International Journal of Applied Research 2015; 1(9): 372-374

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2015; 1(9): 372-374
www.allresearchjournal.com
Received: 29-06-2015
Accepted: 31-07-2015

Neeraj Godara
Department of chemistry
DAV. College Abohar Punjab,
India.

Correspondence
Neeraj Godara
Department of chemistry
DAV. College Abohar Punjab,
India

Disposal of Thermal Power Plant's Waste: Management of Fly ash

Neeraj Godara

Abstract
Fly ash, also known as "pulverised fuel ash" in the United Kingdom, is a coal combustion product composed of fine particles that are driven out of the boiler with the flue gases. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide (SiO2) (both amorphous and crystalline), aluminium oxide (Al2O3) and calcium oxide (CaO), the main mineral compounds in coal-bearing rock strata.
Constituents depend upon the specific coal bed makeup but may include one or more of the following elements or substances found in trace concentrations (up to hundreds ppm): arsenic, beryllium, boron, cadmium, chromium, hexavalent chromium, cobalt, lead, manganese, mercury, molybdenum, selenium, strontium, thallium, and vanadium, along with very small concentrations of dioxins and PAH compounds [1, 2].
In the past, fly ash was generally released into the atmosphere, but air pollution control standards now require that it be captured prior to release by fitting pollution control equipment.

Keywords: pulverised fuel ash, Thermal Power Plant's Waste.

Introduction
Most important ill effect of these global processes has been the generation of large quantities of industrial wastes. Therefore, the problems related with their safe management and disposal has become a major challenge to environmentalists and scientists. Second related problem is the pressure on land, materials and resources to support the developmental activities, including infrastructure.
The thermal power plants generate significantly large quantities of solid byproduct namely flyash. At present, the disposal of generated flyash is by either wet disposal or dry disposal. However, there is a need to address the problems encountered during the disposal or reuse flyash in construction materials.
An attempt has been made in this present paper to highlight on the pollution hazards due to the disposal of flyash into the environment and its utilization in civil engineering activities, their possible remedies and the research and development needed to address the above stated issues. The main topics covered in the present paper are flyash quantification and characterization in terms of physicochemical and mineralogical analysis and the classification of flyash; pollution problems due to flyash disposal systems, utilization of flyash in various construction activities and problems encountered during reuse and storage of flyash and its possible remedial measures. The scope of this paper is limited to flyash from thermal power plants. Bottom ash and slag as well as flyash generated from other industrial sources are beyond the scope of this paper.

Quantification of Flyash
The population explosion and industrial growth are the traits of present day society, which require more electricity generated from the coal based thermal power plants. In order to meet the growing energy demand of the country, coal based thermal power generation shall continue to play a dominant role in the future also [3].
At present in India, about 120 coal based thermal power plants are producing about 112 million tons of flyash every year. With the increase in demand of power energy and coal

being the major source of energy, more and more thermal power plants are expected to be commissioned in near future.

Composition of Fly ash

The variability is directly related to the source of the coal, its pretreatment, and the operation of the plant burning the coal. The chemical composition of the flyash core is nearly overshadowed by the importance of the enriched surface layer.

The major elements in the order of decreasing abundance are; This is probably because they are not volatilized in the combustion process [5]. As we see in table 1

Table 1

Contents	Percentage by mass
Calcium oxide, CaO	0.37-27.68
Silicon dioxide, SiO_2	27.88-59.40
Aluminium oxide, Al_2O_3	5.23-33.99
Iron oxide, Fe_2O_3	1.21-29.63
Magnesium oxide, MgO	0.42-8.79
Sulphur Trioxide, SO_3	0.04-4.71
Sodium carbonate, Na_2O	0.20-6.90
Potassium oxide, K_2O	0.64-6.68
Titanium dioxide, TiO_2	0.24-1.73
Other alkaline & unidentified	4.0-6.0
LOI, (Loss-on-ignition)	0.21-28.37

Flyash contains large quantities of major impurities such as oxides, hydroxides and sulfates of iron and calcium, as well as significant quantities of hazardous leachable trace elements such as arsenic, boron, cadmium, chromium, manganese, selenium and vanadium [6]. During coal combustion, the organic matter in coal is utilised to produce heat and as a result, the concentrations of trace elements are increased relative to those in the source coal. Several trace elements such as As, Se, Cd, Cr, Ni, Sb, Pb, Sn, Zn and B are enriched by factors of 4–10 in coal combustion by-products [7]. These impurities have a negative impact on flyash utilization due to environmental restrictions.

The major constituents of the flyash are SiO2, SO3, Al2O3, Fe2O3, MgO, CaO, Na2O, K2O and TiO2.

The metals present in flyash are in priority pollutants list as their leaching potentials have been expected to be high. Contaminated leachates from acidic flyashes can pose the highest toxicity problem for aquatic environments [8]. Non-toxic soluble elements will dissolve first in water or weak acids [9], but long term leaching of toxic trace elements are associated with slow mobility of elements from glass, magnetite and related minerals [10]. Interaction of groundwater and surface water in flyash emplacements will take a long time to remove mobile trace elements from the solid phase. Depending on the hydrogeochemical environment in which the flyash is emplaced or used, the elevated concentrations could be induced over long periods of time and create potential contamination of associated groundwater and surface water systems.

The flyash, which contains the chromium, has toxic and mutagenic properties related to its oxidizing activity [10]. The concern is its bioactivity and biotoxicology, its ability to accumulate in plants, specially its mobility in the environment and its ability to migrate from flyash to water solutions in the common environmental conditions [11]. Flyash, which contains heavy metals like lead (Pb), is of large public concern due to toxicity to animals as well as human beings, especially young children.

Disposal of Flyash

The flyash produced in the thermal power plant needs to be disposed outside the plant premises so that it causes least disturbance to the main plant operation. Two methods are in practice to dispose off the generated flyash. They are wet disposal and dry disposal methods with ash ponds being the most common methods of disposal in India.

The problem of flyash disposal has assumed such an enormous scale in the country that the Ministry of Environment and Forests (MoEF) issued a regulation on 14 September 1999 specifying normative levels for progressive utilization of flyash. According to the regulation, it is mandatory for the existing (old) and new coal based thermal power plants to utilize 100% of the flyash produced in a stipulated time horizon. The old power plants, however, are required to achieve 100% flyash utilization goal within 15 years from the date of issue of the regulation.

FLYASH UTILIZATION:

Flyash from thermal power plants can be considered either as a waste or as a resource yet to be fully utilized. The flyash content of coal used by thermal power plants in India varies between 25 and 45%, with average flyash content being 40%. As a consequence, a large amount of flyash is generated from thermal power plants, causing several disposal related problems. In spite of initiatives taken by the government, several non governmental and research and development organizations for flyash utilization, the level of flyash utilization in the country was estimated to be less than 10% prior to 1996–97 [13]. On the other hand, in the USA and China, huge quantities of flyash are produced and its reported utilization levels were about 32% and 40%, respectively during 1995 [15].

A. Flyash used as a Soil Stabilizer

In the application of flyash as highway construction material like soil stabilizer for road bases, the importance is given to the self hardening properties of flyash [16]. However, the majority of flyash stabilization projects implemented by various highway departments have devoted more to the measurement of strength and durability of the material rather than its environmental hazards through the leaching potential from flyash structures and possibility of heavy metals from flyash migrating to groundwater systems, thus, contaminating the drinking water sources [16].

B. Flyash in Metallurgy

The amounts of trace metals released from flyash into solution and the rates of release depend on three factors namely [17]:

The total concentration of elements in the solid phases, the distribution of elements in the flyash particles. And incorporation of the elements into secondary solids.

Dudas [18] conducted long term leaching experiments on flyash from a thermal power plant to determine its ion releasing characteristics.

C. Flyash as Construction Materials

Flyash, when mixed with cement and water to form concrete, mortar, render or grout, will produce a mixture that releases alkalis into solution. Strong alkaline solutions in contact with the skin tend to damage the nerve endings first, before damaging the skin and therefore, chemical burns can develop without the pain being felt at the time [19].

Mixtures of flyash with cement and water until set, cause irritant dermatitis. Allergic dermatitis is caused mainly by the sensitivity of an individual's skin to soluble chromium released from the cement [19].

Conclusions

At last we conclude from this are as follows.

- The current world wide production of the flyash is more than 700 million tons.
- In India, about 120 coal based thermal power plants are producing nearly about 112 million tons of coal flyash per annum.
- Indian thermal power plants generate both class F and class C flyash and are disposed in ash ponds or lagoons.
- Flyash is a potential source of pollution not only for the atmosphere but also for the other components of the environment. Remaining portions of the flyash stored in pond and pollute the environment of the region.

There is urgent need to undertake research and development for studying the metal speciation and the changes associated with flyash reuse in the construction purposes and during the wet storage of flyash in ash ponds

References

1. Adriano DC, Page AL, Elseewi AA, Chang AC, Straughan I. Utilization and Disposal of Flyash and Other Coal Residues in Terrestrial Ecosystems: A Review, Journal of Environmental Quality. 1980; 9:333-344.
2. Kumari V. Physicochemical Properties of Flyash from Thermal Power Station and Effects on Vegetation, Global Journal of Environmental Research. 2009; 3(2):102-105
3. Sahu SK, Bhangare RC, Ajmal PY, Sharma S, Pandit GG, Puranil VD. Characterization and Quantification of persistant Organic Pollutants in Flyash from Coal Fueled Thermal Power Stations in India, Journal of Microchemical. 2009; 92:92-96
4. Kumar V, Mathur M, Sinha SS, Dhatrak S. Flyash Environmental Saviour. New Delhi, India: Report Submit to Flyash Utilization Programme (FAUP) to TIFAC, DST, 2005.
5. EI-Mogazi E, Lisk D, Weinstein L. A Review of Physical, Chemical and Biological Properties of Flyash and Effects on Agricultural Ecosystems, Journal of the Science of the Total Environment. 1988; 74:1-37.
6. Querol X, Juan CU, Andres A, Carles A, Angel LS, Felicia P. Extraction of Major Soluble Impurities from Flyash in Open and Closed Leaching Systems. In: International Ash Utilization Symposium, Center for Applied Energy Research, University of Kentucky, 1999.
7. Fernandez TJL, de Carvalho W, Cabanas M, Querol X. Lopez-Soler, A Mobility of Heavy Metals from Coal Flyash, Journal of Environmental Geology. 1994; 23:264-270.
8. Roy WR, Griffin RA, Dickerson DR, Schuller RM. Illinois Basin Coal Flyashes 1: Chemical Characterization and Solubility", Journal of Environmental Science Technology. 1984; 18:734-745.
9. Hulett LD, Weinberger AJ, Northcutt KJ, Ferguson M. Chemical Species in Flyash from Coal Burning Power Plants, Journal of Science. 1980; 210:1356-1364.
10. Dayan A, Paine A. Mechanisms of Chromium Toxicity, Carcinogenicity and Allergenicity, Journal of Human Toxicology. 2001; 20:439-510.
11. Soco E, Kalembiewicz J. Investigations on Chromium Mobility from Coal Flyash, Journal of Fuel. 2009; 88:1513-1519
12. Flyash Utilization-Indian Scenario. In: Proceedings of the International Conference on Flyash Disposal and Utilization, Central Board of Irrigation and Power, New Delhi, 1988.
13. Iyer RS, Scott JA. Power Station Flyash-A Review of Value Added Utilization Outside of the Construction Industry, Journal of Resources, Conservation Recycling. 2001; 31:217-28.
14. Taneja SK. Appropriateness and Need to Promote Flyash Based Walling Materials in Indian Context, In Proceedings of National Seminar on New Materials and Technology in Building Industry, New Delhi, 1998.
15. Mohapatra R, Rao RJ. Review: Some Aspects of Characterization, Utilization and Environmental Effects of Flyash, Journal of Chemical Technology and Biotechnology. 2001; 76:9-26.
16. Jankowski J, Ward CR, French D, Groves S. Mobility of Trace Elements from Selected Australian Flyashes and Its Potential Impacts on Aquatic Ecosystems, Journal of Fuel. 2006; 85:243-256.
17. Dudas MJ. Long Term Leachability of Selected Elements from Flyash, Journal of Environmental Science Technology. 1981; 15(7):840-843.
18. R. Meij (1994), Trace Elements Behavior in Coal Fired Power Plants, Journal of Fuel. 1994; 39:199-210