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# Issues in utilization of ash by Thermal Power Plants in the country

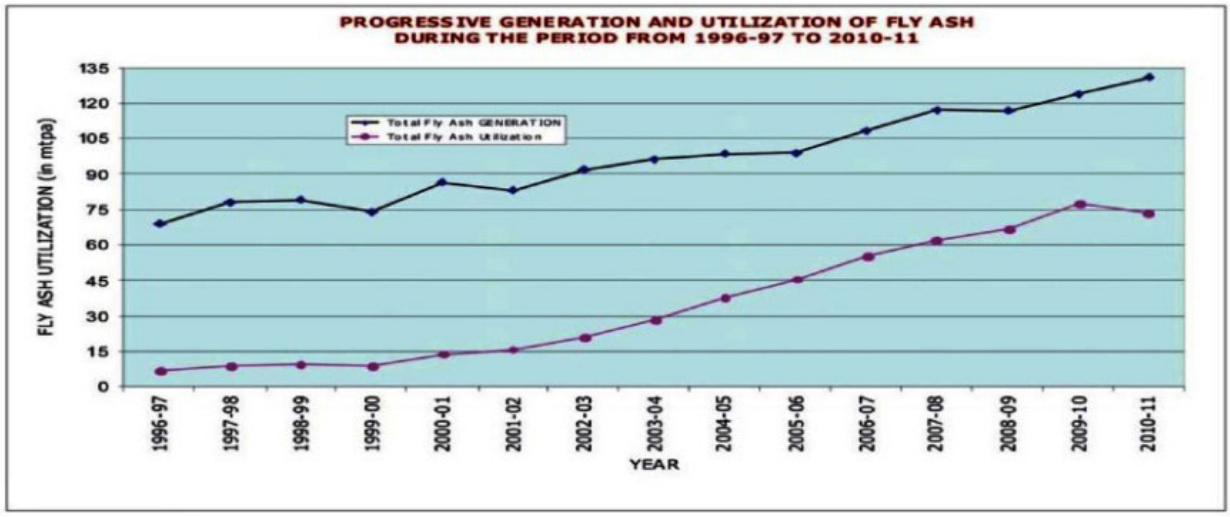
**By Shri. G. C. Chattopadhyay, Dy. Director(Bhilai), Office of the Principal Director of Comm. Audit & Ex-offico Member Audit Board, Ranchi**

**Abstract**

Power generation is the most vulnerable criterion of modern civilization where thermal process takes the lead in our country in comparison with hydro-electricity and others owing to the availability of the main ingredient i.e. coal. Combustion of coal in the Boiler leaves ash either fly or bottom. Disposal of huge quantity of fly ash is a burning problem in our country as it is detrimental to animal, plant life as it pollutes environment and requires large area of land as well as water, which are scarce now a days, for its disposal in the form of slurry. Though Govt. of India policy and subsequent the Ministry of Environment & Forests (MoEF) notification dated 14 Sept.1999 mandated 100% ash utilization within a specified period but achievement is nearly 50% of annual ash generation even after the lapse of twenty years since Fly Ash Mission of GOI. This study has been made to highlight the presence of policy and regulatory barriers in the country to 100% ash utilization with some recommendations for its enhancement.

**Ash Generation *vis-a-vis* Utilisation :** Over 50% of India's electricity generation is coal based. One of the major and important aspects of any coal based Thermal power plant is combustion of coal. The by product of combustion i.e. coal combustion residues (CCR) often called ash so generated falls under two categories *viz*. Bottom ash and Fly ash. Bottom ash is collected at the bottom of the boiler units while fly ash is collected in electrostatic precipitators and economizer hoppers. Normally in a fossil fired boiler, 20% of the total ash is bottom ash and balance 80% is fly ash. Since indigenous coal in India having diverse quality of coal reserves contains 30-45% ash on an average, a thermal power plant with 1000 MW capacity is estimated to produce annually 1.6 to 1.8 million ton (mtpa) of fly ash respectively at 29% and 40% ash content. As per the available estimates, the annual production of coal ash in India including both fly ash and bottom ash was about 131 million ton by the end of 2010-11 which is likely to touch 200 mtpa by the end of 2015 with the present growth rate of 8-10% power generation and with the estimated installed thermal capacity of about 300000 MW by the end of $12^{th}$ 5-year plan(2017).Hence disposal of such huge volume of coal ash (CCR), which has been one of the major sources of pollution of both air and water, is a real challenge of the day in our country.

The Central Electricity Authority (CEA) has been working on behalf of Govt. of India(GOI) for effective utilization coal ash. A large number of technologies have been evolved for gainful utilization and effective management of fly ash under the concerted efforts of Fly Ash Mission of the GOI since 1994. However, achievement towards utilization of ash since 1997 is not very encouraging (nearly 50%) in the country particularly when compared with the growth rate of annual fly ash generation as would be evident from the following line chart:



Even after the lapse of sixteen years since 1994, the utilization of fly ash has increased to over 73.13 million tonne being only 55.79% during 2010-11 as may be evident from the following Table-1:

**Table-1**

**Fly ash utilization during 2010-11**

| Sl.no. | Mode of fly ash utilisation | Utilisation(million tons per annum) | Percentage utilisation |
|---|---|---|---|
| 1. | Cement | 35.47 | 48.50 |
| 2. | Reclamation of low lying area | 9.31 | 12.73 |
| 3. | Roads and Embankments | 8.52 | 11.65 |
| 4. | Mine Filling | 6.04 | 8.26 |
| 5. | Bricks 7 Tiles | 4.61 | 6.30 |
| 6. | Agriculture | 1.27 | 1.74 |
| 7. | Others | 7.91 | 10.82 |
| Total | | 73.13 | 100 |

**Policy frame work and regulatory regime for Fly ash management:** Fly ash management has two inter-related aspects (i) limiting fly ash generation by reducing the ash content of coal in power plant; and (ii) enhancing fly ash utilization by policy intervention. While ash generation and its disposal is a perennial problem in India, it was only in late 1990s that policy frame work was first framed at the national level. The earlier notifications of 1997 and subsequent amendments in 1998 focused on reducing ash generation by using quality and low ash content coal which is, however, not available in India; hence 1999 notification and subsequent other notifications shifted its focus for enhancing fly ash utilization. While the existing mandate under the 1999 notification was to provide free fly ash to its users, **MoEF, GOI notification dated 3 November 2009** made it a saleable commodity. Meanwhile, fly ash was shifted from the category of "Hazardous Industrial waste" to the category of "Waste material" in the year 2000. However,it became a saleable commodity, subject to certain conditions, since November 2009 with the comprehensive **MoEF, GOI notification dated 3 November 2009** in which Fly ash was redefined which included ash collected from ESP, dry fly ash, bottom ash, pond ash from coal/ lignite based TPP including CPP. To address the problem of pollution, caused by fly ash from coal/lignite based TPPs and to reduce the requirement of land for disposal of fly ash in slurry form in ash ponds, MoEF has issued notification stipulating targets for 100% utilization of fly ash in phased manner as per Table-2 :

**Table-2**

| Sl.no. | Coal/lignised based TPP in operation before Nov. 2009 notification. | Target date | Coal/lignised based TPP in operation after Nov. 2009 notification. | Target date |
|---|---|---|---|---|
| 1. | At least 50% of fly ash | 1 year from notification | At least 50% of fly ash | 1 year from commissioning |
| 2. | At least 60% of fly ash | 2 years from notification | At least 70% of fly ash | 2 year from commissioning |
| 3. | At least 75% of fly ash | 3 year from notification | At least 90% of fly ash | 3 year from commissioning |
| 4. | At least 90% of fly ash | 4 year from notification | 100% fly ash generated | 4 years from commissioning |
| 5. | 100% fly ash generated | 5 years from notification | | |

The unutilized fly ash in relation to the target during a year, if any shall be utilized within next two years in addition to the targets stipulated for these years and the balance unutilized fly ash accumulated over the first four years shall be utilized progressively over the next five years in addition to 100% utilization of concurrent generation of fly ash.

However, fixation of any specific target and success on fulfillment thereof presupposes the establishment and creation of a platform where both suppliers and takers would feel lucrative and be benefitted.

**Environmental issues:** The increased volume of ash generation have led to growing concerns for maximizing its gainful utilization. The concerns emanating from low levels of ash utilization are directly correlated with the environmental and other costs associated with ash disposal. The MoEF, GOI notification dated **14 September 1999** may be considered as a mile stone in this regard with the following stipulation:

> No person within a radius of 50 km from coal/lignite based thermal power plant(TPP) shall manufacture clay bricks or tiles without mixing at least 25% ash with soil;
>
> Every coal/ lignite based TPP shall make available ash for at least 10 years from the notification free of cost for the purpose of manufacturing ash based products such as cement, concrete blocks, bricks, construction of roads, embankments, dams, dykes or for any other construction activity.
>
> Every coal/ lignite based TPP shall have action plan for **full(100%) utilization of fly ash** within a period of 9 years from the publication of notification.

**Contradiction in regulatory provisions:** Dry fly ash becoming a saleable product may allure the TPP management to sale the ash while the power utilities are obliged to evacuate the ash pond(slurry) on a regular interval, but may at the same time discourage the fly ash takers from a distant location particularly when radial area has been increased**( By way of MoEF, GOI notification dated 3 November 2009 )** from 50 KM to 100 KM without, however, addressing anything towards compensation of carrying cost which matters much considering the **additional distance to be covered** by the ash buyers under the present high transportation cost regime.

Amount, whatsoever, collected from sale of fly ash was also stipulated to be kept in a separate fund i.e. ash fund by the TPP for utilization towards infrastructure development, promotion and facilitation activities for use of fly ash until 100% utilization was achieved without, however, addressing anything towards compensation of carrying/transportation cost.

Following **MoEF, GOI notification dated 3 November 2009,**fly ash was made a saleable product subject to condition that (a) pond ash should be made available free of any charge on "as is where is basis" to manufacturers of bricks/tiles, farmers, Central and State road construction agencies, PWD, agencies engaged in backfilling of abandoned mines and (b) **at least 20%** of dry fly ash shall be made available free of charge to fly ash brick/tiles manufacturers on priority basis over other users. Subsequently fly ash was also made a **dutiable** product as per **GOI notification No.1&2/ 2011-CE dated 1 March 2011** under section **11A of the Central Excise Act, 1944** and became effective from 1 April 2011 without, however, any stipulation as to exemption from sharing of duty by the power utilities on free supply of fly ash to incentivize them.

**Areas of potential ash utilization:** The usual modes in which fly ash is mainly utilized in our country fall under the following categories: (i) Cement making utilities;(ii) reclamation of low lying land;(iii) construction of Roads & Embankments; (iv) Abandoned/ void mines filling and (v) Ash based building products like bricks, tiles etc.

**Growth of cement sector:** The cement sector in India is expected to increase at a compound annual growth rate (CAGR) of more than 8% during 2015-17 with installed capacity estimated to be 421 million ton by the end of 2017. Since one ton of cement requires about 24-25% of fly ash, Indian cement industry would be requiring 100-105 mt fly ash by the end of 2017.The housing sector in the country is the biggest demand driver of cement accounting for 67% of total consumption while other major consumers viz. infrastructure account for 13%;commercial construction 11% and industrial construction 9%.Continuing with the present growth rate, India is expected to be the main exporter of clinker and grey cement to the Middle East countries, Africa and other developing countries of the world.

In the present scenario, the most promising sector for fly ash utilization appears to be the cement sector and with India's increasing economic growth coupled with some sort of incentives towards transportation cost, the utilization of fly ash by the cement sector may be expected to grow still further in the years to come.

**Backfilling of abandoned/void coal mines:** Almost 90% of coal in India is produced from open cast mines and large number of power utilities with substantial capacities using coal/lignite are pitheads i.e. located in or around coal fields. Using pond ash to backfill abandoned/void coal mines may be considered to be an ideal avenue for augmenting the ash utilization provided some sort of incentives towards transportation cost is assured. Moreover, transportation of fly ash by rail may be considered due to high cost of road delivery and environmental issues for which railway track may be extended from the coal yard of TPP to the ash pond end.

However, there is mismatch between the life cycle of an ash dyke (Time required for its filling up) and the life of an open cast mines. This mismatch often pose a problem for backfilling on a continuous basis. An open cast abandoned mines may not be available as and when required by the power utilities for backfilling of its pond ash uninterruptedly.

**Regulatory frame work for closure of coal mines:** Unlike mineral sector, coal sector, however, has no policy in place for proper closure of coal mines though approved mine plan contains such provision. Since no regulatory compulsion is there, mine owners at the close of mines hardly find any interest of their own to use ash for backfilling of abandoned/void coal mines; hence coal mine owners may be required to be brought under regulatory net for compulsory backfilling of abandoned/void coal mines and at the same time may be considered to be incentivized by providing transport subsidy for carrying ash from the power utilities.

Open cast coal mines

**Construction of Roads & Embankments:** Pond ash can be used economically for the construction of roads and embankments specifically in the vicinity of thermal power stations when lead distances are within 100 kms. In case of concrete pavements construction in a large scale, part replacement of cement by dry fly ash may be cheaper. Adequate attention should be paid for quality improvement of fly ash during construction of road, concrete pavements, embankments for better construction so that fly ash may no longer be considered as liability to power utility and can be turned into a revenue generating byproduct.

**Mandate of free fly ash:** The mandatory requirement of making available free fly ash, though preferred by ash takers, may at the same time act as a disincentive to the power utilities in investing money for installing/improving dry ash collection system for ensuring its quality particularly required for manufacturing of cement. Quality ash in terms of its fineness with low un-burnt carbon is mostly preferred by cement producers for which power utilities may be required to invest extra and obviously would be reluctant; hence some sort of incentive, if provided to the power utilities, may motivate in installing the dry ash collection system (DACS). For new power plants, mandatory installation of dry ash collection system may be contemplated to be a precondition for environmental clearance to the project proponents.

Mandate of free dry fly ash may be reconsidered in view of **duty imposed** following **GOI notification No.1&2/ 2011-CE dated 1 March 2011** under section **11A of the Central Excise Act, 1944 w.e.f. 1 April 2011**. In USA, dry fly ash is not given free of cost. Even if a token amount of ₹ 50/= per ton (In India rate is varying between ₹ 25/ton to ₹ 400/ton) is charged, power utility with 1000 MW capacity producing annually 1.6 to 1.8 million ton(mtpa) of dry fly ash would be earning around ₹ 8/9 crore per annum out of which a portion may be utilized towards maintenance cost of DACS, transport subsidy to the stake holders upto a radial distance of 100 kms.

**Ash Disposal system in the country:** All most all the thermal power utilities barring a few, have slurry system of ash disposal. In the slurry system, both fly ash and bottom ash is mixed with water normally in 1:10 ratio and transported through pipeline for discharging into the artificially created ash pond/dyke in slurry form. This slurry disposal requires large area of land (Usually 350 acres or 0.35 acre/MW for 2x500 MW TPP) for creating ash pond and huge quantity of water which are scarce. Additionally, this wet disposal process reduces the "lime reactivity" in ash being an important property of fly ash to be used in cement manufacture. Hence apart from installing dry ash collection system (DACS) in power utilities, the recent revolution in the existing wet disposal of ash being High Concentrated Slurry Disposal (HCSD) with significantly reduced water content( nearly 1:0.5) should also be encouraged. The installation of HCSD though capital intensive may be thought of in the existing power utilities for which some sort of incentive may be provided to the TPP.

Ash dyke of a Thermal power utility

**Transportation cost:** The transportation cost of carrying dry fly ash, which is considerably high, from the power utilities to the destination of users, be it cement producers, brick manufacturers acts as a limiting factor restricting the use of fly ash. The economics involved in the use of fly ash by cement producers may easily bear the transportation cost as because the cement industry with its large scale operation and remunerative selling price may well absorb the carrying cost of dry fly ash even if it is high.

However, producer of fly ash bricks belonging to the unorganized sector with narrow margin and facing completion from the traditionally available and already established cheaper substitute of clay bricks would definitely feel for obvious reasons discouraged in bringing fly ash from the TPP by incurring high transportation cost, even if ash is made available at free of cost, from a radial distance of 50-100 KM. Hence adequate transportation subsidy may be contemplated to encourage small unorganized sector producing fly ash-based bricks or other products. The State Pollution Control Board, Odisha has made an order in January 2015 by which all thermal power utilities with generating capacity of more than 100 MW shall be providing transport subsidy of ₹ 150 per ton to the ash brick or other ash product manufacturers.

**Conclusion :** Though various GOI notifications are in place in the country in respect of fly ash utilization to address the regulatory and policy aspects in view of the varying and conflicting interests of various stake holders, the policy in place needs to be reviewed to accommodate both the power utilities and the ash takers. The international experience in fly ash utilization is mixed and may give useful inputs to policy makers in this regard. However in our country, the policy still continues to emphasize on mandating rather than incentivizing the use of fly ash. The experiences of other countries also point to the presence of policy and regulatory barriers in our country which need to be adequately addressed to ensure 100% utilization of

fly ash otherwise actual utilization of fly ash would continue to remain far below the increasing volume of ash generation which in turn might go on impacting our environment adversely.

**Recommendations:**

i) The disposal system has to be planned in advance keeping in view the requirements of the MoEF stipulations and keeping the dyke ready for discharge as per the predetermined schedule.

ii) One of the major challenges in ash disposal is to protect the environment. To manage safe disposal and conform to the stipulations of MoEF it is necessary to have proper planning, studies, method of disposal at design stage, implementation stage and management of safe disposal at operating and non-operating stage.

iii) If utilization levels of fly ash has to increase ,backfilling of mines is one of the potential areas for pithead power stations. In case of captive mining by power utilities, utilization of ash should be made mandatory for backfilling of mines.

iv) Transportation of fly ash by rail may be considered due to high cost of road delivery and environmental issues for railway track may be extended from the coal yard of TPP to the ash dyke.

v) Transport subsidy may be contemplated to encourage small/ unorganized sector producing fly ash-based bricks or other products.

vi) Finally, mandate of free dry fly ash (20%) may be reconsidered by the Govt. of India in view of duty imposed following GOI notification No.1&2/ 2011-CE dated 1 March 2011 under section 11A of the Central Excise Act, 1944 w.e.f.1 April 2011.

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