

Mangalore Refinery & Petrochemicals Limited, Mangalore

(A subsidiary of Oil and Natural Gas Corporation Limited)

Company Profile

Mangalore Refinery and Petrochemicals Limited (MRPL), a subsidiary of Oil and Natural Gas Corporation Limited, is a Grass root Crude oil Refinery located at Mangalore, a coastal city of Karnataka. The refinery is certified with ISO-9001: 2000 & ISO-14001 certifications for its Quality management and Environment management systems. MRPL contributes approximately 8% of India's total Refining capacity. MRPL's refinery complex consists of state-of-the-art facilities for crude distillation and secondary processing units. The refinery, with its predominant middle-distillates product focus, is a trendsetter among Indian Refineries with two Hydrocracker, two Catalytic Reforming & Light Naphtha Isomerization units.

MRPL's Phase-1 Refinery was commissioned during March 1996 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 during November 1999.



The major Secondary processing units consist of two Hydro-cracker units (total conversion), two Continuous Catalyst regenerator (CCR) type Reforming units (produces high octane unleaded Motor spirit), a Gas Oil Hydro-desulphurisation unit to produce Ultra-low sulphur Diesel, three numbers of Sulphur Recovery units with Claus and Selectox process for recovering 99 % of the Sulfur in crude thus minimizing emission of SO₂ to the atmosphere. New units like LN Isomerisation to produce ultra quality (Euro-III/IV) grade motor spirit, Mixed Xylene for value addition and CRMB (Crumb Rubber modified Bitumen) units were commissioned in 2006-07.

MRPL is currently implementing an ambitious Refinery expansion and Up-gradation project. Major units will be CDU-III, FCC, Delayed Coker, DHT. MRPL is also setting up an Aromatic complex in the 'Mangalore SEZ'.

Energy Consumption

Energy conservation is accorded the highest priority in MRPL by operating the refinery units at their optimum energy efficiency levels on a continuous basis & also by implementing several energy conservation measures. These have resulted in substantial reduction in Electrical and Thermal energy consumption.

In MRPL, the primary energy sources are low sulfur fuel oil (produced from bottoms of Vacuum Column of CDU & used in power plant & in process heaters), Fuel Gas (consisting of Hydrogen, CH₄, C₂H₆ etc produced in the refinery & used in refinery process heaters), Off gases (mainly consisting of CH₄ & C₂H₆, generated in crude, Vacuum & VBU units & consumed directly in the same units' process heaters) & Hydrogen PSA purge Gas (Consisting of Hydrogen, CH₄, CO & CO₂, directly consumed in the Hydrogen reformer).

Secondary energy sources of energy are Steam (3 levels: HP-40kg/cm², MP- 16kg/cm², LP - 4kg/cm²) & power (2 levels: MV -6600V, LV-430). They are generated in house in cogeneration power plant. Steam is also produced at process plant area by waste heat recovery.

	2005-06	2006-07	2007-08
Net Crude throughput, Million Tones/year	12.117	12.532	12.547
Energy, Electrical, Lakh KWH/year	5671	5828	6137
Sp Energy, Electrical, KWH/MT	46.80	46.50	48.91
Energy, thermal, Million Kcal/year	5018447.3	4926784.2	5354573.8
Sp Energy, thermal, Million Kcal/MT	0.414	0.393	0.427
Complexity	4.889	4.962	5.359
Energy Index, Kilo BTU/Barrel/complexity	64.4	63.13	61.55

It may be noted that, Specific electrical cons & specific thermal consumption is increased in the year 2007-08. This increase is due to inclusion of new units like ISOM & MXylene for cleaner fuels & for value addition, as can be seen by the complexity no (which derived based on CHT method). However the Energy index is reduced over the years.

The following table gives energy cost details:

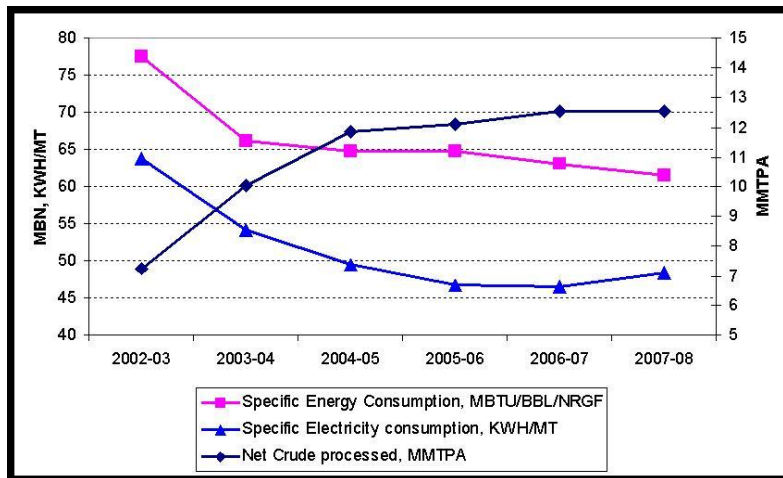
Electricity purchased, Million Rs	30.6	28.3	27.0
Electricity, Own Generation, Million Rs.	2537.6	2843.0	3524.3
Fuel Oil (excluding power portion), Million Rs	3467.4	3794.1	5089.8
Energy cost, Million Rs	6035.5	6665.5	8641.1
Manufacturing cost, Million Rs.	235600.4	276783.4	306321.3
Energy cost/Manufacturing cost, %	2.56	2.41	2.82

Energy Index of 61.55 MBN is the lower by 1.58, than the previous benchmark of 63.13 achieved by MRPL in 2006-07, which is lowest among Indian PSU refineries. MRPL has Bagged the First prize in Jawaharlal Nehru Energy Award in 2007, by CHT, under MoP&NG for the fourth

consecutive year for the lowest energy specific consumption. The major contribution for the reduction in MBN is from the Energy optimization & schemes implemented in 2007-08.

Total investment on Energy conservation	1.6 Crores
Total energy reduced	197804 MM K Cal
Gross Crude processed	12.53 MM TPA
Complexity factor	5.359
Reduction in Energy index	1.58 MBN
Total Cost savings/year	34.8 Crores

The following trend shows MRPL's performance



Energy Conservation Commitment, Policy and Organizational setup

MRPL is committed towards Energy conservation & optimization. At the design/project stage itself, Design features like Balanced draft furnaces, Flue gas analyzers, Draft Gauges, flue gas heat recovery systems, Heat exchanger trains for maximum heat recovery from hot streams, adequate heat insulations etc have been incorporated. Energy conservation is given a two-pronged approach. The first is to day-to-day optimization to minimize dynamic flaring, capacity utilization and process optimization. The second is by implementing Energy conservation projects identified in-house across various process units.

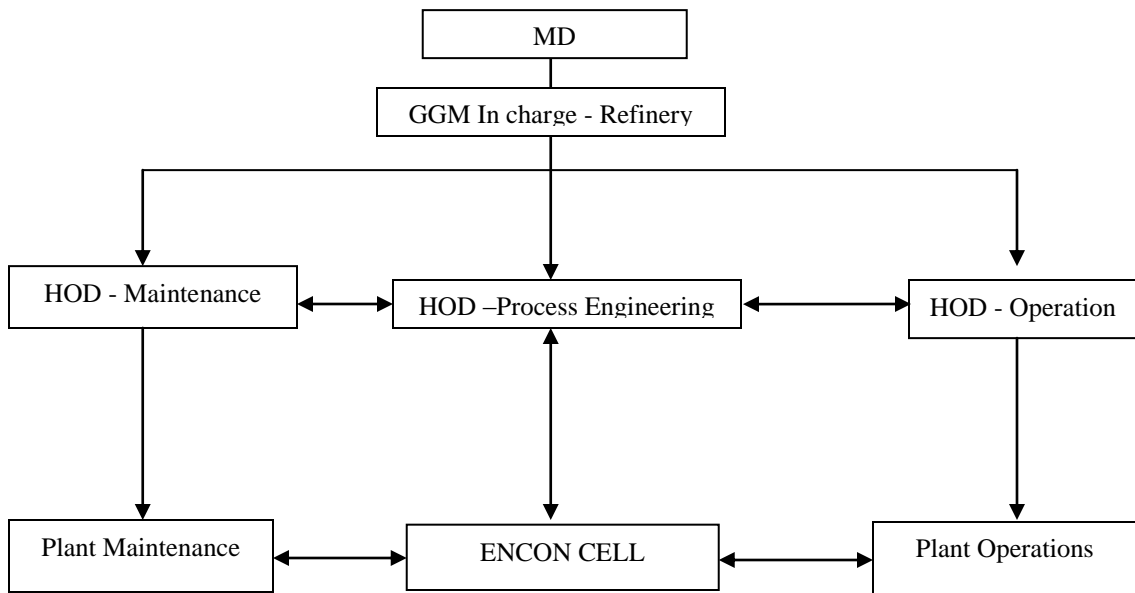


Energy Conservation is a part of the 'Vision- Mission' statement & 'Environmental Policy'.

An ENCON cell is established to monitor, control and optimize Energy consumption. Energy consumption report of entire refinery as well as individual unit is done daily & being reviewed in daily & monthly meetings at the level of Group General Manger. ENCON cell Monitors the plant performances in daily/monthly/quarterly/yearly wise. In addition to that, it identifies short & long-term projects / opportunities for Energy optimization & follows-up for implementation.

Any person in the company can suggest an opportunity. Respective unit process Engineer will prepare the scheme after studying the viabilities and will route it to design & Engineering after necessary clearances from operation department & Hazop study. Design & Engineering Department will prepare the entire drawing & will release for execution. Maintenance department will execute the project. Operations department will commission the project. Individual process personnel will monitor the savings.

The core setup for Energy conservation is as follows



Energy conservation Achievements

In recognition of its energy conservation performance and schemes, MRPL has won the following awards:

- Bagging the First prize in Jawaharlal Nehru Centenary Award for Energy performance in the year 2006-07 among Indian PSU Refineries. This is the fourth time in the row, as MRPL bagged the first prize for the years 2003-04, 04-05 & 2005-06.
- "Energy efficient Unit" award, by 'Confederation of Indian Industry' for consecutive two years for 2006-07 & for 2007-08.

- “Energy Conservation Award” by Karnataka Renewable Energy development Limited for consecutive two years for 2005-06 & for 2006-07.
- Three times Second prize in the Oil and Gas Conservation Fortnight awards in Furnace/Boiler efficiency category –2 (18th OGCF in Jan 2008, 16th OGCF in 2006, 14th OGCF in 2004)
- Oil conservation award, 2001-2002 - Medium projects category
- National Energy conservation award, 2001 – Certificate of Merit

Major Energy conservation schemes implemented in the year 2007-08

1 Condensate Recovery

Condensate recovery scheme is implemented in CPP for recover condensate from steam traps & to recover flash steam from SCAPH condensate.

Net Energy savings	:	3880 Million Kcal.
Net cost savings	:	66.9 Lakh Rs.
Investment	:	5 Lakh Rs.

2 Advanced Process control with Energy conservation objective

Advanced Process control being implemented in ph-2 Crude Distillation Unit with Energy conservation objective.

3 Furnace tube external surface on-line cleaning

Furnace tube external surface on-line cleaning was carried out at ph- 2 Crude Distillation Unit Vacuum heater by chemical spraying.

Energy Savings	:	9920 Million Kcal
Cost saving due to Energy reduction:		174 Lakh Rs.
VGO yield improvement	:	16848 MT
Cost saving due to higher yield	:	910 Lakh Rs.
Total cost savings	:	1084 Lakh Rs.
Investment	:	77 Lakh Rs.
Net savings	:	1007 Lakh Rs.

4 VOC emission Survey, Double seals & Gauge pole sock to reduce fugitive emission:

VOC emission Survey:

An elaborate VOC emission Survey was carried out in refinery to detect the leak and Repair. Almost 33000 points including Valves, flanges, seals etc were covered in the survey. Leaks were arrested to major extent & action plans were derived wherever necessary. Total investment – 4.3 Lakhs

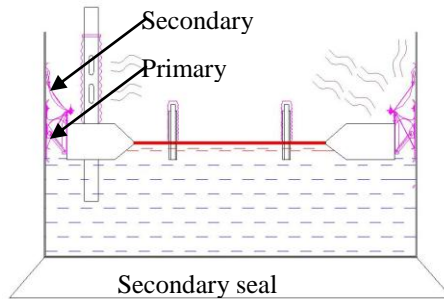
Double seals:

Secondary seals were installed in total 24 floating roof tanks. Expected 50% reduction in Fugitive emission through the seals. Total investment – 130 Lakh Rs.

Gauge pole socks:

Socks have been provided for the sample poles of 6 floating roof tanks. Expected 90% reduction in fugitive emission through the sample poles. Investment – 20 Lakh Rs.

If assumed a net quantity of 0.005% of crude fugitive emission through roof seals & sample poles & 15% reduction in this due to the above modification, then it results in net saving of 937.5 MKCal/year, which is worth of Rs.16.5 Lakh. Payback ~2 years.



5 Reduction Light reformat stream to optimize Hydrogen consumption :

Light reformat is one of the feed to ISOM unit. Optimizing this feed rate has resulted in reduction of hydrogen consumption (highly energy sensitive product). The details as follows:

Reduction in Lt.reformat	:	10 m3/h
Reduction in Hydrogen consumption:		58.5 Nm3/h
Net Energy Savings	:	18803 Million Kcal
Net Cost savings	:	330.6 Lakh Rs.
Investment	:	Nil

To be noted that the above saving due to reduction of hydrogen consumption alone. The other savings such as, reductions in power for compressing hydrogen etc. are not considered.

6 Optimizing ISOM unit running days as per product quality:

Instead of running at low throughput it is found that running at maximum throughput and shut down for remaining days is beneficial, the benefits are as follows:

Shutdown of the unit	:	22 days
Reduction in Hydrogen consumption:		4501.9 Nm3/h
Net Energy Savings	:	17025 Million Kcal
Net Cost savings	:	229.3 Lakh Rs.

To be noted that the above saving due to reduction of hydrogen consumption alone. The other savings such as, reductions in power for compressing hydrogen etc. are not considered.

Investment	:	Nil
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7 Optimizing CCR PSA loading to reduce Hydrogen loss:

The recovery of CCR PSA is ~ 85%. By routing a part of CCR Net gas to hydrogen header (bypassing the PSA), hydrogen header purity is optimized, resulted in precious hydrogen savings.

The benefits are as follows:

Total Net gas bypassed	:	4623.5 Nm ³ /h
Hydrogen savings due to bypass:		624.2 Nm ³ /h
Net Energy Savings	:	21037 Million Kcal
Net Cost savings	:	369.9 Lakh Rs
Investment	:	Nil

To be noted that the above saving due to hydrogen saving alone. The other savings such as, reductions in power for compressing Tail gas etc. are not considered.

8 Optimization of steam in ISOM

ISOM unit steam consumption contributes 70% of overall energy consumption in the unit. In order to reduce the steam consumption; stripper, depentanizer and stabilizer columns were optimized. The details as follows:

Reduction in MP steam	:	8.7 MT/h
Reduction in LP steam	:	4.8 MT/h
Energy Savings due to MP steam :		45789 Million Kcal
Energy Savings due to LP steam :		22550 Million Kcal
Cost savings due to MP steam :		805 Lakh Rs.
Cost savings due to LP steam :		396.4 Lakh Rs.
Net Energy Savings	:	68339 Million Kcal
Net Cost Savings	:	1201.5 Lakh Rs.

9 Steam savings by Trap management

A separate team is established within Maintenance group, for steam trap Management. Trap management is a committed maintenance service for regular monitoring of traps to reduce the steam loss in the refinery. 293 traps were replaced & 1238 spare traps reconditioned by internal parts replacement. The breakup of new traps replaced is as follows: Following are the statistics for the year 2007-08:

Traps	No	Remarks
Total surveyed	5,873	
Good	3,575	
Blocked	658	Rectified
Low Temp.	390	Rectified
Blowing	322	Reconditioned
Leaking	928	Reconditioned

Following is the list of traps replaced:

SI No	Description	nos	Rate, Rs	Value, Rs
1	BPT 21 3/4	50	5941	297050
2	MST 21	5	2000	10000
3	BPT 21 3/4	7	5941	41587
4	TD3 1/2 IBR sw	105	1501	157605
5	TD3 3/4 IBR sw	45	6397	287865

6	TD3 1/2 Flanged	6	1501	9006
7	Ball float	2	12930	25860
8	Ft20	8	25322	202576
9	TD62	65	10559	686335
	Total	293		1717884

Saving due to trap management is as follows:

Net Steam savings	:	68494 MT
Net Energy Savings	:	40055 Million Kcal
Net Cost Savings	:	704.2 Lakh Rs.
Total investment	:	17.2 Lakh Rs.

10 Solar powered traffic signal & lighting

Solar powered traffic signal & lighting of 11W each were installed in the company & in the township as follows:

Streetlights – 10 nos.

Garden lights – 5 nos.

Board lights – 5 nos.

Traffic blinker lights – 10 nos.

Total investment - 7.5 Lakhs

Neat savings – 1000 units of electricity /year



11 Continued Antifoulant to minimize heat exchanger fouling rate

Antifoulant injection was continued in Crude Distillation Unit-1 to minimize heat exchanger fouling rate particularly in in the case of Mumbai High.

Net Energy savings	:	12490 Million Kcal.
cost savings	:	219.6 Lakh Rs/year
Chemical cost	:	33 Lakh Rs.
Net cost savings	:	186.6 Lakh Rs/year

Energy Conservation Plans and Targets

MRPL has very clear vision towards the future. Future plans & Strategies are as follows -

- 1 Developing energy Auditors/Energy managers.
- 2 Implementation of action plans towards gap closure activities identified by Shell benchmarking Exercise will be followed up.
- 3 Participation in CHT activity committee meetings on Energy & Loss for sharing of ideas on Energy conservation & Loss minimization.
- 4 Participation in 'Oil & Gas Conservation Fortnight' January 2009. Participation in joint survey organized by Center for High Technology, under Ministry of Petroleum & Natural Gas. Conducting Energy conservation awareness campaign within refinery & township.
- 5 Participating in PCRA Energy activities/ Oil & Gas conservation fortnight.
- 7 Proposal, initiation, follow-up for implementation & monitoring the performance of new Energy conservation schemes.
- 8 Regular heater/steam/insulation survey, motor/pump periodic preventive maintenance for improved efficiency.
- 9 Regular optimization of heater operation (excess O₂, Stack temp - APH efficiency), column operation (optimization of reflux, vacuum, Temp, Stripping steam, Product distillation gap etc.), Steam balance, Hydrogen balance, minimization of flaring & sloping.

Forthcoming schemes towards Energy conservation:

	Energy Conservation Measures	Anticipated savings		investment (Lakh Rs)	Period of implementation
		MKcal/ Year	Lakh Rs		
1	CDU1 Short residue heat recovery by heating internal fuel oil.	5556	101	101	2008-10
2	Minimizing HP steam consumption by optimizing IFO temperature	3889	71	0	2008-09
3	Condensate heat Recovery in Crude & Hydrocracker units.	3585	65	25	2008-09
4	Hydrogen recovery from off gas streams & PSA tail gas streams.	209869	3816	4500	2008-10
5	Implementation of Secondary seals for balance 22 floating roof tanks			130	2008-09
6	Vapor recovery from Naphtha loading stations	108	3	70	2008-10
7	Product Blending & Optimization				2008-10
8	Replacement of PSA adsorbents in Hydrogen-1 & CCR-1 units for improving Hydrogen recovery				
9	NSU feed heat recovery with Kerosene at CDU1	12000	168		Long term
10	Use of Hydrogen rich CCR Net gas for GOHDS make-up/ISOM, in place of fresh Hydrogen.	48248	1079		2006-07, long term
11	Introducing circulating refluxes in fractionator HCU1 & 2 unit	124286	1740		Long term
12	Installing Power recovery turbine in HCU1	10714	150		Long term
13	Installation of GT with HRSG	142857	2000		Long term
	Total	561111	9193	4826	

Environment and Safety

MRPL is committed to Environment protection and has implemented an effective Environment management system. A comprehensive wastewater treatment facility has been installed for treating refinery wastewater so as to get treated water quality much better than the limits set by Karnataka State Pollution Control Board (KSPCB) and MINAS standards. Refinery consistently recycles about 70% of treated effluent to makeup cooling water.

MRPL continuously operates three sulfur recovery units of 99% recovery efficiency & also controls the internal fuel oil quality for restricting the overall SO_x emission.

MRPL's commitment to the protection of the ecological system evolves from the Design and Operation Stage and continues in its normal operation. The refinery constantly monitors the quality of treated wastewater and air quality surrounding the refinery. A well-equipped Mobile air quality monitoring van has been adopted for routine monitoring of air quality in and around the refinery for this purpose, in addition to five permanent Ambient Air Quality monitoring stations.

MRPL is installing secondary seals for all the floating roof tanks. Conducted a comprehensive VOC monitoring Program for reducing the fugitive emissions. At many places in refinery & in township, solar lighting & traffic signals were installed. Three Battery operated cars were procured & being used for at refinery. Recently installed a Biogas plant for treating the food waste generated in the refinery canteen and township.

"Safety First" – has been MRPL's motto. Lectures, seminars and training sessions on plant safety for MRPL staff & contractors are regularly conducted. MRPL is the convener of the Mangalore Chapter of National Safety Council. A well-equipped live fire-fighting ground is used for the training. Safety and housekeeping committees review the plant safety every month. Mock-drills are conducted regularly in the process units and Refinery to regularly evaluate and improve the emergency preparedness of the Refinery.