Mangalore Refinery & Petrochemicals Limited, Mangalore

(A subsidiary of Oil and Natural Gas Corporation Limited)

Unit Profile

Mangalore Refinery and Petrochemicals Limited (MRPL) a subsidiary of Oil and Natural Gas Corporation Limited, is the Fourth Grass root Crude oil Refinery in Southern India and is certified ISO-9001: 2000 & ISO-14001 for its Quality and Environment systems. MRPL contributes to 8% of India's total Refining capacity and is located close to the ecologically sensitive western ghat region. MRPL is a state of the art refining complex and is a trendsetter among Indian Refineries. MRPL is the only refinery in India to process its own equity crude.

MRPL was commisioned in April'96 with a crude processing capacity of 3.69 MMTPA. Subsequently the Refining capacity was increased to 9.69 MMTPA with the commissioning 2nd phase of 6 MMTPA capacity in Nov'99.
Major Secondary processing units consist of state of the art Hydro-cracker unit with total conversion, CCR unit that produces high octane unleaded Petrol. Further the Refinery has Gas Oil Hydro-desuphurisation unit to produce Ultra-low sulphur Diesel, Sulphur Recovery unit with Claus and Selectox process with 99.9 % recovery to minimise emissions.

In the year 2004-2005, the Refinery has achieved the highest ever crude throughput of 11.8 MMTPA with 120% capacity utilization and has also achieved the lowest ever Energy Index of 64.77 ***MBTU/Bbl/NRGF (CHT)*** among Indian Refineries. The Refinery has been awarded "Five Star Health and Safety Management Audit System" rating by British Safety council, U.K. this year.

An overview of MRPL complex

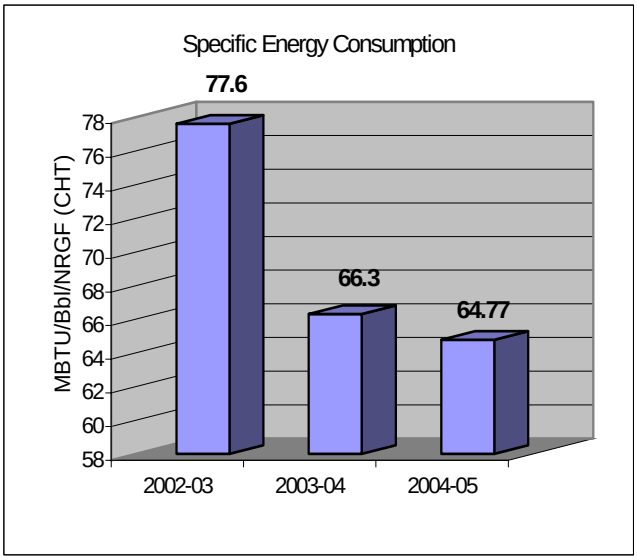
MRPL is putting up additional treatment units to meet the Gasoline standards as per BS-II / EURO-III standards. Further to improve the Refinery gross margin, to produce value-added products and to achieve distillate yields at par with international levels, MRPL is contemplating to install residue-upgrading units.
Also MRPL has plans for setting up an Aromatic complex, Linear alkyl Benzene (LAB) plant as a diversification into Petrochemicals.

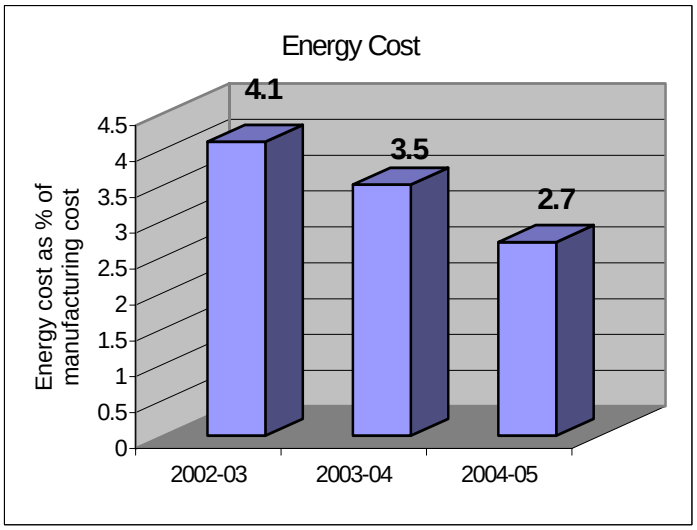
Energy Consumption

Energy conservation is accorded the highest priority in MRPL. MRPL inaddition to operating the refinery units energy efficiently at more than their design capacities has implemented several energy conservation measures. These have resulted in substantial reduction in Electrical and Thermal energy consumed.

Year	Sp. Energy Consumption		% Reduction over 2002-03	
	Electrical Energy KWH/tonne	Thermal Energy Fuel /MT of Crude	Electrical Energy KWH/tonne	Thermal Energy Fuel /MT of Crude
2002-2003	63.82	0.0768	---	---
2003-2004	54.12	0.0691	15.2 %	10.026 %
2004-2005	49.43	0.0653	22.5 %	14.974 %

Due to consistent efforts and implementation of various Energy conservation measures, MRPL has achieved the lowest Energy Index of 64.77 MBTU/Bbl/NRGF(CHT), 81.69 MBTU/Bbl/NRGF(Thomson), among Indian Refineries for 2004-2005. Energy conservation measures have resulted in reduction of Energy cost to 2.7% of





manufacturing cost. Cost savings to MRPL due to fuel conserved is the tune to Rs.37.76 Crores in 2004-2005.

Energy Conservation Commitment, Policy and Organisational setup

Energy conservation is given the highest priority in MRPL. The major fuel consumed in the Refinery is LSHS. Inaddition, the Refinery uses non-condensable fuel gas and off gases as fuel. Energy consumption is given a two-pronged approach in MRPL. The first is to minimise losses by reducing flaring, operating at optimum Hydrogen/HC ratio and achieving higher than design throughputs. The second approach is to implement Energy conservation projects identified by in-house audits.

Inorder to achieve Energy conservation, we are setting energy targets for all the major Refinery units in terms of SRFT. This is monitored daily and necessary action is taken to reduce Energy consumption to set target levels. These activities are initiated and monitored by an Energy conservation (ENCON) cell.

Major Energy conservation activities carried out by ENCON cell are detailed below:

a. Monitoring of Fuel consumption, furnace performance, utility consumption, flaring and other losses on a daily basis.
b. Setting target energy consumption figures (in terms of SRFT) for all major units based on unit's best operating data and monitoring the same on a daily, monthly basis.
c. Suggesting measures to conserve energy to bring down the unit energy consumption to set target levels.
d. Study various Energy conservation possibilities and co-ordinate in their implementation.
e. Reporting the Energy performance of the units to the staff accountable for Energy consumption and to the senior management.
f. Identifying cost-effective opportunities for increasing Energy efficiency either in new or existing plants.
g. Creating and maintaining Energy consciousness throughout the Organisation.

MRPLs commitment to Energy conservation is reflected in the management setting up an ENCON cell for this purpose. The ENCON cell has three expereinced engineers (two chemical & one mechanical) who are in-charge of energy conservation in Process plants, Target setting & resource conservation and energy conservation in Powerplant & Utilities respectively. They report to Manger (ENCON) who in turn reports to GM (PE). Energy consumption is reviewed at the Vice-president (TS) level on a daily basis and by the Associate President (Refinery) and Chairman & Managing Director on a monthly basis.

Energy Conservation Achievements

MRPL has invested more than Rs.140 Lakhs towards Energy conservation projects during the period 2002-2005 in addition to various Energy conservation measures, which has paid rich dividends. The Specific Energy consumption of the Refinery in terms of MBTU/Bbl/NRGF (CHT) has come down from 77.6 in 2002-2003 to 64.77 in 2004-2005, which is the lowest among public sector refineries. MRPL has achieved a reduction of 22.5% in specific electrical energy consumption and 14.974 % reduction in specific thermal energy consumption. MRPL is recycling more than 70% of the treated effluent as makeup water to cooling towers. Fuel cost for the year 2004-2005 has come down by Rs.3776 Lakhs.

In recognition of its energy conservation measures, MRPL has received the following awards:

- Jawaharlal Nehru Energy conservation award 2003-04 under group-1.
- National Energy conservation award, 2001 – Certificate of Merit
- Oil conservation award , 2001-2002 - Medium projects category
- Second prize in the 14th Oil and Gas Conservation Fortnight awards 2004 in Furnace/Boiler efficiency category -2 (total heat duty more than 400 MMKCal/Hr).

Energy conservation projects

1. Advanced Process Control system in Crude Distillation Unit Phase-1 was implemented for yield improvement and energy conservation. The benefits of the same being studied

2. Excess Hydrocracker unit Low-pressure separator off-gas routed to Hydrogen plant feed.

Hydrocracker unit low-pressure separator off gas which was in excess was used as recycle H2 for H2 unit. Thus it reduced total make up H2 production demand. Proportionate amount of fuel was saved by this, which is in the order of 174 lakhs, for which no investment cost is involved.

3. Routing Hot Diesel from CDU directly to GOHDS for BFW preheating and LP steam generation.

Hot Diesel routed directly from Crude unit. This de-bottlenecked the feed bottoms exchanger in GOHDS.
BFW pre-heater and Steam generator installed in GOHDS unit. This scheme produces 7 MT/Hr LP steam and is exported to the steam network.

Investment = Rs. 30 Lakhs.
Steam production = 7 MT/Hr at full load.
Fuel saved in CPP = 0.15 MT/Hr LSHS.
= 1200 MT/Year.
Annual savings = Rs.98.4 Lakhs.
Pay back in 4 months.

4. Energy saving transformer for Plant lighting.

Energy saving transformer was installed in two major major units i.e. Crude unit and Hydrocracker unit for plant lighting. This has reduced power consumption by 20 %

Investment = Rs. 4.46 Lakhs.
Electrical savings = Rs. 27 Lakhs/annum.

Pay back in 2 months.

5. Heavy Flushing oil jump over in Crude distillation unit-1

A process scheme was issued to directly route the HVGO stream to the heavy flushing oil header bypassing the vessel and the pump. The scheme was implemented at a cost of Rs.8.34 Lakhs. This resulted in stoppage of the pump. The Electrical power saved was approximately 65 KWH. The approximate cost saving due to this scheme is Rs.11.7 Lakhs/Year, paying back in less than 9 months.

6. Reflux optimisation in Naphtha splitter unit-2

The column reflux ratio R/D was reduced from 1.0 and optimised by using simulation studies at 0.54. By operating at a lower R/D ratio there is energy saving to the tune of 4.3 MMKcal/Hr. This results in saving of Rs.3.25 Crores/annum.

7. Steam Optimisation in Crude distillation unit-2 Ejectors

Ejector Optimisation was carried out to optimize the column top pressure so as maximize distillate yield and to minimize MP steam consumption by different combination of ejectors.

At present only 3 out of 9 ejectors are on line. Net savings in MP steam is 11 MT/Hr. The annual savings is Rs.5.4 Crores.

8. Interconnection of Process de-aerator's condensate and BFW

By interconnecting condensate and BFW lines, 45 KWH electrical power could be saved. In addition recovered condensate wastage was avoided. The necessary piping modifications were carried out at a cost of Rs. 1.0 Lakhs. This scheme resulted in 45 KWH electrical power saving amounting to Rs.12.2 Lakhs/annum paying back in less than 2 months.

9. Rain water Harvesting

Rainwater harvesting facilities were installed in MRPL's tankage area. Water to the tune of 250 m3/Hr is recovered.

Water harvested = 24,95,520 m3/Year.
Power saved = 4.4 Lakh KwH/Year

Investment made = Rs. 57 Lakhs/Year.
Savings achieved = Rs. 64 Lakhs/year

Energy conservation plans and Targets

Continuing our focus towards high priority area of Energy conservation, MRPL has plans to benchmark its energy performance with the best-operated refineries worldwide. To further conserve the energy and non-renewable resources MRPL is planning to implement the following projects in 2005-2006:

1. Implementation of Advances Process control in Crude unit phase-2.
2. Implementation of Variable speed drives (VSD) in many refinery drives.
3. Routing of Amine flash column hydrocarbon vapors to Sulphur recovery unit incinerator.
4. Interconnecting Hydrocracker stabilisers for avoiding LPG flaring during compressor maintenance.
5. Hydrocracker unit stabiliser revamp for recovering LPG recovery.

The fuel savings by implementing the above schemes is 13,720 MT/Year.

1. Advanced Process Control system in Crude Distillation Unit Phase-1 was implemented for yield improvement and energy conservation. The benefits of the same being studied
2. **Excess Hydrocracker unit Low-pressure separator off-gas routed to Hydrogen plant feed.**
   Hydrocracker unit low-pressure separator off gas which was in excess was used as recycle H2 for H2 unit.

   Thus it reduced total make up H2 production demand. Proportionate amount of fuel was saved by this, which

   is in the order of 174 lakhs, for which no investment cost is involved

3. **Routing Hot Diesel from Crude unit to Gasoil Hydrotreater for BFW heating and LP steam generation**
   Crude unit produces Diesel blending components, Heavy Gasoil (HGO) and Light Gasoil (LGO), which are routed to Gasoil Hydrotreater (GOHDS) for treatment to produce low sulphur Diesel. It was observed that these streams are getting cooled in finfan coolers from 100°C to 40°C and routed to GOHDS unit. In GOHDS unit, these cold streams are getting heated to 120°C using feed bottoms heat exchanger.
   Upon routing HGO, LGO hot to GOHDS, the Feed-Bottoms exchanger in GOHDS gets de-bottlenecked and that heat can be utilised to preheat Boiler feed water (BFW) and produce LP steam.
   Simulation studies carried out in-house revealed that this heat could be utilised to produce 6.7 MT/Hr, LP steam. By producing steam from waste heat, the Captive power plant steam export comes down resulting in saving of 0.15 MT/Hr LSHS. This will result in savings of Rs.98.4 Lakhs/annum. However this required one BFW pre-heater and one kettle type steam generator. Also the lines carrying HGO, LGO for Crude unit had to be provided proper expansion loops and supports for carrying hot diesel.

   One new exchanger was designed in-house for BFW pre-heating and a redundant Kettle type steam generator was relocated for the new service. All lines carrying cold Diesel streams were provided with proper supports and expansion loops to carry Hot diesel. All associated piping together with the above modifications were completed at Rs.30 Lakhs. The scheme was commissioned in 2003-2004 and produces around 7 MT/Hr of LP steam at full load that is exported to the Refinery steam network. Due to this there is fuel savings to the tune of 0.2 MT/Hr in power plant. This scheme has paid back in less than 4 months.

4. **Heavy flushing oil jump over in Crude unit phase-1**

   In the Crude distillation unit –1 heavy flushing oil (HVGO) is consumed for the black oil service pump seals and for the vacuum column level transmitters. The heavy flushing oil was being supplied to the header by adopting a vessel and a pump. A detailed technical investigation revealed that the same can be done by directly routing the HVGO stream to the Heavy flushing oil header with minor modification, while maintain the required heavy flushing oil header pressure and flow.

   A process scheme was issued to directly route the HVGO stream to the heavy flushing oil header bypassing the vessel and the pump. The scheme was implemented at a cost of Rs.8.34 Lakhs. This resulted in stoppage of the pump. The Electrical power saved was approximately 65 KWH. The approximate cost saving due to this scheme is Rs.11.7 Lakhs/Year, paying back in less than 9 months.

5. **Installation of Energy saving transformer for plant area, street lighting of Crude Distillation, Hydrocracker units**

   Energy saving transformer for plant lighting saves energy as per the following principle: The discharge lamp manufacturers list the rated or normal wattage on any given object wattage. This is the target wattage, which the lamp should dissipate, when operated under prescribed conditions. In normal practice, this marking of a rated wattage on any tube or lamp will dissipate in any circuit. The actual wattage will always be higher than the manufacturer's rated wattage and it depends mainly on the characteristics of the Ballast with which the particular lamp is operated on the mains supply voltage at any given time. Thus the saving can be achieved referred to the above by putting inductive impedance across the circuit in parallel with the load in such a manner as to reduce the current.
   By using this Energy saving transformer for plant lighting we can achieve about 20% reduction in power consumption. This was successfully installed in two major units i.e. Crude unit and Hydrocracker unit in MRPL. By this we have achieved a saving of about Rs.27Lakhs/annum. The investment for implementing this energy saving transformer is Rs.4.46 Lakhs.

6. Reflux Optimisation in Naphtha splitter unit – 2

In Crude unit-2, we are having a Naphtha splitter unit (NSU) that splits Naphtha into Light Naphtha and Heavy Naphtha fractions. The splitter has a design reflux ratio (R/D) of 2.5. Reflux ratio has a direct bearing on the energy consumed in the column. Increasing reflux will increase the reboiler as well as the over head condenser duty in a distillation column. NSU column can be operated with a R/D of less than 1.0. As we were having abnormal noise in one of the heater tube passes of the reboiler, we were not reducing the reflux ratio. A detailed analysis of the abnormal condition was carried out and rectified. This helped in reducing the column reflux ratio.

The column reflux ratio R/D was reduced from 1.0 and optimised by using simulation studies at 0.54. By operating at a lower R/D ratio there is energy saving to the tune of 4.3 MMKcal/Hr. This results in saving of Rs.3.25 Crores/annum.

7. Steam Optimisation in Crude distillation unit-2 Vacuum Ejectors

During the year 2002, in VDU-II normally 6 out of 9 ejectors were on line for which MP steam consumption was around 31 MT/hr and column top pressure was 37 mmHg.
Ejector optimization trial was carried out to optimize the column top pressure so as maximize distillate yield and to minimize MP steam consumption by manipulating different combination of ejectors. The optimum column top pressure is 30 mmHg for which maximum VGO and maximum yield of Vacuum diesel (increased by 1.5 wt%) was obtained. At present only 3 out of 9 ejectors are on line for which MP steam consumption is 20 MT/hr. Net savings in MP steam is 11 MT/hr. The annual benefit out of this savings is Rs.5.4 crores.

8. Interconnection of Process de-aerators' condensate and BFW

MRPL is having two crude distillation and other associated secondary processing units. The waste heat from these units is recovered by producing steam. Boiler feed water for this purpose is supplied by de-aerating condensate recovered from the process units topped up with fresh DM water. The individual phases are provided with Process de-aerators for this purpose. A detailed study was carried out for optimising the steam and power consumption by integrating the individual de-aerators' condensate and BFW. It was found that by interconnecting condensate and BFW lines, 45 KWH electrical power could be saved. In addition recovered condensate wastage can be avoided.

The necessary piping modifications were carried out at a cost of Rs. 1.0 Lakhs. This scheme resulted in 45 KWH electrical power saving amounting to Rs.12.2 Lakhs/annum paying back in less than 2 months.

9. Rainwater Harvesting

MRPL's fresh water makeup requirements are catered by pumping water from Nethravati river at a distance of 42 Kms from the Refinery. This involves substantial pumping cost. Mangalore receives around 3 - 4 M rain during the Southwest monsoon season. It was observed that in our tankage area there is a continuous rainwater stream flowing through the Refinery and subsequently to the sea during the monsoon period. This water flow continued upto December month due to spring water flow from the nearby forests. This rainwater could be harvested based on its quality and availability. The water quantity was measured during the monsoon and non-monsoon period and was found to be of the order of 250 m3/Hr. This water sample was analysed in National Institute of Technology, Suratkal and Central Marine & Fisheries Research Institute for drinking water parameters and found to be confirming to IS 10500:1991 standards. As the quantity of water is substantial and the quality of water is confirming to the drinking water standards, it was decided to harvest this rainwater. For harvesting this rain water infrastructure had to be installed in addition to the associated facilities.

A sump was constructed along the flow path of the stream, pumping and piping facilities were provided and instruments were installed for auto start and cutoff of the pump. These facilities were installed at a cost of Rs.57 Lakhs. This scheme was commissioned in 2003–2004. Water harvested from this source is routed to our raw water storage. In addition to saving 55 KWH of power, this reduces freshwater draw from the river.

Water recovered from this scheme is expected to be of the order of 24,95,520 M3, which is 50 % of the freshwater makeup from the river.