

A CASE STUDY: MANIFOLD INCREASE IN FLY ASH UTILISATION IN INDIA[@]

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ABSTRACT

Fly ash, a residue of burning of pulverised coal and lignite in thermal power stations, is now being accepted as a resource material. The concerted efforts in Mission Mode that began in India about a decade back, have developed confidence in fly ash utilisation technologies and its large-scale utilisation. Even in earlier years, a number of attempts were made through various Committees/Groups to develop fly ash utilisation technologies.

As a result, fly ash utilisation in the country has increased from 1 million tonne per year to more than 45 million tonne/year during 2005. The Mission Mode approach and the strategies of project formulation and implementation that have led to manifold increase in ash utilisation are dealt in this paper.

Keywords: Coal Ash, Fly ash, Fly Ash Utilisation, India, Indian Scenario, Management, Mission Mode Approach

1.0 INTRODUCTION

Power, being considered as an engine of growth, has always been a focus area for most of the developing countries, including India. The power generation in India has increased from 1362 MW in 1947 to 1,20,000 MW during 2004-05. Further, Government of India has planned for enhancement of installed capacity to 2,00,000 MW by 2012 and to 3,00,000 MW by 2017. Coal being abundantly available, has been major source of energy till date and is expected to remain so in near future. Indian coals, though low in sulphur, contain higher amount of ash (about 35-45%), hence the generation of huge quantities of fly ash in India. The annual generation of fly ash has increased from about 1 million tonne in 1947 to about 40 million tonne during 1994 and to about 112 million tonne at present. As per an estimate of FAUP, TIFAC, the annual ash generation figures are expected to reach about 170 million tonne by 2012 and 225 million tonne by 2017.

Till about a decade back, fly ash had been considered a "Polluting Industrial Waste" and most of it was being dumped in the ash ponds. Very few utilisation areas of fly ash were known and general perception of people about it was negative. Over a period of last ten years, lot of work has been undertaken with the focussed thrust provided by Fly Ash Mission (FAM), Technology Information, Forecasting and Assessment Council (TIFAC), Department of Science & Technology (DST), Government of India along with other stake holder agencies including Ministries / Departments of Government of India and States, Public Sector Undertakings, Industry, R&D, Academia, User-agencies etc. The potential of the fly ash has been understood & brought to the fore, the utilisation areas known earlier have been further strengthened by way of undertaking Technology Demonstration Projects and facilitating multiplier effects, awareness has been created among the user agencies through dissemination of information and many more new areas of ash utilisation have been developed. The fly ashes and its products generated at various locations in the country have been analysed extensively for various technical parameters and possible harmful effects. All these efforts have yielded good results and the utilisation of fly ash has increased from a meagre 1 million tonne / year during 1994 to about 45 million tonne during 2005 (45 times increase). A brief description of this successful case study is presented in the following paragraphs.

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2.0 EARLIER INITIATIVES (PRE 1990's)

Ministry of Environment & Forests (MOEF) and Ministry of Power (MOP) during the past several years have been actively involved and pursuing various issues related to the policy planning, utilisation and disposal of fly ash in the country. The following are the brief highlights of these policies / programmes:

- At the time of clearance of thermal power projects generating fly ash, it is ensured that provisions are made for proper utilisation and disposal of fly ash. Stipulations are made for 20% utilisation of fly ash within one year of commissioning of the plants, with progressive 10% utilisation increases for the next 7 years, reaching to 100% utilization within 9 years. The project authorities are also asked to keep provision for dry ash collection system and a maximum of 100-350 acres of land is permitted to be acquired for ash disposal depending upon each case.
- A National Waste Management Council (NWMC) consisting of senior officials of various Ministries / Departments, selected State Governments, Research Institutes, Social Workers, NGO's and media persons was formed in January, 1990 under the Chairmanship of Minister of Environment and Forests. Under this council, three sub-groups were formed one of which was related to Industrial Waste Management. In this sub-group, management of fly ash was discussed in detail. Some of the recommendations of the sub-group on providing incentives for fly ash utilisation, its use in building construction work etc., have been pursued systematically and follow-up actions have been initiated for other recommendations. The National Waste Management Council was reconstituted in October, 1992 and included besides Government officials (including DST), specialists, and representatives from different fields. The reconstituted NWMC took up number of issues related to management of fly ash including enacting legislation banning use of top soil around Thermal Power Plants were discussed in detail.
- Ministry of Finance. in 1991, announced excise duty exemption for bricks and other building products using 25% or more of fly ash as raw material and Custom Duty exemption upto 100% on import of machinery and equipment for manufacture of fly ash based products.
 - Steps were taken to make available fly ash free of cost to users. A working Group was constituted in March 1990 and MOP has issued the Guidelines in September 1991 wherein concerned authorities have been asked to make available fly ash free of cost to the entrepreneurs for 10 years from the day a unit goes into fly ash based production. There was also a recommendation for concessional supply of power to entrepreneurs for utilisation of fly ash. However, no system / mechanism existed to see the implementation of the recommendations.
 - MOEF has been consistently taking up with various Ministries / Departments the need for large scale utilisation of fly ash and / or its products by Government Departments which would be emulated by private organisations. Central P.W.D. has developed specifications regarding use of new building materials to promote the use of fly ash. The CPWD specifications and Schedule of rates were circulated on 26.12.1990 to all the Chief Engineers of Roads Organisations, etc. Under Ganga Action Plan, the concerned authorities have been asked to encourage use of fly ash in building materials, road construction and other uses. MOEF had also asked Central & State Pollution Control Boards that the projects utilising solid wastes should be cleared on priority basis.
 - The issues related to utilisation and proper disposal of fly ash have been discussed in several meetings of a number of State / Central Government agencies such as National Waste Management Council, meetings of State Ministers and Secretaries, Regional Meetings of MOEF on Environmentally Sound Management of Solid Wastes and number of other meetings in which representatives from various Central, State Government Departments, Public Sector Undertakings, Industry Associations, NGO's social workers, etc., have been participating. Ministry of Environment and Forests had taken up the issue of promoting use of fly ash and enhance its use to 50% by the turn of the century with Chief Minister of States and Minister of State for Power.

3.0 FOCUSED EFFORTS

Appreciating the overall concern for environmental and management issues pertaining to fly ash, which otherwise is a very useful by-product of thermal power plants, the Technology Information, Forecasting & Assessment Council (TIFAC), Department of Science & Technology (DST), Government of India identified "Safe Disposal and Gainful Utilisation of Fly Ash" as a thrust area and commissioned a Techno-Market Survey "Technologies for Disposal of Thermal Power Station Fly Ash". The study brought to the fore that significant work has already been done by indigenous R&D laboratories and other agencies for disposal and gainful utilisation of fly ash as described in previous paras. A number of technologies have been developed and demonstrated successfully at laboratory/pilot plant levels. The overall complexity of technology transfer, infrastructure support, inter-institutional linkages, development of market, orientation of Government policies to promote and support fly ash utilisation, required sharply focused efforts to promote fly ash utilisation. Further, no single utilisation holds the potential to provide a solution to this mammoth task of safe disposal and gainful utilisation of FA. A judicious mix of a number of applications (considering impact timeframe, investment requirement, technical and infrastructure inputs, requirements by fly ash utilisation potential and expected returns, etc.) was required to be evolved. A number of disposal and utilisation technologies / applications were required to be simultaneously demonstrated to increase the percentage utilisation and environmentally-safe disposal of fly ash. Keeping this objective in view, Government of India decided to launch Mission Mode Project in the form of Fly Ash Mission (FAM), as a joint activity of Department of Science & Technology (DST), Ministry of Power (MoP) and Ministry of Environment & Forests (MoEF) during 1994. Technology Information, Forecasting & Assessment Council (TIFAC) was given the responsibility of implementing the Mission Mode project under the aegis of Department of Science & Technology (the Nodal Agency). The objective of the Mission was to undertake Technology Demonstration Project towards confidence building in fly ash utilisation technologies.

4.0 MISSION IMPLEMENTATION

The implementation strategy of Fly Ash Mission was planned in such a way so as to address the select focused issues in comprehensive mode and with involvement of maximum number of stake holder agencies and individuals in each project, followed by awareness creation among other user agencies. The Mission's efforts may broadly be categorised in three groups:

- i. Technology development and demonstration
- ii. Facilitation and hand holding for the multiplier effects
- iii. Policy measures for sustainable use.

4.1 Technology Development and Demonstration

After due deliberations and careful considerations ten thrust areas were identified for focused efforts through Technology Demonstration Projects. The thrust areas of fly ash utilization are Roads & Embankments, Building components, Hydraulic Structures, Agriculture Related Studies & Applications and Underground Minefills. Further for safe management of unutilized fly ashes, projects were undertaken in the areas of Ash Ponds & Dams and Reclamation of Ash Ponds for Human Settlement. Characterisation of fly ash, Handling & Transportation of fly ash and Research & Development areas were also thrust upon for facilitation of further work/utilization.

The technologies pertaining to these areas were identified for further development and Technology Demonstration Projects were undertaken in different parts of the country towards confidence building in all the thrust areas.

Implementation of Mission mode project was specifically tailored to meet the target of confidence building in technologies for gainful utilisation & safe disposal of fly ash through Technology Demonstration Projects. Task Forces for each Thrust area were constituted to guide, steer & monitor the projects. Experts from R&D, academia, industry, regulatory / facilitating bodies & electricity board / bodies were the members of Task Forces. In addition, for each sub-project an experts monitoring-cum-advisory committee was put in place. The Core TPMM project team's task was to interact with the key persons and others concerned to ensure that work schedules and specific milestones are available to begin with and to monitor it themselves and also through expert groups later especially where there are critical technical parameters. The core team also maintains flow of information and know-how between the sub project teams and dissemination to various other user groups, entrepreneurs and industries to pursue them further. An apex committee with representation from MOEF, MOP, DST, Planning Commission, Ministry of Finance, CEA, Deptt. of Coal, CSIR/DISR, MOUD, DID, ASSOCHAM, FICCI/CII and a few user groups oversaw the project and provided mid-course corrections, if necessary. In addition, an overall Technical Advisory Group with technical experts was formed to specially oversee the development of technologies. All the committees met regularly and provided expert guidance regarding techno-managerial issues in addition to reviews & monitoring. All these measures ensured an effective project conceptualization, implementation and monitoring at the one hand to make the project successful and involvement of maximum number of the concerned agencies / individuals on the other hand for further dissemination of the information / knowledge / confidence generated through the project implementation.

Some of the important technologies developed and disseminated through these projects are:

- (i) Construction of Roller Compacted Concrete (RCC) dams using high doses of fly ash (65% cement replacement by fly ash) under Ghatghar Pumped Storage Scheme of Government of Maharashtra.
- (ii) Use of fly ash for construction of roads and embankments (in lieu of soil).
- (iii) Raising of ash pond dykes using ash from the pond itself.
- (iv) Densification of ash ponds.
- (v) Reclamation of abandoned ash ponds for human settlements and forestry applications.
- (vi) Use of fly ash for agriculture, horticulture, forestry, saline soil / waste land reclamation etc.
- (vii) Hydraulic transportation of ash slurry at medium concentration (40-50% by weight).

Few photographs given below provide a glimpse of the demonstrations:



Upper dam of Ghatghar Pumped Storage Scheme constructed with RCC (65% replacement of cement with fly ash)



First fly ash embankment in the country (Okhla fly over, New Delhi)



Reclamation of saline soils using fly ash (75% savings in Gypsum)



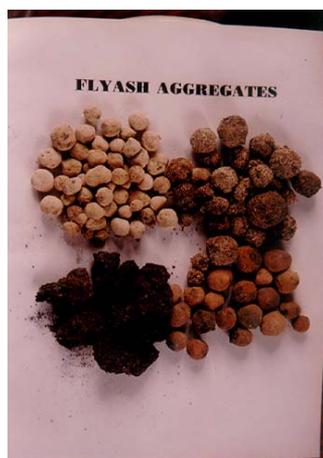
Cabbage at Dodhar, U.P. on fly ash amended soils



Demonstration of medium concentration ash slurry conveying (50% by weight) at Dadri



Floriculture at ash ponds



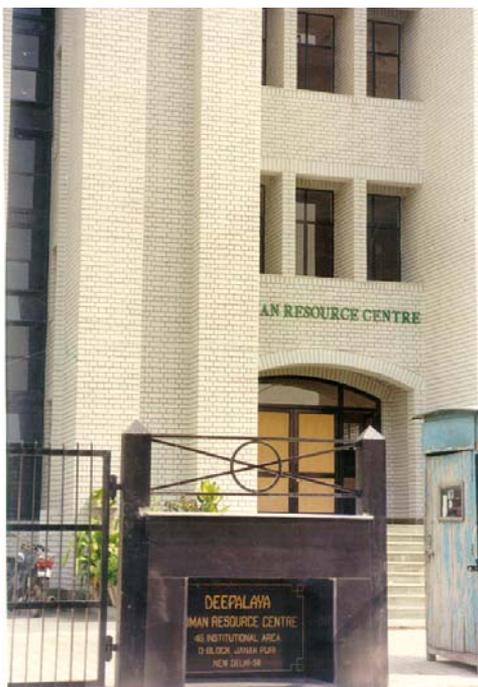
Sintered aggregated (75-85% fly ash)



Dwelling units on ash pond

4.2 Facilitation and hand holding for the multiplier effects

The technology development and demonstration projects undertaken had created lot of awareness among the stake holder agencies / individuals and many of them came forward themselves to use the technologies developed and demonstrated for their projects. All possible support and guidance were provided to these agencies / individuals right from technical know-how to the logistics and operational aspects like availability of fly ash, approvals from authorities etc. Further, the knowledge and information generated through these projects were disseminated among other agencies / individuals, so as to make them aware of the latest developments of this field and to convince them to further gainful utilization and safe disposal of the fly ash in their areas. Technical seminars, workshops, brainstorming, get-togethers etc. were organized along with one to one interactions / meetings, to clear doubts from the minds of the people. Impediments, if any specific to the projects, were also addressed and solutions were provided. Local centres / laboratories for characterization of fly ash and providing local technical support to the user agencies were developed. Specialised consultancy services were provided to the users to solve the problems specific to the agency. All these supportive measures created a magical effect and brought more and more people into this network. It resulted in a large number of multiplier effects taking place all around the country. Some of the photographs given below speak themselves of the success stories of the networked efforts.



Use of fly ash bricks at Delhi



Fly ash embankment at Punjabi Bagh, New Delhi



Use of Fly ash for Road Embankment



Fly ash Roads

4.3 Policy measures for sustainable use

To sustain the utilisation of fly ash by various agencies all across the country, Standard Specifications, Codes of Practice etc. were formulated for fly ash utilisation. The existing standards of Bureau of Indian Standards (BIS), Indian Roads Congress (IRC) etc. were reviewed and revised (wherever found necessary) to include / highlight use of fly ash. The policy guidelines were formulated and got issued by the Administrative Ministries / Departments etc. Interactions were also held with various agencies of Central and State Governments, All India Council for Technical Education (AICTE) etc. to include fly ash management in the curriculum. The recommendations were also made to provide various fiscal incentives for fly ash users to encourage more and more utilisation.

As a result of all these efforts, fly ash and its products have now been included as a regular constructions item in the Specifications and Schedule of Rates of CPWD and various state PWDs. About 10 new standards for fly ash have been formulated / thoroughly revised and about 60 standards have been amended for fly ash use. The Gazette Notification issued by Ministry of Environment & Forests in September 1999 (amended in August 2003) for conservation of soil especially highlights use of fly ash in almost all types of construction. It makes it mandatory to produce and use fly ash / its products (bricks, blocks, tiles etc.) within 100 kms. radius of a thermal power station. It further prohibits excavation of soil for construction of any road / embankment within that area. The Ministry of Road, Transport & Highways has also issued similar circular making it mandatory to use fly ash for road / embankment construction within 100 km. of a thermal power station. The required Guidelines for use of fly ash for road embankment as well as rural roads have been prepared & issued. To further facilitate the availability of fly ash of required quality, the directions have been issued to the thermal power stations to install dry fly ash collection and delivery system.

5.0 OVERALL IMPACT - MANIFOLD INCREASE IN ASH UTILISATION

Over a period of last ten years, the image of fly ash has completely been changed from a "Polluting Waste" to "Resource Material". The economic worth of fly ash has been understood by the people

and it has now become a “sought after material”. The utilisation of fly ash which was about one million tonne per year in 1994 (at the start of Mission) has now reached about 45 million tonne per year. As compared to 2-3 major areas of ash utilization about a decade back, now about 10 areas of ash utilization have been identified and fly ash has started being used in most of them. The focused thrust being provided by Fly Ash Mission (FAM) is still being continued through Fly Ash Utilisation Programme (FAUP), TIFAC, Department of Science & Technology (DST) with the help and support of all other stake holder agencies.

With the significant progress made (45 times increase in ash utilization) during last 10 years, it seems that the flight of ash utilization is right at take-off stage, however, continued thrust and support of all stake holder agencies at much higher levels would still be required to sustain the pace to accelerate it further, especially, as our target (ash generation figure) is also rocketing high day by day.

BRIEF BIOGRAPHY OF THE PRIMARY AUTHOR (Dr. Vimal Kumar):

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Dr. Vimal Kumar holds Bachelors Degree in Mechanical Engineering, MBA from Indian Institute of Management-Ahemadabad & Ph.D in Development and Commercialisation of New Technologies from Indian Institute of Technology-Delhi. Dr. Vimal Kumar has been instrumental for development and large scale utilisation of a number of technologies for use of fly ash in building / construction industry as well as many other technologies in other industrial sectors. He has published / presented more than 150 Technical Papers, Contributed / Co-Authored 6 books, widely travelled, Chairman & Member of Advisory Bodies / Research Council of a number of institutes / research bodies, visiting faculty to technology and management institutes and on the Editorial Board of International Journal of Technology Management, U.K.