EXECUTIVE SUMMARY

1.0 CEMENT MANUFACTURING PROCESS

The cement manufacturing process may be divided into three classes i.e. wet process, semi-dry/semi wet process and dry process. The old cement plants are based on wet process but the new plants invariably adopt the dry process except in rare cases where the raw materials characteristics may decide for wet or semi dry process. The dry process is very much superior in terms of fuel economy. Due to this single main factor a number of older wet process plants are getting converted to dry process.

2.0 CEMENT PRICING AND CONTROL

Selling and distribution of cement was under Government control since August 1942 except for a short period during 1966 and 1967. In February 1982 the Government allowed partial decontrol of cement and the same was in force till February 1989. Since than, under total decontrol announced by the Government in the budget of 1989, cement factories are free of any control on sale and distribution of cement.

3.0 CEMENT INDUSTRY AND ITS DEVELOPMENT

- The cement industry in India has grown from an installed capacity of 5 million tonne per annum at the end of First 5-year Plan (1951-56) to an installed capacity of about 43 million tonne per annum at the end of Sixth 5-year Plan (1980-85). The installed capacity at the end of 1989 is about 55.3 million tonne per annum.

- Cement industry's overall capacity utilization has not been very satisfactory although there is increase in the year 1988 with respect to the year 1987 where there was a sharp fall from the previous year.

- The factors contributing towards low capacity utilization include :

  * Poor quality coal with upto 45% ash content and irregular supply.

  * Power cuts, power trippings and unstable supply voltage.

  * Transportation bottlenecks in transporting cement and coal over long distances.

* Lack of operational experience and trained manpower with the newly emerging large size plants to absorb and adopt the technological developments.

* Lack of proper plant maintenance system.

Various agencies have tried to project the future demand of cement. All the studies have confirmed that there is likely to be a gap between demand and supply of cement until the end of the century. The short fall estimated by the Working Group on Cement Industry, appointed by the Government, by the year 1999-2000 is around 13 million tonne.

The cement machinery industry has grown rapidly keeping pace with the growth of cement industry. The first group of cement machinery manufacturers was established by the end of Second 5-year Plan under foreign technical collaboration. Value of machinery production has increased from Rs.4 million in 1955-56 to more than Rs.800 million in 1984-85 as per available data.

Indian Cement Manufacturing industry backed by collaboration agreements with world-renowned machinery manufacturers are capable of supplying plant, machinery and equipment for large size cement plant of capacity 3,000 tpd and above, based on up-to-date state of the art technology.

As observed during the last few years, there is gradual reduction of import content of cement machinery due to development of manufacturing capability in the country.

With the free sale and distribution of cement, the cement producers now experience a different market situation and the industry is now subjected to increased competitions with respect to availability of high quality cement. This means lower cost of production, increased production efficiency, use of most modern technology for energy efficiency and quality cement production.

4.0 TECHNICAL DEVELOPMENT IN INDIAN CEMENT INDUSTRY

- Different unit operations have undergone substantial development with introduction of Dry Process technology in the Cement Industry based on preheater and precalciner. Various kiln systems have been developed to achieve improved fuel efficiency. The size of modern dry process kilns is now standardized between 1500 tpd to as high as 4500 tpd.

- The development in other areas include use of vertical roller mills in place of ball mills for grinding raw materials and coal, use of preblending stockpile and continuous homogenizing silos for homogenization of raw meal, use of roller press and high efficiency separators for energy efficient cement grinding, electronic packing machines for improved weight reliability and efficiency, packed bag loading machines, advanced process control and instrumentation etc.

- The dry process cement plants presently being installed are equipped with most effective pollution control measures to fulfil the stipulations laid down by the Pollution Control Authorities. Many old plants are now installing pollution control equipment to meet the stipulations. Suitable pollution control equipment of advanced design including ESP, fabric bag dust collectors, gravel bed filters etc. are now available in India from reputed manufactures.

5.0 MINI CEMENT PLANTS

- Mini cement plants have contributed significantly towards the growth of cement industry of India. These plants are based on either vertical shaft kiln technology or rotary kiln technology. The advantages of VSK technology are :

  * Production of cement in a decentralised manner;
  * Low cost of installation;
  * Plant can be designed for lower capacity so that small limestone deposits also can be used;
  * The Machinery can be fabricated by small workshops;
  * Low dust emission;
  * Low maintenance and refractory cost;
  * Low space requirement;
  * Clinker is easier to grind and therefore, consumes less power.

- Mini plants based on rotary kiln usually follow dry process with suspension preheater. The machinery are supplied by a number of medium scale manufacturers.

  The designs for mini cement plants (rotary kiln/VSK based) has been developed indigenously.

6.0 TECHNOLOGY IMPORT AND CURRENT STATUS OF TECHNOLOGY OF INDIAN CEMENT INDUSTRY

- The technological features of various cement plants and their machinery and equipment, designed and manufactured in India under different collaboration agreements with world renowned foreign cement machinery manufacturers, have been analysed. For the purpose of this study, 6 operating cement plants with rated capacities of 1200 tpd, 1500 tpd and 3000 tpd and also a white cement plant of 300 tpd capacity (presently under execution) have been considered.

- Similarly, technological status of 8 reputed Indian machinery manufacturers having different foreign collaboration arrangements have been analysed under the following groups of machinery/ technology :

  * Limestone crushing (Impact crusher)
  * Preblending stockpile for limestone (stacker-reclaimer)
  * Vertic roller mills for raw materials and coal grinding
  * Preheater and kiln
  * Cement grinding
  * Cement packing

  The salient features include unit-wise details of capacity, machinery suppliers, collaboration arrangements, unit performance, training, R & D activities, problems encountered, trouble shooting, status of absorption and adaptation of technology.

7.0 RESEARCH AND DEVELOPMENT EFFORTS

- Absorption and adaptation of technology depends to a great extent on the research & development (R & D) activities of the licensees. The major R & D organisations devoted to cement industry in India are :

  * National Council for Cement and Building Materials (NCB)
  * Central Research Station (CRS) of ACC Limited
  * Dalimia Institute of Scientific and Industrial Research (DISIR)

  The main machinery suppliers who have their own R & D divisions are :

  * Larsen & Toubro
  * Walchandnagar Industries Limited

Among the cement plants, Cement Corporation of India has established a centralised R & D Centre.

- The R & D units have contributed significantly to the development of indigenous technology as well as adaptation of imported technology.

- Areas which may be considered for detailed study by a centralised research institute include energy conservation, production optimisation, quality enhancement, development of special cement, human resources development, modern computerized methods for quarry planning and waste heat recovery.

8.0 TECHNOLOGY ABSORPTION EFFORTS

Factors which effect absorption and adaptation of technology are :

* Organisational capabilities and infrastructure of the receiving company.
* R & D activities of the recipient company.
* Technology support services.
* Training programme for the local personnel.

- The organisational capabilities and infrastructure should be strong enough to handle the following tasks required for project execution :

* Raw materials and fuel investigation.
* Basic equipment design.
* System design and detailed engineering.
* Equipment manufacture.
* Commissioning services.
* Plant operation.

- It was observed that none of the machinery manufacturers have all the facilities and capability for conducting complete raw materials, fuel and product investigation. Technical facilities available at the National Council of Building Materials and Central Research Station at ACC are not utilised to the extent they should be done.

- In the areas of equipment design and commissioning services with particular reference to large modern cement plants, indigenous capabilities are limited. The Indian machinery manufacturers depend considerably on their foreign collaborators who have the requisite infrastructure supported by pilot plants and R & D facilities as well as investment capacity for continuous technology development.

- Some of the equipment manuacturers, however, have developed capability of carrying out system design and detailed engineering of modern cement plants.

- R & D activities are limited to very few specific areas and are being carried out on a modest scale.

- Significant progress has taken place in the areas of electrical engineering and software design for computer aided process and quality control.

- Training of personnel is another area which appears to have been inadequately handled. Most of the cement plants and machinery manufacturers do not have a long term plan for training.

- Effort of exporting cement machinery from India has not achieved success worth mentioning. Except export of machinery for dry process plant in Indonesia installed under Government to Government arrangement and to Nepal there has not been any export of modern dry process plant machinery. Indian machinery manufacturers attribute the failure to high cost of machinery and lack of confidence by potential importers in Indian cement machinery. Efforts shall continue in this direction by the Indian machinery manufacturers convincing the potential buyers about availability of latest technology with Indian manufacturers backed by high degree of quality assurance.

- Efforts made by the Indian Consultants, specialised in the field of cement, in developing an improved concept of system design based on use of energy efficient machinery, modern technology for process and quality control as well as efficient pollution control equipment have significantly contributed towards adaptation of state-of-the-art technology by the Indian Cement Industry.

9.0 GAPS IN TECHNOLOGY AND FUTURE PROSPECTS

- The cement manufacturing process has undergone significant improvement since introduction of precalcinator technology. The maximum capacity of a single kiln has gone up substantially. However, most of these large plants are yet to settle down to their full rated production efficiency.

- Analysis of teething troubles and failures in some large plants reveals that the causes pertain to poor quality of raw materials and coal, non-availability of trained manpower, lack of experience of the industry in operating large size machinery of advanced design, failure of indigenously

made auxiliary equipment in many cases, lack of complete techno-economic evaluation of precalcinator technology since most cement plants using the technology are yet to settle down fully, lack of proper operational feed back from Indian cement plants, inadequate commissioning and post-commissioning assistance from Indian cement machinery manufacturers on their own.

- Special thrust may be given towards developing indigenous technology in case of vertical roller mill components, preblending system, kiln system and cement grinding wherein the contemporary developments achieved in Europe, Japan and USA may be incorporated.

- As per experience of the Consultants and also mentioned above, mechanical failures have often occurred with the auxiliary machinery such as large motors, elevators, screw conveyors, belt conveyors, dampers, gear boxes, electrical and electronic components and others, rather than main machinery, in most of the cases. Main machinery suppliers must fix proper norms for high degree of workmanship, quality assurance and effective after sales services for these auxiliary manufacturers when these are supplied as bought-outs alongwith the main machinery, which is now the most common concept in case of large cement plants.

10.0 RECOMMENDATIONS

10.1 All manufacturers should endeavour to set-up and strengthen R & D infrastructure particularly aimed at absorbing/adapting/developing newer technologies for better energy efficiency, quality enhancement and optimum operating efficiency. The co-ordination between the R & D plans of the licensor and those of the licensees should be clearly established.

10.2 All licensees should have 'Master Design Data' so that at the end of collaboration agreement they are in a position to carry out the basic design engineering on their own and get the same only reviewed by the licensors, if necessary. In other words the licensors should be confined to a 'reviewing' role from their present 'doing' role.

10.3 A centralised training centre may be established under the control of the Cement Machinery Manufacturers Association in collaboration with reputed manufacturers of the machinery. The main area of activity should be manpower development, up-gradation of technology, equipment design, improvement in manufacturing procedures and quality assurance.

A note on the present status of studies carried out under World Bank assistance is enclosed as Annexure-22.

10.4 An attempt should be made by a reputed R & D organisation to have testing facilities, supported by qualified personnel, which are at par with those available with foreign cement machinery manufacturers. The facilities should cover all types of chemical, physical and mineralogical testing. This would generate confidence among the users i.e. cement manufacturers and cement machinery manufacturers of the capability, reliability and accuracy of the work done.

10.5 An agency to suitably monitor the technological development taking place in the world and the status of technology of Indian cement industry should be established. Assistance in evaluation of technology could be taken from R & D establishments. A lead in this direction, for initiating and co-ordinating these activities, can be taken by R & D organisations such as the National Council for Cement & Building Materials (NCB).

10.6 All machinery manufacturers as well as cement manufacturers should prepare and follow a well conceived human resources development plan instead of ad-hoc training. It should inter-alia cover areas of training, number and level of personnel to be trained, duration and places of training.

In view of the erection and commissioning problems, being faced in a number of units using advanced technology which had/have to depend almost exclusively on expatriate engineers/technicians involving substantial expenditure in foreign exchange, all licence agreements should have adequate provision for rendering training to licensees' personnel in carrying out such operations independently.

The technology transfer agreement should inter-alia cover :

- provision for training of Indian engineers.

- involving Indian engineers in actual erection and commissioning of plants at the collaberator end, as a part of the training.

- duration of training should be fairly long, say, upto six months at least.

10.7 All the concerned cement plants should endevour to set-up computerised kiln and mill simulators which have revolutionised the operators' training in these areas for gaining or improving operating knowledge at lower cost, lesser time and practically no risk. To start with, use of these simulators may be taken-up on a centralised basis. A full scale simulator facility at Hyderabad centre of NCB is already available and should be made use of, by the plants for the purpose.

A few cement plants have also set-up their own simulators which can simulate key operating functions and variables for imparting training to their personnel. Such training tool may be adopted by larger cement units.

10.8 There should be an effective monitoring and evaluating mechanism for the implementation of approved technology transfer agreements. Preferably, every year an audit to examine the status of absorption/adaptation should be carried out with the assistance of an appropriate technical agency/ organisation.

10.9 The R & D and training plans outlined in the original as well as renewal applications for technology transfer may be vetted, if necessary with the assistance of an appropriate technology agency/organisation.

10.10 The Centralised R & D centres (Government/non-Government) shall include the suggested thrust areas in the R & D programmes for speedy implementation. Specific projects of R & D nature based on requirements of cement plants, may be chanalised through the Cement Manufacturers Association.

10.11 Modern Computer based methods should be installed whenever possible for improvement/optimisation of process and quality control, energy conservation, deposit evaluation and mines planning, maintenance management etc. Efforts should be made to identify all software packages specifically designed for modernisation of cement plants operation available from indigenous agencies/organisations as well as from reputed foreign organisation.

10.12 An indication that the technology acquired has been assimilated, is the ability of a recepient company to act in turn as supplier of technology to enterprises in other developing countries or even in developed countries as horizontal and reverse flow of technology. Reverse flow of technology, may however take some time for Indian industry to materialize. Possibilities of incorporating such provisions should be explored while dealing with renewal applications.

10.13 System for gathering relevant operational data of different elements of technology discussed in this report should be initiated. Based on this 'data base', a periodic techno-economic evaluation of their performance could be carried out with the assistance of the appropriate technical agency/ organisation.

Actions on recommendations suggested above should be supplemented by proper monitoring of the progress to ensure effectiveness of the programme. The monitoring agency, in addition, may also provide guidance to overcome any bottleneck which may be confronted during the implementation of the recommendations.