

Fly ash utilization strategies for greener environment

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Abstract

Rapid industrialization has resulted in increased use of natural resources, which brought serious ecological and environmental imbalance due to heavy dumping of industrial wastes. Fly ash is such one of the dangerous industrial waste pollutants that cause air, water and soil pollution, disrupt ecological cycles and set off environmental hazards. The disposal of the increasing amounts of solid waste fly ash is becoming a serious concern to the environmentalists.

Currently, more than 100 million tonnes of fly ash is being generated annually in India. Both in disposal as well as in utilization, utmost care has to be taken to safeguard the interest of human for better greener environment.

Keywords: Disposal, Fly ash, green environment, health, pollution, utilization

Introduction

A useful by-product ash in the form of fly ash, found in ample quantities at the Coal based thermal power plants in India. It needs to be utilized in various ways and applications to safeguard human health & environment. Fly ash possesses specific utilities depending upon the characteristics and Engineering properties. Fly ash can be processed to enhance its utility. The safe Environmental concerns cannot afford to increased ash pond areas; increased heights of ash dykes; as well as the likely pollution it may have in air, surface water and the ground water. The protections from environmental hazards that can be anticipated necessitate 100% ash utilization in a variety of ways. Ash needs to be converted into ash based products and utilized so that ash does not fly in air; it does not get washed away with surface water flow and also does not get

leached to cause ground water pollution. Safe utilization of ash is essential. Ash Utilization therefore needs to be a continuous activity at all the coal based thermal power stations. Ash utilization is an industry in itself and fly ash based industry needs to be developed at the thermal power plants in the immediate vicinity and the ash dump areas. It will provide employment opportunities to many in the nearby villages. Ash utilization has number of benefits such as reducing pond areas, its handling system, and consumptive power which saves time and energy that is utilized for creating these infrastructures. Ash based product bring economic return to the society and therefore the effect on tariff is negligible.

Fly ash utilized in different countries (%)

Sr. No.	IND	CH	USA	GER	UK	AUS	CAN	FRAN	DEN	ITA	NET
%	38	45	65	85	50	85	75	85	100	100	100

Source: <http://www.tifac.org.in>

In India, at present nearly 112 metric tons of fly ash is generated per annum and is expected to rise up to 140 metric tons in 2020 approximately which largely responsible for environmental pollution. In developed countries like Germany, 85% of the fly ash generated is being utilized, whereas in India only 38% is being utilized which is great cause of concern.

Environmental & health hazards

The problem arises with fly ash lies in the fact that not only does its disposal require large quantities of land, water and energy, its fine particles, if not managed well, can become airborne easily. Currently 90 million tones of fly ash are being generated annually in India, with 65000 acres of land being occupied by ash ponds. Such a huge quantity dose poses challenging problems, in the form of land use, health hazards and environmental damages.

- It is a very difficult material to handle in dry state because it is very fine in nature and readily airborne even in mild wind.
- It disturbs the ecology of the region, being a source of soil, air and water pollution.
- Long inhalation of fly ash causes silicosis, fibrosis of lungs, bronchitis, pneumonitis etc.
- Flying fine particles of ash poses problems for people living near power stations, corrode structural surfaces and affect horticulture.
- Eventual settlement of fly ash particles over many hectares of land in the vicinity of power station brings about perceptible degeneration in soil characteristics.

Sr. No.	Constituent	(%)	Problems
01	Silica (SiO ₂)	67	silicosis
02	Alumina (Al ₂ O ₃)	26	Vomiting sensation
03	Iron Oxide (Fe ₂ O ₃)	63	fibrosis of lungs
04	Calcium Oxide (CaO)	02	Pneumonia
05	Magnesium Oxide (MgO)	01	Diarrhea
06	Sulphur (SO ₃)	01	Irritation
07	Potassium oxide K ₂ O	02	Skin burning

Source: Critical Review in Environmental Control CRC Press, 3, (1989)

Literature reviewed

Ahmad Shamshad, Fulekar M.H., Pathak Bhawana (2012) ^[1], Impact of Coal Based Thermal Power Plant on Environment Mitigation Measure, International Research Journal of Environment Sciences, Vol. 1(4), 60-64, expressed that coal used widely as a thermal energy source in thermal power plant for production of electricity but available coal in India is of poor quality, with very high ash content and low calorific value. Coal based thermal power plants all over the world is cited to be one of the major sources of pollution affecting the general aesthetics of environment in terms of land use, health hazards and air, soil and water in particular and thus leads to environmental dangers. So, the disposable management of fly ash from thermal power plant is necessary to protect our environment.

Ansari, F. A., Gupta A. K., and Yunus M., (2011) ^[2] Fly ash from coal fired Thermal Power Plants: Bulk Utilization in Horticulture - A long Term Risk Management Option, International Journal of Environmental Research, Vol. 5, No. 1, pp. 101-108, strongly advocate in their research that management of solid waste (fly ash) has attained an apparent scenario for scientific & strategic concern in India due to large-scale dependence on coal-based thermal power plants. However, the large-scale and voluminous generation of fly ash on regular basis calls for bulk utilization options in a productive purpose like horticulture and for production of two important vegetable crops, viz., Brinjal and Spinach.

M. I. M. Loya and A. M. Rawani (2014) ^[3], a review: promising applications for utilization of fly ash, International Journal of Advanced Technology in Engineering and Science, Volume No.02, Issue No. 07, p.no. 143 advocate that to achieve utilization trend higher than the existing trend line; must be retained. Second, in addition to the first, underutilized large potential applications should be explored. The three key underutilized application groups identified are: (i) mine filling, (ii) bricks, blocks & tiles (iii) roads, embankments & ash dyke rising.

S.K. Chaudhary, (2014) ^[4], Fly Ash and Climate Change, Journal of Environmental Science and Sustainability (JESS) Vol. 2 (1) 31 – 35, expressed that Fly ash is one of the numerous substances that cause air, water and soil pollution, disrupt ecological cycles and set off environmental hazards. Such a huge quantity does pose challenging problems, in the form of land usage, health hazards and environmental dangers. Both in disposal as well as in utilization, utmost care has to be taken to safeguard the interest of human.

Vaishali Sahu & Gayathri. V (2014) ^[5], The use of stabilized fly ash as a green material in avement substructure: A review, international journal of civil and structural engineering Volume 4, No 3, page no. 306 – 314 expressed that Fly ash utilization is increasing in civil engineering applications; however the need is to increase the percentage utilization and

to use the other potential industrial by-products along with fly ash. Even the use of cement can be avoided to large extent to save the environment from major greenhouse gas emission during its production.

Problem to be investigated

Energy requirements for the developing countries in particular are met from coal-based thermal Power plants. The disposal of the increasing amounts of solid waste from coal-fired thermal power plants is becoming a serious concern to the environmentalists. Current annual production of Fly ash, a by-product from coal based thermal power plant is about 112 million tons (MT) and as reviled from literature, it is observed that foreign countries fly ash utilization is quite high as compared to Indian applications which is merely 38% only. Some of the major problems associated with Fly ash are large area of land required for disposal and toxicity associated with heavy metal leached to groundwater. Fly ash, being treated as waste and a source of air and water pollution till recent past, is in fact a resource material and has also proven its worth over a period of time.

The important areas of fly ash utilization

- Building Sector for use in bricks, blocks, tiles, cement, concrete, plaster, & construction.
- Land reclamation, filling low lying areas, raising ground levels.
- Roads, embankments, ash dykes, road blocks, kerb stones, etc.
- Agriculture and wasteland area development.
- Hydro Sector, Irrigation, drains, water supply & drainage, lining of rivers, tributaries, canals, minors, sub-minors etc.
- Mine filling, Industrial applications & high value areas, roller compacted dams, pavements, roads etc.

Objectives of research

1. To make maximum application of fly ash in different sectors for economic revenue generation.
2. To protect health & environment from pollution to create greener environment.
3. To suggest some remedial measures to minimize pollution to protect and save environment.

Hypotheses

H₀₁ – Fly ash is not properly used in different sector for economic revenue generation.

H₁₁ – Fly ash is properly used in different sector for economic revenue generation.

H₀₂ – Fly ash is not properly used to protect health & environment.

H₂₂ – Fly ash is properly used to protect health & environment.

Scope of study

The scope of the study revolves around two prime focuses i.e. one from environmental protection and other from organization point of view.

From environmental perspective: Eco-friendly product, pollutant free environment, greener environment.

From organization Perspective: pollutant free environment, effective use of land, extra profit outlet from bi-product.

Conclusion

Over a period of time, the image of fly ash has completely changed from a "Polluting Waste" to "Eco-friendly Resource Material". The economic worth of fly ash has been significantly understood by the people. The utilization of fly ash which was about one million tonne per year in 1994 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 more than 10 areas of ash utilization have been identified and fly ash has started being used in most of them. With the significant progress made during last 10 years, it seems that the ash utilization is heading forward in right direction, however, continued thrust, awareness, and support of all stake holder agencies at much higher levels would still be required to sustain the pace to accelerate it further.

Recommendations & suggestions

- The disposal of dry fly ash require technological innovations of high efficiency, dry fly ash collection and storage facility outside the plant boundary and facilities for loading into the mode of conveyance as well as transportation up to the location of user agencies / manufacturing units of cement, bricks, and ash based products etc.
- Ensure availability of ash based products in the markets for use by all user groups, agencies, and the people at large.
- The fly ash being used as construction materials require inclusion of the same in the technical specifications, schedule of rates, analysis of rates, tender documents by CPWD, PWD's, Construction Agencies, Bureau of Indian Standards, Roads.
- The mining Sector, require identification of abandoned mines within reasonable distance and location of the thermal power plants.
- The Agriculture requires research and development, dissemination of technology and guidelines for use by all.
- The use of Bottom ash, pond ash, for embankments in Roads etc, requires their engineering properties and shear parameters to be tested half yearly and a data bank of engineering properties be prepared.
- Data Management system on Ash generation & utilization and software developed to process the ash quality, quantity, suitability and availability of ash for various usage's.
- Need of ash management agency for collection, distribution and management of ash utilization in various modes and by various organizations and construction agencies etc.
- It is also envisaged that the ash utilization may be handled by a separate ash utilization division exclusively entrusted with the relevant functions including marking aspects and

sale of ash and ash based products and also to ensure their availability in the markets like other construction materials.

- The ash utilization has priority over ash disposal in traditional forms. It needs to be a continuous activity at the Thermal Power Plants.

Scope for Future Research

As application of fly ash application in agriculture and construction gained its full momentum in coming future there is an ample scope for its application in varied areas. As is revealed from literature reviewed fly ash can be extensively used in fertilizers, chemicals, paints, mines filling, partition material and value based fly ash product. In recent past fly ash is treated as a source of pollution but in fact if used properly may be observed as an economic resource & may be helpful for greener environment.

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