Ultra Chemistry Vol. 9(1), 156-160 (2013).

Fly ash production and its utilization in different countries

MANORAMA GUPTA[1] and S.P. SINGH[2]

[1]Assistant Professor of Chemistry, Govt. P.G. College, PANNA-M.P.-488001(INDIA)
07732-253666, Mob. No. 961770122 Email –modistore@rediffmail.com

[2]Professor of Chemistry, Govt. Girls Degree College, SHAHDOL-M.P. (INDIA)

(Acceptance Date 26th March, 2013)

Abstract

Fly ash is the coal combustion residue generated from coal based thermal power plants in all over the world. From some decades the demand of electricity are increasing continually due to increase in population and new industries launched day by day in all over the world, hence the requirement of energy also increased. To fulfill these demands of energy there are a lot of pressure on coal based thermal power stations to produce more and more electricity and hence the amount of this waste by-product (fly ash) is increasing speedily and creates the problem to our environment, because it contains a large number of heavy metals etc. Because of this reason it is necessary to invent some new aspects of utilization of this fly ash in different fields and safe disposal of this waste material also required by human beings. Its disposal is of a serious environmental concern due to its hazardous properties, impact on agriculture and long term risks to ecosystems and human beings both.

Introduction

The large production of electricity is depending on the coal based thermal power plants in whole world, so the amounts of fly ash generated by these power plants are also increased regularly. According to Singh and Siddiqui[1,2], in India there is about 79% of the whole electricity generated by coal based thermal power plants and Jamwal 2003 reported that about 110 MT fly ash produced from these plants every year. Kalra *et al.* has been documented that it will cross the 140 MT by the year 2020. Sinha and Basu[5] have also supported that in other countries like USA, Germany, France and Netherland the use of fly ash about 70% in different aspects, but in our country it was very less only about up to 15%.So, it is necessary to invent some new field of the utilization of this solid waste in a proper and suitable way. Fly ash[1-4] also plays an important role for our whole ecosystem, because its repeated exposure cans causes irritation in eyes, skin, nose, throat and respiratory tract and result in ash poisoning (Carlson and Adriano 1993 and Finkelman et

al. 2000). Now a days, this solid hazardous waste becomes a very useful material for different purposes such as for soil reclamation, for agriculture- as fertilizers and as pesticide to improve crop production and soil fertility, for building materials *etc*. but its use in agriculture in a optimum or limiting quantity is useful for better crop productivity and soil properties like water holding capacity, pH, better porosity and reduce bulk density etc.

Discussion

Industrialization particularly in the developing countries like India is a bane necessity in order to maintain economic growth. In developed countries like USA the annual per capita energy consumption ranges between 5-11 KW, where as it is very less only 1-1.5 KW in developing countries like India, Bangladesh etc. In India, the power sector is the large consumer of non coking coal, so the generation of fly ash is increasing day by day.

In present time, India consume 43000 T of coal per day in the process generate ash (fly ash and bottom ash) of about 18500T. The more developed countries having 25% of world population shows net combustion of 83% energy, whereas in less developed countries with rest of 75% population have only 17% of total energy consumption. The available data reported that Europe is the largest consumer of the world. Commercial energy consumption in India has stated from 30to 60% in last four decades. In India coal is the main source of energy and due to increase in demand of energy, the consumption of coal has also increased and the percentage of fly ash rose effectively.

The utilization and safe disposal of this power plant waste must be done in a proper and well managed ways; otherwise it will create a problem to our ecosystem. It can be used in varieties of ways, in such a large field like agriculture, horticulture, as chemical fertilizers, as insecticides, as pesticides etc. It has been reported by some workers that fly ash has some pozzolonic properties, because of this it can be used as raw material in construction of buildings and roads, by mixing with cement and concrete. According to Naik and Tyson[6], the use of 1 tone of fly ash in concrete will avoid 2 tons of carbon dioxide emitted from cement production and minimize green house effect and global warming, so the use of fly ash in this field can solve the major problem of disposal of this useful waste[7-10].

Chemically, fly ash contains some essential macro and micro nutrients, which are necessary for plant growth; hence it is a very useful in order to increase soil fertility and production of crops. According to Mishra and Shukla[3], it has the ability to enhance the growth and metabolic activities of some plants such as Maize and Soyabean. Some workers suggested that when fly ash mixed with chemical fertilizers, it was found to be more beneficial to enhance soil fertility and crop productivity. While, besides this, fly ash also contains some toxic metals and radio nucleotides, so the optimum amount of fly ash must be used in agriculture and before using this material the chemical and physical nature of soil must be studied by the users[15].

According to 9th five year plan the total projected demand for coal during 2006- 2007 is 653 MT of which 447MT is estimated for power sector.

Table 1. All India projections of demand of Coal- Sector Wise Projected Demand (MT)

Sector	Year	Year	Year	Year
	1996-97	2001-02	2006-07	2011-12
Steel	34.70	46.90	64.0	78.0
Power	201.80	277.1	447.0	559.0
Cement	11.30	22.30	30.0	45.0
Others	50.80	60.40	112.0	153.0
Total	298.60	406.70	653.0	835.0

Source - Working group on coal and lignite for the 9th five year plan.

About 75% of total ash production is fly ash; it consists of dark grey color, amorphous and light weight particles which can travel at the rate of 40- 50 km. in the down wind direction. It has been reported that the nature of fly ash is alkaline and hence it is very useful for acidic soil to increase soil pH and it also contains the large number of macro and micro nutrients, so it can act as a fertilizer but it also possess some toxic heavy metals such as Cu, Zn, Cd, Pb, Ni etc., which limits its greater amount in agriculture[11,13,14].

Beside trace and heavy metals coal also contains some primordial radio- nucleotides in minor amount, so they will reach in fly ash too but in very less quantity. Because of this toxicity of fly ash, it makes the disposal of fly ash is very difficult, either wet disposal method or dry disposal method both are harmful for water sources like river, ponds and lake as well as environment too.

Result

Due to demand of energy is increasing very fast during last some decades in all over world, so the quantity of fly ash also found to be increase year wise and hence it is very important and necessary to use this solid waste in a safe manner in different aspects.

Table 2. Present and projected coal requirement for power generation in India

Plan	Terminal year of plan	Capacity (MW)	Requirement of coal (MT)
VIII plan	1996-97	50000	210
IX plan	2001-02	87100	285
X plan	2006-07	116400	400
XI plan	2011-12	138000	500

Source- Sinha and Basu (1998)

In XI plan (2011-12) requirement of coal in India is 500MT and in coming year the demand of coal will increase because the number of power generation plants increasing continually. According to Sinha and Basu[5] the utilization of fly ash in developed countries like Germany, USA and UK up to 70% where as in developing countries such as India, it is less than 15%.

Table 3.1. Fly ash production and its utilization in all over world

Name of the country	Annual fly ash production (MT)	Ash utilization %
India	60	8-10
China	90	38
USA (1991)	71	31
Germany (1989)	31	58
U K (1989)	12.5	49
Australia (1990)	7.9	10
Canada	2.9	45
France (1989)	2.7	57
Denmark	0.89	100
Italy	0.90	100
Netherland	0.9	100

Secondary source - Parida *et al.* (1998)

The data is provided by Govt. of India. In India during 2005-06 about 112MT fly ash was produced and Kalra *et al.* (1997) have documented that fly ash production in India will exceed 175 MT by 2020. The percentage of utilization of fly ash in India is only 38% and rest of this were dumped into basin or landfill near power plants which is not environmentally safe and hence there is much need to increase this utilization percentage of fly ash by inventing some new ways and techniques in a scientific and an eco friendly manner.

Table 3.2. Fy ash production and its utilization in all over world

Name of the country	Annual fly ash production (MT)	Ash utilization %
India	112	38
China	100.0	45
USA (1991)	75	65
Germany (1989)	40.0	85
U K (1989)	15.0	50
Australia (1990)	10.0	8
Canada	6.0	75
France (1989)	3.00	85
Denmark	2.00	100
Italy	2.00	100
Netherland	2.00	100

Source http/www.tifac.org.in [accessed 26.07.08]

References

1. Adriano, D. C., Page, A. l., Elseewi *et al.*, *Utilization and disposal of fly ash and other coal residues in terrestrial ecosystems: a review, J. Environ. Qual., 9,* 333-334 (1980).
2. USEPA, *Wastes from the combination of coal by electric utility power plants. United States Environment Protection Agency,* Report 530- SW- 58-88-002 USEPA, Washington, DC (1980).

3. Mishra, L. C., and Shukla K. N., *Effect of fly ash deposition on growth, metabolic and dry matter production of maize and soya bean, Environ. Pollut. Ser. A. 42,* 1-13 (1986).
4. Carlson, C.L. and Adriano, D.C., *Environmental impact of coal combustion* residues, *J. Environ. Qual. 22,* pp 227-247 (1993).
5. Sinha, K. S. and Basu, K., *Mounting fly ash problems in growing coal based power stations few pragmatic approaches towards a solution,* in Proc. Int. Conf. fly ash Disposal and Utilization, Ed. by C.V. J. Verma *et al.* (Central Board of Irrigation and Power, New Delhi. 1, 15-27 (1998).
6. Naik, T.R. and Tyson S.S., *Environmental benefits from the use of CCP,* Proceedings of the 2nd International Conference on fly ash disposal Utilization, Feb. 2-4, New Delhi, India, pp. 40-43 (2000).
7. Singh, N. and Yumus, M., *Environmental impacts of fly ash.* In: M Iqbal, P.S. Shrivastava and T.O. Siddiqui (eds). Environmental hazards: *Plant and people CBS* (2000).
8. Gupta, A. K., Fly ash utilization: From *Waste to Wealth-A case study* CSIR Scholar ship project Annual Technical Report 2001, Award No.B-7542/19-5-99 at BBAU, for council of Scientific and Industrial Research, Govt. of India, at BBA Central University, Lucknow, India (2001).
9. Jamwal, Nidhi, *looks the way to utilize fly ash down to earth,* 12(3)1-5 (2003).
10. Kalra, N., Jain, M. C. Chaudhary, R., Hari, R.C., Vatsa, B.K., Sharma, S.K. and Kumar, V., *Soil properties and crop productivity as influenced by fly ash in corporation in soil,* Environment Monitoring Assessment, *87,* 93-109 (2003).
11. Rautaray, S. K., B. C. Ghosh and B. N. Mitra, *Effect of fly ash, organic waste and chemical fertilizers on yield, nutrient uptake, heavy metal content and residual fertility in rice-mustard cropping sequence under acid lateritic soil Bio Resource Technology* (2003).
12. Singh, Lambam, P. and Siddiqui Z. A., *Bio Resources Technology 86.(2),* 189-192 [14Ref] (2003).
13. Lee, H., Ha, H. S., Lee, C. S., Lee, Y. B., Kim, P. J., Fly ash effect on improving soil properties and rice productivity in Korean paddy soil, *Bio resource Technology, 97,* 1490-1497 (2006).
14. Tiwari, S., Kumari, B., and Singh S. N., *Evaluation of metal mobility/immobility zone of Typha latifolia growing on fly ash dumps, Bio Resource Technology, 99,* 1305-1310 (2008).
15. Ansari, F. A., Gupta, A. K. and Yunus, M., Fly ash from coal-fed thermal power plants: Bulk utilization in horticulture- A long term risk management option, *Int. J. Environ. Res.,* Vol. *5 (1),* pp. 101-108 (2011).