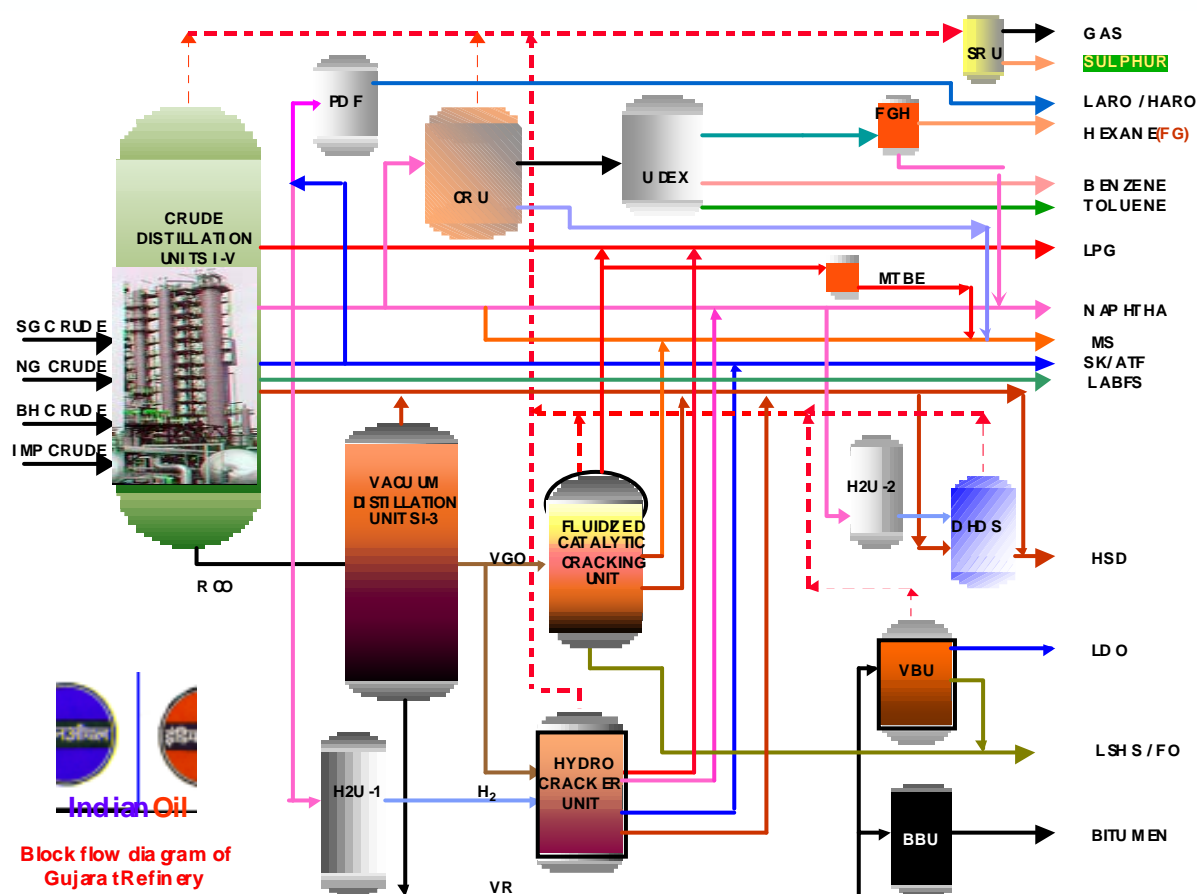


INDIAN OIL CORPORATION LIMITED GUJARAT REFINERY

1.0 UNIT PROFILE

The largest Public Sector Refinery of the country, located at Vadodara, Gujarat, is the biggest and most energy efficient Refinery of Indian Oil Corporation Limited. The first Prime Minister of India Pandit Jawaharlal Nehru laid the foundation stone of this Refinery on 10th May, 1963.

The present installed capacity of the refinery is 13.7 MMTPA and process both indigenous as well as Imported crude oil. In the year 2003-04, the Refinery achieved highest ever crude throughput of 12.7 million tonnes. The typical block flow diagram indicating various process units & the products is given below :



2.0 ENERGY CONSUMPTION.

The energy consumption at Gujarat Refinery is monitored on daily basis and optimization of consumption is an ongoing activity. Energy consumption is always focused as a key parameter of its overall strategy for remaining globally competitive by maintaining lower energy cost.

These helped Gujarat Refinery to bring down the energy consumption level from 110.4 MBTU/BBL/NRGF in 1999-00 to **101.4 MBTU/BBL/NRGF in the year 2003-04.**

Reduction in energy consumption for last 3 years is given below.

Year	Crude Throughput, MMTPA	Sp. Energy MBN	Fuel consumption % on Crude	Thermal Energy consumed per unit production Million Kcal / tonne of product
2001-02	11.7	105.6	6.54	0.4823
2002-03	12.4	104	6.51	0.4786
2003-04	12.7	101.4	6.27	0.4563



Country's largest LAB (petrochemical)plant with biggest HOT OIL furnace commissioned successfully in record times.



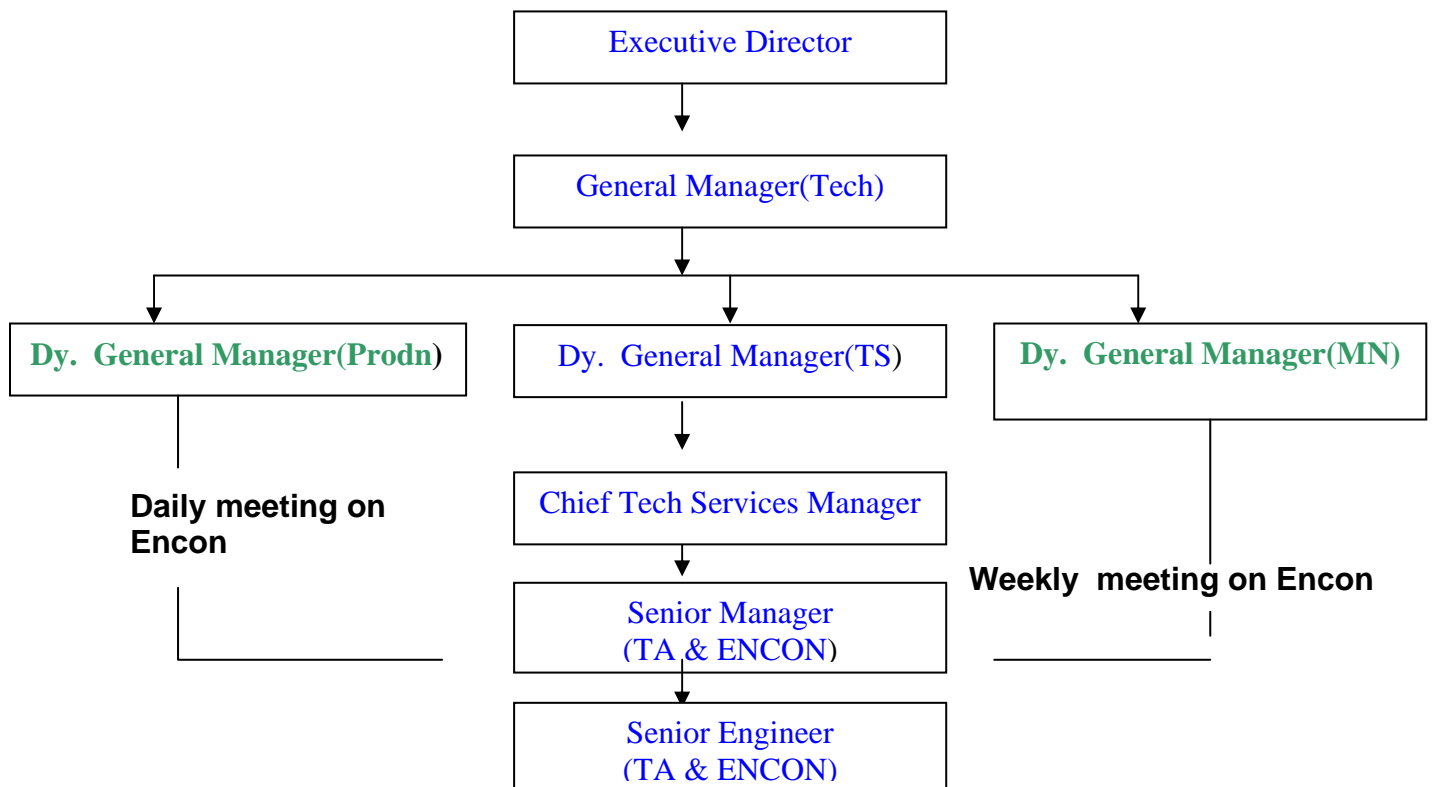
VAM (VAPOUR ABSORPTION MACHINE) INSTALLED AS AN ENERGY CONSERVATION MEASURE , POWER SAVED : 940 MW /YEAR



HIGH EMISSIVE CERAMIC COATING APPLIED ON THE REFRACTORY OF AU1 FURNACE FOR REDUCTION OF ENERGY CONSUMPTION

3. ENERGY CONSERVATION COMMITMENT, POLICY AND SET-UP:

Gujarat Refinery is concerned about Energy conservation at design and operating stages. Right from the beginning a dedicated Technical Audit Cell was formed in 1971 to over-view the energy consumption activities and control of the same. Besides the above, Energy Conservation Cell under Senior Manager was constituted in 1990 to act as a focal point for energy conservation activities. TA and Encon cell presently constitutes a Sr.Manager, a



Sr, engineer, and is headed by a Chief Manager who reports to DGM (TS). There is total involvement and commitment of top management with regards to energy conservation and formal monthly reviews of Energy performance are done where the Executive Director chairs the meeting and the same is attended by all Head of Departments, Deputy General Managers and General Managers.

Groups of Operating, Maintenance and Process contact personnel of various processing units work in cohesion under the leadership of respective managers for optimising the energy consumption in day to day operation. Energy conservation group of Technical services department monitors the energy consumption and in turn work with the co-ordinator of operating group.

In addition to this, Weekly meetings are held in Refinery Shift Manager's (RSM) Office, wherein the areas that needs optimisation and loss control is reviewed and action plan drawn for immediate rectification. General Manager(T) of Refinery participates in these weekly RSM meetings and ensures acceleration in the ENCON efforts put in by every individual department.

Gujarat Refinery has a well defined Energy Policy which is enclosed as annexure-1(a)



*Solar light installed at Guest House
To promote renewable source of
energy.*

TPM (Total productive maintenance) system is one of the new concept in today's competitive scenario for optimisation of cost and increasing productivity. Gujarat refinery had launched this new system in Nov2003.



FCC, a critical plant was selected as model for TPM activities.

4. ENERGY CONSERVATION ACHIEVEMENTS

The refinery has invested more than Rs.200 crores since mid eighties for its various energy conservation projects, which has paid rich dividends. The specific energy consumption figures in terms of MBTU/BBL/NRGF reduced from 128 in 1995-96 and the same to an all time low of 101.4 in 03-04. In recognition of its efforts towards energy conservation, the Ministry of Petroleum & Natural Gas had awarded the Trophy for Best performance in energy consumption award : special prize for consecutive two times (2003 & 2002) after receiving 1st Prize consecutively from 2000 onwards.

New innovative / technology up gradation in insulation system by using ceramic coating on refractory surface of furnace and achieved 3.7% of fuel saving.

VAM (Vapour absorption machine) a new technology towards electrical power saving, was installed in 2003-04.

5. ENERGY CONSERVATION PLANS AND TARGETS

To improve the energy performance further, the following projects are under implementation/active consideration of the company.

- VDU furnace efficiency improvement by installing air preheater.
- Flare Gas recovery
- H2 recovery from off gas of CRU and CLPS off gas of HCU
- Fuel additive trial in TPS
- Refractory coating in other furnaces .
- On-line cleaning of Furnace to improve efficiency
- Installation of additional Coalescer in product line to reduce loss

With the implementation of above major and other miscellaneous projects, specific energy consumption of the refinery will be less than 100 MBTU/BBL/NRGFinn 2004-05.

3. ENVIRONMENT AND SAFETY.

Gujarat Refinery is committed towards minimisation of consumption of resources ,minimisation of the waste production, creation of an environment conducive to increase efficiency and productivity.

Its commitment towards the environment is reflected in the fact that it has been complying with and excelling the statutory limits and norms of Pollution prevention and control.

Use of latest technology so as to conserve the natural resources and production of quality products with minimum adverse effect on ambient cover has been part of our vision & mission.

WATER POLLUTION PREVENTION & CONTROL:

Entire treated effluent is being recycled back for firewater and Cooling water make-up.

AIR POLLUTION PREVENTION & CONTROL:

Total SO2 emission from Gujarat Refinery always remains below the stipulated limit.

SOLID WASTE MANAGEMENT(Bioremediation of oily sludge)

The Energy and Resources Institute (TERI), New Delhi and IOCL, R&D Centre , Faridabad has developed an entirely new method, using bioremediation technique for degradation of oily sludge. After extensive research work, TERI and IOCL, R&D center have developed a bacterial system known as "Oilivorous-S" to biodegrade oily sludge and sulfur containing hydrocarbons. leaving behind no harmful effects. The GR has successfully treated 1750 MT of oily sludge using bioremediation technique for degradation of oily sludge. Treatment of second lot of 1700 MT oily sludge is in progress



OCCUPATIONAL HEALTH MONITORING:

A full-fledged Occupational Health Centre has been set up in the refinery hospital.

ISO – 14001 ACCREDITATION:

Environmental Management System at Gujarat Refinery is at par with international best. **Gujarat Refinery became the first organization in the state of Gujarat to get the coveted ISO-14001 certification for Environmental Management.**

In addition to this many institutions conferred laurels for its efforts in Environment protection & Safety, some of them being

- ❖ Gujarat Refinery achieved ISRS LEVEL-9 on 19.09.03 under the International Safety Rating System.
- ❖ Gujarat Refinery was declared winner of prestigious “Sarva Shrestha Suraksha Puraskar” for 2002 by National Safety council of india.
- ❖ Refinery bagged the prestigious Rajiv Gandhi National Quality award for the year 2003
- ❖ Green tech Environment excellence Platinum award for 4 consecutive years – 1999-00, 2000-01, 2001-02.and 2002-03.
- ❖ “Certificate of Honour” was awarded to Gujarat Refinery on 14/12/2001 by **Gujarat State , Factory Inspectorate & Gujarat Safety Council**, for “Lowest Disabling Injury Index” & also **Winner for best safety performance .**
- ❖ Gujarat refinery received **NATIONAL SAFETY AWARD** for the year 2001 & 2002 –sixth consecutive year.
- ❖ ISO-10006 certification for Project Management including design, engineering, procurement, tendering construction & commissioning of mega Refinery projects for 1999 by M/S DNV, Netherlands.

Details of projects / modifications implemented during 2003-04

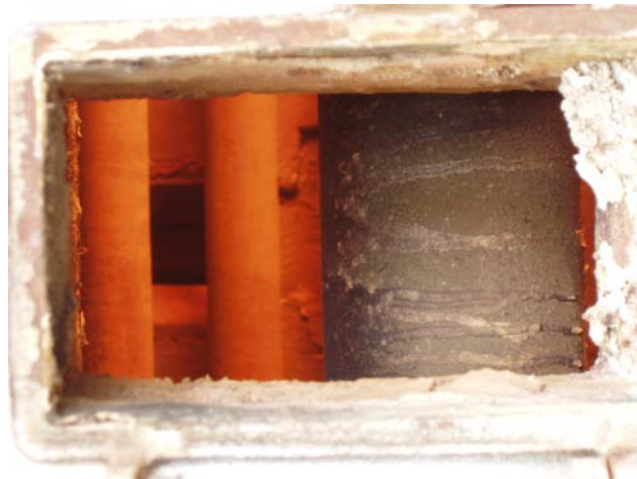
Project no. 1 (High emissivity coating on refractory of process heater)

The major fuel consumption in a refinery takes place in the process heaters. To reduce the radiation loss through the heater walls proper installation and maintenance of refractory is very much essential. It is well known that the emissivity of refractory gets decreased with the rise of temperature, which in turn increases the energy consumption substantially.

High Emissive Ceramic Coating increases the emissivity of the heater wall refractory with the increase of temperature and results in reduction of fuel consumption. The major benefits of application of high emissivity coating are as follow :

- It increases the emissive power of the refractory of heater walls and emits back the heat resulting in fuel saving.
- It increases the life of refractory preventing formation of hot spots.
- It can withstand temperature up to 1500 Deg C .
- It enhances productivity with consistent quality due to stable skin temprature.

During the shut down of AU1 in AUG-03 Ceramic Coating was applied manually on the surface of refractory of AU!F1 furnace at a cost of 12 lakhs .



Ceramic Coating in AU1 FURNACE

Project No. 2 (Preheat improvement in Feed preparation Unit-1(FPU-1))

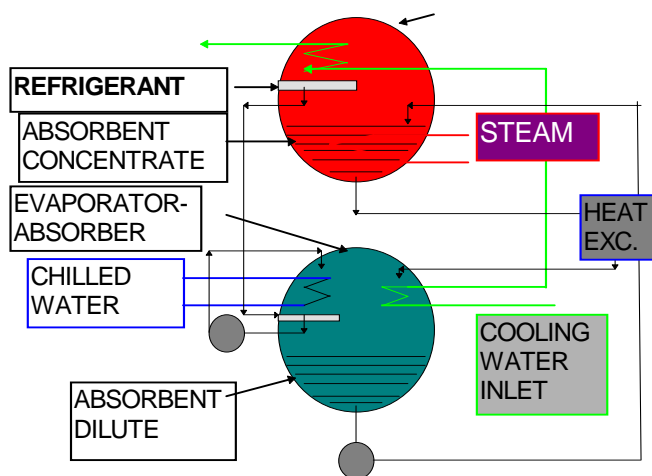
The preheat depends on quantity of hot feed. Processing of more hot feed increases the pre-heat resulting in lower fuel consumption in the process heater.

Earlier Feed of FPU-1 used to consist of mixed RCO (cold +hot) ex Atmospheric unit-no 4. To increase hot feed quantity, facilities of processing of hot Feed (RCO) from AU-5 was commissioned in Apr-03.

Increase in pre-heat temperature was found 8 deg c which resulted in fuel saving of 950 MT per year.

Project no 3 (Vapour absorption instead of normal refrigeration for control room cooling)

Vapour absorption system is environment & energy friendly since they emit no CFC like conventional compression chillers and they system operates on low pressure steam which is available plenty and thus saving of costly electricity. The working principle and saving are given below



ABSORPTION CHILLERS COMPARATIVE POWER CONSUMPTION

CAPACITY TR	VAP. COMP. KW	VAP ABSORP. KW
50	55	1.5
100	110	2.4
500	400	7.75
1000	800	11.25

Vapour Absorption Machine (VAM) of 100 TR was installed in LAB plant at a cost of 30 lakhs with a view to save energy in the form of electricity and as well as environment friendly. Approx 943000 KWH of power is expected to be saved in a year.

Project no. 4 (Redesign of burner tips of CO boiler)

Limitation was being faced in FCC unit at high throughput operation of the unit as CO boiler was operating at its MCR of 78 t/hr. In order to reduce the Fuel oil consumption so that the net Flue gas rate decreases thus reducing the Steam generation from CO Boiler, M/S BHEL was consulted for redesigning the tips.

The objective was to reduce the burner tips of CO boiler were replaced in June-03 with a new design of M/s BHEL with an objective to reduce the consumption of Fuel oil required for auxiliary firing. With the redesign, the Fuel oil consumption in the boiler reduced to 13MTPD from the earlier 25 MTPD and the unit is able to operate at higher throughputs.

Project no. 5 (Commissioning of Slurry settler)

Due to the higher BS&W content in CLO because of the holes in the inlet ducts of the Reactor cyclones and as also due to the erosion in the Slurry circuit, Process licensor recommended to have the Slurry settler in line to reduce catalyst loss. All modifications with respect to commissioning of Slurry settler(June-03) at a cost Rs 20 Lakhs were taken up and thereby resulted in recovery of catalyst to the tune of 1.0 MTPD. The catalyst injection to the system requires operation of air compressor. Due to the reduction of catalyst injection, operating hour of air compressor is reduced by 1 hour resulting in saving of electric power.

Project no. 6 (Commissioning of parallel fuel gas header to boiler)

TPS boiler burners are capable of handling either or both fuel oil and fuel gas . This helps optimizing imbalance of fuel gas generation and consumption. Frequent imbalance was observed due to restriction of fuel gas consumption in boilers due to higher generation of fuel gas.

To circumvent the problem, a new parallel fuel gas header was commissioned to cater additional fuel gas resulted in reduction of imbalance of fuel gas production and consumption.

Project no. 7 (Replacement of DEA by MDEA)

Theoretical H₂S loading in DEA 0.33 mol/mol of amine while in case of MDEA possible H₂S loading is 0.4 mol/mol of MDEA(approx 21% increase in H₂S pick up capacity can be achieved by solvent change over from DEA to MDEA.

H₂S is stripped off from Rich amine by getting heat in re-boiler .For same amount of H₂S stripping, requirement of re-boiler steam for MDEA is less than DEA.

The solvent(DEA) changed over to MDEA was carried out in Mar-04 and around 0.5t/h steam was saved .

Project no 8 (Use of CO promoter in FCC unit)

Air supply to regenerator in FCC unit is met by turbo driven Main air blower. The consumption of MP steam to turbine is a function of air requirement.

CO promoter is being dosed in FCC Regenerator since October 2003. Addition of CO promoter has been started with an objective to reduce the after burn, reduce the air requirement of the Regenerator. On addition of the additive, the requirement of air to the Regenerator reduced by 1500 Nm³/hr at the same throughput which resulted in a saving of 2 MTPH of MP steam consumption by the MAB

Project no. 9 (Saving of electric power due to augmentation of DM plant)

Earlier total DM water requirement was met with by CGP DM plant as well as TPS DM plant.

In June 2003 , TPS DM plant was augmented to 3x 250 M³/hr from 2x250 m³/hr of DM water production. The total requirement of DM water is now met by TPS DM plant. This was caused for non-operation of CGP DM plant resulted in reduction of power consumption. Approx. Rs. 27 Lakhs per year is saved by this project.

Project no. 10 (Augmentation in the throughput of FCC)

Earlier Visbreaker Naphtha (VBN) at the rate of 9 m³/hr was pumped from Surge vessel to MP steam heater before processing in FCC unit. The processing of VBN was also restricting the t'put of FCC unit to 5800 MT/day.

An alternative route was found to process VBN partly in DHDS and partly in Aus. This resulted in the non-operation of allied pumps and LP steam exchanger in FCC unit as VB naphtha was directly being routed to DHDS from Visbreaker unit at the Debutaniser pressure.

Project no. 11(Utilising of LP steam from CRU at AU1)

There was LP steam header in AU1 unit. The requirement of LP steam at AU1 is met through MP steam by throttling MP steam resulted in loss of energy.

A separate LP steam header was laid down from CRU and commissioned in the month of July'03. LP steam is being used in AU1 instead of down gradation of MP steam and thereby, reduction in loss of energy .

Project no. 12 (On-line dosing of polar chem. For furnace cleaning)

With heavy residual oil as fuel , some degree of incomplete combustion is inevitable which leads to formation of carbon deposits on heat transfer surfaces. The sticky carbonaceous deposits also tend to bind or hold together other solid combustion residues including ash. These sticky deposits strongly adherent are not easy to remove by soot blowing. Due to these deposits efficiency of the furnace gets affected due to higher stack temperature. To improve, cleaning up of these sticky material is highly required.

POLARCHEM cleans up the deposit already formed on heat transfer surfaces by one time high doses application. Polarchem is an aqueous solution of Magnesium and Ammonium Nitrates. It is designed for use in boilers and furnaces to reduce fouling and corrosion on the fireside heat transfer surfaces. A very important feature of the product and the system is that it allows application on-line i.e. when the boiler or furnace is in operation, without shutdown.

AU-3 was unable to operate more than 8400 MT/day of crude t'put due to high stack temperature (due to gradually fouling of convention section of the furnace). To improve furnace operation on-line injection of Polar chem. L2k was applied in furnace. Approx, 3% fuel was saved during application of Polarchem.

Project no. 13 (Stoppage of air compressor by interconnecting the air line)

Earlier a separate air compressor of capacity 3860 NM³/hr was in operation at Bitumen area. During augmentation of Bitumen unit a separate line was installed for air supply from TPS to Bitumen unit with the help of existing air compressors at TPS.

The air compressors each of capacity 3860 Nm³/hr at the Bitumen unit were made redundant since the commissioning of Biturox unit.

Project no. 14 (Conversion from gland packing to mechanical seal of crude pump)

The crude pump was provided with old design of gland packing resulting into leakage of crude oil and vapour causing product losses and safety hazards.

Gland packing of the pump was replaced with mechanical seal , thereby, stopping crude oil leakage . It also reduced frictional losses compared to gland packing and saved power.

Project no. 15 ((Installation of Mass flow meters for Bitumen Truck loading bay no 7 & 8)

Mass flow meters were installed for Bitumen dispatches. The accuracy of Mass flow meter is 0.1 %. With installation of Mass flow meters, the losses due to accountal variations has been minimised and improved the Specific energy consumption.

Project no. 16 (Installation of Secondary seal for 8 nos tank)

Floating roofs were designed more than 100 years ago as a safety precaution to keep explosive gasses from building up between the roof of a tank and its petroleum contents. Today, the emphasis is on loss controlling, atmospheric pollution, as well as on safety.

To arrest vapour loss from floating roof tanks , 8 nos of floating roof tanks (2 nos Naphtha, 4 nos MS & 2 nos MTBE tanks) were provided double seals i.e. secondary seal in addition to existing seals .

Project no. 17 (Energy Savings From Implementation Of Multi-Variable Controller In Au-5)

Multi-Variable controller has been implemented in AU-5 unit main column for controlling main parameters such as HN, SKO, HSD tray temperatures; SKO & HSD inferred qualities etc. This is a software program running on a supervisory computer and controls the plant through an interface with AU-5 plant DCS.

Though the primary objective of this program is to control the product qualities and yields within the specification, one of the objectives is to maximise crude pre-heat..

Whenever the circulating reflux flows are increased, crude pre-heat increases as long as there is sufficient heat transfer area available to transfer energy to the crude. However the debit side in increasing circulating reflux flows is that it affects the vapour liquid traffic inside the column and deteriorates the separation between products in the column. Therefore a balance has to be maintained between product quality vis-à-vis pre-heat temperature improvement.

Logic has been provided in the Multi-Variable controller(MVC) to maximise Circulating Reflux flows subject to maintaining the top reflux flows within limits. By this logic whenever the actual top reflux flow is higher than the lower limit set by the operating personnel based on the product quality, circulating refluxes are automatically maximised so as to bring the top reflux as close as possible to the lower limit set by the operating personnel. As this controller operates once every minute, precise control of the product quality as well as maximising pre-heat by increasing circulating reflux flow within the given constraints is achieved.:

Approximate improvement in Pre-heat after implementation of MVC is 2 deg c

Project no. 18(Commissioning of Single Flare Instead Of Two Flare)

Earlier there were two flare stack namely GR flare stack & GHC flare stack. A New GR flare stack had been constructed with higher capacity. The New flare stack had been given connection from GR as well as GHC and, thereby, kept GHC flare stack stand by. This helps in saving of Fuel Gas for pilot burner as well as Steam.

Project no. 19 (Increase in suction height at SKO tanks for elimination of water carry- over resulting in reduction of slop oil Generation)

HSD storage tanks Tk-906, 907, 909 & 910 of capacity 25 000 KL each were having a problem of low pump suction height for Tank Wagon loading. Water draining from these tank also was not effective. This was resulting in to carry over of water into Tank Wagon. Draining water again from tank wagon resulting in generation of slop oil . Higher generation of slop oil requires higher pumping cost as well as higher evaporation losses.

Pump suction height of about 750 mm had been increased from inside the tank resulting in stoppage of water carry over to tank wagons and thereby reduction in slop oil generation achieved..

Project no. 20 (Installation of Solar street light in guest house)



Gujarat is blessed with about 311 clear sunny days and Solar energy is available free. In accordance with the energy policy of GR it is decided utilise this renewable source of energy by installing solar powered Street lights using Solar Photovoltaic Module with energy storage device and automatic electronic control. The SPV street light was installed at the Guest House. Solar street light not only saves costly electricity but provides reliable light even in case of any black out in the electricity system.

Project no. 21 (LP steam extraction from CRU Turbo –compressor)

Earlier the CRU Turbo –compressor was running in condensing mode due to frequent tripping for uncontrolled back pressure (LP steam).

The back pressure (LP steam) was controlled by adjusting the set point of different PRU (MP to LP steam). It established the LP steam flow from the extraction of the turbine and augmented LP steam supply to the steam network.

Project no. 22 (ATF header in 6th gantry converted to HSD service and commissioned)

In 6th gantry, earlier separate HSD & ATF header(one each 4' dia) were available for filling tank wagons. Due to reduced demand for ATF, this ATF header was converted to HSD service. It helped in reducing pumping operation and thereby reducing power consumption .

Approx 13 kwh per rack was saved.

Project no. 23 (in house modification in TPS burner of boiler no 4)

Boiler-4 gas burners were designed to burn 2.15 t/h of fuel gas of density 0.70 kg/sm³ having Hydrogen content up to 40% by volume. The present fuel gas consists of 60 to 70% by vol of Hydrogen and has a density ranging from 0.40 to 0.50 kg/sm³. This resulted in less fuel gas flow(1.3 t/h) through the burner for same burner inlet pressure resulted in imbalance of fuel gas generation and consumption.

To increase the gas flow, two of the burner tips were modified by increasing the No of holes from 16 to 24(hole dia of 9.5mm was unchanged). By this, gas flow increased from 1.3 t/h to 1.7 t/h resulted in minimizing imbalances of gas production & consumption.

Project no. 24 (Inertisation of spent caustic tank in CETP)

The spent caustic tank was not earlier inertised causing frequent release of vapours and created vapour lock in the pump.

The tank was inertised by N₂ pressure which helped in stopping of releasing vapour and also improved pump performance. The pump is now operated with low power consumption due to higher suction pressure.

Project no. 25 (Discontinuation of LPG stabiliser operation in AU3)

Earlier while procceing Norge gUjarat crude , a small quantity of LPG used to produce from Au3 unit . A cost benefit analysis was carried out between two option

- a) LPG & Naphtha product routing separately
- b) Allowing LPG along with Naphtha and there by stopping two pumps resulting in energy saving.

The second option was adopted with effect from March-04 and continue based on differential pricing.

Project no 26 : (Improved CRU combined mode operation for optimisation of yield &energy)

Earlier CRU used to be operated in batch wise for production of MS reformat and Benzene Toluene production, in this process, it was required to change the severity of furnace operation frequently due to changeover of batches.

This called for higher energy consumption due to swinging the furnace with minimum load to high load.

A modification was carried out in AU2 rerun unit through with both MS reformat and Benzene are produced simultaneously on continuous basis without any swing in CRU furnace operation. As a result there is an improvement in energy consumption levels in CRU with optimised yields.

Project no 27: (Improvement of total thermal insulation by special task force)

A multidisciplinary special task force was constituted to find the condition of thermal insulation in the refinery in totality. The survey team identified damaged / bare insulation and suggested for immediate repair. The total re-insulation as per recommendation of the task force was taken up on priority. This resulted in reduction of fuel consumption of about 1432 KL.

Project no 28 : (Replacement of steam trap as well as attending steam leaks by special task force.)

Another multidisciplinary special task force was constituted to find the condition of steam-traps, steam leaks in the refinery in totality. The survey team identified damaged /leaky steam traps and leaky steam points and suggested for immediate repair. The total re-pair/ replacement of steam traps and attending to the steam leaks as per recommendation of the task force was taken up on priority. This resulted in saving of Rs. 162 Lakhs in terms of fuel cost.

ENERGY CONSERVATION ON AT GUJARAT REFINERY

INTRODUCTION:

Energy Conservation in any refinery plays a vital role towards cost reduction as well as as upkeep of the the environment . It is directly related with the reduction in fuel consumption, thus the adverse effects of fuel burning on environment due to organic compound, emissions are contained. In view of above, various projects like

- ❖ Revamping of process heaters of crude units AU-1/2/3 and Udex to 89-90% efficiency.
- ❖ Optimisation of Heat exchanger trains in AU-1/2 using Pinch technology.
- ❖ Steam generation of 3-4 MT/Hr. using waste heat in catalytic reforming unit.
- ❖ Revamping of Visbreaker unit using soaker drum technology.
- ❖ Reduction in Evaporation losses from tanks by conversion from fixed roof to floating roof.
- ❖ Installation of pressure recovery turbine in Hydrocracker unit.
- ❖ Replacement of aluminium alloy blades with FRP blades in all cooling tower fans for reduction of power consumption.
- ❖ Implementation of Digital distributed control system in all process units.
- ❖ Installation of Flare flow meter (3 Nos) for strict monitoring of flare loss.
- ❖ Replacement of power driven compressors with a steam driven compressor in CRU.
- ❖ Replacement of pneumatic soot blowers with electric driven.

- ❖ Use of Physical acoustic leak detector and GMI gas surveyor for arresting process fugitives.
- ❖ Optimisation of Steam Power balance by operating Gas Turbines.
- ❖ In-House design of AU-4 Preheat train, installation and commissioning of the same.
- ❖ Air-Preheater installed in AU-4 furnace for improving its efficiency.
- ❖ Additional Steam generator using process heat in Vacuum Distillation unit.
- ❖ Pre-heat improvement of FPU-2 resulted in saving of fuel .
- ❖ Installation of Plug valves in place of Hamer valves to reduce oil loss

Technical Audit and ENCON cell monitors Fuel consumption of all the process units in the refinery daily and takes corrective measures to optimize the same. Some of the thrust areas of ENCON cell are better heat integration of processing units, heat recovery schemes, better boiler/furnace efficiencies by better burner operation, and optimum excess air levels, optimum steam-power balance in the refinery, use of advanced instrumentation and gadgets for accurate monitoring.

Hydrocarbon loss is also controlled by surprise audits in the areas of tank wagon filling dip and temperature measurement, crude oil sampling and daily monitoring of slop generation. Fugitive emission surveys are conducted using GMI Gas surveyor and Leak detection from passing safety valves are detected using Physical Acoustic Leak detector and repair programs are planned before / during M&I shutdown of units.

Extensive use of “ **myProfitability.com**” a in-house software tool to monitor continuously Encon related important parameters also helps in reduction of MBN (Specific Energy Consumption). MBN(MBTU/BBL/NRGF) is the unit for comparing the energy consumption of different Refineries as every Refinery configuration is different from the other due to the different processing steps for converting crude oil to various finished products.

In addition to the audits and loss control measures, regular training programmes for Refinery personnel are also being organised on Energy Conservation and Hydrocarbon loss reduction.

Apart for the above, Oil conservation fortnight is organised every year to educate the masses the need for oil conservation and during the fortnight auditors from non-IOC Refineries conduct furnace efficiency and steam leak surveys for ascertaining the best performing refinery in the above areas.

In addition to this, periodic surveys are carried out for monitoring energy parameters such as Boiler/furnace efficiencies, preheat exchanger performance, steam leaks in all units/offsite areas etc. It is ensured that Boilers/Furnaces' efficiencies are maximised by minimisation of excess air and reduction of stack temperature of furnaces by regular soot blowing.

Top most priority is given to the Energy saving schemes with respect to fund allocation. The Refinery already invested more than Rs 200 crores since mid 80s for its various energy conservation projects which had paid rich dividends.

ACHIEVEMENTS:

As a result of constant monitoring and various projects implemented in the field of energy conservation, the refinery was able to bring down the energy consumption in terms of MBTU/BBL/Complexity to an all time low of 104 in 2002-03. The Hydrocarbon Loss was also reduced & maintained at the international best of 0.25 % wt on crude during the same period. The following are the awards received on strength of its achievements in Energy Conservation.

AWARDS and ACCREDITATIONS:

Gujarat refinery bagged a number of awards for its efforts in the field of energy conservation. They include:

- ❖ National Energy Conservation Special Award 2002 – **from Ministry of Power** for winning the 1st Prize successively for 3 consecutive years.
- ❖ Jawaharlal Nehru Centenary Award from MOP&NG for “**best improvement in energy consumption**” among all refineries in 2001-02.
- ❖ National Energy Conservation Award 2001 - **IST Prize from Ministry of Power.**
- ❖ Jawaharlal Nehru Centenary Award from MOP&NG for “**best improvement in energy consumption**” among all refineries in 2001-02.
- ❖ Jawaharlal Nehru Centenary Award from MOP&NG for “**best improvement in energy consumption**” among all refineries in 1999-00.
- ❖ National Energy Conservation Award 2000 - **IST Prize from Ministry of Power**
- ❖ Anilraj trophy for best improvement in energy consumption among all IOC refineries in the years 1996-97 & 1997-98.
- ❖ Best insulation effectiveness of heater/boilers trophy awarded for the year 1998 by CHT / MOP&NG.
- ❖ Jawaharlal Nehru Centenary Award from MOP & NG for Best improvement in energy consumption for the year 1997-98.
- ❖ National Energy Conservation Award-**1999 Second prize from Ministry of Power.**

Annexure-I

REFINERIES SECTOR INDIAN OIL CORPORATION LIMITED GUJARAT REFINERY

1.0 UNIT PROFILE

Gujarat Refinery, the largest Public Sector Refinery in the country, where growth is the essence of life is the third of the seven Refineries of Indian Oil Corporation Limited. Pandit Jawaharlal Nehru laid the foundation stone of this Refinery on 10th May, 1963. Initially, the Refinery was set up with a capacity of million metric tonne per annum (MMTPA) for processing of Ankleshwar crude. The first crude distillation unit (AU –1) of 1.0 MMTPA capacity, was commissioned in October, 1965. The refinery since then has been expanded, revamped and modified from time to time and today it has crude refining capacity of 13.7 MMTPA. The following primary/ secondary processing units for production of various petroleum products are in operation.

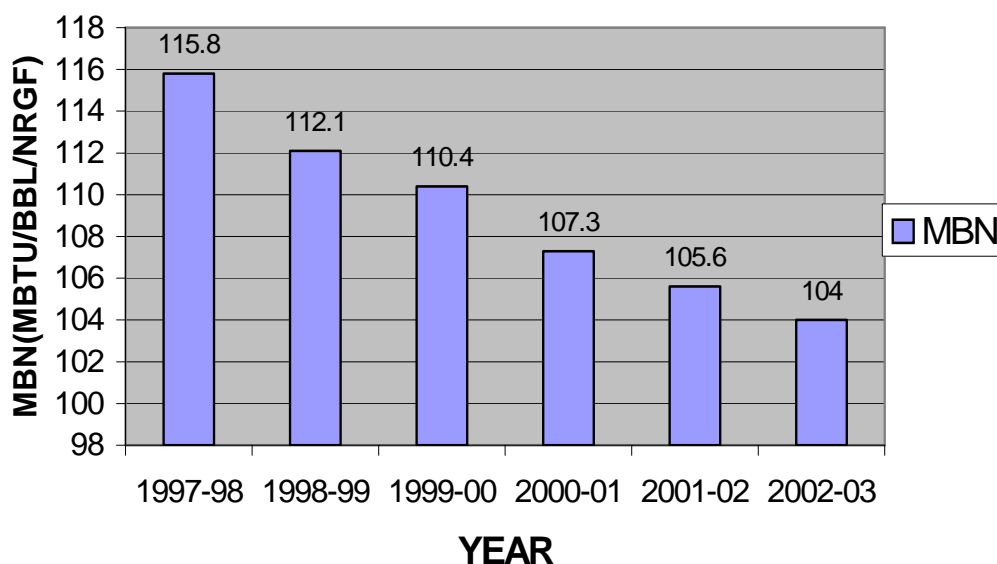
Atmospheric Distillation Unit(5nos),Catalytic Reforming Unit, Udex Unit, Vacuum Distillation Unit, Visbreaker Unit, Naphtha ATF / KERO Merox Unit, Bitumen Blowing Unit, FCC Unit, Feed Preparation Unit (2 nos), Pilot Distillation Facilities, FGH Unit, Hydrocracker Unit, Hydrogen Unit(2 nos), DHDS Sulphur Recovery Unit(2 nos) Nitrogen Unit, MTBE Unit,& Butene-1 unit.

Gujarat Refinery manufactures petroleum products/petrochemical feedstock/speciality products like LPG, Naphtha, Motor Spirit (MS) superior Kerosene oil (SKO), Aviation Turbine Fuel (ATF), High Speed Diesel (HSD), Light Diesel Oil (LDO), Xylene Feedstock, Benzene, Toluene, N-heptane, Food Grade Hexane, Fuel Oil, Low Sulphur Heavy Stock (LSHS), Bitumen and Sulphur.

In the year 2002-03, the Refinery achieved highest ever crude throughput of 12.4 million tonnes per annum.

The specific energy consumption also reduced from 110.4 (for the year 1999-00) MBTU/BBL/NRGF to 104 (for the year 2002-03).

2.0 ENERGY CONSUMPTION.



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3. ENERGY CONSERVATION COMMITMENT, POLICY AND SET-UP:

Gujarat Refinery made significant efforts in the areas of Energy conservation right from the beginning and a dedicated Technical Audit Cell was formed in 1971 to over-view the energy consumption activities and control of the same. Besides the above, Energy Conservation Cell under Senior Manager was constituted in 1990 to act as a focal point for energy conservation activities. TA and Encon cell presently constitutes a Sr.Manager, a Manager, and is headed by a Chief Manager who reports to DGM (TS). There is total involvement and commitment of top management with regards to energy conservation and formal monthly reviews of Energy performance are done where the Executive Director chairs the meeting and the same is attended by all Head of Departments, Deputy General Managers and General Managers.

Groups of Operating, Maintenance and Process contact personnel of various processing units work in cohesion under the leadership of respective managers for optimising the energy consumption in day to day operation. Energy conservation group of Technical services department monitors the energy consumption and in turn work with the co-ordinator of operating group.

In addition to this, Weekly meetings are held in Refinery Shift Manager's (RSM) Office, wherein the areas that needs optimisation and loss control is reviewed and action plan drawn for immediate rectification. **General Manager(T) of Refinery participates in these weekly RSM meetings and ensures acceleration in the ENCON efforts put in by every individual department.**

To enable online monitoring of key parameters throughout the refinery, online monitoring formats have been provided on the network, which provides online data through Refinery-wide Real time Database Management System (RTDBMS).

[Gujarat Refinery has a well defined Energy Policy which is enclosed as annexure-1\(a\)](#)

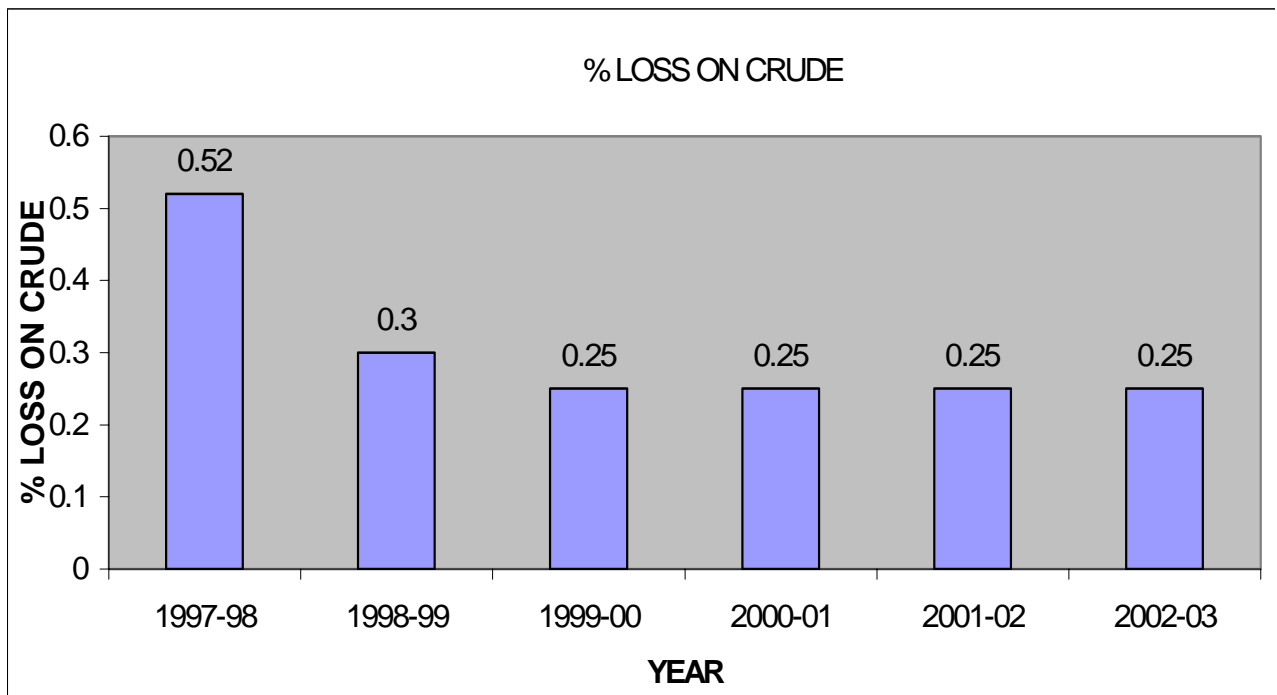
4. ENERGY CONSERVATION ACHIEVEMENTS

The refinery has invested more than Rs.200 crores since mid eighties for its various energy conservation projects, which has paid rich dividends. The specific energy consumption figures in terms of MBTU/BBL/NRGF reduced from 178 in 1993-94 to 128 in 1995-96 and the same to an all time low of 104.5 in 02-03. In recognition of its efforts towards energy conservation, the Ministry of Petroleum & Natural Gas has awarded the Trophy for Best performance in energy consumption award for 1999-00. Gujarat Refinery won 1st Prize from Ministry Of Power for National Energy Conservation Award-2000, Award-2001 and 2nd prize for the year in 1999.

Hydrocarbon Loss Reduction

The hydrocarbon loss has been brought down to an international best level of 0.25% weight on Crude. This has been achieved with the implementation of projects like Off site Automation, Tank Wagon / Tank Truck loading Automation, Flare Flow meter installation, Closed Blow Downs (CBDs) for Slop reduction and conversion of Fixed roof to Floating roof for HSD and Slop tanks and above all a very stringent monitoring and control.

The progressive improvement in hydrocarbon loss reduction has been shown below :



Emphasis is also laid onto conceiving projects for energy improvement through operational modifications.

VIEW OF THE AU-5 PRE-HEAT TRAIN

During the year 2002-03 (Aug/Sept), AU-5 pre-heat train revamp modification was carried out. Twenty three new Exchangers were put in the pre-heat train at the cost of Rs. 26.79 crores.



New innovative / technology upgradation in insulation system by using calcium silicate insulation material had been used by replacing mineral wool insulation and cladding material with holding arrangement is also improved to give a life of 15 to 30 years with efficient energy saving concept. This job is replicated in many more lines in the Refinery.

Adoption/development of new type of steam traps to resolve recurring failure with the help of R & D of EIL. The new steam trap operates in two stages : Impulsive & Disc. The First stage responds to impulse action of condensate at high pressure and temperature. The 2nd stage responds to difference in kinetic energy between steam & condensate .



(view of new steam trap (low noise and Zero live steam loss))

5. ENERGY CONSERVATION PLANS AND TARGETS

To improve the energy performance further, the following projects are under implementation/active consideration of the company.

- VDU furnace efficiency improvement by installing air preheater.
- Reduction in Steam/power consumption by replacing DEA by MDEA in existing ARU.
- Combined rerun unit for AU1 & AU2 in AU1.
- H2 recovery from off gas of CRU and CLPS off gas of HCU
- Fuel additive trial in AU3
- Refractory coating in furnace on trial basis.

With the implementation of above major and other miscellaneous projects, specific energy consumption of the refinery will be **less than 100 MBTU/BBL/NRGF**.

3. ENVIRONMENT AND SAFETY.

Gujarat Refinery has always focused on sustained development. In the strides of growth and excellence, Gujarat Refinery has maintained a dynamic balance of industrial development and surrounding Environment of mother earth. Refinery has not forgotten its duty to preserve the Environment inherited from our predecessors. Use of latest technology so as to conserve the natural resources and production of quality products with minimum adverse effect on ambient cover has been part of our vision & mission.

In this endeavor, Gujarat Refinery has set up first Hydrocracker plant in India for producing low sulfur middle distillates from North Gujarat crude. Similarly first Diesel Hydro Desulphurisation (DHDS) of the country was also commissioned at GR to produce 0.25% sulfur HSD. Also refinery is producing ultra low 'S' HSD (0.05%) and MS (1% WT. max. Benzene, 0.05% S) for supplying to NCR.

Environment Management System at the refinery consists of the following elements:

WATER POLLUTION PREVENTION & CONTROL:

A state-of-the-art Effluent treatment Plant of 1500 m³/hr capacity has been proactively set up in the year 1999 in place of the four earlier ETPs. The effluent quality parameters not only meets but also excels the MINAS (Minimal National Standards) stipulation. **Entire treated effluent is being recycled back for firewater and Cooling water make-up most of the time.**

AIR POLLUTION PREVENTION & CONTROL:

Energy conservation measures like replacement and retrofitting of low efficiency furnaces, optimization of heat-exchanger trains etc. has resulted in substantial fuel saving per year. This has helped in containing stack emissions in spite of increase in refining capacity. Major stacks are equipped with on-line SO₂ analysers to monitor the emission level.. **Total SO₂ emission from Gujarat Refinery always remains below the stipulated limit.**

SOLID WASTE MANAGEMENT:

Sludge Storage and Disposal:

IOCL, R&D along with Tata Energy Research Institute (TERI) has developed microbes, Oillivorous-S for biodegradation of oily sludge. Gujarat Refinery has taken up a project to treat the oily sludge generated from the refinery with these bacteria to convert it into soil.

Chemical Waste:

A Spent Caustic Treatment Plant with state-of-the-art technology has been set up. In this plant, reactive sulfide is converted into less harmful soluble sulfate by wet air oxidation and after treatment, it is mixed up with normal effluent in ETP for further treatment in CETP. This facility has totally eliminated chemical waste generation in Gujarat Refinery.

OCCUPATIONAL HEALTH MONITORING:

Management of occupational health forms an integral part of our Environment Management System. Environment in the sensitive operational areas such as Benzene production and despatch facilities etc. is regularly monitored. Surveys are conducted to monitor high noise level areas. Regular medical examination of workers exposed to hazardous environment is conducted. **No case with any abnormality has been reported so far. A full-fledged Occupational Health Centre has been set up in the refinery hospital.**

ISO – 14001 ACCREDITATION:

Environmental Management System at Gujarat Refinery is at par with international best. To show endeavor of the management towards Environment Practices and continual improvement by adoption of advanced technologies, Gujarat Refinery has framed a written Environmental Policy for effective Environmental Management System which aims to comply and excel the statutory limits and norms of Pollution Prevention and Control. Time bound action plan to further improve the environment, has been drawn for the next three years in identified areas.

To show the dedication towards Environmental Management System, Gujarat Refinery has undergone for most stringent audit as per International Standard by a reputed international organization namely, M/s. Det Norske Veritas, (DNV) Rotterdam, Netherlands. Being satisfied with the Environmental Management System, M/S. DNV, Netherlands has conferred Gujarat Refinery with ISO-14001 accreditation on 3rd July 1997. **Gujarat Refinery became the first organization in the state of Gujarat to get the coveted ISO-14001 certification for Environmental Management.**

Water harvesting:

Roof top harvesting has been started recently in Gujarat Refinery by providing bore wells to facilitate rain water percolation to the ground water so that ground water table may go up.

TREE PLANTATION/GREEN-BELT/ ECO-PARK DEVELOPMENT

A 100 M wide green belt with area of 30 acres had developed wherein 30,000 trees are in grown up stage. Also a 500-M wide green-belt with area of 96 acres with more than 1,71,000 trees has been developed to maintain ecological balance as well as soothing aesthetic senses.

Eco-park:

A beautiful ecological park with a eco pond of 13000 M² area has also been developed in the 500-M green belt for providing natural habitat for migratory birds.

In addition to this many institutions conferred laurels for its efforts in Environment protection & Safety, some of them being

- ❖ Rajiv Gandhi Quality award 1999 instituted by Bureau of Indian standards
- ❖ Golden Peacock Environment Management Award for 3 consecutive years – 1998,1999,2000.
- ❖ Green tech Environment excellence award for 3 consecutive years – 1999-00, 2000-01 and 2001-02.
- ❖ **Golden Peacock award for Innovation Management** for the year -2001.

- ❖ “Certificate of Honour” was awarded to Gujarat Refinery on 14/12/2001 by **Gujarat State , Factory Inspectorate & Gujarat Safety Council**, for “Lowest Disabling Injury Index” & also **Winner for best safety performance** .
- ❖ Gujarat refinery received **NATIONAL SAFETY AWARD** for the year 1999.
- ❖ ISO-10006 certification for Project Management including design, engineering, procurement, tendering construction & commissioning of mega Refinery projects for 1999 by M/S DNV, Netherlands.
- ❖ OHSMS certificate for maintaining world class standards for safety and health at all locations in the refinery premises.