Evolution of RMC in India

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ABSTRACT

Historically speaking, India missed the benefits of the ready-mixed concrete (RMC) technology. It was only in the early nineties that the industry was born; but the real growth commenced from the second half of nineties. Thanks to the consistent growth in GDP of around 6-8% witnessed by the Indian economy during the past decade and the increasing investments in the infrastructure, housing and other sectors, there has been a rise in the demand for faster speed and improved quality of concrete. The newly-born Indian RMC industry responded positively to these demands and spread its wings initially to the metropolitan cities and then to other major cities in India. Presently, RMC industry has its presence across nearly 50 major cities and the unofficially-estimated volume of concrete produced by commercial plants during 2010-11 was of the order of around 40-45 million m^3. Considering the long history in the use of labour-intensive site-mixed concrete in the country, this is indeed a creditable achievement. Yet, the percentage of cement consumed through the batch-plant concrete operations has not crossed the 10% mark. The author, while highlighting the achievements of the RMC industry in India, also discusses the major barriers to its growth. He also provides a glimpse of the promotional work undertaken by the Ready Mixed Concrete Manufacturers' Association (RMCMA) of India — especially its efforts in evolving and implementing a self-imposed regulatory quality framework. This framework is now being modified and expanded and brought under the control of an independent multi-stake holder group, in line with internationally-accepted norms. Incidentally, some other challenges being faced by the industry are also briefly highlighted.

Keywords

Indian scenario, major growth hurdles, Indigenous quality scheme, new regulatory framework, multi-stake holder group, other challenges

Biographical notes

Mr Vijay Kulkarni has more than 35 years of experience in different spheres of construction industry in India. Beginning his career as a design engineer and after a brief stint with the academics, he was involved in R&D work in concrete. The latter, among others, included fly ash-based bricks and grouts, fast track industrial flooring, and high-performance concrete. He was also involved non-destructive testing and repair and restoration work. Mr. Kulkarni was the Editor of the *Indian Concrete Journal* for more than a decade. Presently, he is the Principal Consultant to the RMCMA. He was also the elected President of the Indian Concrete Institute (ICI) for the period 2009-2011. He has presented around 50 technical papers in various national and international forums.

1. INTRODUCTION

Construction is the second largest industry in India, next only to agriculture. According to the document of the 11th Five Year Plan, the contribution of construction to the GDP at factor cost in 2006–07 was Rs. 1,965,550 million[1]. The share of construction in GDP has increased from 6.1% in 2002–03 to 6.9% in 2006–07. The importance of construction activity in infrastructure, housing, and other asset-building activities can be seen from the fact that the component of construction comprises nearly 60 to 80% of the project cost in certain sectors such as roads, bridges, housing, etc.

The public and the private sectors in India have been investing huge sums of money in construction. Over years, nearly half of the annual budgeted expenditure was made on construction. Barring the world financial crisis during 2007-09, which did affect the Indian construction sector badly, the Indian industry witnessed a growth of around 10% during the past decade. The recent slow-down in the Indian economy that drove the GDP growth rate to around 6.5% also affected the construction industry adversely. However, it is believed that this will be a temporary phase and that the construction industry will hopefully be on a growth track again.

Indian construction is highly fragmented. According to the Planning Commission data, with 27,770 enterprises involved directly in the activity of construction in 2005, the industry is one of the largest employers in the country and is characterized by a mix of both organized and unorganized entities. The employment figures have shown a steady rise from 14.6 million in 1995 to more than double in 2005, that is, 31.46 million personnel comprising engineers, technicians, foremen, clerical staff, and skilled and unskilled workers[1].

It is interesting to know that in terms of construction spending, India is amongst the top few nations of the world. According to a study conducted in 2004 by Global Insight Inc., a Massachusetts-based economic consulting firm, India ranked 11th in construction spending[2]. However, based on the forecast by Global Construction Perspective & Oxford Economics, it is estimated that by 2020 India will take the 3rd slot in global construction after China and USA and that Indian construction will accelerate faster than that in China up to 2020[3].

2. CONCRETE CONSTRUCTION SCENARIO

Concrete construction scenario in India has witnessed significant changes in the past decade. Traditionally, construction involving concrete has been a labor-intensive activity, and even today, an overwhelming majority of concrete produced in the country is site-mixed, and most of it is volume-batched. However, thanks to the liberalization of the Indian economy and emphasis on the development of physical infrastructure, concrete construction scenario in India — especially in urban India — is undergoing welcome transformation in the recent years.

The demand for higher speed of construction, especially for residential and commercial housing, flyovers, highways, roads, aviation, etc. in metropolitan and other big cities of India, necessitated adoption of mechanized and semi-mechanized techniques of construction. The need for large volumes of concrete as well as faster speed of construction was felt. This was conducive for the development of ready-mixed concrete (RMC).

The concept of RMC was not new to India. Captive RMC plants arrived in the country in 1950s; but remained confined for application in mega projects. Thus, India missed ‘commercial’ RMC technology for nearly five decades! Early 1990s witnessed the beginning of RMC industry in India. The first commercial RMC facility was set up in Pune in 1992 and was quickly followed by establishment of similar facilities at other locations.

The growth of RMC started with metropolitan cities — Mumbai, Bengarulu, Delhi, Hyderabad, Chennai, Kolkata — then spread to other major cities, and is now trickling down to tier II and III cities. No authentic data is available on the RMC industry in India. Based on rough estimates, it was reported that as on December 2008, there were around 450-500 commercial RMC plants producing about 25-30 million m^3 of concrete per annum[4]. In addition, a large number of batching and mixing plants belonging to medium and large construction companies also operate as captive plants on a number of projects throughout the country. These plants are large in numbers and with the current emphasis on building physical infrastructure in the country, there seems to be a phenomenal increase in captive batching and mixing plants.

3. Major Hurdles to Growth

In terms of cement consumed through the RMC route, the total percentage is too low and it stands at around 7-8% of the total quantity of cement produced in India during 2010-11. In most of the advanced countries, this percentage is much higher, varying from around 48% (Europe) to 73% (USA). Thus, there is a great scope for the development of RMC industry in India. However, there many hurdles for the healthy growth of the industry. Some of these are listed below.

- *Level playing field for RMC vis-à-vis site-mixed concrete:* Higher rate of taxation on RMC is one of the major constraints for its faster growth.
- *Land for RMC plants in urban areas at reasonable rates:* Non-availability of land for setting up plants in urban growth centers is one of the major stumbling blocks in speedy growth. There is a need to reserve specified area in growth centers for setting up RMC plants at reasonable rent/cost.
- *Regulation issues:* Industry regulation through certification of RMC facilities is highly essential to ensure quality. In this regards, a good initiative is already taken by the Ready Mixed Concrete Manufacturers' Association in evolving and implementing a Quality Scheme for RMC[4].
- Lack of knowledge of applications of RMC.
- Tendency of too much dependence on labor-intensive techniques in construction.
- Education and Training of industry personnel and customers of RMC.

Two Indian experts have tried to estimate the future growth potential of RMC industry in the country[5]. They have predicted that the growth of RMC in India may follow a path identical to the "slow" growth pattern followed by some of its counterparts internationally. Basing their estimate on the cement consumed through RMC route, they postulate that the percentage of cement consumption through RMC may reach the 10% mark by 2013-14. Thereafter, the growth may be faster and the cement consumption through RMC may reach the 25% mark by 2022, when the total number of commercial RMC plants in the country will reach 1,516!

4. Growth of Cement Industry

India has the distinction of being the second largest cement producer in the world, next to China. Based on the data from the Survey of Cement Industry, the Indian Cement Industry comprises of around 180 large plants belonging to 55 companies, with an aggregate capacity of 290 million tonnes in 2010[6]. Unofficial estimate predicts that the cement industry capacity will reach a figure of around 350 million tonnes by 2012-13. Historically speaking, the indigenous cement industry has generally achieved 1-2% higher growth rate than that in the GDP. Thus,

even if we assume a very conservative GDP growth rate of around 5-6% during the 12th Five Year Plan (2013-2017), it will be safe to assume that the cement industry will grow at an average rate of 7%. With this assumption, the cement industry capacity would reach 442 million tonnes in 2017, *Fig* 1.

5. Size of Organized Concrete Industry

Based on the cement figures, let us now find out the approximate size of the organized concrete industry in India, which comprises of companies/organizations producing concrete using modern batching/mixing plants — for either commercial or captive consumption. Here, based on the previous discussion, it may be safe to assume that cement consumed through the RMC/batch-plant route will reach 7.5% in 2012-13 and 10% in 2017-18. Further, assuming that the average cement consumption per m^3 of concrete produced is around 300 kg, the volume produced by the organized concrete industry in India will reach 87million m^3 in 2012-13 and 147 million m^3 in 2017. These are approximate estimates from a conservative angle. Yet, when compared with the production figures from other leading countries, the performance of the Indian industry seems impressive. By 2017-18, the organized Indian concrete industry will possibly rank the third largest concrete industry in the world, next to the USA and China.

As pointed out earlier, the RMC culture has now spread to around 50 major cities in India and the unofficially-estimated volume of concrete produced by the commercial plants during 2010-11 was of the order of around 40-45 million m^3. If concrete produced by captive plants is added to this, the total figure may reach around 80 million m^3.

The organized concrete industry in India is unfortunately fragmented. There are only a handful of commercial RMC players who have an all-India presence. Since the entry barrier to the industry are low, there is a preponderance of small players operating in local markets. However, being late-comer, the RMC companies in India have one advantage, in that most of the batching and mixing plants installed in the county during the past decade are of the state-of-the-art variety with computerized controls.

6 Regulatory Framework

Immediately after its formation in 2002, the RMCMA actively participated in revising the Indian Standard specification on RMC. The old standard, IS 4926[7], which was first published by the Bureau of Indian Standards (BIS) in 1968 and then revised in 1976, needed one more revision to incorporate the experience gained in the commercial operations RMC plants. The second revision of the BIS standard which was published in 2003 generally proved appropriate for the industry.

During the early years of its formation, RMCMA realized that in a country like India having a long history in the use of labor-intensive site mixed concrete, quality of concrete has indeed been one of the major concerns of customers. It therefore took the decision of creating a quality platform for winning over the customers using site-mixed concrete. In the absence of any national regulatory framework, RMCMA decided to develop an indigenous quality scheme for ready-mixed concrete in India. It also decided that the quality scheme shall rest on two strong pillars, namely, best international practices that are suitable for Indian conditions and strict observance of the codes of the Bureau of Indian Standards.

For evolving the quality scheme, RMCMA constituted a “Quality Team” consisting of senior representatives from Member companies and eminent experts from the Indian construction

industry. The Quality Team met on several occasions and after thorough discussions, decided to divide the quality in the scheme following two parts:

- Audit-based certification of RMC production facilities; and
- Guidelines for quality control and quality assurance.

With the guidance from experts from construction industry, two detailed manuals were prepared covering the above-mentioned two parts[4, 8].

The QC Manual Part I developed by the RMCMA contains an exhaustive "Check List" covering all the operational areas in RMC plant. It contains some 125 items. Out of these, conformance with some 110 items is considered to be strictly essential for achieving good quality concrete, and hence for getting the certification by the RMCMA.

While developing the Check List, it was ensured that the provisions in the same meet most of the stipulations in the Indian Standard, IS 4926: 2003 and the other relevant codes on concrete such as IS 456[9], IS 383[10], IS 9103[11], etc. In fact, in certain cases, the RMCMA requirements are more stringent than those of IS 4926:2003 and other codes.

With a view to bring in transparency, enhance credibility and win over the confidence of customers, it was considered essential by the RMCMA to introduce a yearly audit of the RMC production facility by an external auditor. For this purpose a detailed audit procedure was drawn and the selection criteria for auditors were also finalized. The scheme was offered to members of RMCMA as well as others.

One more crucial feature of the RMCMA quality scheme is its adherence to the prevailing statutory norms in India. Before undertaking any audit, the auditor seeks and verifies certificates of compliance on the following three aspects from the RMC producer:

- Permission and consent to operate RMC facility from state Pollution Control Board;
- Permission from factory inspector confirming adherence to health and safety norms;
- Permission/license to operate plant from local body/municipal authority.

Till April 2012, RMCMA has certified around 250 RMC facilities throughout the length and breadth of country.

Realizing that mere certification based on the Check List may not be sufficient to instill assurance on quality amongst customers, RMCMA prepared detailed Guidelines for QA and QC of concrete (*Quality Manual Part II*). The minimum benchmarks suggested in the this guideline document are based on the relevant provisions in BIS codes such as IS 456[9], IS 4926[7], IS 383[10], IS 9103[11], IS 3812[12], etc. In fact, certain benchmarks in the guidelines far exceed the provisions in different codes. Based on these guidelines, RMCMA encouraged its members to develop their own documents and make the same available to customers on request.

7. RECENT CHANGES IN REGULATORY FRAMEWORK

After operating the quality scheme for RMC successfully for the past four years, RMCMA decided to raise the quality scheme to a higher pedestal. For this purpose, RMCMA recently signed an Memorandum of Understanding (MoU) with the Quality Council of India (QCI). The latter organization was set up in 1997 jointly by the Government of India and the Indian Industry represented by the three premier industry associations i.e. Associated Chambers of Commerce and Industry of India (ASSOCHAM), Confederation of Indian Industry (CII) and Federation of

Indian Chambers of Commerce and Industry (FICCI), to establish and operate national accreditation structure and promote quality through National Quality Campaign.

The MoU envisages that the quality scheme for RMC would be handed over to QCI, to be operated in an independent and impartial manner based on the best international practices. While QCI and RMCMA shall be the joint Scheme owners, the governing structure of the new scheme shall be under a multi stakeholder steering committee and the scheme would be operated on a non-profit, but self-sustaining basis. It would have a defined consensus based technical criteria laid down for the ready mixed concrete plants which would be evaluated by competent third party certification bodies, who in turn, would be accredited by the National Accreditation Board for Certification Bodies (NABCB), which is a part of the international system of equivalence of accreditations and certifications, as per appropriate international standards.

A multi stakeholder Steering Committee as well as the Technical and Certification Committees have already been formed and the new scheme is expected to take a final shape by July 2012. With the new scheme, the regulatory framework is expected to get strengthened and this will go a long way in ensuring healthy growth of RMC industry in India.

8. Assimilation of Advances in Concrete Technologies

Although the RMC industry in India is still in its infancy, it is heaterning to note that there are certain islands of excellence. Some leading RMC players are striving hard to achieve technological excellence. There are examples of serious attempts being made to absorb some of the latest developments in the field of concrete technology such as high-strength/high-performance concrete, self-compacting concrete, etc. Similarly, serious efforts have been made to achieve higher level of sustainability through the increasing use of supplementary cementitious materials (SCMs) like fly ash, ground granulated blast-furnace slag (GGBS), high reactive metakaolin, silica fume, etc.

8.1 Modest increase in dominent concrete grade

No authentic data on the percentage of concrete production per strength class is available in India.The present author has conducted a quick survey of concrete grades supplied by major RMC producers from metropolitan cities. It is revealed that the dominant grade of concrete supplied by RMC (i.e. the minimum common grade used by a large number of RMC customers for structural use) is showing a moderate upward trend. While the dominant grade has increased from M20 (cube characteristic strength 20MPa) in 2003 to M25 in 2010 in Bangalore, Pune, Ahmadabad and Delhi, the same has increased to M30 in Chennai and Kolkata and M35 in Mumbai. This is certainly a welcome trend.

8.2 HSC for High-rise Buildings

Incidentally, in metropolitan cities like Mumbai, Delhi, Bangalore, etc. the heights of commercial and residential buildings are showing a steep increase. Around a decade back, the tallest structure in Mumbai was around 150m tall. However, in view of the constraints on space on the one hand and the sky-rocketing land cost on the other, builders and developers are forced to go vertical. For example, the height of the tall building in Mumbai has now jumped from 150m to around 300m in the past decade. "WorldOne" , the tallest building in Mumbai currently under construction by the Lodha Group, is reported to have a height of 443m!

For catering to high-rise buildings, high-strength/high-performance concrete is the right kind of material. The economic advantages of using of this concrete in the columns of high-rise buildings have been well-established. In simple terms, high-strength concrete provides the most economical way to carry the vertical load to the building foundation. By utilizing high-strength

concrete, the column size, formwork size and the amount of vertical reinforcement can be reduced[13]. Further, with the high-early strength achieved with HSC, it is possible to remove the shutters early, thus reducing the cycle time of the formwork.

Realizing these advantages, builders and consultants in some of the metropolitan cities were quick to adopt this material in high-rise buildings. For example, in Mumbai, high-strength concretes having cube compressive strengths of 60, 70 and 80 MPa have been supplied by some RMC prooducers and pumped at higher locations. It is reported that HSC having cube compressive strength of 95 MPa is presently being used for the WorldOne building.

8.3 SCC in India

The use of SCC for field applications in India commenced somewhere in early 2000. This was preceded by initial developmental work conducted in a few leading laboratories. Some initial trends in the lab and field works were picked up and contained in the Special Issue of the *Indian Concrete Journal (ICJ)* published in July 2004. Later trends were documented by *ICJ* in another Special Issue published in August 2009[14].

The application of SCC in India has remained confined to niche areas. Initially, SCC was used on a few projects, mainly by the Nuclear Power Corporation (NPC). In recent years, leading commercial RMC manufacturers have commenced supplying SCC for use in selective applications. However, here also, the use of SCC has remained confined to structures having heavily congested reinforcement or having innovative architechtural shapes.

9. SOME MAJOR CHALLENGES

9.1 Growth of Industry

As mentioned earlier, penetration RMC in terms of cement consumed through RMC route is presently very low. Thus, higher penetration of RMC is the top-most priority for the indigenous industry. The RMCMA is striving hard to achieve this.

9.2 Regulatory Framework

As discussed earlier, the industry has now embarked upon a new regulatory regime. The RMCMA believes that the new regulatory norms would bring immense benefits to the industry and its customers in the long term.

9.3 Shortage of Natural Sand

India has been lucky to have good reserves of basalt, granite, limestone, sandstone, etc. However, in recent years, as the concrete volumes have picked up, the industry is feeling the pinch of shortage of aggregates. The problem is exacerbated in respect of natural sand in view of the dredging restrictions enforced by local authorities. Reports emanating from different parts of the country indicate that shortage of natural sand is widespread. In northern India, especially in the Indo-Gangetic plains, coarse aggregates are not easily available locally, forcing concrete producers to fetch them from long distances. Generally speaking, in most of the urban centers, leads for fetching aggregates are increasing and hence their cost.

With the increasing shortage of natural sand, RMC producers have now commenced the use of manufactured sand and crusher rock fines.

9.4 Enhancing Sustainability through Increased Use of SCMs

One of the major achievements of the Indian construction industry during the recent past is its efforts in absorbing higher quantum of industrial wastes like fly ash, granulated blast-furnace slag, silica fume, etc. This has augured well for ensuring sutainability of construction.

Amongst the various industrial wastes, fly ash is generated in large quantity. *Table* 1 shows the amount of coal utilization and fly ash generation during the recent Five Year Plans. It can be seen that currently 175 million tonnes of fly ash is generated from the use of 500 million tonnes of coal. The country is already facing power shortage and a large number of new power plants, including the super-thermal variety, are slated come up on fast track. These plants will mostly use coal as fuel. Thus, country's dependence on coal is going to shoot up. During the 12th Five Year Plan (2013-2017) the requirement of coal is estimated to rise to 980.50 million tonnes. With this, the generation of fly ash is bound to go up drastically further.

Jain provides a broad picture on the current utilization of fly ash in India[15]. Based on the data compiled by him (reproduced in *Table* 2), it can be seen that India is able to utilize only 80 million tonnes of fly ash per annum, *i.e.* less than 50% of the total volume produced. Major consumption fly ash is occurring in cement and concrete. In cement, the process of conversion of Ordinary Portland Cement (OPC) to Portland Pozzolana Cement (PPC) seems to have accelerated in recent years. As can be seen from *Table* 3, the percentage of PPC in total cement produced has gone up dramatically from 43.17% in 2003-04 to 67.21% in 2009-10.

It is creditable that the young RMC industry was able to consume around 8 million tonnes of fly ash in India in 2010-11 (*Table* 2). However, the challenge to consume even more fly ash. For this purpose, it essential to increase the percentage replacement of fly ash in cement — from the present average level of around 20% to around say 30-35 %. This will be one of the major challenges before the industry.

9.4 Training and Education

One of the objectives of RMCMA is training and education of its own industry personnel as well as those from client/ consultant/contractor. RMCMA is aware that a lot needs to be done in this area. A majority of RMCMA members have their own in-house training programs for operators, supervisors and engineers. Yet, looking at the enormity of the problem and taking advantage of the experience of leading world RMC organizations, RMCMA would like to develop and implement its own training and education programs, possibly in co-operation with other bodies/organization. Of course, this will be a long-drawn process.

10. CONCLUSION

Although the ready-mixed concrete industry in India came into being in the late nineties, it has grown steadily and spread its wings into 50 major cities in India in a span of around 15 years. In spite of certain hurdles, the RMC industry is expected to grow further steadily. This optimism is based on the assumption that Indian economy will continue to register a healthy growth rate (i.e. say around 7% in GDP) and that the current emphasis on the development of physical infrastructure and housing will continue. It is to the credit of the RMC industry in India that even when it was in its infancy it successfully implemented a self-regulatory quality framework, which is now being upgraded and brought under the control of an independent multi-stake holder group. The industry has shown encouraging signs in absorbing some latest developments in concrete technology and also in the utilization of industrial wastes such as fly ash and other SCMs.

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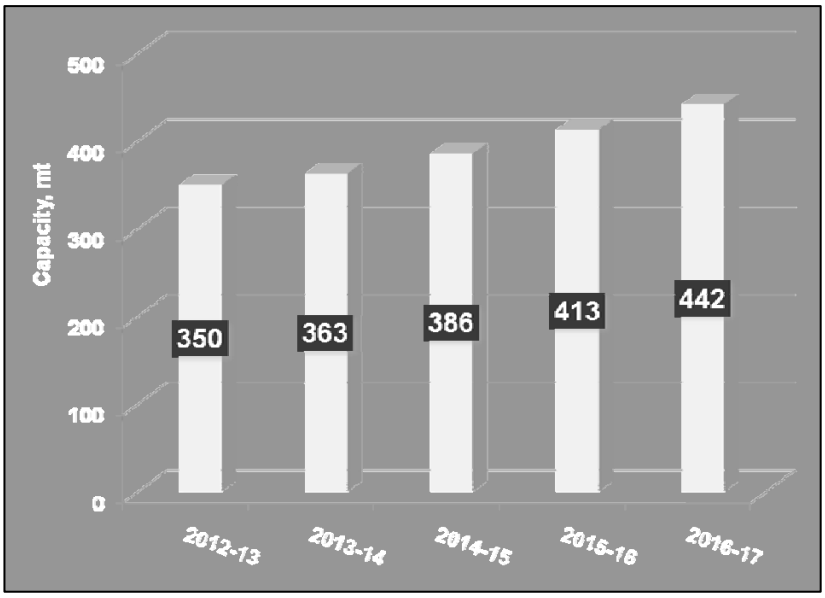

Fig 1: Growth in cement production capacity from 2012-17

Table 1: Generation of fly ash during different five year plans

Plan Period	Terminal Year	Power Generation, MW	Coal (million tons)	Fly ash (million tons)
8th plan	1996 - 97	50,000	210	80
9th plan	2001 - 02	87, 000	285	110
10th Plan	2006 - 07	1, 16, 400	400	140
11th Plan	2011-12	1, 38, 300	500	175

Note: Fly ash Generation during 2009-2010 – 160MT (source DST)

Table 2: Present utilization of fly ash (2010-11)

Sector	MT	% of utilization
In production of Portland Pozzolana Cement	32	40
Cement Replacement at Concrete batching Plants (RMC)	08	10
Filling in low lying areas	14	18
Roads and Embankments	12	17
Dyke Raising	4	5
Brick Manufacturing	3	2.5
Agriculture Sector	3	2.5
Other miscellaneous uses.	4	5
Total	80	100

(Source – Fly ash utilization Unit – DST Govt. of India)

Table 3: Utilization of fly ash in cement production

Year	Total Cement Production	PPC Production	PPC % of total cement production	Utilization of fly ash
2003-2004	115.42	49.82	43.17	13.03
2004-2005	125.07	58.23	46.56	15.06
2005-2006	136.67	68.46	50.09	18.50
2006-2007	152.99	89.36	58.41	23.39
2007-2008	164.45	107.05	65.10	27.80
2008-2009	177.17	117.88	66.53	30.64
2009-2010	202.74	136.23	67.21	32.00

Notes: 1. All figures are in MT except percentage.

2. Period is considered from April-March.

3. Fly ash utilization is considered average 25% in PPC.

(Sources – CMA published data in yearly annual reports)