International Journal of Science, Environment and Technology, Vol. 3, No 2, 2014, 434 – 439

ISSN 2278-3687 (O)

ANALYSIS OF METAL CONTENT AND PHYSICAL PARAMETERS OF BOTTOM ASH FROM A FURNACE OIL BASED POWER PLANT JAMSHORO SINDH, PAKISTAN

Ali Muhammad Rind[1], Dr. G.M. Mastoi[1], Muhammad Amen Quarishi[1] and Fareena Samoo[1]

[1]Center for Environmental Sciences, University of Sindh, Jamshoro, Sindh, Pakistan

Abstract: Flying and deposited ash are by products of furnace oil driven power stations and contain many toxic trace elements. The present study involves the assessment of metal and physical parameters in ash released by thermal power station Jamshoro, Pakistan. The quantitative assessment of ash will help to predict the possible impacts of this ash on soil, air, water and humans. Physical methods used for sample analysis include pH, Conductivity, Salinity and TDS analysis.

Keywords: Thermal power station, solid waste residue, bottom ash, environmental impact.

Introduction

Lot of incombustible material produced during combustion of furnace oil in thermal power stations (M. Srinivasa Reddy *et al.,* 2005), deposited as a residue, and called ash (unburned material). This kind of solid waste disposed off open air and causes different environmental pollution problems (R.S Iyer and J.A Scott 2001). There are no specially constructed land fillings or other disposal sites in Pakistan, for this hazardous materials disposal. There are two kinds of ash i.e. fly ash and bottom ash. About 80% of the ash is entrained in the gas flow and it is captured and recovered as fly ash, It is also estimated that 150 million tones of flying ash is produced annually by oil and coal based power stations. The remaining 20% of the ash is bottom ash, a dark gray, granular, and porous material, whose particle size is predominantly below12.7mm, which is collected in water filled hopper at the bottom of the furnace. When a given amount of bottom ash drops into the hopper, it is removed, conveyed and stock piled for disposal. (E. Benavidez *et al.,* 2003).

In the study area, ash was disposed off in open areas, which are close to the colonies and agriculture fields. This ash transported by two actions, by wind and by the surface runoff, and disposed in the agricultural fields, it is very hazardous as it contains lot of trace elements, heavy metals and fine particulate matters that creates the serious health problems in peoples (Athanasios.I Chatzimouratidis *et al*., 2008). It inhaled by peoples when they breath in contaminated air they seriously affected by different kind of diseases as proved from previous

*Received Jan 22, 2014 * Published April 2, 2014 * www.ijset.net*

work (Cragle *et al.,* 1988, Lopez *et al*., 2005, Pope *et al*., 2002). Mostly these ashes are mobile, when damped openly these travel many miles from the disposal area, through the action of wind and water and deposed on soil and adversely impact the fertility of soil. Several studies discovered that low amount of fly ash assimilation in soil modifies nutritional quality of the soil. Though the high dosage of fly ash assimilation consequences in metal pollution and stop the microbial activity of soil (Vimal Chandra Pandey and Nandita Singh 2010). Crops also contaminate when they take up these trace and heavy metals from soil, and when these crops eaten by humans or animals they impact and cause many problems for them.

This study was carried out by the analysis of Trace elements, heavy metals, and physical parameters to find possible impacts of bottom ash on humans, aquatic bodies, soil and vegetation.

For this study furnace oil based Jamshoro Thermal Power station was selected.

Material and Methods

Sample collection

Two samples of oil ash were collected from disposed of material of Jamshoro thermal power station (25º 28.15′N, 68º 16.82′E). Samples were properly labeled and transferred to polythene bags,

In laboratory 20 mg of sample weighed in 100 ml volumetric flasks. After adding 50 ml of distilled water this was shacked for complete desolation of soil in water. Samples were filtered 100 ml volumetric flask. The filtered solutions were used for the determination of pH, Salinity, Conductivity and TDS (Dogan, M. Kobya. 2006).

Sample preparation

For determination required analysis in given sample, the 0.50 g of sample was taken in Teflon beaker and 5 ml of hydrofluoric acid was added to it (Snigdha Sushil, Vidya S. Batraand 2006). After 15 minutes, 5 ml of 95% concentrated HNO_3 was added to it and heated on hot plate till the sample was completely dried. Then 50 ml 2N HCL was added to the beaker and again heated at 60 ^{o}C for a short time till the residue was almost dissolved. The resulting sample was preserved in test tube and properly capped. This solution of dissolved samples was then aspired in atomic absorption for the determination of various trace elements and result was obtained in mg/l.

Perkin Elmer 800 Atomic Absorption Spectrophotometer was used for the determination of various trace and major elements (Snigdha Sushil, Vidya S. Batraand 2006).

Result and Discussion

Physical parameters of oil ash

pH indicate the acidity or alkalinity of substance during the study it was observed that oil ash was highly acidic that is pH 4.7. It is 100 times more acidic than acid rain which is of pH 5.6. The standard limit of Acidity in soil and water according to National Environmental Quality Standard of Pakistan (NEQS) is pH 6-10. This acidity effects Crop (Lance S and Evans 1982), phytoplankton in aquatic bodies (R. E. Kwiatkowski and J. C. Roff 1976) and human health (DW. Dockery *et al*., 1996).

The amount of TDS is Ash samples were found up to 8260 ppm. While the standard limit for TDS according to (NEQS) is 3500 ppm in waste water. TDS is the sum of salt, cations, anions, minerals and metals in water. Highest amount of TDS, indicating the highest concentration of this material in ashes. The value of conductivity was also highest due to excess of TDS. High concentration of total dissolved solids will make reduce the effectiveness of wastewater treatment plants, as well as the function of industrial processes that use raw water. Mixing of TDS in aquatic system will unfit drinking water reservoirs. Highly concentrated water utilization by communities will adversely affect them. Other hand photo planktons will die in means of reduction in photosynthesis processes, as high amount TDS will make water highly turbid. The conductivity was found 16500 us. Salinity or saltiness was found in greater level up to 9.8 ppt.

Major and trace elements in oil ash

During the study sodium concentration in oil ash was up to 38.48 mg/g. Animal and human studies have shown that high sodium intake is associated with increased blood pressure and cardiovascular disease (Denton et al., 1995). Based on robust findings, national and international groups, including the World Health Organization (WHO), have set out to promote reductions in sodium intake at the population level to reduce the incidence of cardiovascular disease. (Institute of Medicine, 2010; Minister of Health, 2007; WHO, 2007).

Potassium and calcium are important macronutrients nutrients for soil, Zinc and Copper are micronutrients for soil and chromium, iron nickel, and lead are nonessential nutrients and cause the soil pollution, other hand these non essential nutrients also inhabits the macro and micro nutrients in soil.

Amount of Magnesium in dissolved ash samples was found up to 5 mg/l , potassium 4.5 mg/l, Calcium 12 mg/l, Chromium 0.5 mg/l, Iron 24.7 mg/l, Nickel 0.4 mg/l, Copper 10.5 mg/l, Zinc 16.83 mg/l and lead up to 1.15 mg/l. these results of dissolved samples of soil were

compared with National Environmental Quality standards of Environmental Protection Agency of Pakistan. It was noticed that ash was highly contaminated for example: standard limit for chromium is 0.05mg/l, for iron 2mg/l, nickel 1.0 mg/l, copper 1.0 mg/l, zinc 5.0m/l and lead 0.5mg/l.

Conclusion

Study shows that solid waste was highly contaminated and the dumping site was near main highway and the adjoining areas which were populated, it was also noted that there was no specially constructed site for damping of solid waste, for that it is very highly recommended that land filling should be designated for the dumping of this waste to protect the underground water quality and life of humans, living in adjoining areas. Soil may be badly affected when these highly contaminated waste particles washed down to agricultural soil by rain water or by wind transportation.

Acknowledgement

Authors gratefully acknowledge the financial support by University of Sindh.

Rererences

[1] Andrew JG, Robert S, Johnny LC, James MS. 2002. Biologic effects of oil fly ash. Environmental health perspectives 110, 89–94.

[2] Athanasios IC, Petros AP. 2008. Evaluation of power plants impact on the living standard using the analytic hierarchy process. Energy Policy 36, 1074–1089.

[3] Benavidez E, Grasselli C, Quaranta N. 2003. Densification of ashes from a thermal power plant. Ceramics international 29, 61-68.

[4] Derek D, Richard W, Nicholas IM, E. JW, Alan D, Pierre M, Anne MP, Robert S, Raymond A, Franҫhise P, John C, Joelle T, Jean BM. 1995.The effect of increased salt intake on blood pressure of chimpanzees, Nature medicine 1,1095-1009.

[5] Dockery DW, Cunningham J, Damokosh AI, Neas LM, Spengler JD, Outrakis PK, Ware JH, Raizenne M, Speizer FE. 1996. Health effects of acid aerosols on North American children: respiratory symptoms. Environ Health Perspect 104, 500–505.

[6] Donna LC, Richard WM, Judith RQ, John SH, Gregg SW, William GT, Lushbaugh C.C. 1988. Mortality among workers at a nuclear fuels production facility. American Journal of Industrial Medicine 14, 379–401.

[7] Iyer RS, Scott JA. 2001. Power station fly ash a review of value-added utilization outside of the construction industry.Resources, Conservation and Recycling 31, 217–228.

[8] Lance SE. 1982. Biological effects of acidity in precipitation on vegetation. A review, Environmental and Experimental Botany 22, 155–169.

[9] López MT, Zuk M, Garibay V, Tzintzun G, Iniestra R, Fernández A. 2005. Health impacts from power plant emissions in Mexico. Atmospheric Environment 39, 1199–1209.

[10] Qi W, Shulei T, Qunhui W, Qifei H, Jie Y. 2008. Melting characteristics during the vitrification of MSWI fly ash with a pilot-scale diesel oil furnace. Journal of hazardous materials 160, 376-381.

[11] Srinivasa RM, Shaik B, Joshi HV, Jha B. 2005. Evaluation of the emission characteristics of trace metals from coal and fuel oil fired power plants and their fate during combustion. Journal of Hazardous Materials 123, 242–249.

[12] Snigdha S, Vidya SB. 2006. Analysis of fly ash heavy metal content and disposal in three thermal power plants in India, Fuel 85, 2676–2679.

[13] Vimal CP, Nandita S. 2010. Impact of fly ash incorporation in soil systems. Agriculture, Ecosystems & Environment 136, 16–27.

[14] World Health Organization (WHO), Guide lines for drinking water quality, l.2, Recommendation, Geneva, Switzerland 1984, 130.

[15] Yu MC, Jung SK, Chin CH. 1992. Circulating fluidized bed incineration of industrial solid wastes. Waste management & research 10, 357-369.

Table 1. Showing physical parameters in bottom ash

Sample	pH	Conductivity	Salinity	T.D.S
Sample-1	6.3	16500 µS	9.8ppt	8260ppm
Sample-2	4.75	3630 µS	1.9ppt	1820ppm

Table 2. Showing trace and heavy metals in bottom ash

ELEMNETS MG/G	SAMPLE-1	SAMPLE-2
Ca	12	0.5
Mg	20.8	5.6
Na	38.4	28.0
Ni	0.29	0.42
Fe	19.4	24.7
Cr	0.5	0.2
Cu	10.2	7.8
K	4.5	3.3
Zn	16.8	0.95
Pb	1.15	0.1

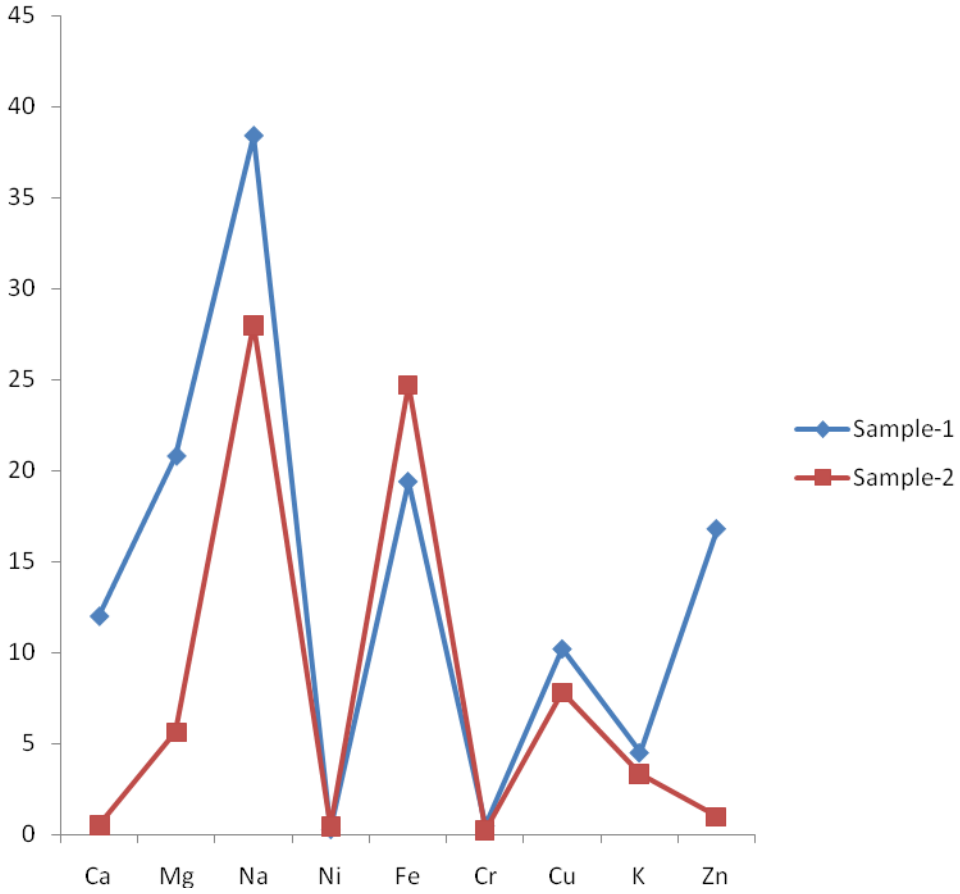

Fig.1. Comparison of elemental concentration in two samples