

BPCL KOCHI REFINERY

(i) Unit Profile

Cochin Refineries Limited was incorporated in the joint sector as a Public Limited Company in September 1963 with technical collaboration and financial participation of Phillips Petroleum Company of USA and Duncan Brothers of Calcutta. The Refinery was commissioned in 1966 with a crude processing capacity of 2.5 Million Metric Tons per Annum (MMTPA). The name of the Company was changed to Kochi Refineries Limited (KRL) in May 2000.

From the date of commissioning to-date, the refinery undertook three expansions in refining capacity and installation of several new process units and other facilities. Many of the facilities have undergone modernization at various stages. The refining capacity was first expanded from 2.5 to 3.3 MMTPA in September 1973. The production of Liquefied Petroleum Gas (LPG) and Aviation Turbine Fuel (ATF) were commenced after this expansion. The capacity was further increased to 4.5 MMTPA in November 1984 along with the addition of 1.0 MMTPA capacity Fluid Catalytic Cracking (FCC) unit. The crude processing capacity was finally expanded from to 7.5 MMTPA in December 1994, with the installation of a second crude distillation unit and associated facilities. Along with this expansion the capacity of the secondary processing facilities was enhanced to 1.4 MMTPA. A Fuel Gas De-sulphurisation Unit was also installed as part of the expansion project as an environmental protection measure, to minimise sulphur dioxide emission from the Refinery.

During the year 1989, the Company commissioned an Aromatics Recovery Unit (ARU) with a design capacity of 87,200 Tonnes Per Annum (TPA) of Benzene and 12,000 TPA of Toluene, marking our refinery's entry into the field of petrochemicals. Distributed Digital Control Systems (DCS) were installed for the process units in the same year.

A Captive Power Plant of 26.3 MW ISO rating was commissioned in March 1991 to meet the power requirements of the refinery and to safeguard the operations against the power supply fluctuations in the State grid. During the year 1998, an additional Captive Power Plant of 17.8 MW capacity was commissioned making the Refinery self-sufficient in power.

Advanced Process Control (APC) technology was first installed in the Crude Distillation Unit – 1 (CDU-1) in March 1992 and subsequently the technology was implemented in FCC unit and CDU-2. The benefits arising out of implementation of APC are increased safety, enhanced yields, increased throughput, reduced energy consumption, etc. A plant wide computer network connected to the DCSs of all the process units, utilities and tankfarm areas along with a real time database for storage and retrieval of process information, was commissioned in the year 2001.

A Light Ends Feed Preparation Unit (LEFPU) to supply Polybutenes feedstock to Cochin Refineries Balmer Lawrie Ltd. (CRBL), a joint venture company, was commissioned in March 1993. CRBL was later merged with KRL in April 2001. A Raffinate Purification Unit (RPU) for the manufacture of 10,000 TPA of Petroleum Hydrocarbon Solvent was commissioned in January 1994, with the technology developed by the in-house R&D Centre. Kochi Refinery started commercial production of Mineral Turpentine Oil (MTO) in March 1995, utilising the existing facilities of the Refinery. Natural Rubber Modified Bitumen, another in house R&D product, started commercial production in September 1999.

A Diesel Hydro Desulphurisation (DHDS) plant with a capacity of 2.0 MMTPA was commissioned in March 2000, in order to reduce the sulfur content of diesel. In 2001 the entire tank farm operations were automated with the installation of Automatic Tank Gauging (ATG), DCS and online product blending systems.

All the major business management functions in Kochi Refinery are now driven by an integrated ERP system. Project MANTRA which went live on July 1, 2003 is the business transformation initiative embarked upon by the Refinery by implementation of SAP R/3 Software to revitalize it's functioning with state of the art information technology tools.

An LPG bottling plant of nameplate capacity 44,000 TPA was commissioned in August 2003.

We started producing auto fuels MS and HSD conforming to Bharat Stage-II norms from January 2005, well ahead of the implementation of the new fuel quality norms in the region. This was achieved by revamping of the DHDS unit for capacity enhancement to 2.6 MMTPA and processing of the FCC unit feed (VGO) and Diesel in block out mode of operation in the DHDS unit. The FCC unit capacity also has been enhanced to 1.75 MMTPA by revamping in May 2005 along with installation of Oxygen enrichment facilities.

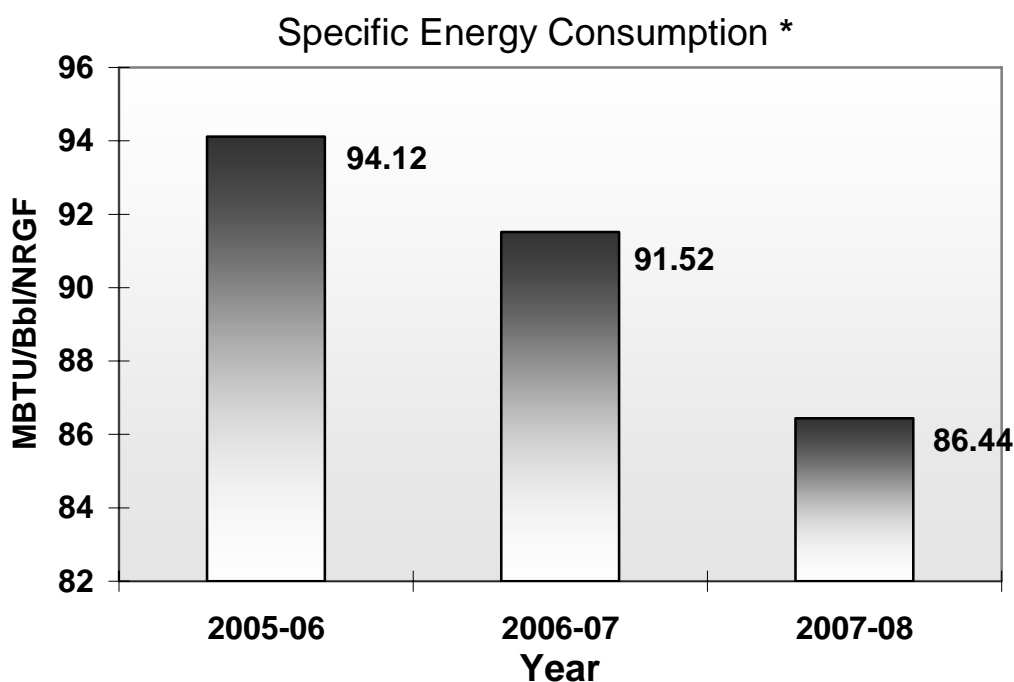
The Refinery became a subsidiary of M/s Bharat Petroleum Corporation Limited (BPCL) in March 2001. Pursuant to Order dated 18th August 2006 issued by Ministry of Company Affairs the refinery has been amalgamated with **Bharat Petroleum Corporation to form BPCL Kochi Refinery.**

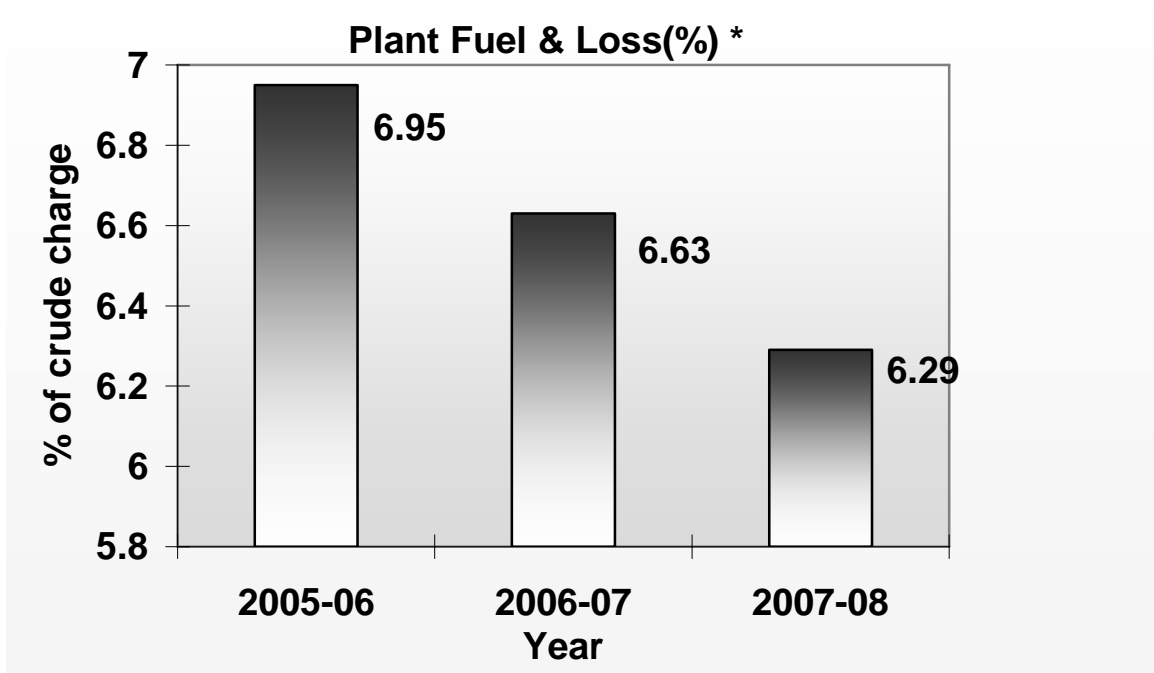
The major products manufactured by BPCL Kochi Refinery include LPG, Gasolene, Naphtha, Kerosene, High Speed Diesel, Light Diesel Oil, Furnace Oil, Low Sulphur Heavy Stock, Ordinary bitumen, Natural Rubber modified Bitumen (NRMB), Benzene and Toluene.

(ii) Energy Consumption

The two major indices of energy consumption for a petroleum refinery are Plant fuel and loss (% of crude oil processed) as well as specific energy consumption (MBTU/Bbl/NRGF). Despite the fact that, new units have been added in the refinery to improve product quality in compliance with increasingly stringent product quality norms we have been able to reduce our energy consumption by adopting energy efficient practices and implementing innovative process schemes for improving the energy efficiency of process units.

Below depicted are the trends on specific energy consumption and plant fuel & loss through the last five years.



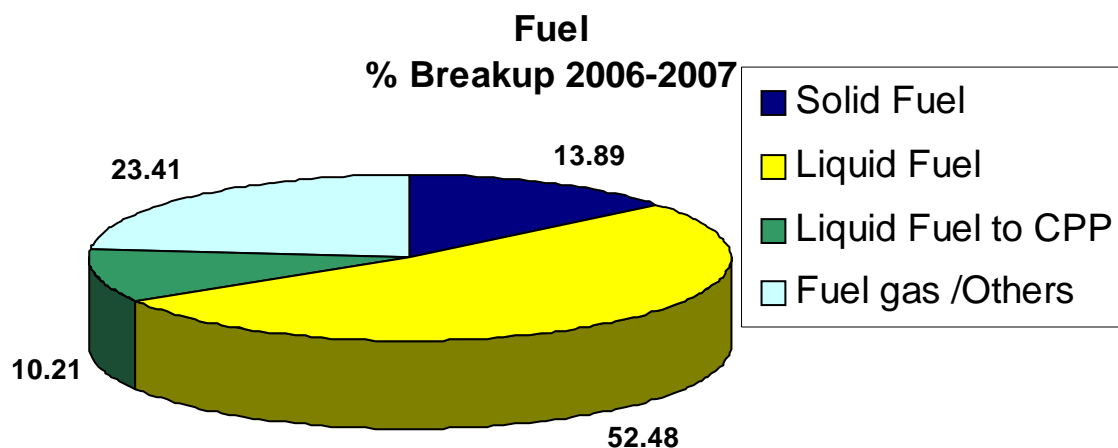


* The figures for 2007-2008 are unaudited figures for the first half of 2007-2008.

There has been a very significant reduction in specific energy consumption of the refinery from 94.12 in the year 2005-2006 to 91.52 in the year 2006-2007. Consistent with the reduction in specific energy consumption, the refinery plant fuel & loss has also come down from the figure of 6.95% in 2005-2006 to 6.63% in 2006-2007. This has been made possible by the consistent efforts in energy conservation by BPCL Kochi Refinery.

The fuel consumption pattern of the refinery during 2006-07 was as follows.

Solid fuel	68835	13.89%
Liquid fuel	260076	52.48%
Liquid fuel for Captive Power Plant	50607	10.21%
Fuel gas/others	116020	23.41%



(iii) Energy Conservation Commitment, Policy and set up

BPCL Kochi Refinery has integrated its Energy policy with its environment, health and safety policy, as any energy conservation measure helps in minimizing adverse impact on environment.

Kochi Refinery's commitment to energy conservation begins at the design stage itself by incorporating energy efficient techniques. Kochi Refinery has also implemented several energy conservation schemes based on the experience gathered during the operation. We have fully optimized heat exchanger trains, air preheaters and steam generators in process heaters and a plant lay out fully utilizing the terrain of the area minimizing the pumping requirements. Our policy is to conserve natural resources and to reduce energy consumption. Energy being a natural resource Kochi Refinery's commitment to energy conservation goes beyond the premises of the plant.

Through its own R&D effort, Kochi Refinery has developed natural rubber modified bitumen for road pavement. Field trials reveal that NRMB paved road has longer service life. Longer service life of NRMB roads results in lesser overlays of roads thereby reducing the pollution associated with heating of bitumen prior to laying. Vehicular emission is also reduced as vehicles plying on NRMB roads consume lesser fuel. Moreover, the fuel consumption of vehicles plying on roads paved with NRMB is expected to reduce by about 10%. This also results in substantial national savings.

Kochi Refinery is also implementing modernization project to meet the future specification of auto fuels.

We have a full-fledged Energy Conservation Cell under the Technical Services Department. A Chief Manager heads this cell and he is supported by the four officers for close monitoring of plant fuel and loss pattern. Regular audits of heater efficiencies, steam, insulation, hydrocarbon loss, overhauling of the energy consumption patterns are reviewed on daily basis.

In order to propagate the essence of energy conservation beyond the premises of the refinery, BPCL Kochil refinery has formed an ENCON CLUB comprising 25 schools and colleges in Kerala. The main objective of this club is to drive home the elements of energy conservation and environmental protection in the minds of the public. Kochi Refinery organizes various activities like seminars/workshops/quiz competitions etc on energy conservation at different locations within the state for the Encon Club members as well as the general public. Regular visits to the refinery are arranged for the Encon club members. Encon club also conducts awareness programmes for housewives, drivers etc.

Kochi Refinery conducts regular training programmes on energy conservation for our employees. In order to motivate our employees on energy conservation, we have a practice of distributing Encon mementos as part of Oil Conservation Fortnight Celebrations.

(iv) Energy Conservation Achievements:

Details of major Encon projects implemented in recent years are given below.

1. Inter connection of steam headers between DHDS & existing refinery

Investment - 491 lakhs
Annual fuel savings - 3115 tonnes
Annual monetary savings achieved - 280 lakhs
Year of implementation - 2002-2003

Two boilers UB8 & UB9 were commissioned as a part of the DHDS unit so as to meet the steam demand in DHDS block. Since the steam demand was less compared to the design capacities of the boilers they were running at lower load and lower efficiency. A scheme to interconnect the steam headers of DHDS and existing refinery was implemented as a result of which the boilers are able to run at higher load and higher efficiency. The modification has also contributed to improvement in the reliability of the steam system.

2. ATF Production without KHDS

Investment - 56 lakhs
Annual monetary savings achieved - 194 lakhs
Year of implementation - 2002-2003

The high energy intensive Hydro treating of Kerosene was switched over to Merox process (Mercaptan Oxidation) for production of Aviation Turbine Fuel.

3. Preheating of Demineralised water with Reformer process gas in DHDS

Investment - 10 lakhs
Annual fuel savings - 1380 tonnes
Annual monetary savings achieved - 130 lakhs
Year of implementation - 2003-2004

In DHE14 gas stream was partially bypassed in order to maintain the temperature of Boiler Feed Water in steam generation section of Hydrogen unit at 90 deg C. The gas stream was then cooled in air fin fan exchanger. A scheme was proposed to utilize the heat, which is lost due to bypassing of gas from DHE14 by routing more DM water through DHE14. The heated additional quantity of DM water was then routed to deaerator of Boilers UB8&9. Bypassing of gas in DHE14 could be avoided and one air fin could be stopped consequent to the above modification. Steam requirement in deaerator of Boilers UB8&9 could also be reduced to the tune of 2.5-3.0 T/hr as a result of the above modification.

4. Replacement of steam with vacuum diesel oil stream in two reboilers in LEFPU

Investment - 80 lakhs
Annual fuel savings - 2453 tonnes
Annual monetary savings achieved - 231 lakhs
Year of implementation - 2003-2004

LP steam was being used as the reboiling medium in LEFPU 1 (Light Ends Feed Preparation Unit). The scheme was implemented to save the steam being used for reboiling by making use of the heat available in VDO (Vacuum Diesel Oil) stream which is drawn at 160 Deg. C from the vacuum column of FPU (Feed Preparation Unit) and routed to storage after cooling.

5. Reduction of blade angle in DHDS cooling tower fan

Investment - Nil
Annual Power savings - 320,000 KWhr
Annual monetary savings achieved - 9.7 lakhs
Year of implementation - 2003-2004

Blade angle of two fans, A&C in DHDS cooling tower was reduced, since the cooling water delta temperature was less than the design delta temperature. Reduction in power consumption could be achieved for the fans, A&C and the power drawn by A or C was found to be less than that drawn by fan B the blade angle of which was not adjusted.

6. Routing of vent air from FCCU main air blower to bitumen blowing unit thereby shutting down of dedicated compressor for air supply to Bitumen unit

Investment - 3 lakhs
Annual Power savings - 1,380,000 KWhr
Annual monetary savings achieved - 70 lakhs
Year of implementation - 2003-2004

Bitumen is produced by blowing air through vacuum residue of Bituminous crude. Air for Bitumen blowing unit was supplied with the help of a dedicated compressor, prior to the routing of MAB (Main Air Blower) vent air from nearby FCC unit. Excess air (the difference between suction flow of the Main Air Blower and the discharge flow to the FCC Catalyst regenerator) is being vented to the atmosphere for maintaining the required total flow through the main air blower to avoid surging of the air blower. A part of the excess air vented to atmosphere was routed to the Bitumen blowing unit and the operation of dedicated compressor was discontinued.

7. Replacing Naphtha Splitter 1 heater with a steam reboiler thereby stopping bottom pump and saving in fuel.

Investment - 89 lakhs
Annual fuel savings - 1861 tones
Annual Power savings - 480000 KWhr
Annual monetary savings achieved - 208 lakhs
Year of implementation - 2004-2005

The existing heater reboiler (NH1) of Naphtha splitter was replaced with steam reboiler as a part of energy optimization scheme. By implementing this scheme the bottom circulation pump was stopped thereby saving power. Fuel saving was also achieved due to switching from less efficient heater to more efficient reboiler.

8. Replacement of metallic blades of air fin fans with FRP blades in crude distillation unit overhead system

Investment - 1.12 lakhs
Annual Power savings - 82000 KWhr
Annual monetary savings achieved - 2.6 lakhs
Year of implementation - 2004-2005

A combined power reduction of 25.12% was achieved in spite of an increase in air flow of 11.59% on replacing the metallic blades with FRP blades.

9. Insulation of Plant fuel Tk 190

Investment - 14 lakhs
Annual Fuel savings - 262

Annual monetary savings achieved - 36.16 lakhs

Year of implementation - 2005-2006

10.Lighting modification

Investment - 20 lakhs

Annual Power savings - 854000 KWhr

Annual monetary savings achieved – 44.40 lakhs

Year of implementation - 2005-2006

Sub station

An additional On Off Push Button Control is provided to reduce energy wastage. Circuit Modification carried out to segregate lighting.

Work Shop

An additional Automatic Timer Control is provided to reduce energy wastage. Circuit Modification carried out to segregate lighting

Administration Building, Canteen, Store and QC Lab

Old model 5 feet fluorescent tubes replaced with Energy Efficient Fluorescent Tubes. 4 feet fluorescent tubes replaced with Energy Efficient Fluorescent Tubes.

(v) Energy conservation plans and targets.

Our policy is to conserve natural resources and reduce energy consumption. In order to reduce energy consumption the following energy conservation activities are planned to be carried out in future.

1. Replacement of metallic blades of 64 air fin fans with FRP blades in process units.
2. Condensate recovery unit in Plant Fuel tank farm.
3. Application of friction reduction coating on 33 numbers of cooling water pumps.
4. Replacement of Naphtha stabilizer reboiler (LH1) with a steam reboiler.
5. Removal of overhead column compressor in Crude distillation unit-1 by routing overhead gas directly to heaters after amine wash.
6. Replacement of ordinary mineral wool with perlite insulation
7. Replacement of Crude charge heaters CH1A/B with high efficiency new heaters.
8. Replacement of KHDS charge heater KH1B with high efficiency new heater.
9. Reduction in reboiling steam in Amine Regenerator through increased DEA strength and reduced circulation.
10. Installation of VFD drives for LT motors, after a feasibility study.

Business Improvement Programme in association with Shell Global Solutions

Apart from the above schemes, BPCL Kochi Refinery had engaged M/s. Shell Global Solutions International (SGSI), Netherlands to carry out an “Integrated Refinery Business Improvement Program” (IRBIP) with emphasis on Gross Refinery Margin improvement, Energy performance improvement and Operations & Asset Management improvement.

BPCL, Kochi Refinery was the first refinery to start IRBIP. The program is being coordinated by Centre for High Technology, Ministry of Petroleum and Natural Gas. The assessment phase was conducted over a period of 7 weeks from 12th February, 2007 and concluded on 29th March 2007.

The IRBIP team consisting of domain experts from SGSI as well as BPCL-Kochi Refinery, thoroughly examined the business processes of BPCL, Kochi Refinery, in the areas of Margin, Energy and Operations & Asset Management, through a structured approach, at the end of which, a set of

business improvement ideas called Proposals for Improvement (PFIs) were identified. The expected margin improvement through the implementation of these proposals is about 0.5 \$/Bbl of crude processed.

The programme aims to optimize the operations of the refinery with minimum capital investment but through optimum use of the available assets. Some of the major PFIs with focus on energy performance improvement are listed below.

- Introduction of automatic combustion control in heaters and boilers.
- KHDS unit heat integration
- Better management of steam and power system using the concept of marginal pricing and reducing steam letdowns and loss of heat to cooling water
- Steam system optimization involving swapping of medium pressure stripping steam with low pressure steam and increase of deaerator pressure etc.
- Provision of LP steam air heater in heaters for improving the on stream factor of Cast air preheater
- Maximizing hot circulating refluxes in crude column in CDU-2.
- Optimization of auxiliary firing potential and increase of steam load in FCCU waste heat boiler.

(vi) Environment and safety

Kochi Refinery continues to strive hard for the improvement of environment performance and prevention of pollution. Commitment for environmental protection starts at the design stage itself by selecting environmental friendly technology. Regular audits are carried out by various internal and external agencies and the recommendations are promptly implemented.

We are the first industry in the state of Kerala to get consent from the Pollution control board for discharge of treated effluents into the inland waters.

We are also the first industry in Kerala to get the ISO 14001 certification. Kochi Refinery joined hands with Cochin port trust for the set up of Tier-1 facilities for combating oil spills. Kochi Refinery was the major contributor in this venture.

Kochi Refinery contributed 57 lakhs for this venture, which is 80% of the total cost. Regular mock drills are conducted as a part of the oil combating exercise.

Kochi Refinery also launched a new product Natural rubber modified bitumen (NRMB). Field trial reveal that NRMB paved road has longer service life. Longer service life of NRMB roads results in lesser overlays of roads thereby reducing the pollution associated with heating of bitumen prior to laying. Vehicular emission is also reduced as vehicles plying on NRMB roads consume lesser fuel. Moreover, the fuel consumption of vehicles plying on roads paved with NRMB is expected to reduce by about 10%. This also results in substantial national savings.

Kochi Refinery is recovering oil from the weathered oily sludge accumulated since 1966. We have processed about 31000 tonnes of sludge and recovered around 9200 tonnes of oil as on 31/03/2007. The oily sludge accumulated over the years have been nearly exhausted by adopting the environment friendly recovery method.

Kochi Refinery has taken proactive steps for the reduction of green house emissions through Clean Development Mechanism Projects (CDM) under the UN Framework Convention on Climate Change (UNFCCC). In this regard, we have identified three CDM projects and have approached Ministry of Environment & Forests for their formal approval.

We have received several awards in recognition of our efforts on the environmental front. Recently, we received 7th Annual GREENTECH Environment Excellence Award (Gold Award) in Petroleum Refinery sector for outstanding achievement in Environment Management for the year 2006. Kochi

Refinery was also awarded the Certificate of Excellence by Kerala State Pollution Control Board for the year 2006, for making substantial efforts to improve the environmental performance.

Safety

Our company is always vigilant in making the refinery a safe place for its employees and has invested substantially in automated safety and process control systems to ensure safe working conditions. Kochi Refinery's concern for safety is not confined to the premises of the company. Roads laid with NRMB (Natural rubber modified bitumen), a product developed by our R & D department, is more skid resistant which helps in considerable decrease in road accidents.

The sustained excellence of Kochi Refinery's safety performance have been rewarded with many a coveted prizes in the past. Some recent recognitions for BPCL-Kochi Refinery were the safety innovation award by Institution of Engineers (India) in the year 2007 and the award for outstanding safety performance by National Safety Council, Kerala Chapter in 2007.