

HPCL

R&D: Key to Unlock Future Challenges

H PCL is poised to follow an impressive growth both in terms of refining capacity & market share even in the emerging highly competitive market in India. There is a strong need for inhouse technical strength backed up by R&D to face the market challenges which can give several direct and indirect benefits. Thus, HPCL has taken up R&D in a significantly big way as one of the company's strategic initiatives.

HPCL's R&D initiatives come through two-pronged approach i.e., one is through setting up full-fledged world class R&D centre at Bangalore to cater the future research activities and other through taking up collaborative R&D in fundamental and applied research areas with national/international academic institutes & industrial R&D centres.

Hindustan Petroleum Green R&D Centre Project, Bangalore:

HPCL is in the process of setting up its Corporate R&D Centre at Bangalore with a total capital investment of about Rs. 500 cr. The R&D Centre's objective would be to make HPCL a Technology Leader through



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continuous innovative R&D efforts in developing, adopting and assimilating competitive, energy efficient and eco-friendly technologies for producing cost effective, profitable and customized quality products / processes. Senior Scientists have been appointed to head various Labs in the R&D Centre to initiate activities.

The R&D Centre is being put up in 2 phases. Phase I is planned to be in operation in about two years time and will have 9 research labs including Crude Evaluation and Fuels, Hydroprocessing, FCC/RFCC, Catalysis, Bio-processes, Process Modeling and Simulation, Standard Testing, Analytical labs and Centre for Excellence in Nano Technology. The objectives would be:

- Improvement of Processes & Cata-

lyst formulations for Key Refining operations: Hydro processing & Fluid Catalytic Cracking

- Widening of Crude oil Basket by evaluating new crudes & Improving Product blends.
- Development of Technologies for 2nd generation Bio-fuels Cellulosic Ethanol, Bio Butanol & Bio Hydrogen.
- Leveraging Nano Technology for improved Lube Blends, Catalysts, Corrosion Inhibitors, Environmental Chemicals/ Additives.

Second Phase will be taken up subsequently and will have facilities for Research in Alternate Energy technologies, Residue upgradation, Metallurgy, Engine, Hydrogen management, Tribo Chemistry, Additive Formulations, Bitumen, etc.

Research through Collaboration:

During the course of R&D Centre establishment, HPCL had also taken up collaborative R&D projects in a big way in all the potential areas of Catalysis, Nano-Technology, Hydrogen production & storage, Bio Fuels, Green House Gases reduction and Process modeling apart from scaling up of Novel technologies. The approximate investment being

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made by HPCL in collaboration projects is about Rs. 15 cr.

A brief of the major R&D collaborative projects taken up by HPCL with renowned organizations/institutes are as below:

a) Joint research with Indian Institute of Technology (IIT), Delhi & Centre for High Technology (CHT) for developing efficient catalyst systems which produce hydrogen from Natural gas and generate valuable by-products like carbon nano-fibers with no CO₂ generation. Experimentation till date has indicated promising methane conversion & hydrogen yield and further studies on modified & new formulations are in progress. Project is being funded by MoP&NG under the Hydrogen Corpus Fund (HCF) of Government of India.

b) Research project with Indian Institute of Technology (IIT), Madras to develop 'integrated artificial photo catalytic systems' for efficient conversion of CO₂ & water to hydrocarbons (e.g. methane, methanol, formic acid). The process involves absorption of sunlight and reduction of CO₂. Experimentation

for evaluation of various catalytic systems and support systems is in progress.

c) R&D project with GITAM University, Visakhapatnam to identify efficient nanoparticles and test as potential additives to lubricant. Research has succeeded in obtaining 8 to 16% mileage improvement using 'Cu' nano particles and achieving a stable formulation for 3-4 months. Inputs from the research work have helped HPCL in introducing commercial Nano-lubes 'NUMERO-UNO' & 'RHINO' in the market recently.

d) R&D project with Indian Institute of Science (IISc), Bangalore to carry out fundamental research on physical & mechanical behavior of nanoparticles (E.g., WS₂ & MoS₂) in lubricants. Research work has indicated less friction for WS₂ nanoparticles over MoS₂ nanoparticles. Further studies for improving stability & reduction of friction coefficients are currently in progress.

e) Collaborative project with Indian Institute of Technology (IIT), Kanpur for setting up a 'Process In-

tensification' technology demonstration unit at Visakh Refinery in lieu of Amine Absorption Unit being used for removing H₂S from the Refinery Fuel gas (Sour gas) using Di-ethanol amine as absorbing agent. The benefit of the process is to reduce footprints of the equipment in the Refineries by reducing area required for processing by using centrifugal forces over gravitational forces for generating high mass transfer coefficients. Process design, mechanical design & detailed engineering of the unit have been completed. Fabrication is in advanced stage.

f) Joint research with The Energy and Resources Institute (TERI), New Delhi with an objective to develop improved technology for production of H₂ through biological route. Research is being carried out on combined dark & photo fermentation processes using various bacterial consortia, with an objective to improve overall Biohydrogen yield (from 5 wt % to 15 wt %). Project is being funded by MoP&NG under the Hydrogen Corpus Fund (HCF) of Government of India.

g) Research with GITAM University, Visakhapatnam with an objective to develop new type of absorbent materials viz., Metal organic frameworks (MOFs) for storage of Hydrogen which will have capability to store & release H₂ at non-cryogenic temperatures and lower pressures. The advantages of MOF include large surface area, permanent porosity & high thermal stability. This will aid in designing efficient storage systems for Vehicular applications.

Project is being funded by MoP&NG under the Hydrogen Corpus Fund (HCF) of Government of India.

h) Joint Research and Exchange Program with IIT Kanpur in partnership with Chevron, USA and Advanced Refining Technologies (ART), USA (a subsidiary of Grace Davison). The program was initiated in 2005 and about 9 projects have been taken up since then with some completed and some in progress:

- Project on 'Monolithic reactors for multiphase reactions' with an objective to evaluate the potential of using novel monolithic reactors for multiphase reactions. Research results gave hope on evolution of new generation reactors.
- Project on 'Supported Ionic Liquid Catalysis & Hydrodynamics in Packed Bed' with an objective to evaluate feasibility and potential of using supported ionic liquid catalysts (SILC) for alkylation of benzene in batch and packed bed reactors. Studies in this area gave hope

on the discovery of new catalyst for Linear Alkyl Benzene (LAB) with enhanced activity.

- Project on 'Modeling of mass transfer effects in Resid FCC' with an objective to develop basic model philosophy & to analyze the mass transfer effects in the RFCC (Resid FCC) unit. Both Two phase & Three Phase Multi Lump models have been developed and validated for FCCs at HPCL refineries.
- Project on 'In-situ sulfiding on NiMo/Al₂O₃ catalysts' with an objective to enhance the hydro desulphurization activity of NiMo/Al₂O₃ catalysts by a better understanding of the In-situ activation procedure. The effects of several variables on sulfiding efficiency have been examined during the study.
- Project on 'Slurry bubble column hydrodynamics' with an objective to explore hydrodynamics of bubble column reactors. Extensive experimentation has been done on low pressure bubble column systems and work on high pressure bubble column is in progress.

- Project on 'Nanocatalysts for hydrodesulphurization' with an objective to design novel and efficient mono-dispersed porous bimetallic core as well as core-shell nanocatalysts and composition on alumina support for the hydro desulphurization reaction.

- Project on 'Alkylation of Isobutane with Butene for production of Gasoline' with an objective to develop several supported ionic liquid catalysts for alkylation of isobutane with butene and devise a procedure for regeneration of the catalyst.

- Project on 'CFD Simulation of Reactor Internals' with an objective to study & analyze the performance of the existing industrial distributors using CFD simulations and to optimize the flow conditions and flow geometry for enhance mixing, quenching and for preventing mal-propagation of temperature.

- Project on 'CO₂ capture using Zeolites functionalized with Ionic Liquids' with an objective to design & implement chemically activated Ionic Liquid based absorbents for enhanced CO₂ capture.

Apart from the above, HPCL is actively considering projects with various other Indian and Foreign universities for development of second generation Bio-fuels.

Thus, significant efforts are being made at HPCL with major R&D investments being made to build a strong technological base which benefits the organization in terms of profitability, market leadership and penetration into new markets.



Single Point Mooring Project (SPM), Visakh Refinery.