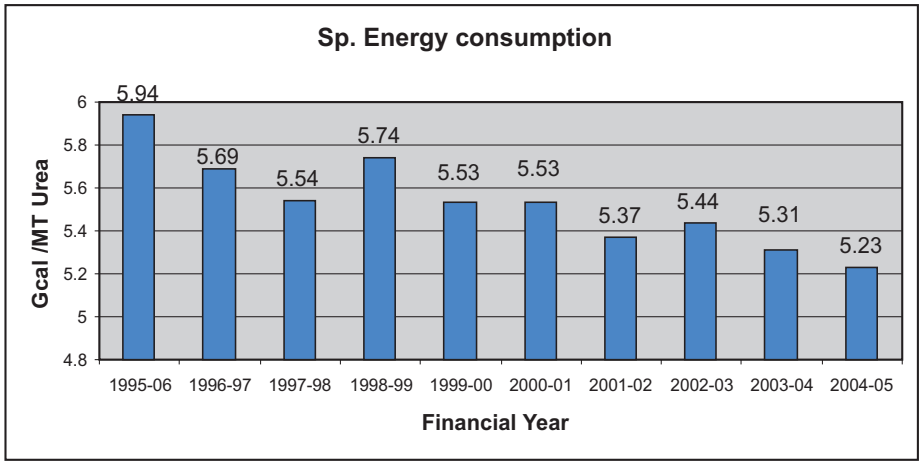
The fertilizer complex at Babrala comprises an Ammonia plant having an installed capacity of 1520 MTPD based on the “state of the art” low energy process of Haldor Topsoe A/S and two streams of Urea each having an installed capacity of 1310 TPD based on Snamprogetti spa technology incorporating several low energy features. The related facilities of off-sites and utilities consist of a captive power and steam generation plant with two Gas turbines, two heat recovery units and one service boiler, cooling towers, ammonia storage, naphtha storage, inert gas plant, effluent treatment plant etc. The design of utility plants was carried out in house. The control system at the complex is most advanced and is based on TDC3000 rel. 530 of Honeywell. An ERP system SAP 4.6 C has been installed to monitor and integrate all key business operations across the organisation for effective optimisation and control.

The fertilizer complex at Babrala is one of the six inland located fertilizer complexes based on cross country HBJ (Hazira- Bijaypur- Jagdishpur) natural gas pipeline. The pipeline transports associated gas from Bombay High and Natural Gas from South Basin to fertilizer and power plants located inland. Babrala happens to be at the tail end of the pipeline and experiences therefore frequent fluctuations in the gas supply pressure and quantity. As a consequence normally 70% of the total requirement of feedstock and fuel is being met with Natural Gas and the balance is met with Naphtha. Naphtha is drawn in rail tankers from a refinery in Mathura located at a distance of 150 Km by rail.

Energy Consumption

About 80% of the energy required for urea production is drawn from Ammonia. Reduction and prevention of ammonia losses in the plant helps in reduction of energy consumption. The total loss of ammonia is reflected in the form of ammonia and urea emanating as gaseous and liquid effluent continuously or intermittently from MP, LP, vacuum sections and prilling tower besides spillage and leakage. Regular monitoring of the process vents including PSV’s was initiated to ensure that the ammonia and CO2 losses are minimized. Energy check lists are used to monitor the plant operating parameters and losses.





Tata chemicals have consistently achieved lower energy levels than the design parameter of 5.79 Mkcal per tonne of urea. The Company had achieved an energy consumption figure of **5.21 Mkcal per tonne of Urea** which is the lowest recorded energy consumption value on a national level. Currently Tata Chemicals is considered the ***Benchmark for energy efficiency in the Indian Fertiliser Industry.***

* The % of Naphtha used in Feed & Fuel had gone up from 5.2% in 2002-03 to 20.9% in 2003-04 **and 25.2% in 2004-05 owing to a severe restriction in NG allocation by GAIL**. **Also 11.2 % of energy came from RNLG which is costlier than APM NG**. Also the cost of Naphta had gone up by Rs.4145/KL in 2004-05 over the 2002-03 figure. **If we consider the same fuel composition as 2002-03 and negate the effect of price increase, then we get an energy cost for the actual energy consumption of 2004-05 (ie Rs 26570 Lakh/yr).**

However if we take into account the actual cost of naphtha & the naphtha consumption of 25.2% the Manufacturing cost becomes 448.15 crores and the Energy cost becomes 75.0% of manufacturing cost. **Production of urea was substantially higher than previous years.**

Energy Conservation Commitment, Policy and Set up

Energy conservation is continuous and on going process. Energy Balancing/Monitoring and tracking at Tata Chemicals is done by Process Engg. Deptt on a daily basis. The energy consumption is monitored on daily basis in each plant and appropriate and immediate measures are taken to minimise consumption on a continuous basis by cross functional team comprising of Operation & Maintenance, and Technical Services. The company's strategy is to sustain the position as " Lowest Energy / Cost Consuming Urea Producer in the World".

There is well defined **Energy Policy**, modification and project management system for implementing any process changes in the plant regarding energy conservation, safety and environment. Tata Chemicals has institutionalized the concept of **"MANTHAN"** (Total Operative Performance) Accelerated Performance Improvement, the project aims at saving Energy/costs in various units of operation.

The MANTHAN is a structured, time bound and team based with top management support and bottom up approach which uses the creativity and energy of employees and all the partners and suppliers to impact the company's bottom line with minimal investment in the shortest possible time. It is a performance focused, people driven, and Comprehensive bottom up program that channels the experience and knowledge of employee to generate and implement ideas that significantly improve operations and bring breakthrough improvements. The Manthan has completed 10 waves of operation respectively for Ammonia, Urea, Offsites , ENCON and 2 waves for marketting, logistics and fixed costs, technology up-gradation, data management etc.

All the plant data related to energy and production gets automatically downloaded each day at 10:00 AM via a DCS to SAP interface module Energy Balancing via SAP-PP module is done by Technical Services by 11:00 AM. The departments are immediately informed to take corrective and preventive actions The HOD's can confirm the production figures in SAP only after the GO AHEAD clearance form Technical Services. Each department has a Balanced Score Card (BSC) and Annual Quality Improvement Plan (AQUIP) and is daily monitored via a SAP linked Dashboard which contains the yearly targets and the asking rate to achieve the targets. Each HOD has to present his departmental project target Vs Actual before the VP-Manufacturing and GM-Operations in the AQC (Apex Quality Circle)and elaborate his action plan for deviations. VP-Manufacturing sends Monthly and Quarterly performance reports to Chief Operating Officer -Fertiliser SBU and MD.

Energy Conservation Achievements

Energy conservation and safety are given top most priority in plant operation. Ideas are generated through Brainstorming within employees, discussion with experienced vendors, ex-employees and technology supplies. All ideas are analysed for techno-commercial feasibility by a Manthan and technical cell of the plant. The ideas are implemented after critical evaluation, HAZOP study, if found suitable. In this process Tata Chemicals implemented following energy conserving projects during the year 2004-05 :-

- To connect the Low Pressure section vent to Process condensate treatment section overhead condenser of urea plant. **Expected Savings Rs. 12.04 lakhs/year.**

- To supply oxygen enriched exhaust from Inert gas generation plant top to secondary reformer through Process air compressor. **Expected Savings Rs.32.72 Lakhs/year**
- To provide arrangement for Pre heating of Reformer fuel in feed pre-heater coil (E-204B). **Expected Savings Rs 81.67 Lakhs/year**
- Controlling of Steam flow of Process condensate stripper (06FIC21) through cascade control with TIC122. **Expected Savings Rs.6.79 Lakhs/year**
- Continuous Flushing system in pre-vacuum and vacuum section. **Expected Savings Rs.114 Lakhs/year**
- Transferring of Effluent by ejector instead of running transfer pump **Expected Savings Rs 0.37 Lakhs/year**
- Re-circulation of Urea Melt system in first and second vacuum separators of Urea plant **Expected Savings Rs.1.21 Lakhs/year**
- Re-routing of PCC O/L to de-gassed water storage tanks bypassing de-gasser leading to stopping of de-gasser blower**:**. **Expected Savings Rs.0.95 Lakhs/year**
- Recovery of compressor area steam traps condensate to LC header:. **Expected Savings Rs.1.59 Lakhs/year**
- Insulation of Superheated steam line :. **Expected Savings Rs.85.78 Lakhs/year**
- Water spray system in the well of the Prilling tower top to recover the urea dust :. **Expected Savings Rs.0.66 Lakhs/year**
- To provide water spray system in ME-14 of urea plant. **Expected Savings Rs.3.58 Lakhs/year**
- Installation of Electronic chock in place of conventional chockes. **Expected Savings Rs.3.39 Lakhs/year**
- Removal of one tube light with installtion of new reflector at site office. **Expected Savings Rs.0.19 Lakhs/year**
- ON-OFF switch at CCR marshalling room to put off tube light whenever is not required. **Expected Savings Rs.0.18 Lakhs/year**
- Optimization of DM plant power Consumption . **Expected Savings Rs.1.50 Lakh/year.**
- Ammonia and urea plant proves optimization.

Energy Conservation Plans and Targets

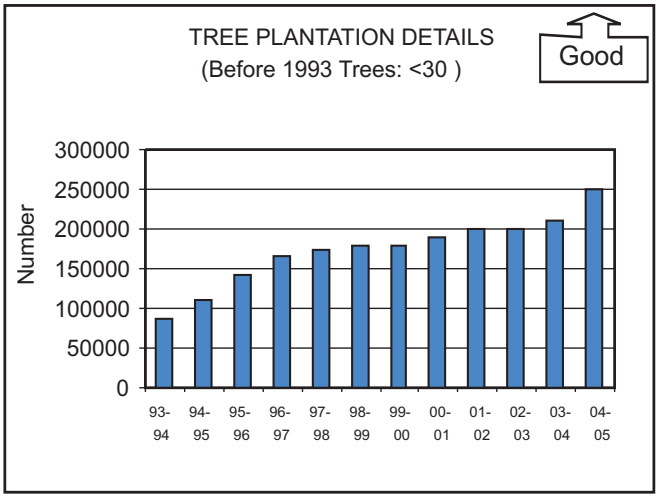
The company is committed to improve upon its energy performance further. The excellence in Energy consumption is not a destination but a continuous journey for the unit as a whole. '**All ideas are implemented In fulfillment of its commitment to ENCON, Babrala has set target for specific energy consumption at 5.0 Gcal/MT of urea by the year 2007'.** The statement reflects the spirit of the team as it has been committed by the management in **'Energy Management policy'.**

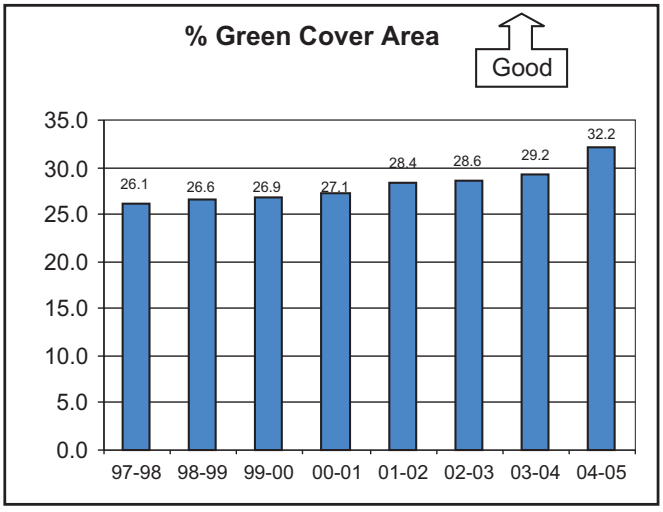
The following energy saving initiatives are in the pipeline for 2005-06 and onwards:-

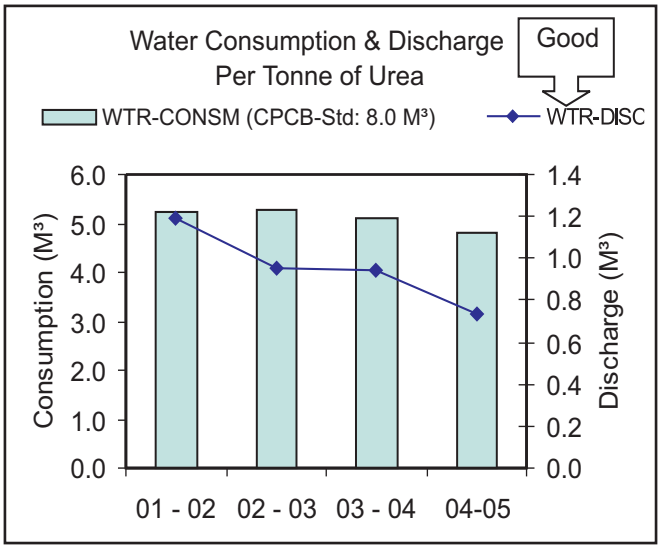
- MP Process condensate stripping system instead of LP system in Ammonia Plant. **Expected Savings Rs.336.71 Lakhs/year with an investment of 560 Lakhs Rs.**
- Optimisation of Process parameters by installation of Advanced Control System. **Expected Savings Rs.100 Lakhs/year with an investment of 333 Lakhs Rs.**
- To provide control valve in Urea process condensate stripper (C-02) off-gas line. **Expected Savings Rs.18.45 Lakhs/year with an investment of 2.02 Lakhs Rs.**
- Blinding one stage of Boiler Feed Pumps in Ammonia Plant. **Expected Savings Rs.2.58 Lakhs/year with an investment of 4.74 Lakhs Rs.**
- Steam saving by providing the close loop to all the traps' outlet at CPP area. **Expected Savings Rs.3.05 Lakhs/year**
- E-602 replacement with old one as the existing is having lower capacity than design. **Expected Savings Rs.86.15 Lakhs/year**
- Installation of PME De-hydrator: **Expected saving of 261.7 Lacs per year with an investment of 500 Lakhs Rs.**
- Change of High pressure steam (HS) line insulation. **Expected Savings Rs.35.09 Lakhs/year**.

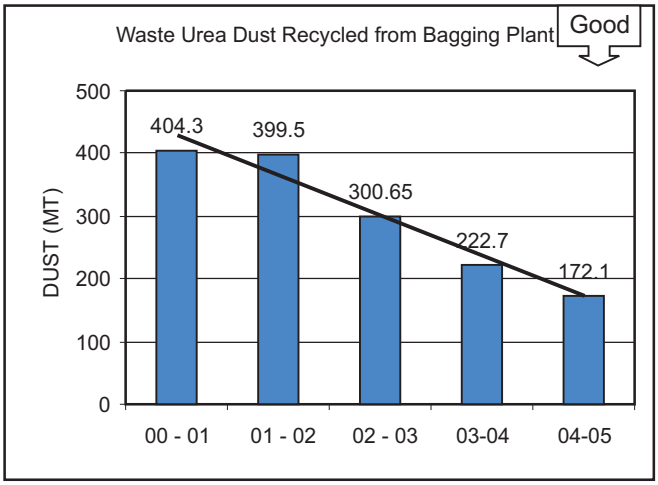
Environment and Safety

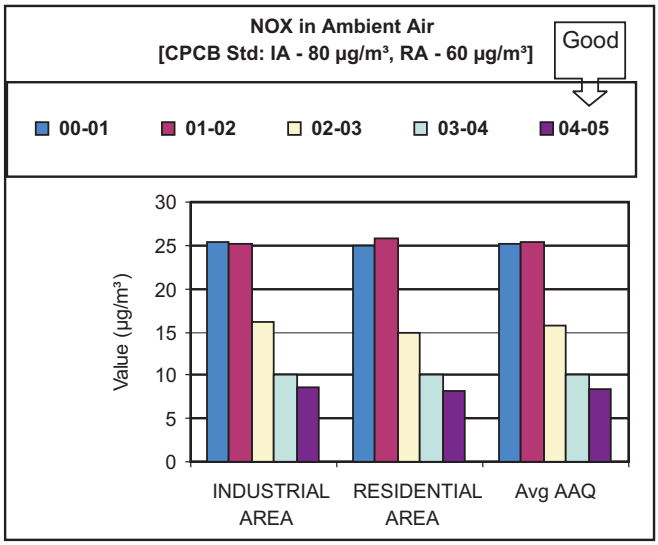
Tata Chemicals has a safety management system conforming to **ISO-14001 & OHSAS-18001**. The company has built an Effluent Treatment Plant and developed 13 km long green belt to ensure the concept of **Zero liquid effluent discharge**. At Tata Chemicals (Fertiliser plant) the quality of effluents and air emissions always conform to the standards stipulated by UP Pollution Control Board and the Ministry of Environment and Forest.

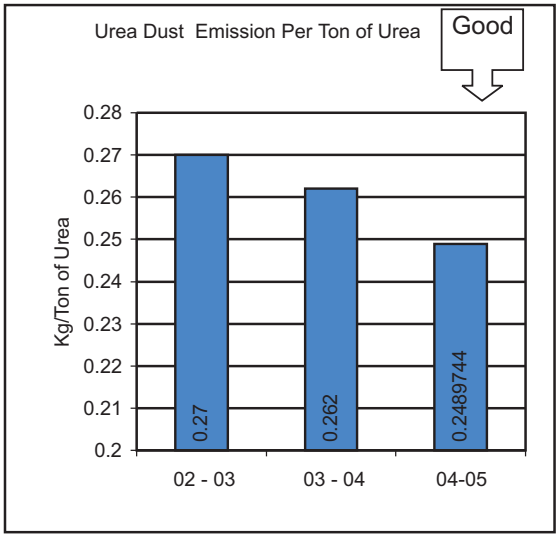












The company has a strong commitment towards safety. High standard of safety guided by OHSAS-18801 and British safety council are experienced through out the works. The total man-hours lost during 2004-05 was zero although there were 7.66 number of direct million man-hours engaged(including contract labours)in the entire nitrogenous fertiliser production facility. Recently on 18th August-2005 the unit has completed 100 days of accident free days which is a excellent record in safety management system. The company (both the fertiliser plant & Chemical Plant) was awarded **5 Star (scored 96%) Rating by the British Safety Council** , and had applied for the **Sword of Honour which is a internally accepted great honour to the organization.**

Second Prize ***Fertilizer***

RASHTRIYA CHEMICALS AND FERTILISERS LIMITED

Thal Unit, Raigad (Maharashtra)

Unit Profile

Thal Unit of Rashtriya Chemicals & Fertilizers Ltd. (RCF) located about 100 KM south of Mumbai on the western coast of Raigad district, is a giant fertiliser unit..

The fertilizer plant comprises of two mixed feed (gas + naphtha) based ammonia plants of 1500 MTPD capacity each and 3 urea plants of 1725 MTPD each. *The unit has received ISO14001 certification in June 2001.*

To take benefit of the market potential existing for industrial chemicals, a complete range of diverse value-added products are manufactured at Thal. The installed plants include 2500 T/year Dimethyl Formamide (DMF), 5000 T/year methylamine, 5000 T/year Dimethyl Acetamide (DMAC) and a Formic acid plant of 10000 T/year capacity.

The unit is implementing an Argon recovery project from purge gas in Ammonia plant which is wealth from waste. The production of argon is expected by November 2006.

The performance in the year 2004-2005 was so magnificent that all the previous production records have now become insignificant history. The dream figures of highest ever capacity utilisation of 106.94 % for Ammonia and 107.44 % for Urea plants with lowest ever specific energy consumption have been achieved.

The annual turnover of the company (Trombay + Thal) was Rs.2840.44 Crores in the year 2004-05 which was the highest ever turnover achieved, registering a growth of 20.82 % over last years (2003-04) turnover of 2351.09 Crores.

Energy Consumption

In past 20 years of continuous operation, production & energy targets have been regularly met or exceeded. In the recent past new standards of production and efficiencies were set and record production figures were achieved. The performance record of Ammonia, Urea, and Chemical group of plants to date, together with efficiencies, reliability and length of continuous runs achieved, illustrates RCF's firm commitment to operational excellence since inception. These achievements, comparable to best in the country, have been accomplished without compromising safety or environmental standards.

The unit was adjudged as the " Best production Performance Fertiliser Unit in the country " by Fertiliser Association of India.

Specific Energy consumption of Ammonia has dropped to 9.132 Mkcal/MT for the year 2004-2005 against 9.202 Mkcal/MT for the year 2003-04. This has been possible due to maximisation of capacity utilisation and best co-ordination between operation and maintenance for increasing stream days. Highest ever stream days of 353.80 Days were achieved for ammonia plant in the year 2004-2005.

Specific energy consumption for Ammonia and Urea plants is shown below :

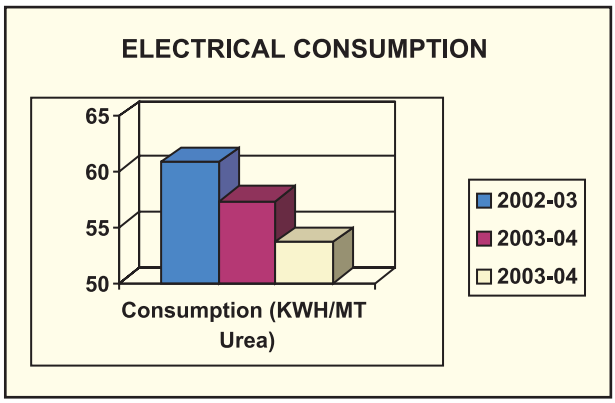
Plant	2002-03	2003-04	2004-05
Ammonia production (MTPY)	885550	1014900	1058720
Ammonia (Mkcal/MT)	9.639	9.202	9.132
Urea production (MTPY)	1537300	1731350	1833750
Urea (Mkcal/MT)	6.949	6.574	6.477

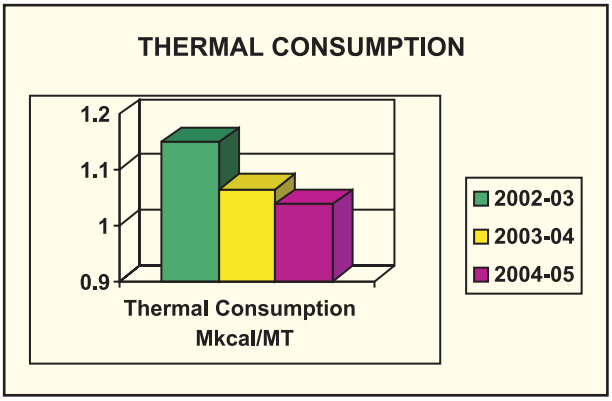
YEAR	ELECTRICITY		THERMAL	
	Consumption (KWH/MT UREA)	% reduction over 2002-2003	Consumption (MKCAL/MT UREA)	% reduction over 2002-2003
2002-2003	60.80	—	1.148	—
2003-2004	57.30	5.76	1.065	7.23
2004-2005	53.61	11.83	1.037	9.67

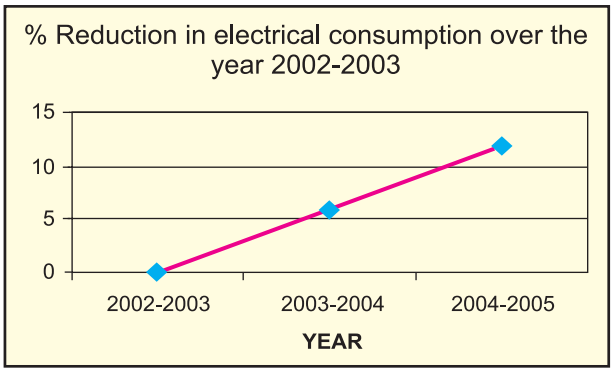
Although there is steep hike in naphtha prices and increase in naphtha consumption (Costlier substitute) due to natural gas shortage, the plant has been able to reduce the cost of energy as % of manufacturing cost for the year 2004-2005 against the previous year. This is due to substantial reduction in thermal consumption & Electrical consumption on all fronts.

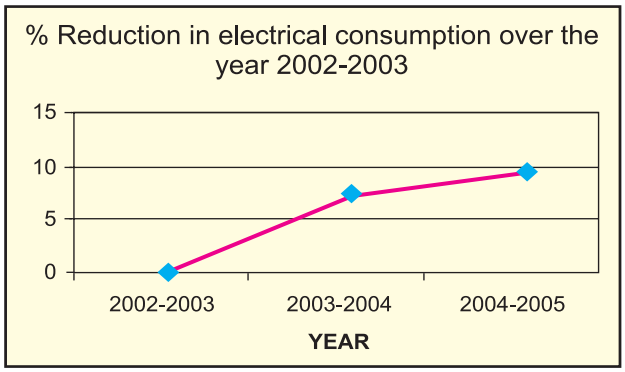
Energy Conservation Commitment, Policy & Organizational Set up

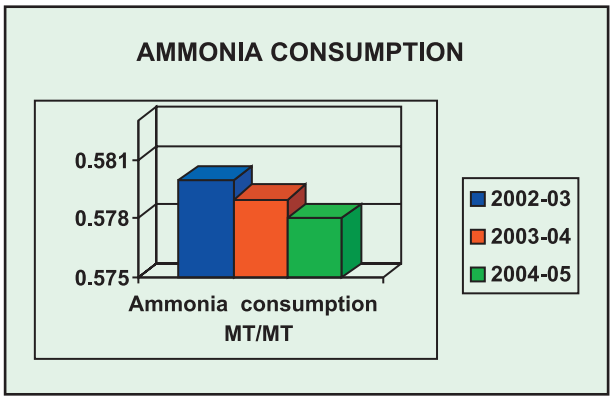
The energy levels maintained by 20 years old RCF, Thal plants itself shows its commitment and outlook towards Energy conservation. Inspite of feedstock crisis, plants at Thal have performed well largely due

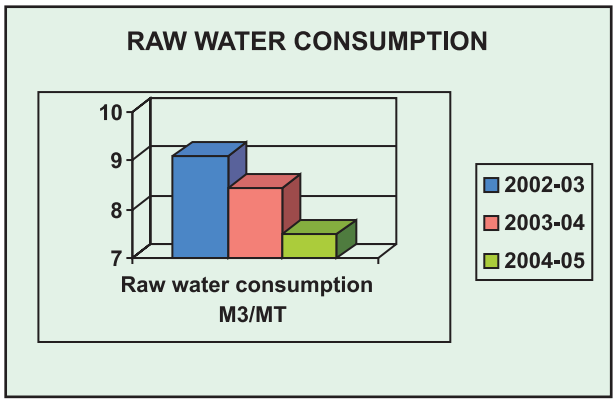

ELECTRICAL CONSUMPTION
65
60
55
50
Consumption (KWH/MT Urea)
2002-03
2003-04
2003-04

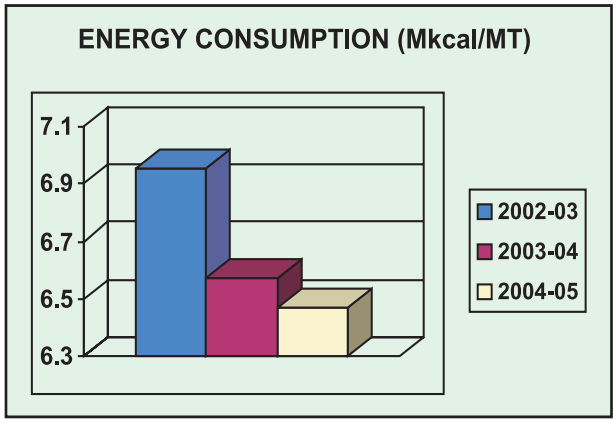

THERMAL CONSUMPTION
1.2
1.1
1
0.9
Thermal Consumption Mkcal/MT
2002-03
2003-04
2004-05

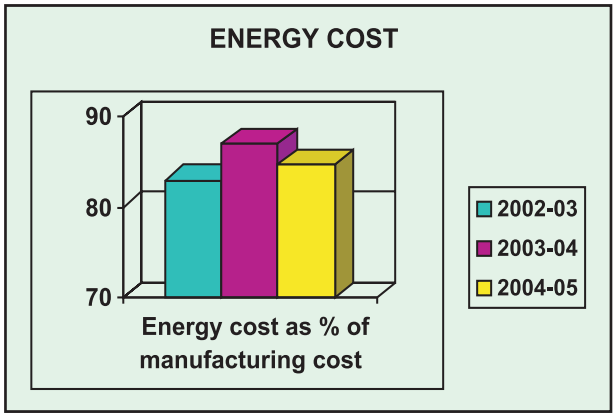

% Reduction in electrical consumption over the year 2002-2003
15
10
5
0
2002-2003
2003-2004
2004-2005
YEAR


% Reduction in electrical consumption over the year 2002-2003
15
10
5
0
2002-2003
2003-2004
2004-2005
YEAR

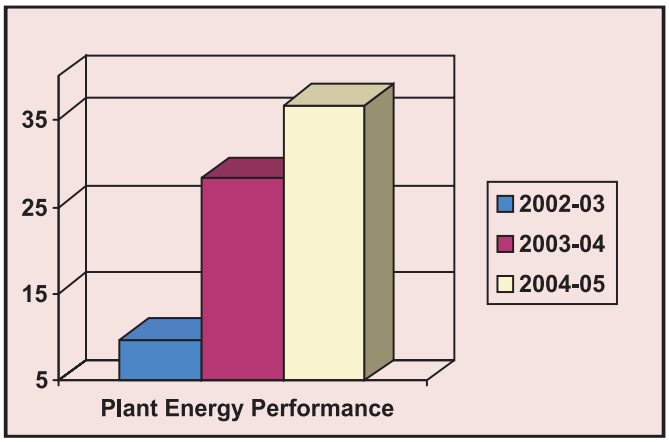

AMMONIA CONSUMPTION
0.581
0.578
0.575
Ammonia consumption MT/MT
2002-03
2003-04
2004-05


RAW WATER CONSUMPTION
10
9
8
7
Raw water consumption M3/MT
2002-03
2003-04
2004-05


ENERGY CONSUMPTION (Mkcal/MT)
7.1
6.9
6.7
6.5
6.3
2002-03
2003-04
2004-05


ENERGY COST
90
80
70
Energy cost as % of manufacturing cost
2002-03
2003-04
2004-05

to the proactive and painstaking efforts taken in the field of energy conservation and capacity enhancement through technical foresight. All this was coupled with shrewd management in the areas of manpower resources, contracting, finance. The Graph indicates Plant energy performance in last three years over the base year 2001-02 performance.



YEAR	Energy Consumption Mkcal/MT of Urea	PLANT ENERGY PERFORMANCE
2001-2002	7.218	
2002-203	6.949	9.66
2003-2004	6.574	28.23
2004-2005	6.477	36.63

The plant has an exclusive Energy Conservation Cell. The cell is headed by Chief General Manager of the Unit. As per the EC Act-2001 the unit has two designated 'Energy Managers'. These two Energy Managers are reporting to Chief General Manager. Energy conservation is the exclusive duty of these two Energy Managers. There are EIGHT certified Energy Auditors who have passed examinations conducted by BEE in 2004.

Energy cell conducts a monthly review meeting. In this meeting core group members present the various energy saving potential in their working areas. After brain- storming sessions and cost benefit analysis, the schemes are finalised for implementation after proper approval. The projects already undertaken are reviewed in the monthly meeting.

Energy conservation week is celebrated every year from 14th December to 21st December. All the plants including chemical group & utilities are invited to present their achievements towards energy conservation alongwith the future plan and targets. The plant making best efforts and realising the set targets is awarded. Also slogan competition, poster competition & Quiz competition is held which is open to all.

Rashtriya Chemicals & Fertilizers Ltd. Thal

(A Government of India Undertaking)

ENERGY MANAGEMENT POLICY

We at Rashtriya Chemicals & Fertilizers Ltd. Thal Unit commit ourselves to continually improve our energy performance in all our activities, products & services through:

- *Continual upgradation of ecofriendly technology for production of Fertilizers & Chemicals.*
- *Conservation and optimal utilization of natural resources by adopting reduce, reuse & recycle methods.*
- *Continuous training programme for increasing energy conservation awareness throughout the organization.*
- *Regular management reviews to ensure continual improvement & to achieve our goal of reducing specific energy consumption by 1 % every year till 2010.*

(S.K.BORWANKAR)

EXECUTIVE DIRECTOR (THAL)

Date: 22nd December 2003

Energy Conservation Achievements

During the year 2004-2005, plant has implemented 45 energy saving schemes resulting into power saving of 32.51 Lakh KWH & 68935.30 Mkcal (Gas +Naphtha). Potential Savings worth Rs. 1470.93 Lakhs were accrued against investment of Rs.449.18 lakhs.

Sustained operations of all the plants i.e process and utilities with minimum downtime resulted into highest ever productions with lowest ever energy levels and highest stream days for the year 2004-05.

Major schemes implemented during the year are listed below :

ENERGY CONSERVATION SCHEMES

1. CORROCOATING OF COOLING TOWER PUMP IN AMMONIA PLANT

Corrocoating of two cooling tower pumps in Ammonia plant has been carried out resulting into substantial power saving.

Before Corrocoating :

Power cons. : 882 KW for one pump

After Corrocoating :

Power cons. : 840 KW for one pump
Power saving : 84 KW Total for two pumps
Savings : Rs.33.72 Lakhs/Yr.

2. ADVANCED CONTROL SYSTEM USING MODEL BASED MULTIVARIABLE CONTROL TECHNOLOGY FOR AMMONIA PLANT STREAM –II.

Advanced Control System has been installed in Ammonia Plant stream-II. It mainly controls following process parameters :

- Pri. Ref. outlet temperature.
- Oxygen % in flue gas.
- Steam to carbon ratio.
- Hydrogen/Nitrogen ratio.
- RPM of Benfield Turbine
- RPM of Process Air Compressor
- RPM Of Ammonia Refrigeration Compressor

Before ACS :

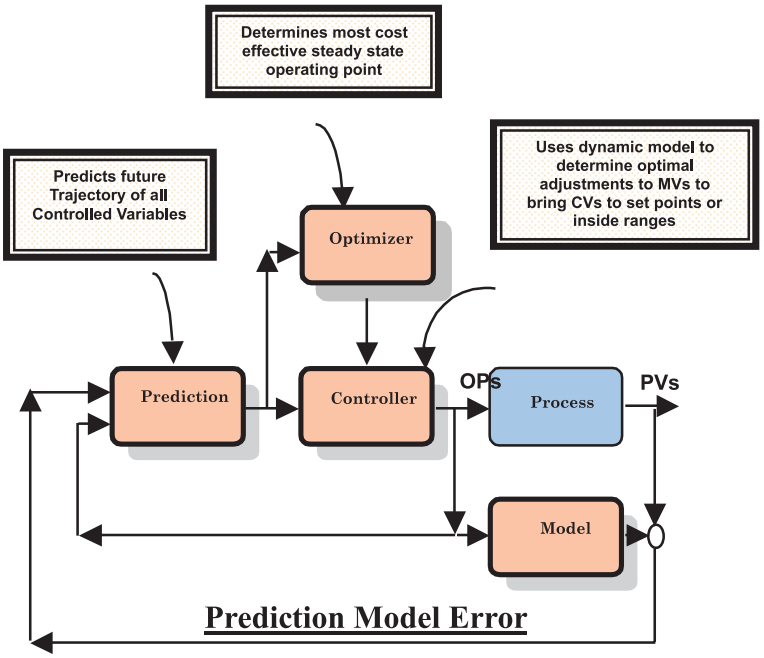
Sp.Energy : 9.093 Mkcal/MT

After ACS:

Sp.Energy : 9.045 Mkcal/MT

Net saving : 0.0481 Mkcal/MT

Savings : Rs.215.76 Lakhs/Yr.



3. HOLLOW FRP BLADES FOR BENFIELD SOLUTION COOLER IN AMMONIA PLANTS

Benfield solution cooler fan blades for 6 fans were replaced with hollow FRP in ammonia plant.

With Solid fan blades :

Power cons. : 14.01 KW per fan

With Hollow fan blades :

Power cons. : 7.68 KW per fan
Power saving : 6.33 KW per fan
Savings(8nos) : Rs.20.33 Lakhs/Yr.

4. INSTALLATION OF EVAPORATIVE COOLING SYSTEM FOR PROCESS AIR COMPRESSORS IN BOTH TRAINS.

Availability of process air from Process air compressor was a major bottleneck in Ammonia production & consequently in the Urea production. This was due to high suction temperature of Process Air from atmosphere. This limitation was more evident in summer season. Reducing suction temperature of process air with the help of Evaporative Cooling System has resulted in compression of more volume of process air at the same RPM. This has lead to increase in Ammonia production. The scheme remains in line for 150 days in a year in both streams.

Savings per stream:

Increase in air flow	:	0.38 TNCH
Saving in steam	:	1242 MTPY
Monetary savings	:	Rs.9.43 Lakhs/Yr.

5. INTERCONNECTION OF BOTH NATURAL GAS COMPRESSORS DURING LOW NG AVAILABILITY.

Natural gas booster compressor (NGC) of both trains were interconnected for stopping one NGC during low natural gas availability.

Steam saving due to stopping of one NGC

Steam saving	:	4.5 MT/Hr
No. of days actual stopped	:	15 Days
Monetary savings	:	Rs.12.30 Lakhs/Yr.

6. PASSIVATION AIR BLOWERS FOR CO2 COMPRESSORS IN ALL THREE TRAINS OF UREA PLANT

Low capacity passivation air blowers (2 running+ 2 standby) have been installed in Urea plant instead of old large capacity blowers (1 running+1 standby)

Earlier Blowers :

Capacity : 5000 M3/Hr
Power cons. : 160 KWH

New Blowers :

Capacity : 1300 M3/Hr
Power cons. : 50 KWH

Power saving : 110 KW

Savings : Rs.44.16 Lakhs/Yr.

7. USE OF UREA CONCENTRATE FOR CROWN WASHING IN UREAPLANTS

MV-6 (Ist stage vacuum separator) is washed with hot condensate twice a week in each unit to remove the polymers deposited on the crown. This added water is removed in E-14 & E-15 concentrators which requires additional low pressure steam. In order to save this additional steam MV-6 crown washing line was modified to use concentrated urea melt was used for crown washing. This was implemented in two streams.

Savings per stream after modification:

Steam saved : 468 MTPY
Monetary Savings : Rs.7.03 Lakhs/Yr.

8. LINING UP OF MP SECTION OFF GASES FROM UREA PLANT TO AMMONIA PLANT PRIMARY REFORMER

Off gases from MP Section of Urea plants were earlier being vented to the atmosphere. This was causing an undue loss of hydrogen and Hydrocarbons. In the said scheme the gases are being used as fuel in the primary reformer of ammonia plant. The scheme has been lined up in all three units.

Natural gas saving : 133.7 Sm3/Hr for all streams

Monetary Savings : Rs. 30.30 Lakhs/Yr.

9. INSTALLATION OF MAGNETIC RESONATORS ON NAPHTHA FUEL LINE TO BOILER –2 IN STEAM GENERATION PLANT.

The magnetic resonators are places across naphtha fuel line of the boiler. The major constituent of naphtha fuels are hydrocarbon chains. The polarisation of hydrocarbon chains occurred due to magnetic field. This polarisation results in excitation of the hydrogen atoms present in the chains to a higher energy level i.e from para form to ortho form. Thus converting hydrogen to higher reactive state and phenomena of resonance in the fuel and breaking of complex hydrocarbon chains to simpler hydrocarbon chains.

Naphtha saving : 616.54 MTPY

Monetary Savings : Rs.117.69 Lakhs/Yr.

10. USE OF 14 ATA T.G EXTRACTION STEAM AS ATOMISING STEAM IN NAPHTHA BURNERS FOR STEAM GENERATION PLANT.

Earlier HP steam was used for atomising fuel naphtha. With implementation of this scheme 14 ata extraction from Turbogenerator set is now being utilised for atomising. This has resulted into more extraction from T.G thus improving its efficiency and reduction in specific consumption of steam to T.G.

Steam saving : 0.82 MTPH

Monetary Savings : Rs.97.61 Lakhs/Yr.

OTHER SCHEMES IMPLEMENTED DURING THE YEAR 2004-2005

AMMONIA PLANT

1. Replacement of 20 W tubelights by energy efficient 14 W T-5 tubelights (25 no fittings.) in Apr.04.
2. Primary reformer walls are provided with refractory layers. During thermal scanning it was found that the temperature at furnace casing and burner plate was as high as 250 °C. It was suspected that some of the refractories were in damaged condition. It was causing loss in terms of radiation & convection.These Damaged refractories were replaced with “Z” block insulation. The temperature has come down to 70 °C . This has resulted into fuel saving.
3. The Synthesis gas compressors are consuming steam much more than design since inception. An attempt was made to reduce the steam consumption by changing guide blade carrier of SGC in Ammonia-I. This has resulted into saving of 0.071 MKcal/MT for single train.
4. Replacement of 20 W tubelights by energy efficient 24 W T-5 tubelights (25 no.).

UREA PLANT

5. Replacement of 20 W, 140 No.tubelights(Consuming 26 watts) by energy efficient 14 W (Consuming 15 W)T-5 tubelights (70 no.).
6. There are three compressors in Urea plant each having capacity of 1400 Nm^3/Hr. Out of three one compressor is always in line. Requirement of air for Urea plant is approx. 1200 Nm^3/Hr. There was always venting of 200 Nm^3/Hr. This was direct power loss. To avoid this Auto loading unloading operation for Instrument air compressors was made functional..
7. Corro-coating of cooling water pump ‘C’ which is an spare pump was carried out in Urea plant. Only 2 full capacity & one small capacity pump are always in line. Whenever one full capacity pump is in maintenance, this “C” pump can be utilised to derive benefits of power saving.

8. Replacement of 20 W, 210 No.tubelights(Consuming 26 watts) by energy efficient 24 W (Consuming 25 W)T-5 tubelights (70 no.)

9. Tempered water circuit pumps (P-4) were stopped in all three units . With the inlet temperature of cooling water to E-7 being maintained at 45 ° C with the tempered water circuit pump in line and at a pH of 7.5 +, the depositing tendencies on the cooling water side are high. This resulted in fouling and poor heat transfer in E-7. On stopping of the pump the inlet temperature of E-7 on cooling water side has reduced to 37° C and the fouling of the heat exchanger has correspondingly reduced. This has resulted in better condensation and better operational control even st higher loads. The power consumption has reduced by 12.3 KW for each pump. The saving is for total 3 pumps, one for each plant.

10. With new bimettalic stripper the bottom temperature of the stripper was maintained at 202 ° C to prevent corrosion . This was causing excess steam consumption of 25 Kg/MT of Urea due to overloading of downstream sections. After installation of Passivation air compressor for air to stripper, the corrosion tendency has reduced and the stripper bottom temperature could be maintained at 203-204 ° C. This has accrued a benefit of 12 Kg of steam per MT of Urea.

STEAM GENERATION PLANT

11. Use of gravity line already existing for supply raw water to all plants increased from 12 to 24 hours. Water coming from State Industrial development corporation was directly supplied to the plants for 12 Hrs a day through gravity line and 12 Hrs a pump was run last year. But now the pump has been stopped permanently and the water is supplied through gravity line 24 Hrs a day.

12. Old hydraulic governors for the pump supplying Boiler feed water to steam generation boilers was replaced with Electronic governer for both BFW turbines (502A & 503A). It has resulted into saving of 0.908 MT of high pressure steam per Hour.

13. Underloaded Transformer No. TR-41, TR -321 & TR -641 were switched off .

14. T.G condensate was earlier collected in Make up tank and then pumped to deaerator as D.M.water. Now the TG condensate is directly diverted to De-aerator to avoid running of Make-up water pump thus saving power of 11.67 KW.

15. Earlier urea turbine condensate was received in D.M. water plant and then it was pumped to Ammonia plant. But now it is directly diveretd to to SGP boilers thus reducing the D.M water from D.M.Plant and hence pumping time has been reduced to 8 Hrs which was earlier 24 Hrs. This has lead to power saving.

16. Use of raw water instead of Make-up water as coolant for Analyser cooler thus avoiding running of Make-up water pump for 4 hours daily.

17. Use of redundant Lighting transformer for plant lighting.

18. Earlier a dedicated pump was running for supplying D.M. water to Thal Ammonia extension plant (TAE). But now Urea process condensate is diverted to TAE and the dedicated pump consuming 5 KW has been stopped.

19. Corro-coating of cooling water pump has been carried out resulting into power saving of 11.43 KW.

20. Replacement of Mercury vapour lamps with Sodium vapour lamps(40 NOS).

PRODUCT HANDLING PLANT

21. PLC logic for belts was modified which has resulted into automatic switching off of idle empty belts. This has resulted into power saving of 34.47 KW.
22. Construction of chute for truck & wagon loading has resulted into stopping of ET-17 belts & motors thus giving a power saving of 13.20 KW.

WORKSHOP

23. Replacements of packaged A/C with window A/C has resulted into total power saving of 8.87 KW.
24. Feeding of street lights of the area around ETP through Energy saver and chemical group of plants from lighting transformer.

ELECTRICAL ENGINEERING SERVICES

25. Replacement of inefficient Central A/c machines with split type with flexibility of different operating temperatures has resulted into power saving of 7.42 KW.
26. Replacement of tube lights with CFL in Technical building.
27. Replacement of 70 nos. of A/C in offices and utility buildings.

Energy Conservation Plans and Targets

1. End-to-End to survey of Ammonia plant including proposal for additional coil in waste heat section.
2. Use of low grade waste heat for refrigeration/Cooling for PAC in ammonia plant, CO2 in Urea plant etc.
3. Use P-8 solution for crown washing in 1st vacuum separator MV-06 for Unit-11.
4. Revamping of Polishing Mixed Bed Unit in water treatment plant.
5. Installation of Magnetic resonator for burners in the SGP boiler No. 1.
6. Installation of variable frequency drive (VFD) for Ammonia, Urea & SGP plants (17 nos.).
7. Re-Commissioning of Flapper position limit switch for 19 Urea bag conveyor flappers for empty belts control.
8. Installation of Solar water heater for Central canteen & Hospital..
9. Use of solar power for Street lighting.
10. Replacement of reciprocating compressor by Screw compressor for one unit of air conditioning in administration building.
11. Corro-coating of 2 No. cooling water pumps in Ammonia plant and 2 No. in Steam generation plants.
12. Calcium silicate insulation for steam piping in Steam generation plant to avoid losses through convection and radiation.
13. Provision of vibrators for flappers in Product Handling Plant.
14. Helical coil heat exchangers for suction cooling of CO2 compressor in Urea Plant.
15. Zirconium coating of Refractory in Primary Reformer furnace of Ammonia Plant.

Implementation of the above schemes in the year 2005-2006 will help in achieving energy target for Ammonia and Urea plants.

Environment and Safety

ENVIRONMENT MANAGEMENT AT RCF THAL

The environment management of RCF Thal is not satisfied merely by meeting all the stipulated requirements laid down by the statutory authorities. The environment management system has been re-certified for ISO 14001. Internal audits and management reviews are undertaken regularly to identify the areas of improvement. Measures taken to conserve water has yielded fruitful results. The water consumption for the year 2004-2005 has been the **LOWEST** i.e 7.52 M3/MT. This consumption is comparable with gas based plants where as that plants are of mixed feed.

SAFETY

RCF, Thal has achieved a lowest accident frequency rate and longest accident free period in the year 2004-2005. The Plant had **ZERO** No. of reportable accidents in the year 2004-2005.

INDIAN FARMERS FERTILIZER COOPERATIVE LIMITED
Phulpur Unit - I, Allahabad (U.P.)

Unit Profile

During mid- 60's the Co-operative sector in India was responsible for distribution of 70 per cent of fertilisers consumed in the country. This Sector had adequate infrastructure to distribute fertilisers but had no production facilities of its own and hence dependent on public/private Sectors for supplies. To overcome this lacuna and to bridge the demand supply gap in the country, a new cooperative society was conceived to specifically cater to the requirements of farmers. It was an unique venture in which the farmers of the country through their own Co-operative Societies created this new institution to safeguard their interests. The number of co-operative societies associated with IFFCO have risen from 57 in 1967 to more than 37000 now.

IFFCO commissioned the ammonia - urea complex at Kalol and the NPK/DAP plant at Kandla both in the state of Gujarat in 1975. Another ammonia - urea complex was set up at Phulpur in the state of Uttar Pradesh in 1981. The ammonia - urea unit at Aonla was commissioned in 1988. The annual installed capacity of all the plants was 1.62 million tonne of Urea and NPK/DAP equivalent to 309 thousand tonne of phosphates.

In 1993 IFFCO had drawn up a major expansion programme of all the four plants under overall aegis of IFFCO VISION 2000. The expansion projects at Aonla, Kalol and Phulpur have been completed on schedule. The latest feather in the cap of IFFCO was completion of Kandla Phase-II on 5th August 1999 which has heralded realisation of all the objectives set forth under VISION - 2000. As per the tradition of IFFCO the project was completed more than two months ahead of schedule. As a result of these expansion projects IFFCO's annual capacity has been increased to 3.69 million tonne of Urea and NPK/DAP equivalent to 825 thousand tonne of phosphates.

The distribution of IFFCO's fertiliser is undertaken through over 37,000 co-operative societies. The entire activities of Distribution, Sales and Promotion are co-ordinated by Marketing Central Office (MKCO) at New Delhi assisted by the Marketing offices in the field. In addition, essential agro-inputs for crop production are made available to the farmers through a chain of 166 Farmers Service Centre (FSC). IFFCO obsessively nurtures its relations with farmers and undertakes a large number of agricultural extension activities for their benefit every year.

At IFFCO, the thirst for ever improving the services to farmers and member co-operatives is insatiable, commitment to quality is insurmountable and harnessing of mother earths' bounty to drive hunger away from India in an ecologically sustainable manner is the prime mission.

IFFCO, today, is a leading player in India's fertiliser industry and is making substantial contribution to the efforts of Indian Government to increase food grain production in the country.

Situated near Allahabad in Uttar Pradesh , IFFCO Phulpur complex has two production units : Phulpur Unit-I and Phulpur Unit-II and is the world's largest fertilser complex based on naphtha as feed stock. Phulpur Unit- I comprising of one 900 Te/day Ammonia Plant and a 1500 Te/day Urea Plant along with associated offsites facilities like Steam generation plant, Power generation plant, DM water plant, Inert gas plant etc. was commissioned way back in 1981.

Due to increasing demand-supply gap of Urea in the country, Govt. of India has given approval for expansion project at Phulpur site since basic infrastructure facilities were available at Phulpur. The unit Phulpur-II was commissioned in December 1997 and consists of 1350 MTPD Ammonia plant and 2200 MTPD Urea plant along with associated offsites facilities based on latest state of art technologies.

Energy Consumption

Ammonia & Urea manufacturing is highly energy intensive and it contributes more than 80% of the total cost of production Urea. Therefore, a slight change in energy consumptions affects the cost of production in a big way. Apart from cost of production reduction in energy saves the valuable fast depleting natural resources such as Naphtha & Coal. Therefore, the Energy conservation is a major corporate objective at IFFCO and it is a continuous process at its units.

IFFCO-Phulpur complex has become one of the lowest energy consuming units amongst Naphtha based fertilizer plants in India. It has substantially reduced its energy consumption during last three years. The details are highlighted below :

Plant	2001-02	2002-03	2003-04	2004-05	%reduction over 2002
Ammonia -I	9.648	9.621	9.466	9.452	2.03
Urea -I	7.689	7.636	7.489	7.630	0.77
Ammonia –II	8.094	7.989	7.944	7.989	1.30
Urea - II	6.111	6.001	6.024	6.052	0.97
Urea (I+II)	6.70	6.64	6.59	6.68	0.30

Note : All figures are in GCal / MT

Energy Conservation Commitment, Policy and Organizational Set up

As energy contributes more than 80% of cost of production and sharp rise in energy cost, energy conservation receives top priority at IFFCO Phulpur.

Energy Management Policy

Energy Management policy revised as on 1st March, 2005 is as follows:

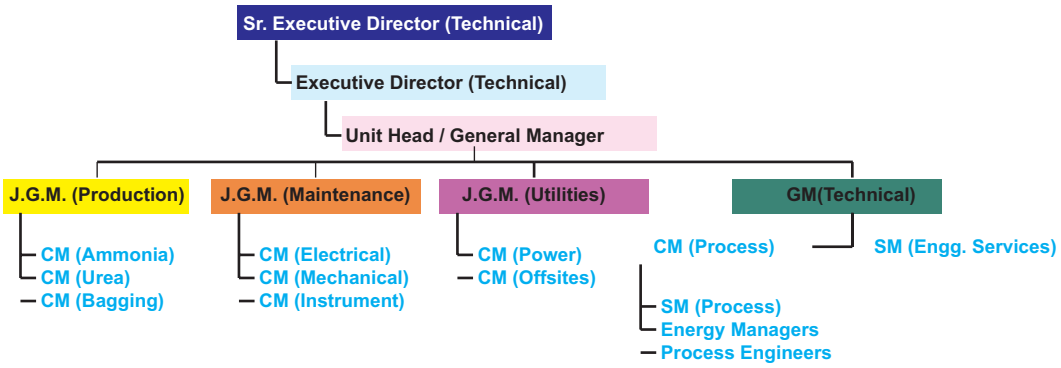
IFFCO Phulpur Unit is playing a vital role in the national economy by providing chemical fertiliser 'Urea' to the Indian Farmers for prosperity and growth. Manufacturing Process of Urea Complex is highly energy intensive and therefore, IFFCO Phulpur Unit is committed to produce good quality product with a mission to reduce the specific energy consumption 1% every year. Action Plan for achieving the target, is as follows:

- Regular Monitoring of Specific Energy Consumption and its Periodical Review.
- Adoption of Proven, Energy Efficient and Eco-Friendly Technologies.
- Adoption of Fuel and Energy Substitution resulting into improvement in efficiency and low cost.
- Gainful Recovery of Waste heat and Low Level Energy.
- Energy in Electrical Appliances including lighting to be conserved by modification/ modernization.
- Review and Appraisal for Maximizing Equipment Efficiencies. Benchmarking the Performance of the Unit with the other efficient Units.
- Training for All Employees for Energy Conservation.

Energy Conservation Cell

The energy consumption is monitored on daily basis. Phulpur unit has constituted a task force, headed by Joint General Manager – Technical. The task force comprises of senior persons from various departments, viz. Production, Maintenance, Utilities, Technical Services, Finance & accounts etc. It meets periodically to discuss the various loss points either due to plant operating troubles or owing to design limitations or development of new technology. Besides this, for improving the energy efficiency within the existing facilities, studies are carried out and modifications are done in-house.

ENERGY CONSERVATION MONITORING CELL AT IFFCO



The Engineers and operators / technicians connected to each plant are regularly sent for in house / outside training programmes and Seminars on energy conservation to created their their interest in this area as well as make them aware of the various methods / developments in the field of energy conservation. Reputed professionals are invited as Faculty for the in - house programmes.

Energy Conservation Achievements

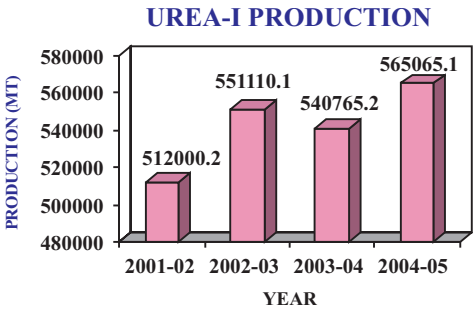
Phulpur unit has always been a leader in adopting new developments in the field of fertilizer production and number of modifications/revamp have been carried out over the years which have resulted in substantial improvement in energy consumption. Major modifications carried out in Phulpur-I are listed as below :

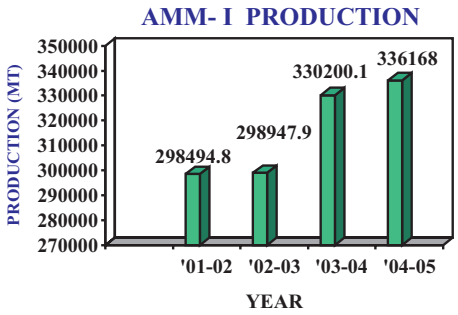
PHULPUR-I

1. Purge Gas recovery unit in Ammonia-I plant
   Net Improvement in energy saving : **0.1108 Gcal / MT of Ammonia**
2. Synthesis Converter Retrofit
   Net Improvement in energy saving : **0.117 Gcal / MT of Ammonia**
3. Lo - Heat benfield retrofit in CO2 removal system
   Net Improvement in energy saving : **0.096 Gcal / MT of Ammonia**
4. Modified CO2 Compressor Turbine in Urea plant
   Net Improvement in energy saving : **0.16 MT Steam / MTof Urea**
5. Installation of Pre- Concentrator in Urea plant (In Year 2001-02)
   Net Improvement in energy saving : **0.08 Gcal / MT of Urea**

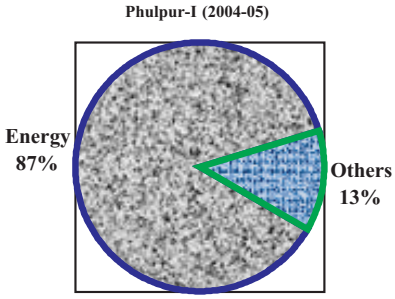
There has been a steady decline in specific electrical and thermal energy consumption. Energy consumption in Phulpur-I has been brought down from the level of **12.5 Gcal / MT** in initial years to the current level of **7.6 Gcal / MT** i.e. a reduction of about **40%.** Following table shows the energy consumption pattern & savings achieved in energy during last three years which shows a remarkable reduction.

Performance Overview of PHULPUR-I

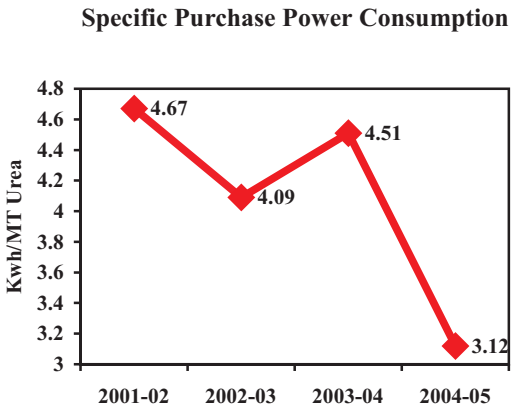




Energy Cost as percentage of Manufacturing Cost



PHULPUR-I: REDUCTION IN CONSUMPTION OF INPUTS



Details of Energy Saving Projects Carried out during 2004-05

1. Installation of New LT shift guard, BFW Preheater and Separator

The main objective by introducing changes to the shift section is to lower the pressure drop created by the reactor outlet systems and to reduce the CO slippage from the section. Furthermore, more heat will be recovered at a higher energy level in this section by installing an HP BFW Preheater.

Due to the changes in the reforming section and the new outlet system in the LT shift reactor the shift section will be run at a higher pressure level than is seen in the base case. Even after introducing the pressure drop across the new reactor and BFW Preheater the overall pressure drop of the section is decreased from 2.3 Kg/cm2 to 2.2 Kg/cm2. The CO slippage is, despite of the lower steam to carbon ratio, reduced from 0.32 to 0.15 mole% (dry) outlet the low temperature shift 104-DB.

LTS Guard Scheme in Phulpur- I Commissioned

Energy savings	= 0.071Gcal/MT of Ammonia.
Cost of modification	= Rs. 480 lakhs.
Estimated cost savings per year	= Rs. 320 lakhs.
Pay back period	= 1.5 years.

2. Complete revamping of CO2 removal system to a modern 2-stage GV Process

The original CO2 removal system was a Benfield system with full regeneration of all the solution in two parallel operating CO2 strippers, 102-EA & 102-EB. Each stripper has its own carbonate reboiler, 105-C A/B, and LP steam fired reboiler, 111-C A.B. The system has been revamped in 1993 to include a 4 stage flash, 502-F, and a condensate reboiler, 501-C, common for the two CO2 strippers.

The two CO2 strippers, 102-E A and 102-EB, are operated at different pressures. 102-EA is operated at a pressure of 1.1 Kg/cm2g and 101-EB is operated at 0.14 Kg/cm2g. Loaded solution is introduced to 102-E A/B in parallel, whereas semilean and lean solution are going from 102-EA to 102-F, before the gas is recompressed in 110-J, CO2 blower, and added to the OH, CO2 gas coming from the HP stripper, 102-EA.

The total solution flow is increased slightly, the lean solution flow decreased, whereas the semilean solution flow is increased by approximately 7 %. The total energy consumption is reduced due to the lower regeneration duty. Regeneration duty for the revamp case is 24.29 Gcal/hr against the base case figure of 39.74 Gcal/hr and the total net saving in energy consumption is reduced by 37 %.

Since the solution has been changed, the material of construction in the different parts of the plants was also not changed. The existing reboiler, 105-CB, has also been connected to 102-EA.All the solution piping around the strippers, 102-E A/B, were re-routed and the original sizes changed according to changed flows. In the OH system a new separator, a blower, a condensate pump and a new control valve has been installed.

Regarding packing the following modifications are made : Absorber bottom bed replaced with IMTP 40. The discharged packing (76 m3 Hy-pak no. 2) was fully utilized to replace the bottom bed of 102-EA, where the existing Hy-pak no.1 was not suitable.

Total energy saving per year	= 0.108 Gcal /MT of Ammonia
Total cost of above modifications	= Rs. 1670 lakhs.
Estimated cost savings per year	= Rs. 486 lakhs.
Pay back period of the scheme	= 3.4 years

3. Power Savings due to Variable Speed drive installed in C.T. Fan:

One No. of Variable Speed drives have been installed during the last week of January'05 in Power-I Cooling towers. Motor speed control is kept on Auto mode based on Cooling water supply temperature. During night hours when CW supply is low, speed reduction up to 900 rpm from 1485 rpm has been observed.

Following table shows the observed savings during their Operation:

VSD Model No: CIMR-F7-A4-110, Supplier: L&T

Parameter	Previous	Present
Area installed	Power Cooling Tower-I	
Motor rating, kW	93	93
Rated speed, rpm	1500	-
Speed reduction observed, rpm	-	up to 900
Power consumption, kW	55	14
Power saving, kW	-	41
Cost of drive	-	3.0 lakhs
Payback period	-	5 months

Note: Pay back period is estimated based on 12 hours power savings in a day.

4. Installation of Electronic Governor for CO2 Compressor drive Turbine in Urea-I Plant

The installation of Electronic Governor for CO2 Compressor drive Turbine in Urea-I Plant resulted in the following advantages which helped in improving on-stream reliability and efficiency of the CO2 Compressor:

- **Precise control of speed :** There were no direct control over the speed of compressor. The speed was controlled by varying the secondary oil pressure manually which was causing speed hunting of the order of 25 to 30 rpm. With the installation of Electronic governor, the speed controlling is being done automatically, it can be increased or decreased in the small steps of 2 to 5 rpm. The speed variation is now reduced to 0 to 5 rpm.

- **Extraction pressure variation eliminated :** There was variation in the extraction steam pressure earlier. Now with the help of electronic governor, the extraction pressure can be kept on automatic control which keeps the extraction pressure variation minimum.

- **Automatic startup and shutdown sequence :** The startup and shutdown of the machine is now taken through a software program, which allows the machine to run on the idle speed for pre-specified time and then ramp-up or ramp down the speed in a controlled manner for the safety of the machine.

- **Improvement in the steam consumption (start-up) :** Through the automatic startup sequence, the steam consumption during startup has come down.

View of Governing oil Console and I/H Converter of Electronic Governer.

5. Replacement of Check Valve between Super heater outlet and Common Header in Steam Generation Plant in Phulpur-I

In the operation of Coal based boilers in Steam Generation Plant. It had been observed that the common header pressure of HP steam remains at around 107.5 kg/cm2 g despite keeping HP steam pressure of around 112 kg/cm2g at super heater outlets. A study had been carried out for the high pressure drop in the pipeline steam from super heater outlet to common header.

Study revealed that the pressure drop across super heater outlet and common header is high between 3 to 5.5 kg/cm2. This actual pressure drop created by piping & fittings was very high compared to calculated pressure drop. Installed pipe size was found OK. Isolation valves are Gate valves which does

not contribute much in pressure drop. Therefore it was concluded that NRV's provided in the system are causing high pressure drop. These NRV's were similar to lift type check valves, which are known for high pressure loss in the system. It was also found that in other similar installations in Ammonia plant, swing check valves have been provided at similar locations causing low-pressure drop in the system.

This high pressure drop in the system was causing problems in operationflexibility and it was difficult to maintain steady Steam pressure during normal operation. It was therefore decided to replace "Lift type NRVs" installed in pipeline with "Swing type check valves" to reduce the pressure drop in the system.

After installation of these drum pressure has reduced by 3 kg/cm2 at full load and also it helped in maintaining steady HP steam pressure during normal operation.

6. Stoppage of One no. motor driven BFW Pump in Power Plant :

After implementation of LTS Guard System in both Ammonia-I and Ammonia-II, 2 stage GV CO2 removal system and Replacement of Check Valve between Super heater outlet and Common Header in Steam Generation Plant in Power Plant etc. the overall steam consumption in the Plant has come down resulting in lesser BFW requirement in Power Plant. As a result , one no. of motor driven Boiler Feed Water Pump connected to 950 KW motor has been stopped. This has resulted in a saving of 825 KW per hour.

Power Savings	= 825 KW per hour.
Yearly Cost savings	= Rs. 261 lakhs
Cost of modification	= Nil
Simple pay back period	= Immediate

7. Installation of Energy efficient CFL lamps:

Total 50 number of street lighting sets having 2 X 40 W have been replaced with more efficient CFL lamps of capacity 2 X 18 W (Crompton make). Also, 1500 number of 100 W incandescent lamps in IFFCO-Phulpur township have been replaced with more efficient 25 W CFL lamps (Crompton make).

Yearly Power savings	= 3.38 lakh kWH.
Yearly Cost savings	= Rs. 13.5 lakhs.
Cost of CFL lamps	= Rs. 2.75 lakhs.
Simple pay back period	= 2.5 months.

Energy Conservation Plans and Targets

Energy conservation is an ongoing process at IFFCO. Following major proposals are in hand at Phulpur unit as a part of its future plans for energy conservation.

Energy Saving Project (ESP):
Phulput unit has launched its major Energy Saving Project (ESP) worth Rs. 150 crores for its existing Ammonia plants. Phase- I of the project has been completed during March & April 2005. Phase-II of the project consisting of following schemes in Ammonia-I & Ammonia-II is scheduled to be completed by April 2006.

ITEM DESCRIPTION	Saving in GCal/MT	Investment in Rs. Crores
AMMONIA-I		
S-50 Converter & Syn. Loop Boiler	-	-
Synthesis gas compressor Revamp	-	-
Ammonia Wash Unit	-	-
Final gas Chiller	-	-
Integrated Energy Savings for Ammonia-I Schemes	**0.47**	**71.00**

- **LNG Conversion Project :**

It is proposed to convert the present feed stock of Naphtha with LNG to reduce energy & cost of production of the complex. Agreement with GAIL was entered on 25th August,2004 and tentative pipeline availability is February, 2006. All major material required (LNG Feed Preheater Coil, LNG Burners, GT Fuel Modifications, Changes in DCS) have been already ordered.

- **CDR Project :**

- After conversion of plant feed stock to LNG, there will be a short fall of CO2 for the manufacture of Urea. To overcome this a

- 450 MTPD Carbon di oxide Recovery Plant (CDR) is proposed to be installed in Ammonia-II to recover CO2 from stack gas. Order has been placed on M/s MHI for license & engineering and on M/s TICB on LSTK Basis for which scheduled commissioning is December 2006. Cost of project is Rs. 79.8 crores

- **Capacity Enhancement Project :**

  It is also proposed to increase the Plant urea capacity by about 20 %. Design basis already freezed. Agreement with M/s HTAS for pre-engineering study has been entered for Ammonia Plant and similarly with M/s Snamprogetti for Urea Plant. Estimated cost of project is Rs. 150 crores. Project is likely to be completed by March 2007.

NATIONAL FERTILIZERS LIMITED
Vijaipur Plant - I, Guna (Madhya Pradesh)

Unit Profile

National Fertilizers Limited, a Govt. of India Undertaking, was incorporated on 23rd August 1974. It is the second largest producer of nitrogenous fertilizer in the country and has four operating fertilizer units located at Nangal, Bhatinda, Panipat and Vijaipur with a total installed capacity of 32.083 lakh tones Urea.

The Vijaipur unit, which is a ISO 9001:2000 & 14001 certified unit, comprises of two streams-Vijaipur-I and Vijaipur-II, which went into commercial production in July, 1988 and March, 1997 respectively. Both the streams are based on *"Steam reforming process"* of Haldor Topsoe (Denmark) for Ammonia plants with Natural gas feed in Vijaipur-I & NG/Naphtha feed in Vijaipur-II.The Urea plants are based on Snam Progetti (Italy) 's *"Ammonia stripping process"*

Energy Consumption

The details of various energy inputs and specific energy consumption during the last three years are highlighted in the table below. The % mix of NG & Naphtha use depends on the availability Natural Gas from M/s GAIL. Though there has been significant reduction in specific energy consumption in the Year 2004-2005, the energy cost has not reduced proportionately since the Energy cost is dependent on the input ratio & the input raw material cost.

DESCRIPTION	UNIT	2002-03	2003-04	2004-05
Annual Urea Production	Lakh MT	8.64676	8.83699	9.26400
Total Electric Energy consumption	Thousand MWH	93.430	100.966	108.422
Total Thermal Energy consumption	GCal	1274958.20	1223918.72	1098178.64
Total Energy consumption (Electrical+Thermal+Raw material)	GCal	5331592.21	5327821.27	5386089.60
Total Sp. Energy Cons. (Electrical+Thermal+Raw material)	Gcal/MT	6.166	6.029	5.807
Total Manufacturing Cost	Lakhs Rs.	41610.06	41344.01	46980.26
Total Energy Cost	Lakhs Rs.	34526.83	35584.56	38718.03
Total Energy Cost (Electricity + Thermal)	Lakhs Rs.	16450.35	17175.18	19358.27
Total Energy cost as %age of Manufacturing Cost	%	82.97	86.06	82.41

Energy Conservation Commitment, Policy and Setup

NFL, Vijaipur is very much committed to Energy Management and for the same has a dedicated Energy management cell. For all ENCON measures, the ECC is the principal functioning & Coordinating cell .The functioning of Energy Management is from the top. The head of the unit holds regular weekly meetings to discuss the status of energy consumption levels & action taken on ENCON options. The middle management, consisting of departmental in charges, reviews the ENCON options identified by the Energy Cell or the Audit Group for implementation. ENCON options/ schemes, requiring higher investment are put up to the top management (Head of unit, CMD, Directors) for approval of budget & implementation. Further, suggestion scheme system for workers is in vogue in the unit. Energy saving suggestions are given utmost priority for implementation and are suitably rewarded. Energy saving modifications from plant are also given top priority for early implementation.

In addition to the monthly energy audit based on inputs, detailed plant wise energy audit is carried out by in-house energy cell or selected technical audit team. Energy audit was also conducted by M/s HTAS, Denmark for Ammonia-I Plant .NFL has planned to implement the recommendations of M/s HTAS and for the same, action has been initiated based on the action plan formulated

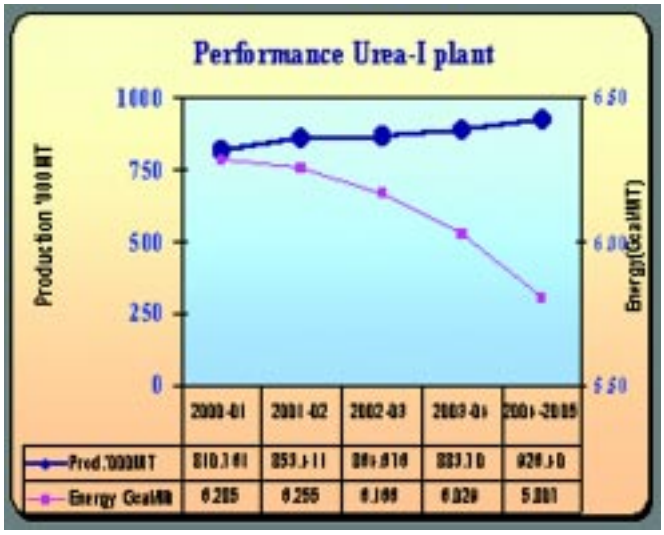
Energy Conservation Achievements

The specific energy consumption for the last three years are highlighted below.

Year	Overall specific energy consumption (Gcal/MT of Urea)	% reduction in energy consumption (base year 2002-2003)Rs. Lakhs	Monetary saving effected (base year 2002-2003) in
2002-2003	6.166	-	-
2003-2004	6.029	2.22 %	345.04
2004-2005	5.807	5.71 %	929.36

PERFORMANCE OF VIJAIPUR-I AT A GLANCE

ITEM	UNIT	2002-03	2003-04	2004-05
AMMONIA				
AMMONIA PRODUCTION	MT	499416	518262	529164
CAPACITY UTILIZATION	%	99.56	103.32	126.59
ON STREAM DAYS	DAYS	328.24	347.73	349.13
ONSTREAM EFFICIENCY	%	89.93	95.01	95.65
AVG. PLANT LOAD	MTPD	1521	1490	1516
NO. OF INTERRUPTIONS	NOS.	6	6	2
SPECIFIC ENERGY CONS.	Gcal/MT	8.114	8.019	7.861
UREA				
UREA PRODUCTION	MT	864676	883699	926400
CAPACITY UTILIZATION	%	100.01	102.21	128.58
ONSTREAM DAYS	DAYS	327.89	339.62	346.48
AVERAGE PLANT LOAD	MTPD	2637	2602	2674
ONSTREAM EFFICIENCY	%	89.83	92.79	94.93
SPECIFIC ENERGY CONS.	Gcal/MT	6.166	6.029	5.807



Various energy saving schemes implemented during 2004-2005 are highlighted below:

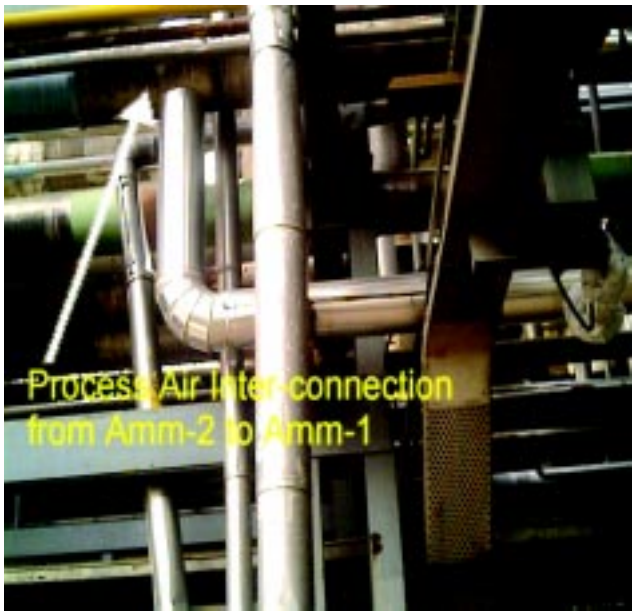
In it's constant endeavour to optimise and improve upon the present systems, besides optimization of process parameters & maintenance practices, energy saving schemes were implemented recently after thorough & extensive study in the related fields.

In view of NG limitation from M/s GAIL, unit has been forced to use Naphtha. Hence , all Energy savings has directly resulted in saving in terms of naphtha .

1. IMPORT OF PROCESS AIR IN AMMONIA-1 FROM AMMONIA-2

- The process air compressor (PAC) in Vijaipur-I becomes bottleneck for increasing load during summer because of decrease in capacity. It is due to increase in air suction temperature as well as CW temperature. The drive of PAC in Vijaipur-II is Cogeneration mode Gas Turbine, which is more efficient & consumes low specific energy. Moreover, margin in air capacity is also available. Therefore import of process air from line-II @ 2000 Nm^3/h is being done to take care of capacity of Line-I Process Air compressor as well as save energy.

  The scheme has been implemented on 08.04.2004 & is in line since then. Actual energy saving is to the tune of around 0.01 GCal / MT Urea

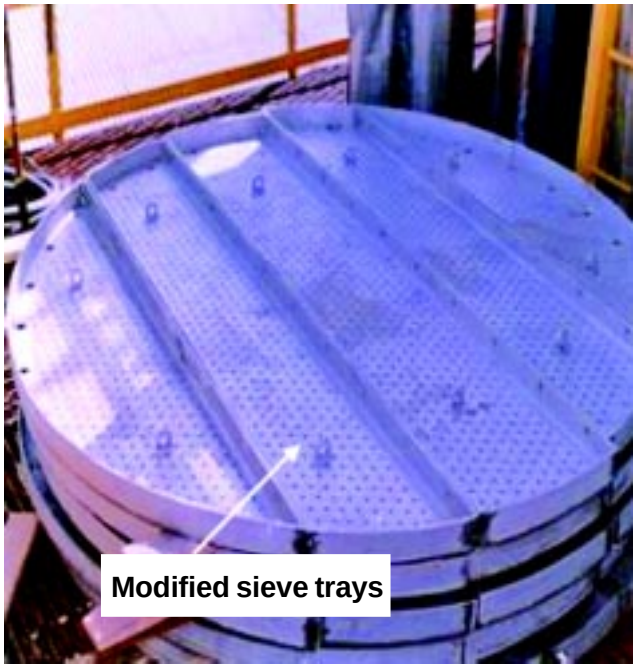


- **PAYBACK:**
  Annual savings : Rs. 198 Lakhs
  Investment : Rs. 4.0 lakh
  Payback Around < 1 month

2. INSTALLATION OF ADDITIONAL TRAYS IN UREA REACTOR BOTH THE STREAMS OF UREA—I PLANT

The Urea reactors installed in 1987, in Vijaipur-I, consisted of 10 Nos of classical snamprogetti design sieve trays In order to improve the conversion Efficiency in the Urea Reactor, additional 5 No high efficiency Sieve trays as per Snamprogettti design has been installed in the Urea reactors ,during the annual turnaround in March 2005.Actual steam saving has been approx@30kg/MT of Urea. (Steam at 105ata, 510ºC)

- **PAYBACK:** Annual savings: Rs 396 lakhs
  Investment: Rs. 115.0 lakhs
  Payback : 3.5 Months



3. INSTALLATION OF PURGE GAS HEATER IN AMMONIA-1

A Purge gas pre-heater has been installed in Ammonia-I to recover the heat that was being wasted into the Cooling Water . This has reduced the heat duty on purge gas chiller E-1511 from 0.35Gcal/h to 0.26 Gcal/h.

- PAYBACK:
  Annual savings : Rs. 19.82 lakhs
  Investment : 8.0 lakhs
  Payback : 5 months

Energy Conservation Plants and Targets

On the basis of Internal Energy Audit and the detailed Energy Audit of Ammonia- carried out by M/s HTAS, the unit has the following future action plan in the pipeline for conservation of energy.

Sl. No.	Plan	Implementation (Year)	Annual Savings	
			Energy, GCal	Lakh, Rs.
1	Installation of Pre-concentrator in both streams of Line-I Plant	2005-06	84730	605
2.	Implementation of Schemes proposed by M/s HTAS under the Energy Audit conducted in Ammonia plant of Vijaipur-I- with the Installation of S-50, Retrofit of Benfield to GV, Installation of CA pre-heater and other modifications	Contracts for basic & Design Engineering are to be awarded. Expected completion schedule is 24 months from the award of Contract.	199550	1656

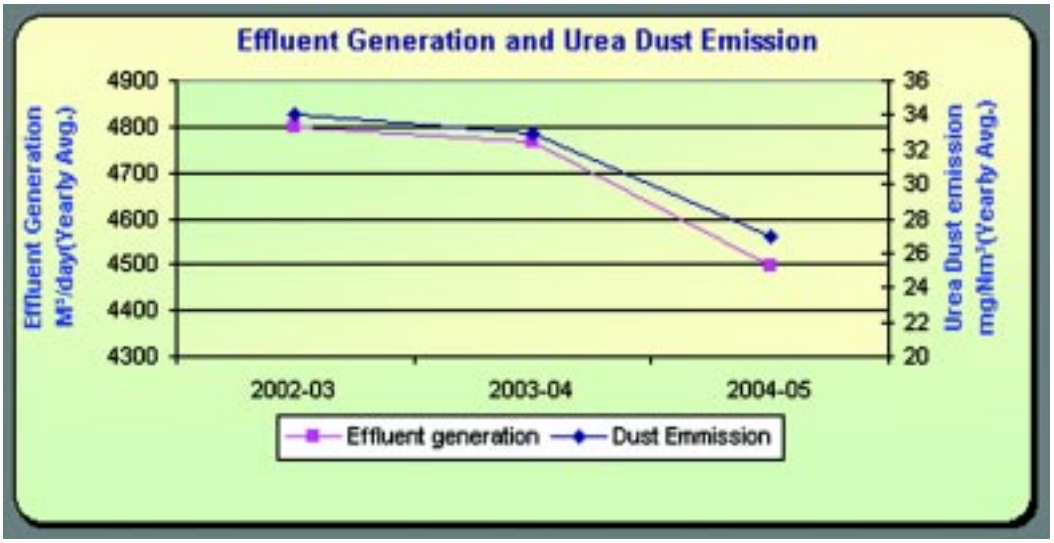
Environment and Safety

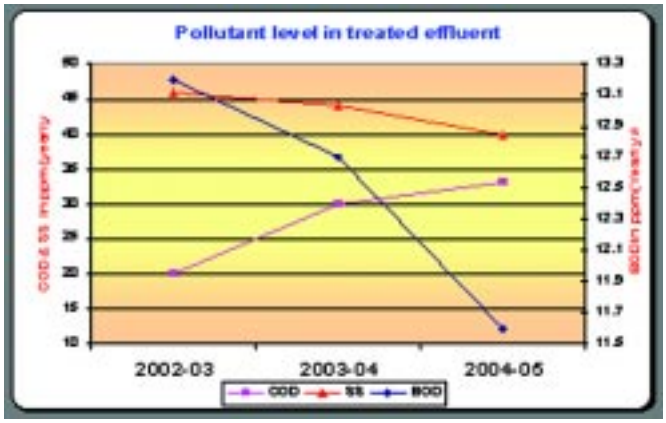
ENVIRONMENT

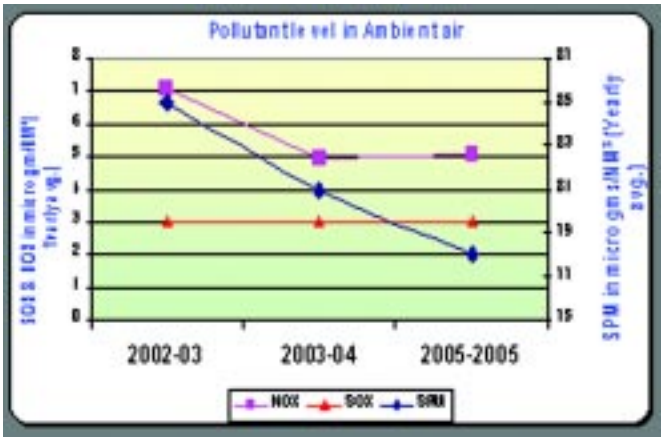
National Fertilizers Limited has its own corporate Environment Management Policy, which gives utmost importance to 'Environment Protection' in and around the complex. N.F.L., Vijaipur is an ISO-14001 unit , which is a testimony of it's commitment towards Environment consciousness**.**. The unit has been constantly upgrading the concept of conservation, recycle & reuse for optimum utilization of inputs. This has also helped in reducing waste discharges thus preventing pollution. The unit has bagged many prestigious awards for efficient environment control.

A separate Effluent Monitoring Cell (EMC) has been established to keep round the clock vigilance on effluent quality so that the discharges are much lower than Minimal National Standards.

In addition to the Water Pollution Control Measures incorporated since Design, NFL Vijaipur in it's enbeavour to improve upon the systems has indigeneously developed A Pilot plant for treatment of Urea Bearing Effluent by BIO-HYDROLYSIS







SAFETY

National Fertilizers Limited, Vijaipur has its own Safety policy. It aims at creating safe working conditions & habits in order to eliminate Industrial Accidents. National Fertilizers Limited, Vijaipur has adopted several measures to achieve this goal.

First Prize *Food Processing*

PERFETTI VAN MELLE INDIA PRIVATE LIMITED
Urapakkam, Chennai (Tamil Nadu)

Unit Profile

Perfetti Van Melle India Pvt. Ltd. (PVMI) is a100% subsidiary of an Italian Multinational Company. The company has two units in India, one at Manesar in Gurgaon and the other unit at Chennai. The company is a market leader in sugar boiled confectionery products in India. The Chennai unit commenced production from Jan 2001and has a capacity to manufacture 10,000 tons annually. Some of the global brands manufactured here are Mentos, Alpenliebe, Fruittella etc.

Energy Management Policy

At PVMI, it is our constant endeavor to reduce energy consumption / ton of production so as to remain competitive in the highly price sensitive market. This is made possible by,

a) Conducting both internal and external energy audit on regular basis;

b) Creating the awareness of energy conservation among the employees and encouraging and rewarding the key initiatives taken by them;

c) Critically monitoring various data on daily basis and taking instant corrective steps in case of any major deviation;

d) By setting a standard of reduction in energy cost by minimum 5% year over year;

e) Initiating investment proposals to use renewable resource;

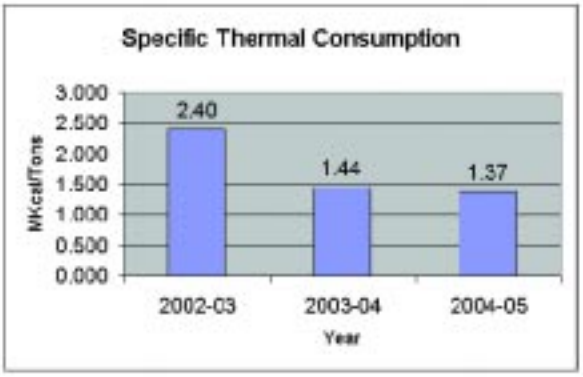
f) Up-gradation of processes and equipments with latest technology;

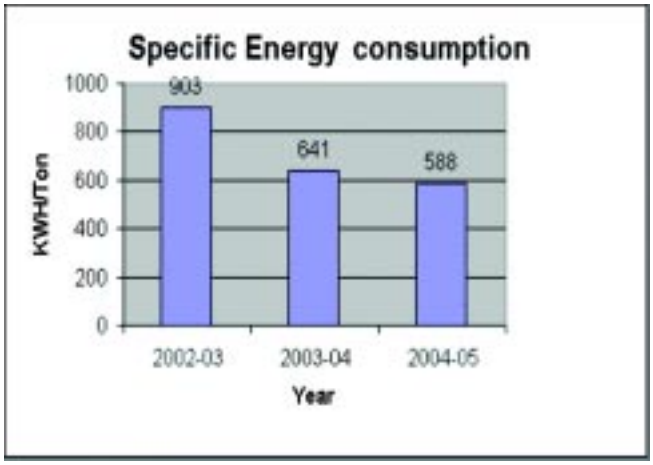
Energy Conservation Process and Set Up

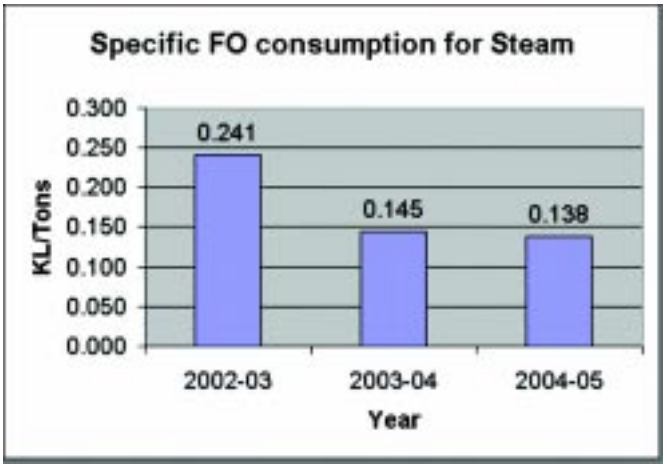
The unit has energy conservation team headed by the Factory Manager. He is assisted by Sr. Executive (Engg & Projects) with 3 technicians working in the Utility area. The team focuses constantly on the ways and means of conserving energy in the factory. The team also encourages active participation from other employees in providing suggestion for conservation. Good suggestions received from the employees and implemented, are duly recognized and rewarded. There is no minimum level of conservation or savings, all implement able suggestions are accepted and reviewed by the team. The team also focuses on alternate source of energy apart from conservation. Energy conservation awareness programs are also conducted for the employees.

Energy Conservation Achievements

Description	Units	2002-03	2003-04	2004-05
Annual production	Tonns	3835	7606	8753
Total Energy consumption	KWH (lakhs)	34.63	48.78	51.43
Total Thermal energy consumption	Mkcal	9217	10982	12030
Total Turnover based on dispatch	Rs (Lakhs)	4113	8762	8909
Total Energy cost in Rs(Lakhs)	Rs (Lakhs)	299.7	413.17	506.19
Total Furnace Oil consumption for Steam	in KL	924	1101	1206
Specfic Thermal Energy consumption	Mkcal/Tons of prod	2.40	1.44	1.37
Specific energy consumption	KWH/Tons of Prod	903	641	588
Specific FO consumption	KL/Tons of prod	0.241	0.145	0.138







1. Jacket Water Recovery:

Background:
To utilize the high temperature hot water of the Jacket water of Diesel Generator Set for Vapour Absorption machine (VAM) to make chilled water.

Observations:
The Engine rejects approximately 30% of the Input fuel energy in Jacket water-cooling circuit to the cooling tower water, which is going to atmosphere as waste heat.

Technical Analysis:
As system of recovering the heat using a plate heat exchanger was installed in which the primary side has Jacket water of the engine and the secondary side water is passed through the hot water VAM to generate chilled water at 7^{o} C for Air-conditioning application

Jacket Water Recovery

Financial Analysis:
Chiller capacity - 64TR

Steam requirement for the same 64x4.5=288 kg/hr(in case of steam VAM)

1 ltr of F.O gives 12 kg of steam

for 250days 24 hours operation= (64x4.5/12)x250x24= 144 KL

Investment Rs 10 Lakhs

Impact of Implementation:

Reduction of steam demand by 288kg/hr and savings of 144 KL of F.O equal to 18.72 lakhs

2. Desiccant Based Rotor system for Dehumidification:

Background:

To utilize the desiccant property of water absorption to reduce chiller capacity

Observations:

Confectionery manufacturing process requires Particular Low air temperature & RH for proper Drying. To make that condition instead of using Direct Compression based chiller, we installed Desiccant Based Rotor system for Dehumidification

Technical Analysis:

The air conditioning for the process air requires dehumidification to 20% R.H. In the normal traditional system of cooling a chilling capacity of 66TR is required. With the Installation Desiccant based system, the chilling capacity requirement is only 40 TR.

Financial Analysis:
The total electricity saved (1kw/1TR) is 26KW
Total year saving- 187200 KWhr
Total cost saving- Rs 14.97 lakhs
Investment - Rs 14 lakhs

Impact of Implementation:

Reduction of 187200 Kwhr of annual units.

Other Major Energy saving activities carried out in the Plant during 2004-05:

1) Conversion of Furnace Oil Based Boiler to Briquette Fuel based Boiler-Savings of Rs 20Lakhs/ year.
2) High efficiency Electronic Diesel Generator 1500 KVA with SFC of 3.7 units/ltr. Leads to 79KL of HSD saving.
3) Installation of overhead water Tank for water supply leading to 0.28 lakhs Kwhr of electricity- Investment of Rs.50000.

4) High velocity air curtain in Process area open to outside to avoid contamination entry from shutter. The limit switch control of opening was linked to the opening and closing periods of Shutter. Savings of 0.9 lakhs kWhr.
5) Impeller Trimming of Cooling tower Pumps and optimization by Parallel Operation 0.6 lakhs kWhr. Investment Rs 5000.
6) Process Drying time reduction leads to lower space requirement and hence the energy for drying room is reduced. Reduction of 0.47 lakhs KWhr/year. Investment Rs 50,000/-.
7) Air Pre-heater in the 4 ton/hr Boiler gives 2% efficiency improvement leading to 24 KL of oil savings Investment of Rs 3 lakhs.
8) Economiser in the wood fired Boiler gives 1% efficiency improvement. This has reduced fuel consumption by 7.2 KL. Investment involved Rs. 1 lakh.

Safety, Health and Environment Policy (SHE):

The unit has SHE policy which enumerate in detail various aspects of good practices to be followed by the employees, contract workmen, visitors etc with respect to safety, health and environment.

Safety

PVMI, Chennai has a safety committee, comprising of employees from cross functions , to ensure that safety measures are strictly followed by one and all. The team is also well supplemented by a reputed safety consultant. The inputs from the consultant are taken into account in executing various safety measures in the factory. Frequent training is also imparted to the employees on fire hazard, first – aid. etc.

Health & Hygiene :

Being a food industry, high importance is given to Health and Hygiene aspect. Special training is provided to the contract workers to create awareness and importance of the same. HR department plans a major role in organizing various awareness programs to the employees. The company is also on the verge of obtaining certification for Hazard Analysis and Critical Control Points (HACCP) and Safe Quality Food-2000, from a reputed institution.

Environment

The unit apart from being ISO 9001 certified, its Environment Management Systems is also certified for ISO 14001, which was obtained in 2004. There are many environmental objectives laid for the year. As a part of corporate social responsibility (CSR) many initiatives have been taken to protect the environment in and around the factory. The unit also won the Best Industry Award in Tamil Nadu for creating HIV/AIDS awareness among the employees and in the surrounding villages.

GLAXOSMITHKLINE CONSUMER HEALTHCARE LIMITED
Rajahmundry (Andhra Pradesh)

Unit Profile

GlaxoSmithKline (GSK) is a world leading research-based pharmaceutical company with a powerful combination of skills and resources that provides a platform for delivering strong growth in today's rapidly changing healthcare environment. GlaxoSmithKline Consumer Healthcare Ltd. (GSKCH) is an Indian branch of GlaxoSmithKline plc U.K. GSKCH is one of the largest players in the Health Food Drinks industry in India

GSK, Rajahmundry site located in southern part of India manufactures nutritional powders viz. Horlicks Chocolate Horlicks and Jr. Horlicks. Its annual capacity is 21 kilo tons with 7 lines in operation. Current site headcount is 530 permanent workmen and 95 staff.

Utilities are a major expenditure on site and accounts to approximately 5% of the cost of goods manufactured.

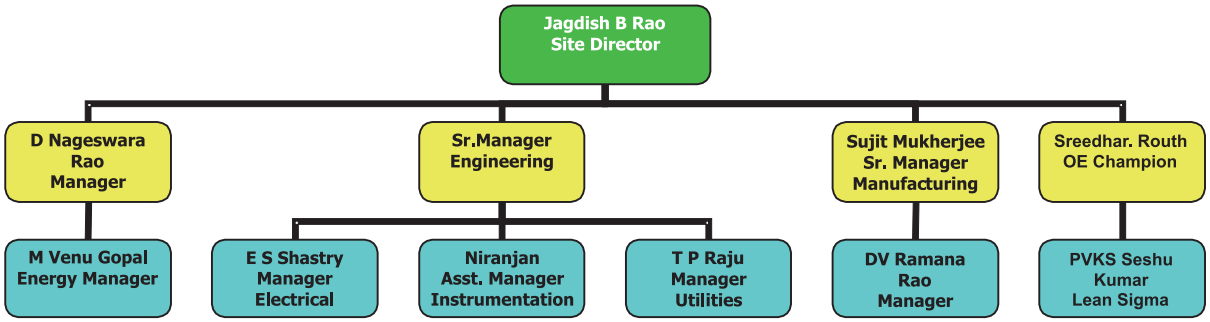
Rajahmundry site accredited **ISO 9000, ISO 14001 and ISO 18001** certifications for quality, environment & safety management systems.

Energy Management Policy

In pursuit of excellence in Energy management, GSKCH Rajahmundry is committed to:

- Assess and prioritize opportunities to minimize energy use.
- Adopting and continuous improvement in efficient energy management
- Maximizing the throughput through de-bottleneck the process operations.
- Systematically increase energy efficiency through lean sigma methodology.
- Continuously introduce energy efficient technology.
- Monitor, measure and review of energy management process.
- Explore possibility of non conventional energy.

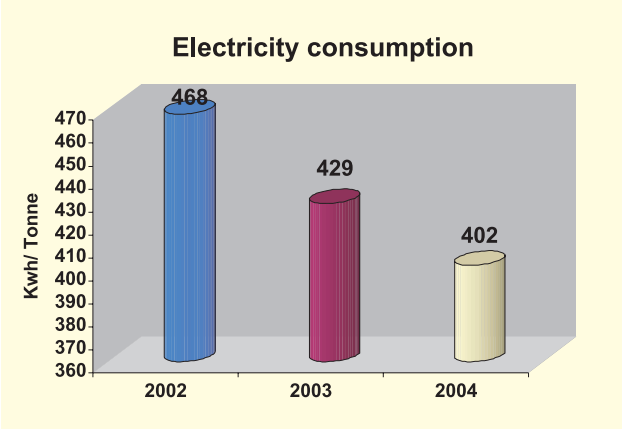
Energy conservation cell structure

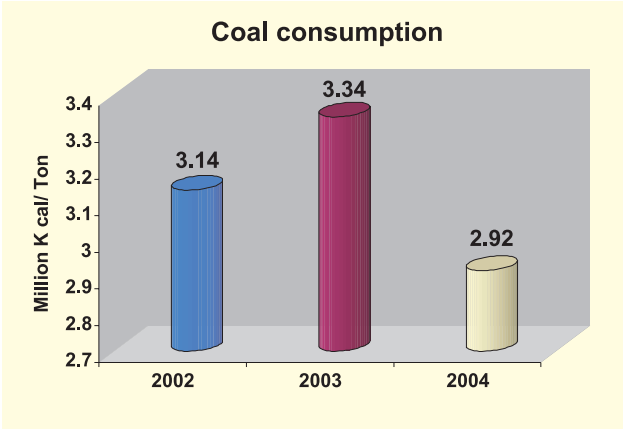


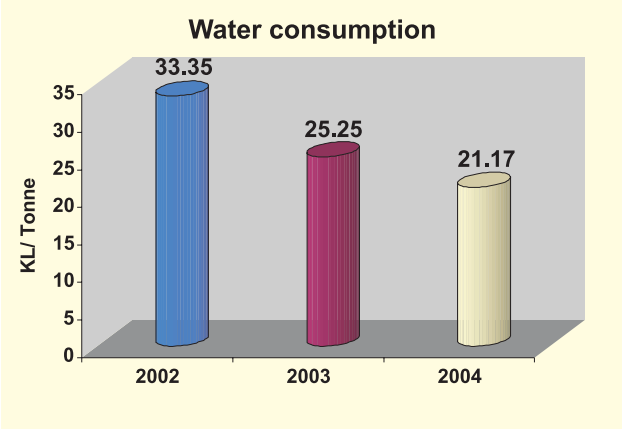
Energy consumption

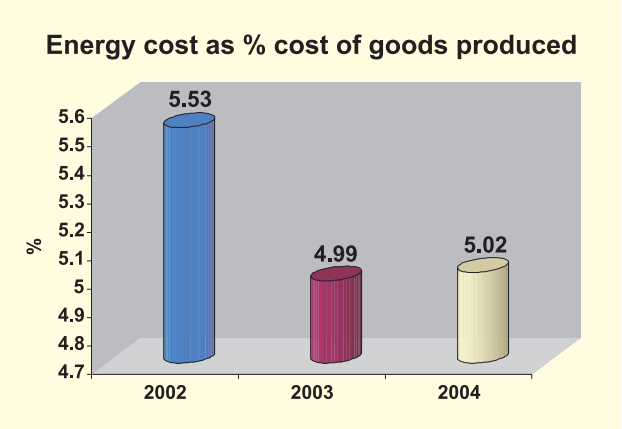
Specific Energy consumption details	Unit	2002	2003	2004
Annul Production	MT	13924	15720	16936
Total energy consumption per annum	KWH(Lakhs)	65.12	67.47	68.05
Total thermal energy consumption	Million K Cal	43767	52515	49402
Total cost of goods produced	Rs. Lakhs	7718	8206	8756
Total energy cost	Rs. Lakhs	426.5	409.3	439.2
Total energy cost as % of Cost of goods produced	%	5.53	4.99	5.02
Electricity (Kwh) per ton of product	Kwh/Ton	468	429	402

Graphical Representation of Specific Energy consumption:









Energy Conservation Achievements

Major energy conservation projects implemented are as under:

1. VAM

In place of vapour compression system Vapour Absorption Machine (150 TR) is installed for process air conditioning to reduce the site OPEX cost by incorporating energy efficient systems, thereby reducing the utility cost by 10% and to eliminate Ozone Depletion Compounds by 60%(Freon) to move in a eco friendly way.

Investment (INR)	5800000
Power saving (KWH)	1270930
Annual saving (INR)	2410000
ODC reduction	60%
Noise level reduction	95dBA to 85 dBA
Pay back period	2.4 Years

2. Vermi composting

The solid organic waste generated in the process of manufacturing, used to be disposed off through incineration. The process of incineration shifts the problem of land pollution into air pollution by air emissions with suspended particulate matter, SOx, NOx. COx etc., This is a serious environmental concern. The project on Vermi-composting is aimed at eliminating land and air pollution and generating manure (chemical free fertiliser) for site green belt development and avoiding the use of incinerator for waste destruction

Power saving (KWH)	25200
Investment (INR)	75000
Annualized Savings(INR)	92232
Payback period	< 1yaer

3. VFD (Variable frequency drive)

To make use of the modern technology for energy savings, installed variable frequency drives at cooling tower

Investment (INR)	354000
Savings (INR)	259000
Payback period	1.5 years

4. Limit switches

Limit switches have been provided and the oven water pumps have been interlocked to stop the pumps during loading and unloading of food from the ovens (meant for baking)

Annualized power saving (KWH)	63209
Savings in INR	387000
Investment made	35000
Payback period	< 1year

5. Economizer and Oxygen analyzer at Boiler

Installed economizer at boiler and Oxygen analyzer to limit % O2 for better combustion of coal and there by reducing the overall consumption of coal

Coal saved per annum	292 T
Investment (INR)	1000000
Annualized Savings (INR)	500000
Payback period	2 years

6. Electronic ballast

This project reduced wastage in the form of ballast loss by replacing with 28 W superior electronic ballast which has long life, reliable and suitable for operation between voltage range of 145 Volts to 260 Volts.

Power saving (KWH)	136579
Investment (INR)	627000
Annual savings (INR)	519000
Payback period	1.2 Year

7. Enhanced condensate Recovery

Steam is the only heating media for horlicks manufacture and is generated from coal fired boilers at 10 bar pressure and 180 degC. Steam is being condensed into condensate during the process and gets collected by gravity into condensate collection pit, which in turn is pumped to boiler house for steam generation. Since condensate cannot be recovered fully due to practical constraints, make-up water is fed through DM water which is at ambient 35 degC.

Condensate being hot water at just than 100 degC if re-circulated to the maximum possible extent, results in enormous fuel savings as boiler needs to only raise temperature from 100 degC to 180 DegC. Hence if condensate recovery can be enhanced from 60% to 75%

Investment (INR)	250000
Annual savings (INR)	470000
Payback period	< I year

8. Non Conventional Energy

Use of non-conventional energy (sun light) through replacing part of the roof with transparent sheets and avoided electrical lighting.

Total Investment (INR)	27000
Annual energy savings (INR)	77000
Payback Period	< 1 year

Projects implemented during 2003- 2005

S. No.	Energy saving measure	Saving (Rs. Lakhs)	KWH (Lakh)	MKCal	Investment (Rs.Lakhs)	Year
1	Hot well sink agitator stoppage in refrigeration plant	0.959	0.21	0	Nil	2004-05
2	Energy efficient light fittings at various locations in Utility areas	0.204	0.05	0	0.12	2004-05
3	Reduction of Agitator usage at Chilled Water Plant	0.803	0.18	0	Nil	2004-05
4	Maximise efficiency of AHU blower motor	0.228	0.05	0	Nil	2004-05
5	To reduce fuel consumption on DG Sets by reducing no of starts in a month	0.816	0.18	0	Nil	2004-05
6	Project Energy by water ejectors in place liquid ring vacuum pumps	2.388	0.53	0	4	2004-05
7	Project ECON, replacing inefficient pumps by efficient pumps	4.888	1.09	0	1.5	2004-05
8	Energy conservation through vapour absorption machine	24.795	5.51	0	59.71	2004-05
9	Gravity filling of ghee avoiding pump usage for the same	0.071	0.02	0	Nil	2004-05
10	VFD for cold water pump in Cooling tower	2.897	0.64	0	3.54	2004-05
11	Flat belt for disintegrator, AHUs & IInd effect evaporator agitator	0.5	0.11	0	0.2	2004-05
12	Exhaust fan avoidance in No.:7 Godown and at canteen	0.15	0.03	0	Nil	2004-05
13	Use-Methane(Generated at ETP) at cafeteria	0.674	Nil	43	2	2004-05
14	Electrical Energy savings	12.369	2.75	0	Nil	2004-05
15	Part - B Mixer, reduction in HP	0.146	0.03	0	Nil	2004-05
16	Project Recon(Maximising condensate recovery)	4.8	Nil	290	2.5	2004-05
17	Energy Savings	7	1.56	0	Nil	2004-05
18	V.F.D to No3 Cooling Tower I.D Fan	0.3	0.07	0	Nil	2004-05
19	Steam Pump	1.84	0.41	0	1.34	2004-05
20	Electrical heating kettle for sensory drink water	0.263	0.06	0	0.007	2004-05
21	Bio-composting of process waste powders	1.844	0.41	0	0.75	2004-05
22	Natural Ventilation	0.77	0.17	0	0.27	2004-05
23	Continuous running of steam turbine	0.591	0.13	0	Nil	2004-05
24	Providing VFD for 25 HP instead of 30HP at Raw water pump	0.456	0.10	0	Nil	2004-05
25	Oxygen analyser and economizer at boiler	5	Nil	1139	10	2004-05
26	Limit switches for ovens	3.87	0.86	0	0.35	2004-05
27	Conversion of V-belt drive to flat belt drive for air conditioning compressors	0.97	0.22	0	0.4	2004-05
28	Reduce raw water consumption by reducing pressure at Pump house	1.708	0.38	0	Nil	2004-05
29	Milk transport rationalization(fuel savings)	4	0.89	0	Nil	2004-05
	Sub Total 1	85.3	16.63	1472.00	76.6	

1	Elimination of air-conditioning for the storage of Malt extract3	4.471	0.99	0	Nil	2003-04
2	Energy conservation in 12 Ton FBC boiler (VFD at feed water & fan)	5.627	1.25	0	5	2003-04
3	Energy conservation in lighting through replacement with energy efficient bulbs	0.712	0.16	0	0.22	2003-04
4	Conservation of energy No.10 Air conditioning ware house through 5S	0.46	0.10	0	Nil	2003-04
5	Improvement in Energy efficiency by eliminating the continuous running of 7.5 hp, Soft water pumps.	1.903	0.42	0	Nil	2003-04
6	Use recycled cooling tower water for evaporator pump seal instead of raw water	1.318	0.29	0	Nil	2003-04
7	Improvement in energy conservation by installing thermostat to water bath	0.342	0.08	0	0.02	2003-04
8	Reducing energy consumption at ETP by controlling agitator rpm speed of aeration tank	5.423	1.21	0	Nil	2003-04
	Sub Total 2	20.256	4.50	0.00	5.24	
1	To reduce power consumption at Manager's quarters by installing energy efficient light fittings	1.169	0.26	0	0.5	2002-03
2	Interlocking Ghee Boiler exhaust fan with temperature	0.374	0.08	0	0.05	2002-03
3	Switch off condensate pit exhaust fan and run it as and when required	0.228	0.05	0	Nil	2002-03
4	Running Incinerator on alternate days instead of everyday	0.335	0.07	0	Nil	2002-03
5	Limit switches for air curtains	0.05	0.01	0	0.02	2002-03
6	Shut off the exhaust fans (2 No's) at Squeezer	0.398	0.09	0	Nil	2002-03
7	Installation of steam Turbo alternator (300KW)	99.505	22.11	0	68	2002-03
	Sub Total 3	102.059	22.68	0.00	68.57	