KEYNOTE ADDRESS

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Fly ash disposal & utilisation shall continue to be an important area of national concern due to India's dependence on coal for power generation for foreseeable future. The scenario with respect to fly ash management has undergone considerable improvement over past few years. Due to increasing environmental concern and growing magnitude of the problem it has become imperative to manage fly ash more efficiently. It is more important in view of the fact that 'fly ash' has tremendous potential that is yet to be exploited.

India's 82 utility and more than 25 captive thermal power plants contribute more than 70% to the country's total electric power installed capacity (approx. 100,000 MW). Due to vast coal reserves (about 211 billion tonnes), coal is being used as the largest source of energy. In fact about 240 million tonne of coal is being used every year to generate electricity. Indian coals though low in sulpher, radio active elements and heavy metals content, yet rich in incombustible siliceous material and other inorganic matter which comes out as ash on combustion. These particles are so intimately mixed with the coal and have the specific gravity in the range close to that of coal, that the washing of coal is also not very successful so far. As a result of that India is producing about 105 million tonne of ash every year. This figure is likely to go up in view of developing nature of Indian economy, which involves large no. of energy intensive infrastructure projects. It is estimated that fly ash generation would increase to around 170 million tonne by 2012.

Most power stations dispose ash using wet slurry system. This method is now proving a luxury in terms of land and water requirements. Further, it downgrades the cementious properties of dry fly ash. Generally, more than 1 acre of land is required for ash pond area per MW power capacity. In recent times dry fly ash collection has gained momentum. In addition, increasingly power stations are shifting to separate collection of flyash and bottom ash with growing realisation that each kind of ash has advantageous uses.

Fly ash is finely divided residue resulting from combustion of pulverised bituminous coal or sub bituminous coal (lignite) in thermal power plants. It consists of inorganic mineral constituents of coal and organic matter which is not fully burnt. It is generally grey in colour, alkaline and refractory in nature and has a fineness 3000 to 6000 sq.cm. per gram and possess pozzolanic characteristics.

Typical chemical composition of Indian fly ashes is as follows :

Constituent	**Representative percentage range (%)**
Silica (SiO_2)	49-67
Alumina (Al_2O_3)	16-29
Iron Oxide (Fe_2O_3)	4-10
Calcium Oxide (CaO)	1-4
Magnesium Oxide (MgO)	0.2-2
Sulphur (SO_3)	0.1-2
Loss of Ignition	0.5-3.0

The utilisation of fly ash in India was around 3 % of 40 Million Tonne annual generation during 1994, the year of formulation of Fly Ash Mission (FAM) of Government of India.

As a result of the focussed thrust being provided by Fly Ash Mission of Government of India alongwith many other agencies, its utilisation has increased from 3% (in 1994, of 40 million tonne production) to about 30% of 110 million tonne production). Lot more is required to be done including creating awareness among the people & user agencies.

The intrinsic worth of fly ash for various gainful applications has started getting recognition. It is being now taken as a friendly and useful resource material. Several agencies – (Govt., private, public sector, NGOs etc.) are taking / have taken sincere steps in recent times towards more & more utilisation of fly ash. These agencies include Department of Science & Technology, Ministry of Power, Ministry of Environment & Forests, Ministry of Urban Development, National Thermal Power Corporation, Council of Scientific & Industrial Research (CSIR) & other laboratories, academic institutes, State Electricity Boards, industries, etc. Fly Ash Mission (FAM), the national level effort, in this area since 1994, is a Technology Project in Mission Mode being implemented by Technology Information, Forecasting and Assessment Council (TIFAC) with Department of Science & Technology (DST) as Nodal Agency.

Several areas of fly ash utilisation wherein Technology Demonstration Projects (55 numbers) have been completed or are underway in FAM include mine filling, construction of road / flyover embankments, hydraulic structures, raising of dykes, manufacture of several building components like bricks, blocks, tiles & its use in agriculture, etc. The future poses challenge to the scientist & engineers towards sound management of fly ash. The technical know-how and its feasibility has generally been demonstrated.

Prior to 1994, large number of efforts have been made to develop and commercialise technologies for use of fly ash. Academia, national research institutes, private R&D as well as industry have been doing some work in this field even prior to 1960s. It was only in 1970s that fly ash utilisation started getting attention. Fly ash properties were researched for vide range of applications, inter alia, pozzolanic, geotechnical, metallurgy, ceramic and agriculture applications. Scientific results were published, laboratory trials and even a few field demonstrations were undertaken to demonstrate the beneficial applications of fly ash. However, most of the work remained confined within the academia / research arena. A few utilisations of fly ash were made primarily in mass concrete, brick / block manufacturing and reclamation of low lying areas.

Ministry of Environment & Forests (MoEF), Ministry of Power (MoP) and a few other agencies took initiatives. National Waste Management Council (NWMC) and a few other groups/committees consisting of senior officials of various Ministries/Departments, State Governments, Research and Development Institutions, Social Workers etc. were formed. Thermal Power Plants were directed to take actions to enhance ash utilisations and a few fiscal incentives such as concessional excise duty and sales tax were declared.

A well researched comprehensive techno-market survey report was prepared by Technology Information, Forecasting and Assessment Council (TIFAC) of the Department of Science & Technology, Government of India, during early 1990s for safe disposal and gainful utilisation of fly ash. The report was widely distributed and discussed among concerned agencies. It highlighted that only a meager percentage (less than 3 per cent) of ash was being utilised in the country and the balance was being stored in ash ponds through slurry discharge system. The report brought to fore that the fly ash that is being considered as a waste material, is in fact a useful material and can be put to gainful economic applications.

Appreciating the overall concern for environment and the need for safe disposal and gainful utilisation of fly ash, the Government of India commissioned Fly Ash Mission during 1994 with Department of Science & Technology (DST) as the Nodal Agency and Technology Information, Forecasting and Assessment Council (TIFAC) as the Implementing Agency. The focus is on Technology Demonstration Projects for developing confidence in fly ash technologies towards large scale adaptation.

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, are addressed. Further, as no single utilisation holds the potential to provide a solution to this mammoth task of safe disposal and gainful utilisation of fly ash, a judicious mix of a number of applications is evolved (considering impact timeframe, investment requirement, technical and infrastructure inputs requirements by fly ash utilisation, potential and expected returns, etc.). A number of disposal and utilisation technologies / applications have been simultaneously demonstrated. Optimum technologies are facilitated to catelatize projects on a wider / larger scale. The Fly Ash Mission has also created critical size of engineering teams for each of the application / disposal areas to provide help for mass replication. The formulation of national standards and code of practices / guidelines is also addressed to for wider acceptance and development on self sustaining principle.

The confidence building exercise has been taken up through 55 Technology Demonstration Projects (TDPs) spread through out the country (see enclosed map & a few site photographs). The projects have been undertaken in the field involving user agencies, industries, technology suppliers, fly ash producer, experts from academia / R&D under the following ten **THURST AREAS**.

i. Utilisation of fly ashes

- Roads & Embankments
- Building components
- Hydraulic Structures
- Agriculture Related Studies & Applications
- Underground Minefills

ii. Safe management of unutilized fly ashes

- Ash Ponds & Dams
- Reclamation of Ash Ponds for Human Settlement

iii. Facilitation of further work/utilisation

- Characterisation of Fly ash
- Handling & Transportation
- Research & Development

In addition, Fly Ash Mission has facilitated ash utilisation through :

Technology Commercialisation

- Identification of promising technology
- Setting up of technology demonstration / confidence building projects
- Facilitate availability of fly ash
- Part financial assistance on soft terms
- Networking with potential user agencies (Govt. & private)
- Research & industrial infrastructure development

Techno- managerial Services

- Mobilisation of scientific & technical manpower resource
- Site specific fly ash management plans

Information Dissemination

- Induction of fly ash in academic curriculum
- Identification & encouragement for research
- Participation & organisation of workshops, seminars, conferences, kisan melas

Policy Initiatives

- Facilitation in preparation of standards, specifications, protocols
- Facilitation for fiscal incentives & policy measures by the Govt.
- Interaction with state Govts. & user agencies for improved fly ash management practices & induction of fly ash in their specifications & schedules of rates

The confidence building and awareness created by Fly Ash Mission through its technology demonstration projects, workshops, seminars as well as association and support of other agencies has lead to a beginning towards acceptance of fly ash and its products. The facilitation in terms of creating awareness towards removal of mindset and other bottlenecks, availability of fly ash and up-dating / formulating standards codes, etc. have also provided meaningful support.

Some of the Multiplier effects are illustrated below:

Roads & Embankments

1. Approach road embankment connecting new Nizamuddin bridge, New Delhi to Noida has been constructed using fly ash.
   It is about 2 km long, 6-8 meter high road embankment in flood zone area of Yamuna river. It has used about 1.5 lac tonne of fly ash (in lieu of soil) resulting in a saving of Rs. more than 1 crore to PWD-Delhi, about Rs. 30 lacs to DVB and protected the land that would have been degraded by excavation 1.5 lac tonne of earth. Design was provided by CRRI, New Delhi and approved by MOST & PWD, Delhi.

2. Fly ash road (1/2 km long) has been constructed at Budge-Budge Power Station (CESC) with technical consultancy from CRRI. More fly ash roads are being planned by CESC.

3. Road embankment (300m long and 1 to 2m high) is being taken up for construction using fly ash at Ramagundam with CRRI design.

4. Hanuman Setu embankment, Yamuna Bazar, Delhi has been constructed using fly ash.

5. Fly ash road has been constructed at NTPC, Dadri, as per design provided by CRRI, New Delhi.

6. Use of fly ash for construction of flyover bridge embankments at Sarita Vihar, Punjabi Bagh, Raja Garden New Delhi

7. Railway embankment, 8m high & 3 km long, at Ramagundam Power Station, NTPC would use about 2.5 lakhs tonne fly ash (in lieu of soil).

8. Railway embankment of Delhi Metro Rail project has been constructed by use of Fly ash. It has used about 15 lac tonne of ash.

Building Components

10. IIT-Delhi has taken a decision that henceforth all construction at it's campus would use fly ash bricks. It would also use fly ash in concrete & mortar.
    2 lac bricks have already been used for construction of cafeteria and hostel buildings. Requirement of about 5 lac bricks for hostel extension is in process along with about 1000 tonne of dry fly ash for use in concrete & mortar.

11. American Embassy has used around 25,000 Fly ash bricks for construction at their campus.

12. TERI, New Delhi is finalizing their requirement for about 2 lac fly ash bricks for construction at their R&D center.

13. Special protection group has agreed to use fly ash bricks for their housing construction. Order for supplying of 80,000 fly ash bricks has been received by BTPS.

14. NTPC has set up 2 additional Fly ash bricks plants at BTPS.

15. PWD-Delhi has planned to use about 10 lacs fly ash bricks for construction of school building.

Ash Ponds & Dykes

16. Selection of ash disposal site for SPIC Power Company by IIT-Madras as consultancy assignment.

17. Ennore Thermal Power Plant ash dyke design review by IIT-Chennai.

18. Soil-Fly ash mix design for Ennore Power Plant dyke construction by IIT-Chennai.

19. Ash Pond maintenance & design for Tuticorin Power Station by IIT-Chennai.

20. Ash Dykes design for Korba Power Station (NTPC), Korba Power Station (MPSEB), Sarni Power Station (NTPC), Rourkela (SAIL), Bokaro (SAIL) by IIT-Kanpur.

Agriculture

21. More and more farmers are seeking fly ash for application in their field as a result of higher yields at demonstration sites.
22. Agriculture agencies in Karnataka requesting more & more support from Raichur, Agriculture University for use of fly ash in agriculture. Farmer's Melas & Goshaties are being held six monthly since last 1 ½ years.

23. Use of Fly ash for agriculture applications has been taken by NLC; STPP Chandrapur and TPP - Bhusawal with technical support and advice from CFRI, Dhanbad.

24. Large scale fly ash use by farmers has started around Raichur, Bakreswar (WB) and Phulpur (U.P.)

Structural Fill

25. DDA's low lying area at Shalimar Bagh, Parmeshwar park, Pitampura and Saria Kale Khan have been reclaimed using DVB fly ashes.

26. Arrangements have been finalised with PWD, Delhi for filling up low lying land of PWD-Delhi at Sarai Kale Khan, using DVB fly ashes.

Dissemination of information and share of expertise

Information dissemination is done through workshops seminars, publications and experience sharing meets etc. Fly Ash Mission has organized more than 10 workshops and supported equal number of seminars / workshops.

In addition information sharing has been done with national and international agencies.

Fly Ash Mission has also provided expertise / technical support towards management / resolving of specific issues regarding safe management and utilisation of fly ash, directly or through its associated agencies to about 40 agencies as paid consultancy assignments.

In addition to working with a large number of project execution agencies across the country for technology demonstration projects, a network of 25 laboratories has been developed to provide facilitation and guidance towards safe management / utilisation of fly ashes. (see map given below)

With an objective of wider acceptance and intitutionalisation of demonstrated technologies, Fly Ash Mission is working very closely with Bureau of Indian Standards (BIS) for up dating the existing standards for fly ash and its products and also to prepare standards for product / utilisation which do not exists as of now.

Some of the Standardisation initiatives include :

(a) Design guidelines for "Use of Fly ash in Road Embankments" have been approved and issued by Indian Roads Congress.

(b) Revision of IS 3812 – the standards for specification of fly ash for its use in cement / mortar / concrete & fine aggregate have been revised in view of the improvements in quality of fly ash over the years. The codes for other applications of fly ash viz. for lime pozzolana mixture applications, sintered applications, geotechnical application and agricultural application are also under formulation.

(c) Updation of IS:456 – code of practice for plain and reinforced concrete has been updated with use of fly ash.

(d) Minimum and maximum percentages of fly ash in PPC have been enhanced to 15% and 35% respectively etc.

- CPWD has issued orders to all the zones to have atleast one construction using fly ash bricks/ blocks etc.
- Notification has been issued by Ministry of Environment & Forests banning the use of top soil for manufacture of bricks and construction of roads and embankments with in a radius of 100 kms from a thermal power station.
- A number of states (Orissa, Tamilnadu, Karnataka) have also announced fiscal and policy incentives for fly ash based products.
- Central Government has granted excise & custom duty exemptions/ reliefs

The impact and the considerable change in fly ash utilisation scenario is evident from the fact that acceptance of fly ash products has started picking up and fly ash is now emerging as an important resource material for the new millenium. Use of fly ash in bricks, blocks, cement, in construction of roads and embankments and also in agriculture related areas are fast emerging.

The intrinsic worth of fly ash for various gainful applications is being understood. It is slowly being taken as a friendly and useful resource material than a liability. Let us harness this resource jointly.