# EXECUTIVE SUMMARY

## 0.1 INTRODUCTION

Methanol is the first in the series of aliphatic monohydric alcohols & undergoes many of the reactions typical of this class of compounds. Methanol is a colourless liquid with a pleasant characteristic odour and burning taste. It is highly poisonous, causing blindness, madness & death depending on the dose. There is Indian Standard (IS 517) for methanol adopted by Bureau of Indian Standard.

Methanol finds extensive use in making formaldehyde, acetic acid, methylamines, DMT and others. The greatest consumption of methanol may turn out to be as fuel in admixture with gasoline and diesel. Methanol is a cleaner fuel for cars with better thermal efficiency and less pollution. Another outlet for methanol could be very fast growing chemical, methyl tert butyl ether (MTBE) replacing tetra ethyl lead.

## 0.2 PROCESS

Methanol is produced mainly from natural gas. Naphtha, fuel oil and coal are other suitable feedstocks. Modern industrial scale methanol production is based exclusively on synthesis gas mixture of hydrogen, carbon monoxide and carbon dioxide at a pressure of 50-100 atm and 250-300°C in the presence of copper catalyst (low pressure process). The process generally consists of four steps :

a. Pretreatment of feedstock for removal of sulphur.

b. Steam reforming for production of synthesis gas, sulphur free natural gas mixed with three volumes of steam are reformed at 815-843°C in presence of nickel oxide catalyst.

c. Methanol synthesis is conducted in methanol converter at about 250°C and 100 atm in the presence of copper catalyst.

d. The methanol formed is purified in a number of distillation columns one, two, three depending on end use. The production of methanol from coal involves gasification of coal, followed by shift reaction for generating synthesis gas with $H_2/CO$ ratio of 2:1. The synthesis gas is subsequently converted like natural gas.

## 0.3 STRUCTURE OF INDIAN INDUSTRY

There are five units spread all over the country with licensed and installed capacities of 351,500 TPA and 301,500 TPA respectively. The production in 1988-89 was 145,000 MT. Haldia plant is not in operation.

There was appreciable import of methanol; 78,000 tonne in 1987-88 and 43,000 tonne in 1988-89; apparently there is no import in 1989-90 and 1990-91. The current demand of methanol is more than 200,000 tonne. This demand is expected to grow to around 300,000 tonne in 1994-95 & 425,000 tonne by 2000 AD, as per perspective plan projections.

The feedstock for the manufacturing units is Fuel oil/LSHS and Naphtha. Associated gas is now available to RCF at Trombay, and natural gas to both GNFC at Gujarat and Assam Petrochemicals Ltd., Assam.

Two manufacturing units RCF & NFL have Haldor Topsoe technology while Rama Petrochemicals is based on Lurgi technology. ICI supplied technology to GNFC & Assam Petrochemicals Ltd. (Unit-II), Unit-I Mitsubishi. The technology imported by indigenous manufacturers have been evaluated and the actual consumption of raw materials and utilities by different units have been furnished with profile of each manufacturing unit.

## 0.4 TECHNOLOGY STATUS INTERNATIONAL

The present installed world capacity of methanol is about 21.0 million TPA. There are in total 70 methanol plants with capacities ranging from 50,000 TPA to 825,000 TPA. The current world consumption is around 18 million TPA. The chemical demand is 15.3 million TPA and fuel demand 2.7 million TPA.

The demand in 1995 is expected to be 21.0 to 22.0 million TPA which will go upto 24.0 to 30.0 million TPA by the turn of the century.

The thrust in international technology is towards energy efficient process. There is intense competition which is reflected in total energy requirement claimed by various process licensors. The names of process licensors with consumption coefficients (G. cal per M.T.) in brackets are Uhde, Germany (7.0), Lurgi, Germany (7.3), ICI, U.K. (7.17), Haldor Topsoe, Netherlands (7.44).

Simultaneous thrust is also towards improvement of catalyst.

Experiments are on to develop methanol converters where methanol formed will be removed to shift the equilibrium favourably. Liquid phase methanol process to utilise unshifted carbon monoxide rich feed gas from coal gasification, by Air Products, USA is fairly successful. As reformer represents nearly 30-35% of cost of the project, work is intense in this field to develop radically new reformer technology. The modern trend is towards the steam reforming of natural gas followed by autothermal reforming (mainly for large plant) so as to produce a stoichiometric gas and hence minimise feed consumption. The catalyst used in the original high pressure process was based upon zinc oxide and chromium oxide. This catalyst is activated at high temperature and consequently high pressure is required for favourable equilibrium. The copper based methanol syn-

thesis catalyst is the key to the low pressure process. The development of copper based catalyst gave a much more active catalyst which allowed the reaction to be carried out at a low temperature.

## 0.5 TECHNOLOGY ABSORPTION EFFORTS BY INDIAN INDUSTRIES AND GAPS

Indian manufacturing companies by and large have not put sufficient R&D efforts for indigenisation and absorption of imported process technology and catalyst. However, catalyst is available from indigenous sources like PDIL, Sindhri and United Catalyst Ltd, Delhi, for desulphurisation and reforming of natural gas. PDIL claims to have developed methanol synthesis catalyst but yet to be tried in commercial plant. Switch over to natural gas for all the manufacturing units and possible utilisation of coal for gasification to act as alternate feedstock should be considered seriously in view of uncertain supply position of petroleum crude and foreign exchange reserve. Engineering capability exists for fabrication of reformer tubes, methanol convertor and distillation columns/ equipment. However, material of construction for reformer tubes and methanol converter are still imported. About 80-85% of the capital equipment are indigenously available as per industry sources.

Projects & Development India Ltd. (PDIL) is the only wholely Indian organisation who is licensed to offer Haldor-Topsoe methanol technology. PDIL offers all catalyst except synthesis one. Synthesis Catalyst is under development. Infrastructure facilities in certain areas need improvement for safe, efficient and economic movement of raw material and finished product besides attracting talented persons by the industry.

The international technology has moved towards energy efficient low pressure technology. The energy consumption has gone down from 9.0-10.0 G cal/MT of product to 7.0-7.5 G cal/MT. The development of copper based catalyst has made this possible by operating the plant at lower temperature and pressure. As reformer accounts for nearly 30-35% of project cost, attention of research scientists in methanol field is directed towards developing a compact gas heated pressure reformer to replace present day massive multiple burner structure.

The manufacturing units that are operating more efficiently in India consume about 9.35-9.74 G Cal/MT of methanol compared to 7.2-7.5 G Cal/MT achieved by advanced countries. The thrust area for indigenous technology should be to utilise natural gas to the maximum extent to cut crude oil import bill but also to concentrate on coal gasification & subsequent manufacture of methanol. Indigenous methanol technology should also be considered for development.

## 0.6 RECOMMENDATIONS

Blending of methanol with diesel and petrol upto 3% without engine modification could be allowed for automobile use as demonstrated by Indian Institute of Petroleum.

India has large reserve of natural gas. Steps may be taken to utilise the gas (specially associated gas) for manufacturing methanol.

Immediate attention may be paid to huge reserve of coal in eastern sector for gasification and possible utilisation as synthetic gas for manufacturing methanol.

Considering the present level of energy consumption of 9.35-9.74 G Cal/MT in India compared to 7.0.7.5 G Cal per MT abroad, necessary action may be taken for yield and energy optimisation in Indian plants to approach International level of energy consumption.

Projects & Developments India Ltd., Engineers India Ltd. and such other organisations are well equipped in terms of resources to give turnkey service in the field of methanol and may be encouraged.

For improvement of methanol industry in terms of capital goods, process technology and catalyst established manufacturers, PDIL, research institutes and fabricators may form a consortium.

Indian industry may venture into MTBE production to meet twin objective of methanol consumption and octane booster replacing TEL from air pollution point of view. Efforts to indigenise capital goods and accessories should continue keeping economics and safety in mind.

Cost of production should be competitive enough for export in future.