EXECUTIVE SUMMARY

1. Methyl Ethyl Ketone (MEK) worldwide is, primarily, produced with n-butene/2-butene as the raw material via sec butyl Alcohol (SBA) route as 90-95% of SBA produced is utilized for manufacture of MEK.

2. The mixture of 1-butene, cis-2-butene and trans-2-butene is referred as n-butene whereas cis and trans-2-butene are collectively termed as 2-butenes. Production of pure butene isomers or a concentrate of n-butenes requires separation/processing from the complicated nature of raw C_4 streams containing isomers of butane and butene besides multiple unsaturated C_4 hydrocarbons.

3. The raw C_4 stream is obtained on Separation of C_3 /C_4 stream form Fluid Catalytic Cracking (FCC) units in Refineries and Naptha steam crackers in petrochemical plants. The components of C_4 stream offer many potential Petrochemical applications. Technology and Processes are available for separation, conversion and upgradation of these components for desired end use.

4. The utilization of 2 butenes or n-butenes as feed stock for MEK production is dependent on Demand and supply scenario particularly of 1-butene, which is highly in demand as a copolymer for Linear Low Density Polyethylene (LLDPE).

5. A modern MEK manufacturing unit shall comprise of the following key sections :-

   a) Hydration of n-butenes to produce Sec Butyl Alcohol.

   b) Catalytic Dehydrogenation of SBA to produce Methyl Ethyl Ketone.

6. Process Technology for a Modern complex for production of MEK is available from a number of Technology Licensors.

7. Sec Butyl Alcohol is produced either by hydration of n-butenes/2-butenes in a two step process consisting of esterification with sulphuric acid and subsequent hydration of the Ester to SBA or in a single step process of direct hydration using acidic Ion-Exchange resin (IER) as a catalyst.

8. For catalytic Dehydrogenation of Sec Butyl Alcohol to produce MEK two alternative technologies are available.

   a) Vapour phase dehydrogenation using copper, zinc or bronze as catalyst.

b) Liquid phase dehydrogenation using Raney Nickel catalyst and an inert high boiling solvent to keep the mixture in liquid state at the reaction temperature.

9. Process technology is also available for production of MEK by direct oxidation of n-butenes (Hoechst-Wacker Process) in the presence of palladium chloride and copper chloride. The main disadvantage of this process are formation of chlorinated butanones and n-butyraldehyde and corrosion caused by free acids

10. Small quantities of MEK are also produced as a by-product in the liquid phase oxidation of n-butane to acetic acid.

11. Technology of Vapour phase Dehydrogenation of SBA with Copper Catalyst is favoured for MEK production due to its lower temperature operation and minimum side reactions. For liquid phase Dehydrogenation of SBA, the only technology available from IFP is adopted. In most of the MEK plants, however, facilities for SBA production from n-butenes have to be provided as SBA is not readily available.

12. USA, Western Europe and Japan constitutes about 95% of the worldwide production capacity of MEK. The total production and consumption of MEK in USA, Western Europe and Japan in the year 1992 was around 869,000 MT (production) and 718,000 MT (consumption). Export form these areas to other MEK consuming countries were of the order of 151,000 MT in 1992.

13. The production of MEK within the country is of recent origin as the two plants viz. Cetex Petrochemicals, Madras and Consolidated Petro-Tech Industries, Baroda have been commissioned in 1991 with a total installed capacity of 7,000 MT per year.

14. Besides the two plants, already commissioned, a project by Vam Petro-Products Ltd. (a joint venture of vam Organic chemicals Ltd. and PICUP) is planned for production of 4,000 MT per year of MEK besides poly butylene and Maleic an-ahydride, at Kosi Kalan, Mathura based on raw C_4 stream (after propylene separation) from FCC of Mathura refinery. It is, however, understood that Vam Petro-Products have not yet initiated any action on this project although the separation facilities being provided at mathura Refinery are in an advanced stage of implementation. There is, therefore, some uncertainty about the implementation of this project.

15. MEK is an excellent solvent and is mainly used in production of paints and lacquers, adhesives, magnetic tapes, dewaxing solvent, printing ink, solvent extraction, fluids, dyes, artificial leather, pharmaceutical applications. MEK is also utilized for production of high value chemicals/compounds for industrial application.

16. Cetex Petrochemicals, Madras (Capacity 4,000 MT per year) has achieved about 83% capacity utilization in 1993-94. The capacity utilization of consolidated Petro-Tech industries was, however, about 34% in 1993-94.

17. The direct information about consolidated Petro-Tech. Industries was not available. The information/data has, therefore been obtained from various sources. It appears that they are having problems in stabilizing the production and it is understood that some debottlenecking has been undertaken by them.

18. To achieve stable production and minimise operational difficulties in the manufacturing process of MEK, the broad areas requiring attention are metallurgy and Instrumentation in acid handling areas, process control parameters and scheduled Inspection and maintenance.

19. The commercial production of MEK in the country, commenced in the year 1991. The requirement of MEK till then were being met by imports only. However, even after commissioning of the two plants, the imports are still continuing, although at a lower level.

20. MEK is a low volume consumption chemical in the country. The end use consumers of MEK are quite large in number, each consuming small quantities except for oil refineries where its consumption is significant as a solvent in dewaxing plants. The demand during 1992-93 was of the order of 4,200 MT comprising of about 1,500 MT at the oil refineries and remaining 2,700 MT for other large number of small consumption end users.

21. The future increase in demand of MEK in the country is expected from two levels. The first is from the growth of end users who are already using MEK. The second level is from the consumers who can use MEK but are using other solvents and are willing to switch over to MEK, once its easy availability is assured

22. The future demand projection of MEK, in the country, by the year 1999-2000 is estimated to be around 7,800 to 9,500 MT per year based on probable or optimistic estimates. These estimates includes the increase in requirement of MEK by three oil refineries where dewaxing unit capacities are planned to be increased.

23. The three lube complexes have been proposed by the end of 9th plan (year 2001-2002) with a total lube capacity of 1.2 million tonne per year. These projects are in very preliminary stages and the processing scheme and other details have yet to be firmed up. In the present context, catalytic Dewaxing being the State-of-art technology for Dewaxing, any unit is unlikely to be based on old conventional solvent Dewaxing process. Any additional requirement of MEK for these projects is considered unlikely. This could, however, be reviewed.

once the processing scheme and schedules for these plants are firmed up.

24. The feed stock availability is adequate for the present installed capacity of 7,000 MT per year of MEK production, as it has been committed by IPCL to consolidated Petro-Tech Industries, Baroda and MRL to Cetex petrochemicals, Madras.

25. In the country there are 9 F.C.C units in Refineries from which Madras Refineries is the only refinery presently separating C_4 stream from F.C.C. mathura Refinery is putting up facilities for separation of C_3/C_4 stream of F.C.C. which are in advanced stage of implementation. The raw C_4 stream is expected to be available from Mathura Refinery for further separation/processing to obtain feed stock for about 4,000-5,000 MT per year of MEK production.

26. There is potential for production of raw C_4 stream from F.C.C. units of other Refineries if required and proper separation facilities are considered for C_3/C_4 stream. The provision of these separation facilities are high capital intensive investment in the range of rupees 30 to 50 crores depending on the capacity and off-site facilities required. To ensure economic viability of such investment, it is imperative that all the cuts obtained form the separation facilities are tied up as feed stock for production of high value added petrochemicals in the down stream units. The separation facilities with high investment does not appear to be economically viable only for MEK feed stock.

27. The cost of production in any capital intensive petrochemical plant broadly comprise of 50% variable cost and 50% capital related charges. In variable cost the major factor is feed stock pricing and is, therefore, important for economic viability of the plant. Presently, the international price of MEK feed stock is lower than the indigenous feed stock price, where as MEK product price has to be maintained comparable to imported MEK. This puts the MEK producers, using indigenous feed stock, presently, at an economic disadvantage, which in any case is likely to change depending on the movement of prices of feed stock and MEK in the international market.

28 The plants designed and commissioned in recent years give emphasis on energy conservation at the design stage itself. However, continuous effort is required in day to day operations for optimising energy consumption. The broad areas analysis in this respect are heater efficiency, optimisation of heat exchangers and their cleaning at scheduled frequency, recovery of gases from flare for use as fuel, optimisation of reflux in fractionation columns and leakage control.

29. Cetex petrochemicals have taken steps for environment control so as to achieve, no liquid effluent discharge from the plant and minimising

flare by recovery of gases from flare system of utilization as heater fuel.

30. The limited demand of MEK in the country was being met by imports only, till commercial production in the country commenced in 1991 and as such no R&D effort has been made in this field. The Technology for the installed production capacity has already been imported. The priority for R&D efforts in this areas is not likely to be commensurate with the effort and investment required. However, cetex petrochemicals have initiated some in house R&D activity in respect of development of catalyst and utilization and market for oligomers.

31. There appears to be no technology gap at present as indigenous producer of MEK has successfully absorbed the imported technology while achieving 83% capacity utilization. Cetex petrochemicals has even indicated that they are in a position to provide Basic Engineering Package (BEP) to other prospective MEK producers and commission new MEK plants.

32. The Indian Design and Engineering companies have developed adequate expertise for detailed engineering of projects based on process know-how supplied by foreign vendors.

33. Indian vendors have developed excellent capabilities to design, fabricate and manufacture static and rotating equipment including pumps, comressors, instrumentation, electricals etc. There has been continuous drop of imported items for the projects. In the cetex petrochemicals plant for MEK production, the foreign exchange component was less than 8% of the total project cost. Most of the items like columns, vessels, heat exchangers, heaters, pipe fitting, electricals, instrumentation (DDCS) are also being indigenously manufactured. Bulk of the equipments and materials are, therefore, available in the country for setting up a MEK plant.

34. Indian Standards for MEK has not yet been formulated and the Quality Control is being carried out as per international test methods.

35. The laboratories of the production plants, where MEK is currently produced and various other R&D and testing laboratories in the country are well equipped to carry out full tests for checking the quality of MEK, as per the test methods.

Recommendations

36. The manufacturing process of MEK is corrosion prone in some areas and could result in operational difficulties. The metallurgy and instrument control system besides other operating parameters may be reviewed by production units and action initiated, where ever necessary, so as to achieve stable production and improve capacity utilization.

37. An additional production capacity of the order of 3,000 to 4,000 MT per year of MEK by 1998 can be considered to meet the demand, primarily from indigenous production.

38. The Indian design and engineering companies should keep abreast of developments taking place overseas in the area of engineering design so as to produce designs with emphasis on energy conservation and Environment Control.

39. Bureau of Indian Standards may consider formulation of Indian Standards/Test methods for MEK.

40. The MEK production involves handling of hydrocarbons and acids in the process. The industrial units should ensure that, adequate steps, as per prescribed safety standards, are taken for Environmental protection and safety assurance.