

**TECHNOLOGICAL ADVANCEMENT AND CHANGES IN CEMENT INDUSTRY
IN TELANGANA STATE, INDIA**

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ABSTRACT:

Telangana state is new and 29th state in Indian Union formed on 2nd June, 2014. Presently Telangana state has diversified its industrial base, with thrust on high-tech sectors. Traditional sectors like textiles, mineral based and food processing are also playing key role in industrialization. In 2018, the cement industry in Telangana has completed 60 years and having a first class cement technology. Since its instigation the cement industry in Telangana state has undergone the whole way through many technological up-gradation and changes in process of cement production. The Development of cement industry with technological innovations is a field of behavioural science related to regional planning. Technological advancement and changes is essentially achievement of sustainable development. In the present paper it is aimed to analyse the dramatic changes fascinating place in technology of cement production in Telangana, where innovative and better enhanced methods required to be developed to deal with such changes in the industry. Changes in the various variables cause modification in firm's organization which is important to its survival: skilled manpower, machinery, technology and knowhow in the modern industrial sector. The present research paper depicts the technological development and changes in cement industry in Telangana state. This paper also focuses the impact of technological advancement and growth of cement industry in Telangana state in terms of installed capacity, cement production and capacity utilization.

Key words: Technology, up-gradation, sustainable, machinery, capacity utilization.

INTRODUCTION:

Cement is the most pre-eminent material used for construction process next only to water. Cement industry plays a vital role across the world as its products occupied top priority to the construction industry and fabricates a vital contribution in growth of Gross Domestic Product (GDP) of a nation. Due to the huge geographical extent and more population of the country, innumerable constructions were initiated by government both central and state as well with private sectors leading high demand for cement in Indian states. Recently, Telangana Government has initiated many constructional programmes in state such as provision of 2BHK to all the houseless poor families and other includes Mission kakatiya, Mission Baghiratha and many irrigation projects like Kaleshwaram project and Nakkalagandi reservoir etc., across the districts of Telangana state, which are potential for growth of cement demand in the market.

Since it is partial deregulated in 1982, the cement industry in Indian states attracted a lot of investment lead the industry second largest cement producer in world next only to

china. In Telangana state, the growth of cement industry with modern technology has started in 1990s and it has reached to a first class technology by 2000s. (Technological advancement includes computer aided technology, operation research, scientifically management). Generally, technology refers about the information of tools or instruments or machinery that is used for enhancement of output at minimum operation cost and to maintain good quality at desirable level. The technological progress and cement process advancement help in the reduction of requirement of manpower in the process of manufacturing cement.

The energetic environment necessitates modifications in their organization to alter and adopt better manoeuvre methods. The cement industry in Telangana state is also undergone through the different changes in technological front in the last two and half decades and taking part in the growth of cement industry in Telangna state. The Telangana cement industry is the combination of semi-dry and dry process plants and pre-calculator technology plants of large capacity assimilating with latest technological advancement. The growth of investment in the cement industry in Telangana state gave a momentum to the state of art technology. At present, Telangana cement industry has been constructing modern major cement plants since 1990s, which are resemble to the plants being launched in world class technology. In the present paper an attempt is made to analyse the all the way changes taking place in technological progress of cement industries in Telangana state.

STUDY AREA:

Telangana state is the new and 29th state of Indian union which has come into existence Hyderabad as capital city on 2nd June, 2014. Telangana state has been carved out of united Andhra Pradesh with a geographical extent of 112077 km² and it has a population of 35 millions (as of 2011 census). It stood 12th Rank in terms of areal extent, population and forest cover in Indian union. The state lies between 15° 55' North latitudes to 19° 55' North latitudes and 77° 15' East longitudes to 81° 19' east Longitudes.

The Telangana state comprises of 10 districts namely – Adilabad, Nizamabad, Karimnagar, Medak, Rangan Reddy, Hyderabad, Mahaboobnagar, Nalgonda, Warangal and Khammam. The erstwhile 10 districts of Telangana state have been re-organised into 31 districts for better and decentralization of administration from 11th October, 2016.

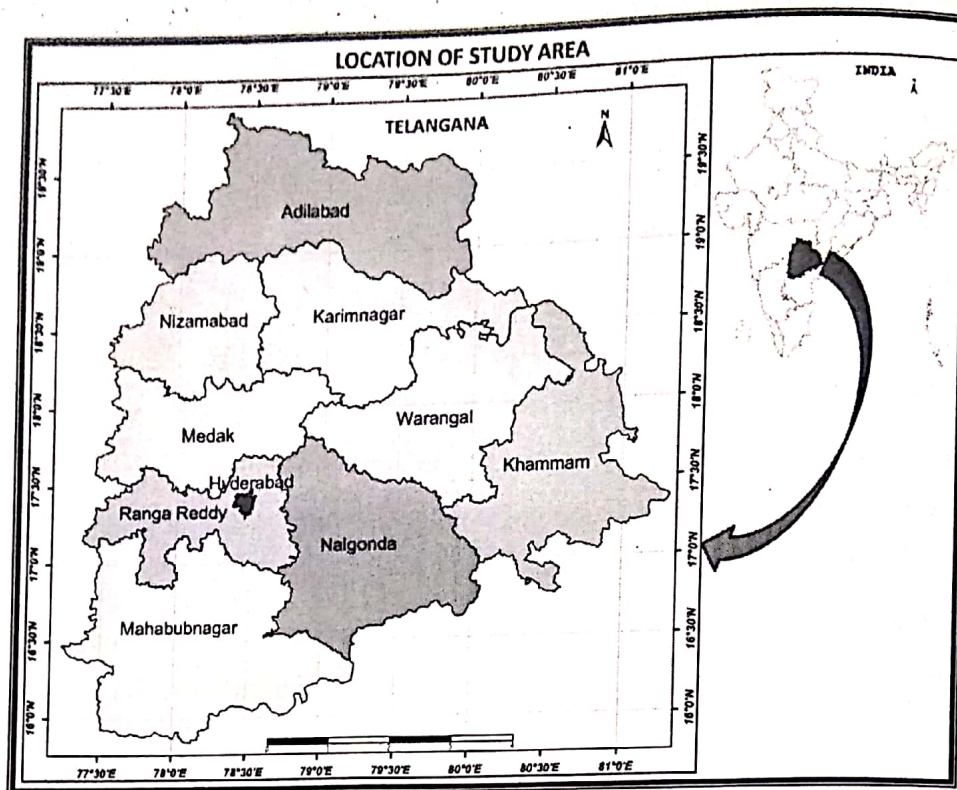


Figure 1: Study Area

LITERATURE REVIEW:

The cement industry in Telangana state is 60 years old and it is one of the major manufacturing industries in the modern economic sector. The cement industry is well bestowed all types of necessitate raw materials, man power, modern technology and know-how. The studies carried out till now on technological aspects of cement industry are very fewer and mostly they were macro in analysis. There was no broad study conducted on the cement industry problems and technological aspects especially at micro level. Although a plethora of studies of analytical literature is present on various aspects of the cement industry at macro level and all those studies are out dated. The present research study paper makes an attempt to spotlight on the studies similar on the cement industries in Indian states.

Vijayaragavan T and Rajamohan S., (2007), stated that growth of cement industry is one of the imperative indication of infrastructure and economic development of a country on a wide-ranging scale. Since beginning of plan period's growth of the industry has been recorded continuously. In terms of technological advancement, improvement of quality and capacity of cement production in cement firms have been upcoming a long way.

Ghose S (1962) has made an attempt to analyse the correlation between employment, earning and productivity of labour during 1949 to 1958. He found that the employment has

gone up due to the extreme cement demand in huge quantity, money earning of labour has enlarged and productivity has increased from 1952 onwards.

Ramanadhan K., (1973) has studied growth and working of cement firms and he focused on the designed endeavour to uphold the growth and development of economy for placing the cement industry at top position.

Balakrishna A V.,(2008) has studied and found that the fast increase in expenditure for infrastructure sector by Government of India gave an impetus in rise for cement demand in the country. He also found that the cement industry was the choice of many corporate spreading away from the difficult traditional areas of textiles and jute industries.

Lalwani (1984) investigated productivity tendency with special reference to utilization of capacity in cement industry for 15 cement firms during the period from 1970 to 1981. Productivity changes are the consequence of power shortage, coal incompatible performance and railway sectors and mechanical troubles.

Goel V K and Nair N K., (1978) had studied the level of capacity under-utilization and efficiency of principle inputs in the cement industry in India for a period 1954 to 1976. They also made imperative contributions on production trends of the Indian cement industry.

Arya (1983) had evaluated the technological change contribution in the growth of cement production for 1956 to 1972 using cobb-Douglas production function for 15 cement firms in India. He observed that out of 15 firms 8 firms proved considerable growth rate and strength of capital increases at a rate of 2.9 per cent per annum.

NEED OF THE STUDY:

A detailed review of literature given above are the foremost studies in industrial economics in general and related to growth, production, employment generation and trends in productivity of Indian cement industry in particular. There is no inclusive and intensive study carried out on different facets of development of technology and changes taking place in cement industry of Telangana. In Telangana state numerous researchers, agencies and institutions have conducted scientific studies and the cement industry was incapable to exemplify the attention of researchers to any traceable degree. Nevertheless the studies related to technological front are vital to play a key role in attracting and noticeable attention in the era of rivalry. They were not acutely concerned to the subject of cement problems and failed to diminish existing maladies of the cement industry, which most of them are outdated. Thus, the present research paper is designed to through some light on the technological gaps and trends with reference to practices of cement industry in India. Data scantiness has

restrained the scholar to take-up in depth and up to date analysis of technological problems of cement industry in Telangana state.

OBJECTIVES OF THE STUDY:

Principle objectives of the present research study are:

- i. To examine the technological progress and changes in Cement industry in Telangana state
- ii. To bring out technological gaps and changes of cement industry in Telangana with orientation to national level practices.
- iii. To suggest suitable measures for better improvement of cement technological process.

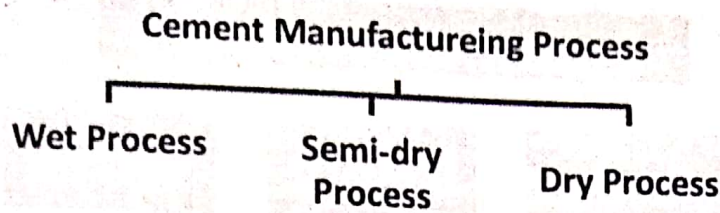
DATABASE AND METHODOLOGY:

The present research paper is based on secondary data. The principle sources of secondary data are annual reports of cement plants, Cement Manufacturer's Association reports, statistical abstracts of Telangana, Statistical hand books and published journals etc. The study also required statistical techniques of percentages, averages, graphs and diagrams for analysis and presentation of available data.

1. Cement manufacturing process:

Cement is a fine powdered inter-mixture of multi compounds. It includes the calcium silicates and aluminates in definite fixed fractions. The principle raw materials used in cement production are limestone, clay, sand, gypsum, dolomite, coal, bauxite and energy in form of electric power. The cement production has three distinct manufacturing processes namely, Wet, Semi-dry and Dry process.

Wet Process: In this process, the raw material is combined into the kiln in the form of standardized slurry, which has 40 per cent water content. The wet process take places essential in the case when the raw materials extracted from nature with huge moisture content where limestone grade is less quality has been improved through a process of beneficiation necessitating utilization of water as a process media. According to a study wet process requires 0.28 tonnes of coal and 110 kwh of power to produce one tonne of cement. Hitherto, concerning employment, the wet process cement plants requires twice as many workers as a dry process cement plant need.



Semi-dry Process: the semi-dry process is cheaper than the wet process. This process is developed to counter the negative aspect of the wet process. Wet process involves fewer heat input, but it requires high energy than wet process. This process has 12 to 14 per cent of moisture content. In this process powdered raw meal is either renovated into nodules by adding controlled quantity of water by de-wasting slurry in a filter press to form filter cake of the raw material. The limestone nodules accordingly formed are fed onto a stirring grate where raw meal becomes partly calcined. Further it is transferred into a rotary kiln for absolute calcining and sintering clinker form.

Dry Process: Dry process is inexpensive of cost and energy on the contrary to other type of processes. This process has below 1 percent moisture content. For this raw materials are dehydrated in a raw meal drying a grinding plant. This process of drying of raw material is attained by kiln exhaust gases, which will be supplemented by supporting hot boilers in rainy seasons.

2. Analysis and Discussion

In Telangana, there was existed unremitting technology transfer from the old wet process technology to modern dry process technology during 1960s to 2000s. Generally, the technology selection choice of the wet process and dry process depends upon the water content of raw materials locally available. In 1990-91 out of 24 firms, 18 were dry process, rest of them 5 were wet processes and 1 was with semi-dry process. But, in 2010-11, out of 25 plants, 24 plants are dry process and only 1 by semi-dry process and all wet process kilns were replaced by plants with modern dry process technology. At present, there are 23 cement plants in the state. Out of 23, the dry process cement plants are about 22 and only one plant belongs to semi-dry process technology. The study reveals that the achievement in innovation and technological progress is quite impressive in cement industry of Telangana state (see table 1).

Table 1: Changing Profile of Cement industry in Telangana state

Process / Year	1990-91	2000-01	2010-11	2014-15
Wet Process				
No of Kilns	5	2	--	--
Installed capacity TPD	1239	396	--	--
% of Total	6.08	1.25	--	--
Semi-dry Process				
No of Kilns	1	1	1	1
Installed capacity TPD	1005	1005	1005	1080
% of Total	4.93	3.16	1.28	1.29
Dry Process				
No of Kilns	18	22	24	22
Installed capacity TPD	18129	30369	77814	82686
% of Total	88.99	95.59	98.72	98.71
Total kilns	24	26	25	23
Total Capacity TPD	20373	31770	78819	83766
Average kiln	849	1271	3284	3642

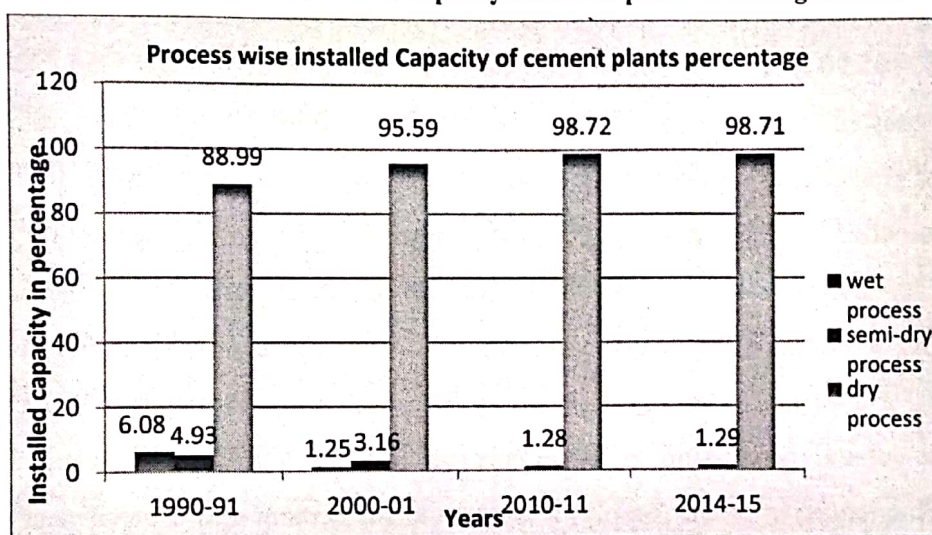
Source: Cement Manufacturer's Association report, Telangana and Andhra Pradesh

In 1990-91, the installed capacity of dry process technology was comprised of 88.99 percent; wet process accounted of 6.08 percent and 4.93 percent of semi-dry process technology. And by the end of 2000-01 the cement process technology dramatically changed and the installed capacity of dry process technology increased to 95.59 percent, where as capacity of semi-dry process technology declined to 3.16 per cent and capacity of wet process reduced to 1.25 percent. At present, in Telangana, 98.7 per cent of installed capacity is based on modern dry process technology and 1.29 per cent by semi-dry process technology. It is found from the analysis that the plants with less energy efficiency of wet process technology steadily transferred to more fuel and energy efficient dry process technology during the period 1990-91 to 2000-01.

Today, the cement industry of Telangana encompasses predominantly of dry process technology with suspension of pre-heater and pre-calciner technology plants. It is observed that there have been all flexible technological renovations in each and every segment of production process such as exploration of raw materials, up-gradation of process, plants and machines modernization, adoption of computer aided technology and modern equipments in packing and distribution of cement products. The introduction of new technologies in cement sector such as remote sensing and photogrammetric techniques have contributed the cement industry in determining the cement grade limestone deposits.

The advanced and up-graded instruments such as surface miners, new loaders with large wheels, new crushers and hydraulic excavators etc have make possible to growth of installed capacity of cement industry. The cement industry in Telangana has been implemented the modern pre-heat and pre-calcinator technology which caused in growth of installed capacity of cement industries during 2000-01 to 2010-11. And few numbers of mini cement plants have been enlarged their installed capacity and now they become major plants with modern equipment in all the way of production process. At present, in Telangana, the cement plants with new kilns and dry process technology are mostly energy efficient and almost all dry process plants account 99 per cement are of efficient in low energy consumption.

Figure 2: Process wise installed capacity of cement plants in Telangana state



In Telangana state, till 1990s the average installed capacity of cement plants was about 300 TPD. After a decade, in 2000 the installed capacity of cement plants increased to about 1200 TPD and it further increased around 3200 TPD in 2010 to 4000 TPD in 2015 (see table 2). The introduction of pre-heater and pre-calciner technology bestowed an opportunity to the cement industry to upgrade the dry process and to start major cement plants with latest technology.

Table 2: Changing Profile of Kiln Capacity, Heat Consumption and Power Consumption of Cement industry

Year	1990-91	2000-01	Post 2010-11
Kiln Capacity (TPD)	300-1200	1200-3200	3200-4000
Heat Consumption (Kwh/ tonnes Clinker)	800-900	650-750	600-750
Power Consumption (Kwh/Tonnes Cement)	120-130	100-110	70-90

Source: Cement Manufacturer's Association reports, Telangana and Andhra Pradesh

This led the industry to improve the installed capacity of existing cement plants. The trend in the present day cement industry in Telangana is an indicative of affinity to establish modern major cement plants with installed capacity of more than 600 TPD. In Telangana presently there are about more than 6 plants with installed capacity of 6000 TPD.

3 Growth of installed capacity and cement production:

In Telangana state, there are about 19 major cement plants and 4 mini cement plants with an installed capacity of 283.5 LTPA and 7.5 LTPA respectively. Telangana cement industry has increased from an installed capacity of 3.35 LTPA by the end of Second Five year plan period 1956-61 to 62.85 LTPA by the end of Seventh Five year plan period 1985-90. Furthermore, the installed capacity of cement plants increased to 67.92 LTPA during 1990-91, 105.90 LTPA in 2000-01, 262.73 LTPA in 2010-11 and 291.22 LTPA in 2014-15. It is forecasted that the installed capacity increases about 352.14 LTPA in 2020-21. It is observed from the analysis that the installed capacity of cement industry in Telangana has been dramatically increasing with the advent of modern dry process technology since 1990s.

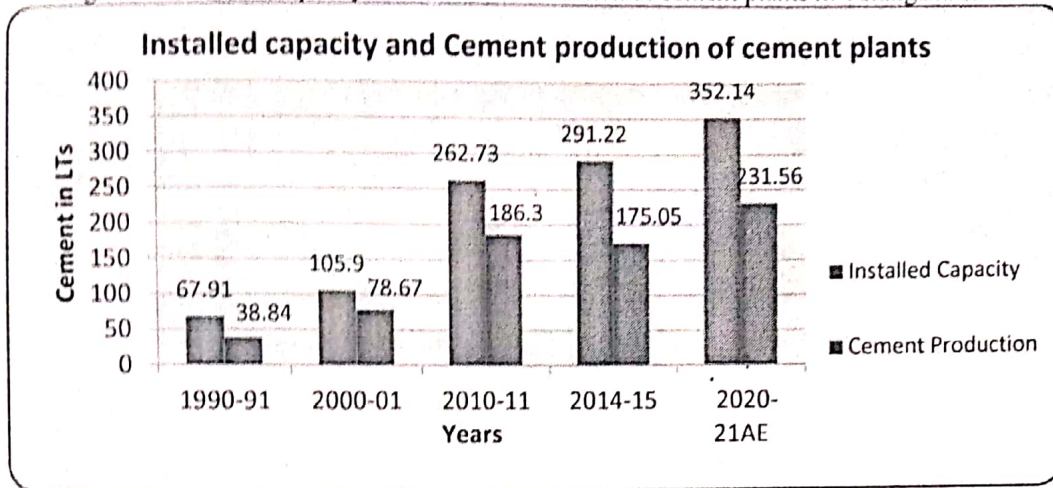
It is also observed from the study that the cement production in Telangana has been increasing with many ups and downs. The total cement production was about 38.84 LTs in the year 1990-91 and it has increased to 78.67 LTs in 2000-01 and 186.30 LTs in 2010-11. But, the cement production in Telangana declined to 175.05 LTs during 2014-15. The abrupt fluctuation in power supply, less demand for cement and unsteadiness in real estate sectors are also responsible for the decline in the cement production in Telangana. It is expected that the cement production in Telangana increases about 231.56 LTs by the end of this decade. The initiation of new irrigation projects and flag ship programme of 2BHK housing in Telangana and the construction of new Amaravathi city in Andhra Pradesh state are the potential sources for the growth of cement demand in Telangana state.

Table 3: Installed Capacity and Cement Production in Telangana state

Year	Installed Capacity (in LTPA)	Cement Production (in LTs)	Capacity Utilization (in %)
1990-91	67.91	38.84	57.19
2000-01	105.9	78.67	74.29
2010-11	262.73	186.30	70.91
2014-15	291.22	175.05**	60.11
2020-21AE	352.14	231.56	65.76

Source: Cement Manufacturer's Association reports, Telangana and Andhra Pradesh
AE- Advanced Estimates, ** does not include production of coramandal cement company which is not in operation in 2014-15.

Figure 2: Installed Capacity and Cement Production of cement plants in Telangana state



Source: Cement Manufacturers Association report, Telangana and Andhra Pradesh.

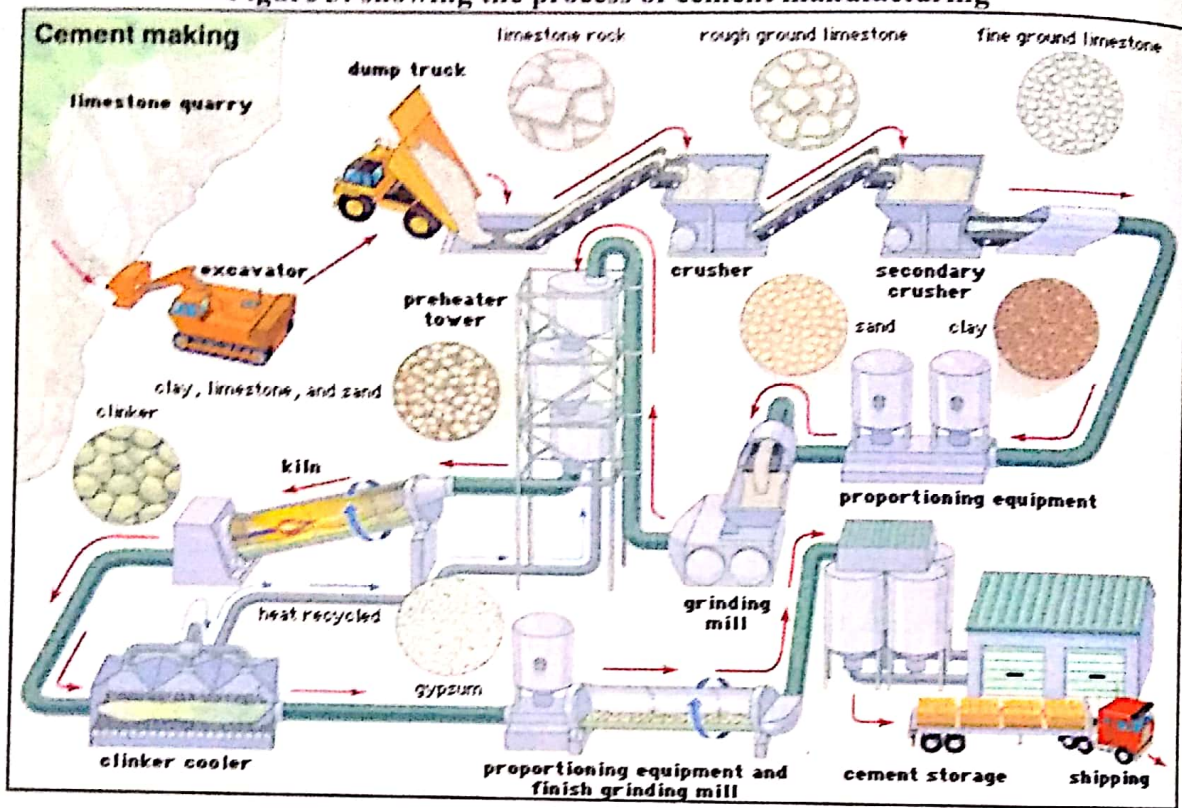
The above table 3 discloses that there has been found a wider gap between installed capacity of cement plants and cement production since the instigation of cement industry in Telangana and maintains till yet in 2020-21. It is forecasted that the gap will be continued in the upcoming. The cement plants in Telangana are not utilizing its complete installed capacity in cement production. The capacity utilization of cement plants in 1990-91 was 57.19 per cent, in 2000-01 increased to 74.29 per cent and 70.91 per cent in 2010-11.

However, the capacity utilization of cement plants in Telangana during 2014-15 is declined to 60.11 per cent. It is found from the analysis that the cement plants in Telangana are suffering from over installed capacity of cement. This is led by the modernization of dry process technology plants which accounting of 98.7 per cent and more than 60 per cent of installed capacity built in recent past. The gap between cement capacity and cement production in 1990-91 was 29.07 LTs, 27.23 LTs in 2000-01, 76.43 LTs in 2010-11, 116.17 LTs in 2014-15 and it is projected that the gap will increase about 120.58 LTs in 2020-21. The trends of cement capacity and cement production for the above period depicts the expansion and development of cement industry in Telangana and increasing growth for cement demand, and Capacity un-utilization of cement plants since on years. The cement industry in Telangana has been implementing the modern manufacturing technology for conservation of energy and quality control based on state of art of automation system.

The cement plants in Telangana have been changed from the old wet process technology to the most energy efficient dry process technology. Consequently, the setting up of pre-heater and pre-calciner technology has gave an impetus in growth of installed capacity and cement production of cement plants more than two and half times. At present more than

98 per cent of cement plants in Telangana have been adopted modern dry process technology in all the way.

Figure 3: showing the process of cement manufacturing



Source: Encyclopaedia Britannica

In general, the stages in the process of cement manufacturing involve as the following:

- | | |
|---|------------------------------|
| 1. Limestone quarrying | 6. Clinker production |
| 2. Crushing | 7. Cooling and storing |
| 3. Proportioning & Raw material grinding, | 8. Blending |
| 4. Pre-heater | 9. Cement grinding and |
| 5. Pre-calcining | 10. Cement storing in silos. |

Telangana is 8th largest state in terms of installed capacity of cement in Indian union. Now the cement industry in the state is distinguishing of operational plants with a curious mixture of Dry process and semi-dry process technologies. Few of the modern cement plants are comparable with the best plants in India in terms of quality, energy efficiency and varieties. Cement industry in Telangana continued positive in implementing technological innovation taking place in India.

Table 4: Technological Transition of Cement Industry in Telangana state & India

Processes	Old Technology plants	Modern Plants	National & Global Technology plants
Mining & Handling of Material	Conventional type	Computer Aided technology	Computer Aided Technology
Crushing	Two stage	Single stage	In pit crushing and conveying
Limestone conveying	Dumpers/tippers/ropeways	Belt conveyors	Pipe-conveyers, Belt conveyers
Grinding	Ball mills with/without conventional classifier	Vertical roller mills/roller presses with dynamic classifiers	Vertical roller mills, Roll Presses, horo-mills with dynamic classifier
Pyro-processing	Wet/Semi-dry/Dry processes - 4 stage Pre-heater - Conventional coolers - Single channel burners	Dry Process - 5/6 state Pre-heater - More efficiency coolers - Burner with Multi Channels	Dry Process - 6 stage Pre-heater - High efficiency cooler - Multi channel Burner - Co-processing of WDF - Co-generation of power - Low NO _x /SO ₂
Blending & storing	Batch blending silos	Continuous blending silos	- Continuous blending silos - Multi-channel silos - Dome silos
Packing & Dispatching	Bags	- Bags - Bulk	- Bulk - Palletizing & - Shrink wrapping
Process Control	Relay Logic/Hard wired/PLC	- DDC - Fuzzy logic expert system	- DDC - Neuro-fuzzy expert system
Size of Plant (in TPD)	300 - 1200	2000 - 6000	6000 & above

Source: Cement Manufacturers Association, New Delhi.

The major changes in advanced technology took place during 1980s and 1990s across the Indian union in designing of modern cement plants instruments system mostly as the following vicinities:

- i. Pre-calcinations
- ii. High pressure grinding
- iii. Automation in the process control
- iv. High efficiency particle separation and
- v. Cooling of clinker

The new cement plants in Telangana encompasses a pre-calcining system, huge size crushing system, limestone pre-blending beds, raw material and coal grinding vertical mills, huge capacity blending silos, 5/6 stage pre-heater with pre-calcinatory system, large efficiency channel, high pressure roll press, computerized operating system, DDC/neuro fuzzy expert system, lower level consumption, large plant size in terms of TDP. Most of the plants have computer based centralized plants operation system. The major technological advancement appears in today's cement industries of Telanagana state are incorporating the technological innovations at par with the national and universal standards. The modern cement plants mostly aimed to realize especially low consumption of fuel, thermal and electric energy utilization, analogous to the plants being constructed somewhere else in India and world.

FINDINGS AND SUGGESTIONS:

- The Cement industry in Telangana state is using outdated techniques for raw material exploration. It is suggested to intensify the exploration of raw materials by implementing modern technology such as Remote sensing and Photogrammetric techniques and use of computer aided technology for planning of mines.
- The conventional rope shovels in quarrying by hydraulic excavators and loaders with big wheels. It is recommended that modern mobile crushers with flexibility belt conveyor would be more applicable for the cement industry.
- The Telangana cement industry is a combination of old semi-dry and dry process technology. There is one semi-dry process cement plant is in operation and the cement plants with old wet process technology were closed down by 2000. It is suggest that the government should take initiation and should start mini cement plants across backward districts where limestone reservoirs are available in Telangana state.
- The most of the cement plants in Telangana are based on Pre-heater and pre-calculator process technology. And they are comparable to the plants somewhere else in India. However some technological gaps exist in the study are: i. Lack of pre-blending facilities of coal, ii. Air separator mill with low efficiency, iii. Lack of mechanical loading equipments into vehicles, iv. Lack of computer aided operation plants, v. power consumable and pneumatic system, vi. Belt/pipe conveyer system. vii. In-pit crushing conveyer, viii. Vertical roller mills roller presses, ix. Dry process with 6 state heater system, and more efficiency cooler, x. multiple channel silos, xi.

Palletizing and shrink wrapping, and xii. DDC/neuro fuzzy expert system. The domestic practices are far away to global practices. An effort should be made to implement modern computer aided techniques and modern software packages for the national and global technological practices in manufacturing of cement in Telangana.

- The cement industry in Telangana is biased in four districts adjacent to the limestone reserves. The government has to make necessary steps to develop better transportation facilities in the areas where cement grade limestone deposits are available. So that the gap in the infrastructural facilities could be overcome and it leads pavement of way to start up modern cement plants.
- The Telangana cement industry is behind the Research and Development (R&D) which is important for the growth of the industry. Hence it is suggest to allocation of ample funds for R&D and it should be focused on success oriented.
- The cement industry in Telangana is suffering from over installed capacity problems. The capacity of large single kiln has moved up significantly. Analysing the teething troubles of major plants, they have to settle down to their fullest rated efficiency of production. It reveals that the industry is suffering from abrupt power cuts, low grade raw materials, lack of skilled man power, lack of knowledge of modern plants operation, and incomplete economic evaluation of modern technology of pre-calculator. It is recommended to start a well considerable Human Resource Development planning should be replaced the temporary training.
- It is found from the study that the cement industry is suffering from mechanical failures associated with auxiliary machinery. It could be better to start up a new and centralized centre for training and should be kept under the control of Cement Manufacturers Association in alliance with largest cement companies. The raining should cover development of skilled manpower, technological up-gradation, training on operation of modern technology, design of equipment and quality control and operation of manufacturing.

CONCLUSION:

This research study measures the present status of modern technology in Telangana state main areas spotlighted are raw material, manufacturing process, operations, distribution, and finding up of technological gaps with reference to National and Global practices and changes in

cement industry. The cement industry has shown incredible improvement due to technological up-gradation and amalgamation of the modern technology on high fuel-energy efficient modern dry process technology. From the study it is observed that the cement industry has moving forward in aiming dry process technology ever since 1991 onwards. The study more emphasised on cement production through modern dry process technology which is most cost efficiency and saves time and also labour extensively. This is the most effective technology in utilization of cement capacity compared to other manufacturing processes. However the industry in Telangana is suffering from the problems of over installed capacity, under-capacity utilization and mechanical troubles. If the focus is laid on these problems of the industry can be sustained and can compete with National and global cement markets. Although it is anticipated that the instigation of flagship programmes like Mission Kakatiya, Mission Bhagiratha, 2BHK houses for all poor families in the state and new irrigation projects construction by Telangana government are the good sources of potential growth for the cement industry in the Study area in near future.

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