



CHARACTERISTICS OF FLY ASH AND USE ABILITY IN VIETNAM

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ABSTRACT

Physically fly ash occurs as very fine particles and having low to medium bulk density. Fly ash has a vast potential for use in agriculture as an amendment especially due its physical condition which are conducive for plant growth as well as due to the presence of Ca, Mg, K and P in it. Fly ash of Pha Lai thermal power plant contains high contents of SiO₂ and Al₂O₃ so it has colloidal properties like puzzolant. Fly ash can be used for agricultural and environmental purposes.

Keywords: Vietnam, fly ash, thermal power plant, soil amendment.

INTRODUCTION

In the production of electricity from coal, problems of container for ash waste and use is very important. Investigating the use of coal ash is not only economic - technical, but also means huge social (reduced land area landfill, environment). Thus, there is a lot of research on this issue in the world and so far there is almost no country which is not using coal ash from thermal power. Annually, Vietnam power plant (Pha Lai, Uong Bi, Ninh Binh) in the North will release hundreds of thousands of tons of waste coal ash. Most of this ash is mixed with water and released to reservoirs or ashyard, adjacent to agricultural lands and residential areas.

Release of large amounts of ash may have adverse effects on the environment. In addition, it is a waste of resources because the coal ash can be used in various fields.

Research in the world (India, China etc.) showed the possibility of using coal ash as an adsorbent of heavy metals, fertilizer is very effective.

However, studies using coal ash in agriculture and environmental rehabilitation of land and water in Vietnam is still limited. Fly ash in the pipe plant was collected by blowing steam flow, falling down; water is used to push them into ashyard. Management and use of coal fly ash is not interested, fly ash often sold for bricks or cement plant, or used as material for the road construction. This is a huge dissipation!

Coal ash with high fineness, high adsorption capacity of exchange, high specific surface, which can be used in agriculture as fertilizer and can improve some soil properties such as cation exchange capacity (CEC), availability of water retention, treatment for soil contaminated with heavy metals, pesticides etc.

The goal is to make use of waste, environmental protection, until now, scientists has made some progress in studies using the ash (the smooth part of the coal ash) in the production of cement, concrete, construction materials but the application is still limited. The shortage of Vietnam fly ash is a high content of unburned coal, low hydraulic activity ... So in fact the use is still limited.

Coal ash was studied by many scientists and research institutions in the world. Coal ash of thermal power plants have very large reserves, estimated to be

burning coal in the world 550.10⁶ tons per year (Querol *et al.*, 2001) [1], so that coal ash dumped in the environment in large amount. The coal ash contains many minerals, such as calsit, quartz, kaolinite, chlorite, plagioclase, gypsum, pyrite, montmorilonit, K-felspat, dolomite and the elements necessary for plants, such as Ca, Mg, K, B, Mo, Mn.[1].

The chemical composition of coal ash depends on the quality and use of coal combustion technologies for power plants. Up to 95-99% of coal ash containing oxides of Si, Al, Fe, Ca and from about 0.5 to 3.5% Na, P, K and S, the other trace elements. Actual coal ash contains most of the elements in the soil, except for organic carbon and nitrogen [2].

Investigating the use of coal ash as a fertilizer in India with 20-40% of the volume of soil can increase the productivity of rice, because coal ash contains some nutrients such as P, K, Ca and S. In addition, coal ash has a smooth particle (the average diameter of less than 10 mm); the density of low to moderate, the largest percentage and light texture, so increases the soil porosity and increased water retention up to 39-55%. These properties are very useful for crops [2].

MATERIALS AND METHODS

Materials

Fly ash with physical and chemical properties for the Pha Lai thermal power plant (TPP), Vietnam.

Research methods

a) Methods of data collection and analysis

The basis of this method is the collection and examination of documents related to research issues, rules and standards for environmental protection:

- System documentation of available data on the natural features and social research.
- Analysis and assessment of documents and data on research, particularly in the coal ash is the subject of Pha Lai TPP.



b) Field surveys, sampling and analysis

Methods field studies are needed to help the researcher to look reality in the preliminary study subjects. The study also helps to actually check the accuracy of the documents; data were collected with a step of processing information better in the synthesis and analysis. During the fieldwork, sampling combined to meet the future research.

c) Research methods in laboratory

Sample is classified and studied the chemical and physical properties of the following methods:

- Method of analyzing chemical parameters (performed in a control center for building materials with the Institute of construction materials):

N	Parameter	Unit	Test methods
1	Loss on ignition	%	ASTM C114
2	SiO ₂	%	ASTM C114
3	Fe ₂ O ₃	%	ASTM C114
4	Al ₂ O ₃	%	ASTM C114
5	CaO	%	ASTM C114
6	MgO	%	ASTM C114
7	SO ₃	%	ASTM C114
8	K ₂ O	%	ASTM C114
9	Na ₂ O	%	ASTM C114
10	P ₂ O ₅	%	AQS на XRF
11	Pb	%	AQS на XRF
12	Cu	%	AQS на XRF

RESULTS AND DISCUSSIONS

Analysis of the mechanical composition of various fly ash gave the following results:

Table-1. The mechanical composition of Pha Lai thermal power plant fly ash.

Diameter (mm)	Unit	M1	M2
1-0.05	%	56.52	55.11
0.05-0.01	%	28.52	26.73
0.01-0.005	%	4.81	7.64
0.005-0.001	%	9.86	10.11
<0.001	%	0.29	0.31

Notes:

M1: Fly ash from electrostatic precipitator systems one time

M2: Fly ash from electrostatic precipitator systems 2 times

The results showed that fly ash of Pha Lai thermal power plant is mainly with a particle of 1 to 0.01 mm (80-90%), however, fly ash from static electricity, 2 times is more smooth particles (number of particles <0.01

mm was 18.6% in compared to 14.96%).

Table-2. Results of some physical and chemical properties of two types of fly ash from Pha Lai thermal power plant.

TT	Parameters	Unit	Samples	
			M1	M2
1	Loss on ignition	%	27.77	6.00
2	SiO ₂	%	42.00	53.80
3	Fe ₂ O ₃	%	4.60	8.20
4	Al ₂ O ₃	%	19.38	23.33
5	CaO	%	1.58	1.72
6	MgO	%	0.60	1.10
7	SO ₃	%	0.00	0.00
8	K ₂ O	%	2.80	4.70
9	Na ₂ O	%	0.77	0.64
10	P ₂ O ₅	%	0.00	0.24
11	Pb ²⁺	mg/kg	23.4	-
12	Cu ²⁺	mg/kg	24.48	-
13	pH	-	9.05	9.1
14	Density	g/cm ³	2.19	2.56

Note:

M1: Fly ash from electrostatic precipitator systems one time

M2: Fly ash from electrostatic precipitator systems 2 times

The results showed that M1 has a large amount of coal remaining after coal burning to 27.7%, and M2 - 6% unburned carbon.

Fly ash have an alkaline pH, density less than the soil, high content of SiO₂ and alumina (54 and 23%, respectively).

The result showed that the main components of ash from Pha Lai thermal power plants are SiO₂, Al₂O₃.

American Standard ASTM C618 - 94a [4] classified two types of fly ash (Class F and Class C) with the following characteristics:

- Type F:** CaO <5%, obtained from burning anthracite and bituminous coal, unburned carbon more than about 20.10%. This has property of Puzzolan cement. Puzzolan cement material containing silicon or silicon and aluminum oxide, which has no or little adhesive properties, but when finely ground, and water vapor it can enter into chemical reaction with calcium hydroxide at normal temperature and became a compound binder.
- Type C:** CaO >=5%, always 15-35%. It is a product of burning coal or bituminous coal lignin less unburned carbon, less than 2%. Some Class C fly ash with lime content greater than 10% and sometimes even up to 24%.



The result of analysis of two heavy metal elements copper and lead in fly ash; Pb 23.4 mg/kg, Cu 24.48 mg/kg, which is below acceptable standards (QCVN 03-2008 BTNMT; Pb-70, Cu-50 mg/kg for agricultural soil categories). Therefore, fly ash of Pha Lai thermal power plants can be used in agriculture and environmental remediation.

CONCLUSIONS

- a) Fly ash has very good properties can be used to improve the physical and chemical properties of soil i.e. neutral pH and relatively high concentrations of alkali and alkaline earth metals.
- b) Application of fly ash into the environment does not pollute with the two elements Cu and Pb.
- c) Fly ash contains oxide silic and aluminum, which can form compounds that have good potential for adsorption can be used in agriculture and environmental remediation.

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