

MATHURA REFINERY - INDIAN OIL CORPORATION LIMITED **Mathura (Uttar Pradesh)**

Unit Profile

Indian Oil Corporation Limited (IndianOil) is the largest commercial enterprise in India with a sales turnover of Rs.150, 677 crores and profit of Rs. 4, 891 crores for the fiscal year 2004.

Indian Oil is India's number one company in Fortune's prestigious listing of the world's 500 largest corporations, ranked 170 based on fiscal 2004 performance. It is also the 18th largest petroleum company in the world and adjudged number one in petroleum trading among the 15 national oil companies in the Asia-Pacific region.

Indian Oil alone accounts for 56 % petroleum product market share among PSU companies, 42% National refining capacity and 68% downstream pipeline throughput capacity. **Indian Oil** group owns and operates 10 of India's 18 refineries with a current combined rated capacity of 54.2 Million metric tonnes (MMTPA). These include subsidiaries viz. Chennai Petroleum Corporation Ltd and Bongaigaon Refinery & Petrochemicals Ltd. It owns and operates the country's largest network of cross-country crude and product pipelines, with a combined length of 7,730 km with a combined capacity of 56.85 MMTPA. For the year 2004-05, IndianOil sold 50.1 million tonnes of petroleum products, including exports of 1.96 million tonnes.

IndianOil's countrywide network of over 23,000 sales points is backed for supplies by its extensive, well spread out marketing infrastructure comprising 165 bulk storage terminals, installations and depots, 95 aviation fuelling stations and 87 LPG bottling plants. Its subsidiary, IBP Co. Ltd, is a stand-alone marketing company with a nationwide network of over 3,000 retail sales points.

Mathura Refinery, commissioned in 1982, current rated capacity of 8.0 MMTPA crude processing, is meeting the product demand of Northwest region of the country including the National Capital Delhi. The Refinery processes low sulphur crude from Bombay High, imported low sulphur crude from Nigeria, and high sulphur crude from Middle East Countries. In the original refinery configuration, there was one primary Atmospheric Vacuum unit coupled with Vis-breaker Unit, Fluidised Catalytic cracking Unit, Bitumen Unit and Sulphur Recovery unit as secondary units. Subsequently, in order to meet the stringent product specification arising out of environmental considerations secondary units viz. Catalytic Reforming Unit (CRU), Diesel hydro de-sulphurisation Unit

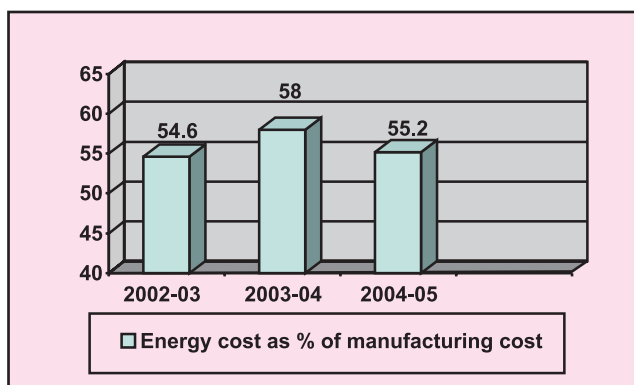
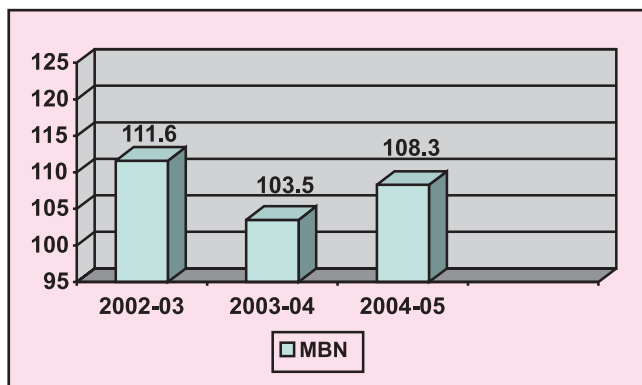


(DHDS), Once Through Hydro-cracker unit (OHCU), new Sulphur Recovery unit (SRU), MS quality upgradation, DHDT etc were incorporated in the refinery configuration. The process configuration of the Refinery employs state-of-the-art technologies with minimal impact on the environment. Mathura Refinery has taken many initiatives to produce more and more clean fuels in stages in the interest of environment, public health and preservation of national monuments around Mathura region. As a result Mathura refinery has been able to supply highly eco-friendly petrol and diesel to NCT, NCR and Agra region in phase manner. Since, April 2005, Mathura Refinery is the first refinery in India, which is capable of producing 100% auto fuels meeting Euro - III norms.

Energy Consumption

Mathura Refinery consumes various types of fuels viz. Natural gas, R-LNG, refinery fuel gas and low Sulphur internal fuel oil (IFO) in furnaces / boilers. Natural gas, which is about 50% of total fuel consumed at MR is supplied by M/s GAIL whereas all others fuels are generated in the refinery itself. The IFO is fired as alternate fuel in old furnaces only.

The energy consumption in refinery is reported in terms of % Fuel & Loss on crude and MBTU/BBL/ NRGF (MBN), where the term MBTU refers to total heat value of fuel & loss in thousand BTU, BBL refers to barrel of crude processed and NRGF is a derived factor that depends upon actual intake in both primary and secondary processing units. The % fuel & loss, MBN and energy cost as % manufacturing cost for last three years is as given below:



It may be mentioned that % fuel & loss of refinery has gone up in last two years because of higher secondary unit throughputs in an effort to produce clean and higher value eco-friendly products. However, the specific energy consumption in terms of MBN (the real yard stick for energy performance) is slightly higher than previous year due to Annual Turn Around during June'04 & July'04.

Energy Conservation Commitment, Policy and Set-up

- **IndianOil** is having strong Energy Conservation Commitment, which is also reflected in its Energy Management Policy. The policy consists of all points related to adopting & nurturing Energy Efficient and environment technologies. The policy is approved by the board of directors of the company and adopted by Mathura refinery.

Energy Conservation Achievements

Annual Energy savings to the tune of 26, 250 SRFT which is equivalent to Rs. 25.25 crores were achieved with the implementation of major energy conservation schemes.

Some of the major steps taken by Mathura Refinery for energy conservation are as given under:

- Installation of Air pre-heater (APH) in furnaces.
- Provision of high efficiency burners.
- Use of low-pressure gas in AVU /VBU furnaces which otherwise was being flared.
- Soaker technology in Visbreaker Unit.
- Process optimization using advance process control.
- Steam turbine for Boiler feed pump and use of turbine exhaust in de-aerator
- Installation of Gas Turbines along with Heat Recovery Steam Generation.
- Use of LP steam in VDU for stripping purpose and for re-boiling in PRU etc.
- Replacement of Metallic Fans with FRP blades in process units.
- Heat integration between different process units.
- Change of service in crude pre-heat circuit from SR to LVGO for pre-heat improvement
- De-bottlenecking of main column 19-C-1 & Debutanizer 20-C-4 overhead circuits of FCC for recovery of gas and reduction of flare in summer months.
- Provision of secondary seal in one crude & 3 MS/ Naphtha tanks.
- Tank wagon gantry automation.
- Generation of MP steam in place of HP steam in CRU steam generator.
- Chemical treatment of CW system, thereby improving exchanger's fouling factor.
- VBU preheat exchanger-cleaning management.
- Comprehensive survey of burners components and re-assembling during annual turn around in 2004-05 by external agency M/s Camvid, Bangalore.
- Additional condensate recovery at Propylene unit.
- Yield and energy revamp of crude distillation unit in Aug-Sep' 04.
- New overhead Air coolers for crude distillation unit.

Optimization of pre-heat train in AVU, FCCU & NSU with addition of new heat exchangers.

In addition, the benefits of energy conservation measure implemented earlier were sustained during the year 2004-05 also. Refinery has used extensively Physical Acoustic Leak detector for detecting gas loss to flare by regular survey of safety valves and control valves connected to flare. Encon audit of furnaces, steam leak, heat exchanger, crude oil receipt, Natural gas receipt, custody transfer operation etc were carried out by Internal Energy Audit group.

Energy Conservation Plans and Targets

Mathura Refinery is committed to further reduce energy consumption by finding out new avenues on continuous basis. Refinery has planned for VBU revamp, APH in VBU, Flare gas recovery system, Introduction of specialty amine for Amine treatment, Retrofitting existing Hydro-mechanical governor with electronic governor, H₂ recovery from CCRU cat reduction gas and step less control for high power consuming make up compressor in OHCU etc at an estimated cost of ~ Rs. 23 crores which will bring a saving of ~ 14,000 SRFT/year.

Environment and Safety

Environment

Mathura Refinery, being located on National Highway No.2 connecting the capital city Delhi with the historic city Agra and in the sensitive Taj Trapezium Zone (TTZ), is the first industry in India for which an expert committee carried out a scientific Environmental Impact Assessment (EIA) study. Implementation of the recommendations of the EIA study even before commissioning of the refinery, laid a strong foundation of the Environmental Management System right since inception and it is an ever-continuing mission.

A full-fledged Environment Protection (EP) Cell having qualified engineers exists to deal with all environmental issues. A well-equipped Pollution Control Lab has also been established to monitor environmental performance on day-to-day basis. The lab is approved by the Ministry of Environment & Forests (MoE&F) and accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL). In addition, A full-fledged Occupational Health Center (OHC) is functional at the refinery for monitoring of work-related hazards namely toxic gas hazards, noise hazards, etc. and health monitoring of employees.

Safety

Safety being an integral part of refinery operation, best practices on safety are in place at Mathura Refinery. The safety is accorded the highest priority. To make the refinery a safe place for its employees, environment and nearby community, the high standard of safety is maintained. Latest equipments on safety are introduced time to time. Safety system is continuously monitored and upgraded through monthly shop floor safety meetings, Management Review and through Internal/ External safety audits.

RELIANCE INDUSTRIES LIMITED
Refinery Division, Jamnagar (Gujarat)

Unit Profile

Reliance, Jamnagar is the largest grass root refinery set up with annual capacity of 27 million tons and the 3rd largest refinery in the world at any single location.

The refinery and Petrochemical Complex comprises of Crude Unit (2 parallel trains), Diesel Hydrotreater (2 trains), VGO Hydrotreater (2 trains), Sulfur (3 trains), Hydrogen (2 trains), Coker, Fluid Catalytic Cracker, Propylene Recovery Unit, Amine treating Unit, Desalination Units, Naphtha Hydrotreating, Catalytic Reforming, Paraxylene Extractions trains (3 nos), Tatoray Unit, Xylene extraction, Polypropylene Unit (3 trains), Captive Power Plant and a Effluent treatment plant.



Highlights:

- ✓ Largest Grass Root Refinery.
- ✓ World's Largest FCCU - 10.05 MMTPA (200 KBPSD).
- ✓ World's Largest Coker - 8.3 MMTPA (155 KBPSD).
- ✓ World's Largest Aromatics Complex - 2.1 MMTPA (PX + OX) capacity in one site.
- ✓ World's largest PP in one site - 750,000 MTPA
- ✓ India's largest Sulfur Recovery Complex - 1350 TPD
- ✓ Large size Captive Power Plant 360 MW Capacity (Power) and 1500 MT/Hr (HHP Steam)
- ✓ India's largest Petroleum Terminal, Oil movement and Storage area.

Energy Consumption

| Year | Sp Power Cons. Kwhr/MT of intake | Thermal Consumption Mkcal/MT of Intake |
|---------|----------------------------------|--|
| 2002-03 | 73.87 | 0.668 |
| 2003-04 | 73.49 | 0.661 |
| 2004-05 | 73.1 | 0.662 |

In the Refinery Energy monitoring, the practice of evaluation of Energy Index is prevailing. An Energy Index is the ratio of actual energy consumed and the standard or theoretical energy consumed. Lower the Energy Index better is the Energy Efficiency.

In Energy Indices evaluation, the feedstocks of all the processing units are considered and the energy Index arrived at by International Systems such as either Shell or Solomon Benchmarking normalizes all the specific energy consumption and the reduction in the Index Indicates true reduction in the energy consumption. Following are the Energy Indices for Reliance Jamnagar.

| Shell Benchmarking | | Solomon Benchmarking | |
|--------------------|------|----------------------|------|
| Year | CEL* | Year | EII* |
| 2001 | 94.3 | 2000 | 69.2 |
| 2002 | 88.7 | 2002 | 64.2 |
| 2003 | 87.6 | 2004 | 62.3 |
| 2004 | 86.9 | | |

Reliance Jamnagar is topping the list of Shell Benchmarked Refineries in the world and also topping the list of Large Complex Refineries in Solomon Benchmarking in the Asia Pacific Region for last five years.

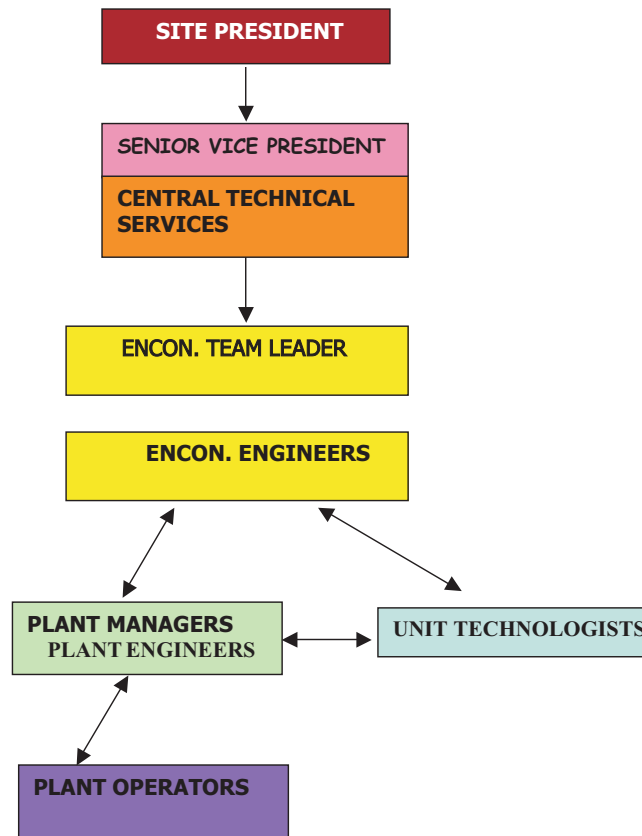
Energy Conservation Commitment, Policy and Organizational Set up

Reliance has a comprehensive policy on energy conservation. Innovative energy conservation practices are practiced all throughout the site. Better operating practices, improved operating efficiencies, optimum utilization of resources increased automation, introduction of advanced control systems, new techniques and technologies, higher capacity utilization are the various methods used which aim at the corporate goal or commitment to conserve / optimize energy consumption .

Energy Management Set-up

At Reliance Jamnagar on a continuous basis, a detailed review is made at sector chief levels fortnightly with complete focus on Energy Consumption. A rigorous plan is generated by Central Technical Services for implementation of the various projects which are being implemented or are planned in future. Top, middle, junior management and workmen of all level are committed and involved to meet the same corporate goal. The Energy conservation team structure which work out together for implementation of the projects.

Energy Conservation Organogram:



Energy Conservation Achievements

Major Projects implemented in 2004 are as under

1) In-house Optimizer in CPP to reduce fuel

Observations

While calculating power margin, slabs on maximum capability of each GT are fixed as 29 MW at or below 30°C, 28 MW at 30 - 40°C and 27 MW above 40°C. GT capability decreases as ambient temperatures increase and the average temperature difference between day and night is about 10-15°C. Refer to Figure-1, there exists an opportunity to improve the gap between actual Available Margin and Present Margin with slab system.

Instead of fixing slabs on GT capability with respect to ambient temperature ranges, the actual GT capability & heat rates at current ambient temperature can be used to optimally distribute power load amongst GTs as well as GTs & STGs.

Technical & Financial Analysis

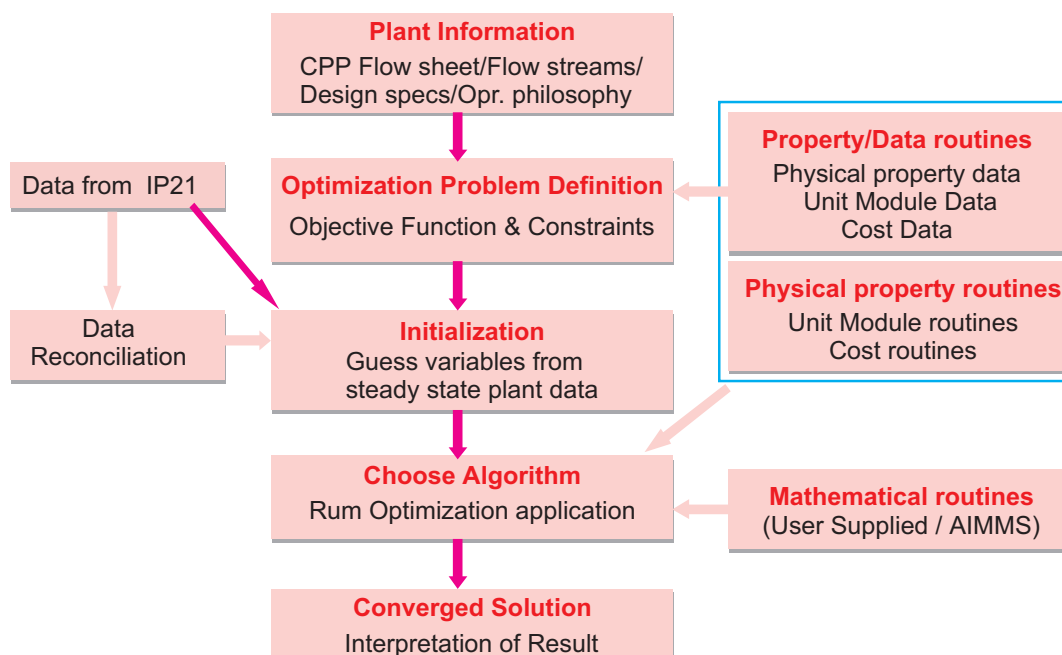
Fine-tuning results in fuel savings by reducing condensation in STGs and improved cogeneration efficiency of GT-HRSG systems. An on-line open-loop optimizer for steam & power system was developed in-house (Refer to Optimization Flow Sheet) and implemented to adjust controllable parameters continually based on performance of boilers & generators and fuel costs.

Savings were monitored under controlled conditions for the above said configuration at 273 MW of power generation, 910 TPH of steam generation with 40 MW of power margin in GTs. Before project implementation, heat input with fuel to CPP was 948.6 MM kCal/hr. After implementing optimizer results for load adjustment amongst GTs, heat input was reduced to 947.5 MMkcal/hr, resulting in net savings of 1.09 MM kCal/hr equivalent to Rs. 45 lakhs/yr.

Implementation

The project was implemented in December 2004.

Optimization Flow Sheet



2) LLP Flare Gas Recovery

Background

Flaring from refineries has been under constant pressure due to environmental regulations and the need to recover valuable hydrocarbons which are otherwise burnt. Delayed Coker is one of the major sources of flaring in a refinery.

Coking operation is a semi batch process which involves various sequential activities between coking and coke cutting cycle. Each pair of Coke drums are switched online and offline after filling cycle of 16hrs. Filled Coke Drum is first cooled by steaming. During the steaming step, hydrocarbon from the filled coke drum is routed to the Blowdown Recovery tower. Heavier hydrocarbons are recovered in this Blowdown tower but the lighter fraction (non condensable) from the blowdown system is routed to Flare (Low Pressure Flare system).

Reliance has recently commissioned an in house designed flare gas recovery system (FGRS) that helps recovering these hydrocarbons from the blowdown system .The flare gas from the blowdown system is collected at the common flare knock out drum from where the gases are recovered with the help of ejectors. The ejector system is a combination of four steam ejectors of equal capacity in parallel. Medium pressure steam is used as a motive fluid and the flare gas is routed to the main fractionator overhead condenser receiver vessel after cooling. Since this is an intermittent operation, 3 steam ejectors are switched in services during the flare gas recovery operation only (to conserve energy).

This Flare gas recovery system is one of its kind in the world. Foster Wheeler Corporation (Process licensor for the Coker unit) audited this system.

Observations:

Around 44 T/day of hydrocarbon flare gases are recovered by the recovery system Apart from the reduction of flaring from Coker, the following minor changes were observed in the plant:

- Marginal increase in Gas plant compressor power to accommodate additional flare gas.
- Increase in fuel gas yield.
- Increase in H₂S in Rich amine.
- Increase in sour water generation from fractionator overhead condenser.

Technical & Financial Analysis:

Due to this system, flaring of hydrocarbons from Coker plant has reduced by 95.4%.There was also a reduction of SO_x levels in the flared gas by 95%.

Economic benefit = Rs. 15.75 crores/yr.

Implementation:

The above changes were implemented in October 2004.

Figure:

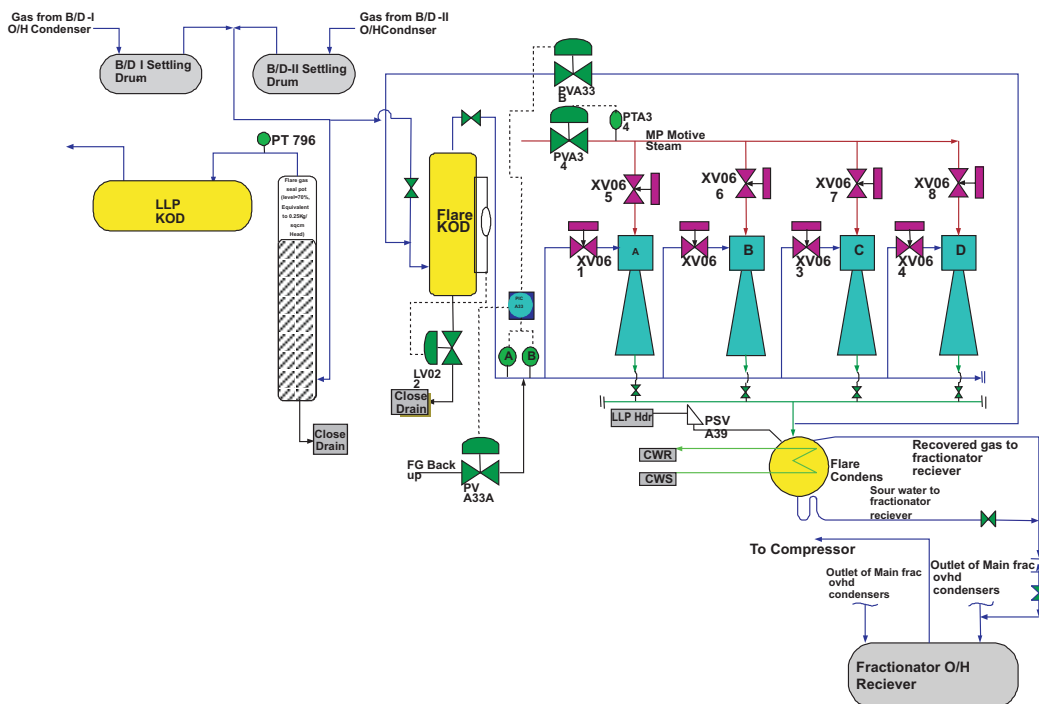
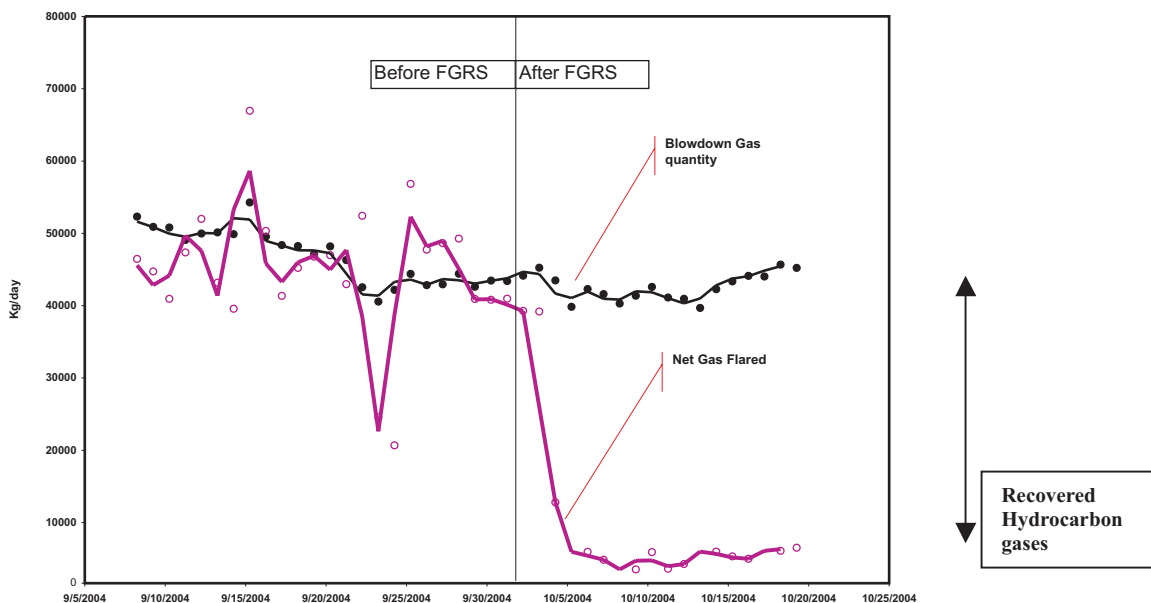


Figure: LLP Flare Gas Recovery System Schematic.



Photographs of LLP Flare Gas Recovery System in Coker Plant:

Energy Conservation Plans and Targets

Reliance Jamnagar aims/plans to become the pace setter and world leader in respect of Energy Conservation and Management in the refining sector. The List of Planned projects is shown under:

| S.No. | Energy Conservation Measures (Planned) | Anticipated savings in | | Approx. investment (Rs.lakhs) |
|-------|---|----------------------------|---------------|-------------------------------|
| | | Energy Value (kTSRF/annum) | Rs. Lakhs | |
| 1 | Heat Recovery from HK product when routed to storage | 7.9 | 672 | 288 |
| 2 | Installation of 2nd Effluent Desalter-Wash water exchanger | 2.8 | 240 | 240 |
| 3 | Increase in Preheat temperature from 241 DegC to 266 Deg C by Heat recovery from VGO product stream | 21.16 | 1800 | 1680 |
| 4 | Preheating CPP Deaerator make-up by Condensate return from Sulphur & Crude Units. | 12.37 | 1051.73 | 1308 |
| 5 | Heat recovery from New plate-frame type exchanger Rich /lean Amine Exchanger in one train of ATU | 4.27 | 362.9 | 235.2 |
| 6 | Acid gas flare recovery | 2.77 | 235.2 | 243.84 |
| | Total | 51.29 | 4361.8 | 3995 |

Ultimate Target

The ultimate target is to achieve lowest energy consumption per barrel of Crude oil feed stock processed.

- To achieve Solomon International Energy Intensity Index of 55 or lower.
- To achieve Shell Corrected Energy and Loss Index of 80 or lower.

Environment and Safety

At Reliance Jamnagar, clean environment for sustainable development is of prime concern, and is an important business objective, achieved by every employee's contribution and responsibility towards environmental performance.

Reliance Jamnagar is committed to the protection of environment. The design of state of the art effluent treatment plant, low NOX burners in Furnaces and zero liquid effluent discharge ensure the safety of the environment. Treated sewage, industrial effluent and stack emissions are extensively monitored to ensure

no harm is done to the environment. Reliance is committed to transform the arid land in and around the complex into a lush green belt. Following are the major improvements achieved during 2000-2003.

- ✓ Reduction in Emission of CO₂ (Tons/Kilotons of Crude processed) to 10.25
- ✓ Planting of 4.0 million trees in and around the complex has already been done till 2004 which includes planting of 25,000 Nos of additional Trees during last year.
- ✓ Reduction of plastic cup consumption from 5.1 Lakhs cup (In 2000) per month to 3.2 Lakh (2003) per month
- ✓ Construction of landfill facility for the disposal of hazardous waste

The Jamnagar refinery complex is certified as ISO-14000 company conforming the Environmental Management System. State pollution control board has given rebate in the water Cess consecutively for the past three years.

Commitment to Safety is of paramount importance at Reliance. New work permit procedures developed are being consistently followed in Jamnagar. The new procedure provide for more checks and responsibility according to the hazard potential of each activity.

The British Safety Council conducted a Safety and Health Management audit at Jamnagar and awarded the highest Five Star rating to the site.

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HALDIA REFINERY- INDIAN OIL CORPORATION LIMITED Haldia (West Bengal)

Unit Profile

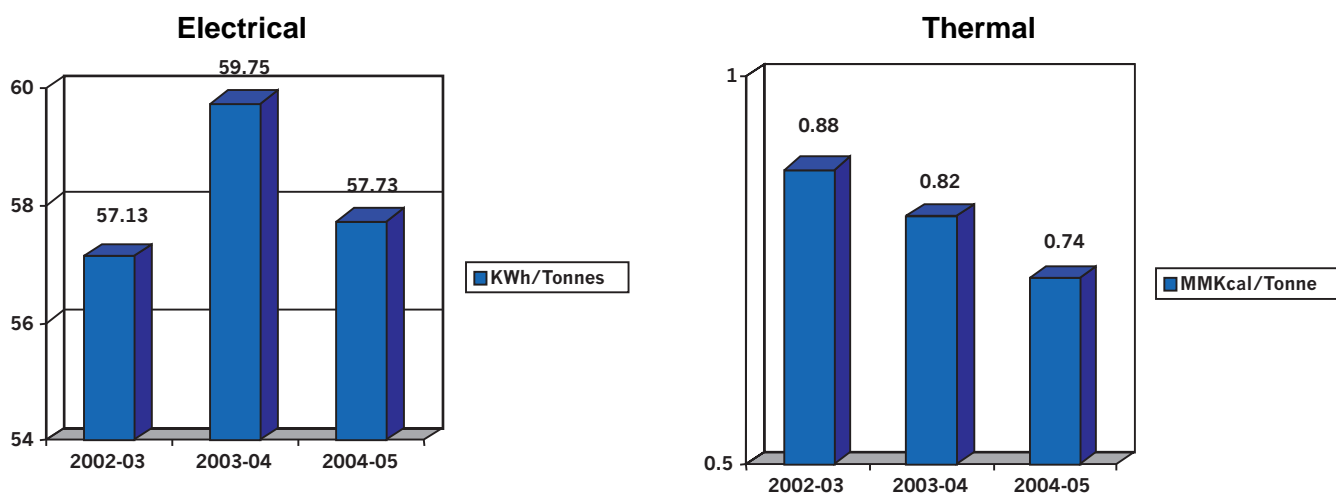
Haldia Refinery is the fourth in the chain of Seven refineries owned and operated by Indian Oil Corporation Limited, the largest commercial enterprise in the country and the leading Indian company in the “Fortune Global 500” listing of the world’s largest corporations.

Haldia Refinery was commissioned in January 1975 with an initial crude processing capacity of 2.5 Million Tonnes per Annum (MMTPA); the capacity was progressively increased to a level of 3.6 MMTPA through low-cost debottlenecking and innovative technology. A new crude distillation unit with a capacity of 1.0 MMTPA was installed and commissioned in March, 1997 for processing of low Sulphur imported crude to generated low sulphur internal fuel oil for burning in process furnaces/ TPS boilers for reducing SO2 emission; capacity of New Crude Distillation Unit was also progressively increased to a level of 2.4 MM TPA through low-cost debottlenecking. Thus, the total installed capacity of the refinery is currently 6.0 MMTPA. Apart from normal fuel distillates like, LPG, MS, ATF, SKO, HSD etc. Haldia Refinery also produces the high valued Russian Turbine fuel (RTF) for use in fighter plane (MIG) & Lube oil base stock (LOBS).

Energy Consumption

The Energy Scenario of Haldia Refinery in the past three years is given below:

| DESCRIPTION | UNIT | 2002 - 03 | 2003 - 04 | 2004 - 05 |
|--|---------------|-----------|-----------|-----------|
| Annual Product Processing Rate | MT | 4060976 | 4067040 | 4935347 |
| Total Electrical Energy Consumption / annum | Lakhs KWh | 2320 | 2430 | 2849 |
| Specific Energy Consumption - Electrical | KWh/Tonne | 57.13 | 59.75 | 57.73 |
| Total Thermal Energy Consumption / annum | MMKcal | 3556162 | 3315534 | 3632066 |
| Specific Energy Consumption – Thermal | MMKcal/ Tonne | 0.88 | 0.82 | 0.74 |
| Total Manufacturing Cost | Rs. in Lakhs | 535083.00 | 543061.00 | 815486.00 |
| Total Energy Cost | Rs. in Lakhs | 41930.52 | 39149.54 | 46161.67 |
| Energy Cost as %age of Total Manufacturing Cost. | % | 7.94 | 7.19 | 5.66 |



Specific Energy Consumption Over 2002-2003

Energy Conservation Commitment, Policy and Setup

Haldia Refinery has always accorded top-most priority for energy conservation and a dedicated Energy Conservation and Technical Audit Cell has been set up in the Refinery right from the time of commissioning of the Refinery. This cell is headed by a Chief Technical Services Manager and includes Energy Manager and experienced chemical engineer for monitoring, reviewing the refinery operations and implementing energy conservation measures in the refinery.

The engineers from Encon/TA cell review the energy consumption on a daily basis after visit to the various major energy consuming centers. These are discussed in the daily review meeting conducted in the Refinery Shift Manager's office (called RSM meeting) under the chairmanship of General Manager (Technical).

Based on regular monitoring and periodical survey of the energy performance of the various process units, Thermal Power Station (TPS), heaters, heat exchangers etc., areas for further improvement in the energy efficiency are identified and are studied in details either through in-house efforts or external consultants. The outcome of these studies are discussed and reviewed with all the concerned departments before actually implementing the scheme.

Routine survey are carried out with regard to steam leaks, insulation effectiveness, HC loss survey (with Physical Acoustic Leak Detector, Fugitive Emission by GMI surveyors, product loading / despatch operations, energy balance etc. to identify potential areas of improvement.

Specialized studies are carried out through reputed process/energy consultants to compare the energy performance with the best practices adopted worldwide and new opportunities for energy conservation are explored/identified. The outcome of these studies are reviewed and analyzed in details at various levels and energy conservation measures that are practicable / feasible are implemented at the earliest opportunity. Monthly energy performance of the Refinery vis-à-vis the targets are discussed in details in the Monthly Refinery Performance Review Meeting chaired by the Executive Director.

Energy Conservation Achievements

Haldia Refinery has incorporated and implemented number of major energy conservation measures based on in house studies and studies by reputed external consultants. Some of major energy conservation schemes implemented during the recent past by the refinery are given below:

- o Installation of 20 MW Co-generation Gas Turbine along with Heat Recovery Steam Generator (HRSG) with additional auxiliary gas firing facility.
- o Reduction in Steam consumption of Main Air Blower in FCCU.
- o Calcium Silicate Insulation in MP/LP steam header - Phase-II.
- o Installation of high efficiency furnace in Lube Hydro-finishing unit.
- o MP Steam condensate recovery in FCCU (Naphtha Splitter Reboiler).
- o Condensate recovery from TG Condensate pumps seal flushing line.
- o Installation of Balance Pressure Thermostatic Traps (BPT) in copper tube steam tracing line.
- o Control valves related to flare upgraded to higher-class valves.
- o Provision of fuel gas firing facility in Furfural Extraction unit furnace.
- o Improvement of VDU-II furnace efficiency through in-house modification.
- o Sick wagon unloading facility.
- o Replacement of Motor driven pump with Turbo-driven.
- o Provision of Insulation for tanks in 700 tank farms.
- o Provision of High Efficiency and High Capacity Centrifugal Air Compressor.
- o Reduction of HRSG Stack temperature through Optimization of HRSG Deareator Operation.
- o Single FD fan operation in VDU-II.
- o Calcium Silicate insulation in MP & LP steam header - Phase – III.
- o Ceramic Fibre Insulation in VDU-I Furnace – 31-F-01.
- o Installation of Mechanical trap(Float type) in steam outlet line of Boiler IV Steam coil Air preheater.
- o Installation of Flash Vessel in 11E111 (CDU-I Add. Naphtha Stabilizer reboiler) condensate line to recover MP steam condensate (1.5 MT/hr).

Total investment planned vis-à-vis energy saving targets are given as under:

| ENCON Projects | Investment in (Lakhs) | Energy Savings in FO MT/annum |
|--|-----------------------|-------------------------------|
| Under implementation & future Projection | 12646.20 | 25953 |

Encon Project Implemented in the year 2004 – 2005

1. Provision of Hot Insulation on tanks in 700 tank farm

Storage tanks for intermediate products like RCO, SR, Heavy extract, Dewaxed oil, light Vacuum gas oil, Asphalt and IFO are located in 700 tank farm. The respective intermediate products are fed to different process units for further processing / usage. As per original design, the above-mentioned tanks, storing intermediate products at higher temperature, were made of bare metal (i.e. without external insulation). This led to continuous heat loss (both by convection and radiation) from the tank surfaces to atmosphere.

Nine nos. of above said tanks were insulated using mineral wool mattress in running condition by clamping MS Strips (with pre-welded lugs) on the tank body. The job was completed in **May-2004** at a total cost of Rs. 59.00 Lakhs.

Benefits :

| | | |
|------------------------|---|------------------------|
| Savings in Heat energy | : | 4.4 MMKcal/hr |
| Savings in IFO | : | 4000 MT / annum |
| Financial Benefit | : | Rs. 3.93 crores/annum. |



700 Tank Farm – After Insulation

2. Provision of High Efficiency and High Capacity Centrifugal Air Compressor.

In TPS as per original design 5 nos. of Reciprocating Air compressor were installed to supply Instrument Air and Service Air to different process units. Out of these five compressors, four compressors are of capacity 1500 Nm³/hr and one is of capacity 1900 Nm³/hr. The specific power consumption of these compressors are very high i.e. in the range of 14-15 kW/100 Nm³/hr of air. As these compressors are very old, maintenance cost of these compressors are also very high. On an average the maintenance expenditure is around 15-16 lakhs/annum. The total air requirement (both instrument and service) is around 4500 to 5000 Nm³/hr. If any one of the air compressor trips, air pressure comes down rapidly.

To sort out the operational constraint and to improve the air compressor efficiency High Efficiency and high capacity Centrifugal Air Compressor was installed in TPS in **April 2004**. The specific power consumption of Centrifugal Air Compressor is around 10-11 kW/100 Nm³/hr as compared to 15-16 kW/100 Nm³/hr of Reciprocating compressor.

Benefits :

| | | |
|---|---|--------------------|
| Power savings due to high efficiency compressor | : | 1680 MW/annum |
| Savings in reduction of maintenance cost | : | 9.15 Lakhs/annum |
| Total savings | : | 42.75 Lakhs/annum. |



New Centrifugal Air Compressor

3. Reduction of HRSG Stack temperature and Optimization of HRSG Deareator Operation.

A test run was conducted in GT HRSG, with an objective to reduce the HRSG stack temperature, which was at a level of 173°C, by reducing Deareator pressure. The Deareator pressure was gradually reduced to 1.0 kg/cm² from 2.4 kg/cm². At this pressure, deareator temperature reduced to 118°C from 137°C. The LP steam injection rate to deareator, reduced to 11.05MT/hr from 13.65 MT/hr and HRSG stack temperature reduced to 163°C from 173°C. Based on the test run report the HRSG operating pressure is being maintained at 1.0 kg/cm², from **May, 2004** which leads to following benefits:

Benefits :

| | |
|---|------------------------|
| Reduction in LP Steam Reduction to Deareator: | 2.6 – 3.6 Tons/annum |
| Financial Benefits | :1.70–2.35Crores/annum |

4. Installation of Flash Vessel in 11E111 (CDU-I Add. Naphtha Stabilizer reboiler) condensate line to recover MP steam condensate (1.5 MT/hr)

In CDU-I additional stabilizer column reboiler, provision was there to route MP steam condensate directly to desalter water vessel (11-B-03) through a steam trap. Due to high pressure of the condensate, tremendous hammering / bubbling was experienced in the vessel. To avoid this problem, condensate was being directly drained to the open system.

In order to recover this valuable condensate, a LP steam flash vessel was installed in CDU-I on **July 2004**, with a facility to route condensate to LP condensate header and flash steam to LP steam header.

Benefits :

MP Condensate Recovery : 1.5 – 2.0 tons/hr
 Financial Benefit : 75.00 Lakhs / annum



Flash Vessel

5. Calcium Silicate insulation in MP & LP steam header - Phase – III

The mineral wool insulation (LRB mattress) of the MP / LP steam header of offsite area was replaced with Calcium silicate insulation in phased manner. In calendar year 2004, the MP / LP steam header of offsite area from LOB block to TPS was provided with Calcium silicate insulation. This project was completed on **November 2004**.

Benefit :

Savings in IFO consumption : 560 MT /annum
 Financial Benefits : 56.00 Lakhs/annum.



Calcium Silicate Insulation Over Steam Header

6. Single FD fan operation in VDU-II.

As per original design, VDU-II furnace (Absorbed heat duty: 37.9 MMKcal) is provided with one (1) ID Fan and two (2) FD Fan for supplying combustion air under balanced draft condition. Since commissioning two (2) FD fans used to run in parallel, which leads to extra power consumption of around 295 MW/annum, which equivalent to Rs. 10 lakhs/annum.

On verifying the design of FD fans, it has been observed that one FD fan of the furnace is very much capable to supply 67,000 Nm³/hr of air at 100% load, where as the maximum air demand even at design throughput is around 42,000 Nm³/hr. Considering this fact, a trial run of the furnace was conducted with single FD fan in line at different throughputs. During the test run with single FD fan, fired heater operation was very smooth and trouble free. Based on the test run report, single FD fan operation was implemented in VDU-II from **June 2004**, with the following benefits:

Benefits :

| | | |
|------------------------------|---|------------------------|
| Savings in Power Consumption | : | 295 MW / annum |
| Financial Benefit | : | Rs. 10.00 Lakhs/annum. |

7. Ceramic Fibre Insulation in VDU-I Furnace – 31-F-01

Old castable refractory of VDU-I was replaced with Ceramic fibre insulation in February'05. This modification reduced the furnace wall temperature from 154 °C to 60 °C. Due to reduction in furnace wall temperature, setting loss of furnaces is reduced to 3.9% from a level of 6.5%.

Benefits :

| | | |
|----------------------------|---|-------------------|
| Reduction in Heat Loss | : | 645095 kcal/hr |
| Savings in IFO consumption | : | 527 MT/annum |
| Financial Benefits | : | 52.00 Lakhs/annum |



Ceramic Insulation Inside 31-F-01 Furnace

8. Installation of Mechanical trap(Float type) in steam outlet line of Boiler IV Steam coil Air preheater

To reduce the steam consumption in Boiler IV Steam Coil Air Preheater and to prevent live steam going to Atmospheric Condensate Flash Vessel, Mechanical trap(Float type) was installed in steam outlet line of Boiler IV Steam coil Air preheater.

Benefits :

| | | |
|--------------------------------|---|------------------------------------|
| Reduction in Steam Consumption | : | 1.70 Tons/hr [13600.00 Tons/annum] |
| Financial Benefits | : | 45.00 Lakhs |



Float Type Steam Trap in Boiler IV SCAP Outlet Line

Energy conservation Plan & Target

Refinery has time bound action plans to further bring down energy consumption and hydrocarbon loss from present level of operation. Some of the major schemes under implementation / planned are as under:

- o Upgrading FG control valve from Type IV to Type V.
- o Replacement of old Reciprocating Air Compressor with High Efficiency Compressor.
- o Pre-heat improvement in CDU-I.
- o Pre-heat improvement in CDU-II.
- o Pinch modification in the preheat circuit of Kerosene Hydro-Desulphurization Unit.
- o Ceramic insulation in PDA Heater.
- o Ceramic insulation in FEU Heater.
- o Heat recovery from VDU-II Tempered Water System.
- o Installation of Packinox Heat Exchanger in CRU.

- o Waste Heat recovery from KHDS furnace (23-F-01).
- o Calcium Silicate Insulation in MP & LP Steam header of Offsite Area (Phase-IV).
- o Efficiency improvement in PDA Heater (32-F-01).
- o Efficiency improvement in VBU Heater (37-F-01).
- o Liquid Ring Vacuum Pump in place of 2nd stage ejector in VDU-I.
- o Installation of GT-II & HRSG.
- o Installation of Flare Gas Recovery System.

Environment and Safety

Haldia Refinery has always taken the lead to undertake environmental improvement programmes with respect to the liquid effluent, air emission and solid waste management. Haldia Refinery has well-established Environmental Management System certified under ISO-14001. An investment of around Rs. 750 Crore has been made by Haldia Refinery towards environmental improvement. Haldia Refinery received Golden Peacock Environment Management Award given by World Environment Foundation, New Delhi during the year 1999 & 2000 (runners-up) and Indo-German Greentech Award for 2001 for outstanding achievement in the field of Environment management. Haldia Refinery also received the prestigious “ Millennium Business Award (2000) for Environmental Achievement” from International Chamber of Commerce, Paris.