EXECUTIVE SUMMARY

1. Acrylonitirle (ACN) is a monomer, also known as propenitrile or vinyl cyanide is a colourless liquid with a characteristic odour resembling peach seeds. Pure acrylonitrile is very reactive and polymerises readily especially under the influence of light, whereby its storage needs addition of polymerisation inhibitors.

2. ACN has varied application ranging from manufacture of acrylic fibers, styrene co-polymers e.g. ABC and SAN, nitrile rubbers and as an intermediate for manufacture of acrylates, acrylamide, drugs and pharmaceuticals.

3. In India presently, there is only one unit manufacturing Acrylonitrile. The Company, Indian Petrochemicals Corporation Limited (IPCL), Baroda, using Sohio technology involving ammoxidation of propylene. Propylene, ammonia, and air are reacted over a catalyst (Catalyst C-41 or C-49) in fluidised bed reactor to form some HCN and acetonitrile, which is separated from ACN by distillation. The resulting acrylonitrile, containing water and other impurities, is then further distilled to achieve a purity of 99%. IPCL, Baroda had originally a Licensed/Installed capacity to manufacture 24,000 tonne/annum of ACN, which has been increased to 30,000 tonne/annum after revamping. The production of ACN has increased from 18,000 tonne in 1982-83 to 27,000 tonne in 1991-92

4. At IPCL, Baroda, the average capacity utilisation during the last decade has been around 84%. In some of the years low capacity utilisation has been due to shortage of basic raw material propylene. IPCL gets process updates from SOHIO/BP chemicals in the form of technical disclosures and licensee meetings for exchange of information.

5. There are two letters of intent issued for ACN manufacture in India, viz; Reliance Industries Limited for 70,000 tonne/annum and Haldia Petrochemicals Ltd. for 50,000 tonne/annum. There is no progress on implementation by these two companies.

6. The demand of ACN in India based on end use pattern has increased from 27,500 tonne in 1988-89 to 48,000 in 1990-91 and is expected to reach upto

62,000 tonne by end of 1992-93. The gap in demand and supply which is approximately 34,000 tonne is currently met through imports.

7. The only Indian manufacturer, IPCL has increased the installed capacity from 24,000 tonne to 30,000 tonne per annum by modification in the plant design and operation techniques with limited capital expenditure. The modifications include change of Catalyst C-41 by C-49, modification in reactor cyclones, modification in air grid, feed sparger, trickle valve and absorber to reduce reactor pressure at higher throughput. The single stage quench system was modified by a two stage system and incinerator heat input was reduced by introducing suitable additives.

8. IPCL has absorbed the technology as transferred by the process licensor adequately and are able to operate the plant efficiently and effectively. The quality of ACN produced is at par with International Standards. However, recovery of major by-product i.e. HCN needs to be improved by IPCL and a more aggressive marketing of HCN may have to be undertaken for additional operating benefits.

9. The world's proven technology licensor M/s. Sohio (now taken over by M/s. B.P.Chemicals) are very conservative in their licensing policy. M/s. B.P. Chemicals themselves have a ACN manufacturing facility of their own and their licensing policy will be restricted by the responsibilities faced by licensor in India in terms of pollution control, safety requirements, process yields, plant design etc. The consideration that in a slow growing ACN international market, their own exports may be affected by additional plants, using their technology will also be a restrictive factor in further licensing.

10. The salient features of major contemporary technologies have been discussed in this report. The major process technologies available world wide are Sohio (Now B.P Chemicals), Montedision - UOP Nitto, PCUK/Distillers, OSW and SNAM process. However, more than 90% of world wide ACN installed plants use Sohio technology.

11. The world wide production capacity of ACN in 1990 was 4216 thousand tonne per annum. The actual production in the same year was about 3548 thousand tonne. The world capacity of ACN is likely to touch 5313 thousand tonne by the end of year 1999 and world production is likely to touch 4537 thousand tonne by the end of the same year.

12. The major end use of ACN is Acrylic fiber industry which consumes more than 60% of the total ACN produced, followed by ABC and SAN resins, adiponitrile and Nitrile rubber industry.

13. World over currently ACN is manufactured using propylene ammoxidation technology. More then 90% of the installed capacities for ACN are now based on this technology. The ammoxidation technologies are based on either fluidised bed or fixed bed. The reactor effluents in respect of each of these technology differ with the catalyst and reactor configuration. A comparative analysis of different parameters of ammoxidation as also technologies been carried out is described in Chapter 3 of this report.

14. There has been no research activity undertaken by IPCL in the area of ACN manufacturing technology. Some efforts have been made in the pollution control and waste treatment of various products coming out of the ACN plant of IPCL at Baroda and the same have been beneficial.

15. The thrust areas identified for R&D activities in India related to ACN manufacturing include, design of a heterogeneous catalysts for ammoxidation reaction and fluidised bed reactor development.

16. The R&D efforts being carried at International level have been studied and classified into (a) Reactor modelling and apparatus design for reactions (b) Pollution controls and waste treatment (c) ACN manufacturing technology (d) Purification of by-products and (e) Catalyst structure, composition and their production. International Abstracts of patents and other published references in each of the above areas have been presented in this report. Indian patents taken by international process licensors have also been presented in the report.

17. Due to certain recession in the Acrylic Fibre markets, there are some ACN plants which have closed down in Europe because of slack market conditions. Some of these ACN plants are available for sale.

18. In developing countries the developmental emphasis is on catalyst and process which gives maximum yield of ACN from propane/propylene and minimum yield of by-products i.e. Hydrocyanic Acid, it can only be incinerated being extremely poisonous. The by-products value addition in such an eventuality becomes negative.

19. Propane ammoxidation is the thrust area of R&D for major process Licensor of ACN. However, commercialization of the process technology is still awaited. This development is considered to be significant in view of large propane and restricted propylene availability.

RECOMMENDATIONS

1. The setting up of new Acrylonitrile production facilities in India may ensure timely setting up of downstream plants which can use all HCN produced, as by-product. This will avoid problem of pollution control and cost of incineration of HCN.

2. There has been no development in the areas of manufacturing process technology/process engineering etc. by either IPCL or NCL. Efforts must be made to implement recommendations of high powered committee on thrust areas of research to be undertaken at NCL and IPCL.

3. In the context of recent liberalisation policy of Government, setting up of new ACN capacity will be governed by following factors:

   a) Adequate availability of basic raw materials namely propylene & ammonia

   b) Opportuity cost of propylene when used for manufacturers of ACN & or other end products like polypropylene

   c) Possibility of setting up ACN capacity with Technology levels comparable to international plants in other developed & developing countries. The acrylonitrile from such a new plant should be available at prices & quality comparable to international standards.

   d) The proposed propane amoxidation technology is expected to be commercialised by 1995. M/s. BP/Sohio will be the process licensor and the possibilities of licensing of this new development is not very bright. The option before Indian (Present & prospective) are:-

      i) Wait for licensing of the new technology (May be after 5/6 years)

      ii) Set up plant based on propylene and current Sohio technology of propylene ammoxidation

iii) Try to negotiate purchases of some ACN plant which have now ceased operation & after refurbishing of worn out equipments and use it for additional demand satisfaction

iv) Pursue BOC offers for P.S. absorption for propylene recovery and using a plant combining dehydrogenation/absorption of unreached propylene and ammoxidation of propylene.

Detailed discussions regarding actual states of BOC Technology reliability & efficiency of the process and cost benefits can only be carried out by IPCL or prospective entrepreneurs. They may also verify BOC claims by checking up experience of another licensee. A decision can only be taken to accept this technology after such detailed discussions, with process licensor and a user are carried out.

4. In view of restrictive licensing of process licensor of ACN, a possibility of setting up a reconditioned plant, which may be available for sale in Europe can be examined.

5. In view of the likely increase of consumption and lack of indegenous capacity for ACN manufacture and reluctance of M/s. B.P. Chemicals for further licensing technologies, IPCL's ability to set up new plant may perhaps be the only way to avoid large import and foreign exchange outflow in the nineties for the country.

6. An organisation having process and engineering expertise having close links with research institutions, end users can be made responsible for new technology selection and adoption.