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HARNESSING FLY ASH IN AGRICULTURE

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The intensive use of coal for electrical power generation led to production of large amount of coal residue which needs to be disposed safely. Since coal residue has a variety of potentially hazardous heavy metals, improper disposal and management could have a much environmental impact. Coal residue is produced during the combustion of solid fuel and can be carried with the flue gas, which is called fly ash (FA) or deposited as a bottom ash (BA), flue gas desulfurization (FGD) gypsum and boiler slag (BS). Fly ash is that part of the ash stream composed of particles small enough (0.001 to 0.1 mm) to be carried from the boiler in the flue gas. These particles are either mechanically captured or emitted *via* the stack. Bottom ash and boiler slag are residues found in the furnace and are common to all types of coal combustion. Both materials generally have a particle size within the range of 0.1 to 10 mm. Coal combustion byproducts can be used in agriculture because of their special physical, chemical and biological properties. They contain almost all the nutrients necessary for proper plant growth and development. One of the important byproduct of coal combustion is fly ash which holds significant importance due to its versatile applications across various industries. Initially seen as a waste material, its potential for beneficial reuse has garnered attention globally. The importance of fly ash lies in its ability to address environmental challenges, enhance sustainability, and contribute to economic development.

What is Fly Ash?

- Fly ash is a fused residue of amorphous ferro-alumino silicate produced after combustion of coal at high temperature generated in thermal power plants, which transforms the clay minerals into a variety of fine spherical particles that rise with flue gases.
- Fly ash is a light coal dust coming out with the gases of coal-fired boilers

- It is a residue of burning of coal and lignite, the organic sources of energy

Applications of Fly Ash in Agriculture

Effect of Fly ash on Physical Properties of Soil

- Fly-ash application to sandy soil could permanently alter soil texture, increase microporosity and improves the water-holding capacity (Ghodrati *et al*., 1995; Page *et al*., 1979).
- The particle size range of fly-ash is similar to silt and changes the bulk density of soil. Thus, application of fly ash decreases bulk density of soil.
- Fly ash improves the soil structure, which in turn improves porosity, workability, root penetration and moisture-retention capacity of the soil (Kene *et al*., 1991).
- The Ca in fly-ash readily replaces Na at clay exchange sites and thereby enhances flocculation of soil clay particles, keeps the soils friable, enhances water penetration and allows roots to penetrate compact soil layers (Jala and Goyal, 2006).

Effect of Fly ash on Chemical Characteristics of Soil

- Lime in fly ash (FA) readily reacts with acidic components in soil and releases nutrients such as S, B and Mo in the form and amount which is beneficial to crop plants.
- Most of the fly-ash produced in India is alkaline in nature; hence, its application to agricultural soils increases the soil pH and thereby neutralizes acidic soils (Phung *et al*., 1978).
- Fly ash cause gradual increase in soil pH, conductivity, available phosphorus, organic carbon and organic matter**.**
- Fly ash is considered to be a rich source of Si

Table 1: Physico-chemical properties of Fly ash

Parameters	Content
pH	6.0-10.0
EC (µS m^{-1})	0.14
Bulk density (g cm^{-3})	0.99
WHC (%)	62.0
Surface area (m^2 gm^{-1})	0.96
N (%)	0.009
P (mg Kg^{-1})	19.02

K (mg Kg^{-1})	52.0
Mg (mg Kg^{-1})	101.5
Ca (mg Kg^{-1})	238.0

Effect of Fly ash on Biological Properties of Soil

Fly ash improves population of *Rhizobium* sp. and P-solubilizing bacteria

Advantages of Fly Ash Utilization

There are numerous advantages of fly ash utilization some of them are follows:

- Fly ash addition generally increases plant growth and nutrient uptake
- Use of fly-ash along with chemical fertilizers and organic materials in an integrated way can save chemical fertilizer as well as increase the fertilizer use efficiency
- Improves physical, chemical and biological properties of the soil
- Provide micro nutrients (Fe, Zn, Cu, Mo) and macro nutrients (K, P, Ca, etc.)
- Reduces the use of soil ameliorants fertilizers and lime
- It decreases the metal mobility and availability in soil
- Saving of space for disposal
- Saving of scare of natural resources
- Energy saving, firstly because the material is automatically produced as a byproduct and no energy is consumed for its generation and Secondly because it can replace material which otherwise would need to be produced by consuming energy
- Protection of environment, as in construction it can partly replace cement, production of which entails energy consumption and CO_2 emissions.

Conclusion

Fly ash can be used as a potential nutrient supplement for degraded soils thereby solving the solid waste disposal problem to some extent. However, the bioaccumulation of toxic heavy metals and their critical levels for human health in plant parts and soil should be investigated. An ultimate goal would be to utilize fly ash in degraded/marginal soils to such an extent as to achieve enhanced fertility without affecting the soil quality and minimizing the accumulation of toxic metals in plants below critical levels for human health. There are several potential beneficial and few harmful effects of fly ash application in soil.

References

Ghodrati, M., Sims, J. T. and Vasilas, B. S. (1995). Evaluation of fly ash as a soil amendment for the Atlantic coastal plain. I. Soil hydraulic properties and elemental leaching. *J. Water Soil Air Pollut*., 81, 349

Jala, S. and Goyal, D. (2006). Flyash as a soil ameliorant for improving crop production-a review. *Bioresour. Technol*., 97, 1136-1147.

Kene, D.R., Lanjewar, S. A. and Ingole, B. M. (1991). Effect of application of flyash on physico-chemical properties of soils. *J. Soils Crops*, 1, 11-18.

Page, A.L., Elseewi, A. A. and Straughan, I. R. (1979). Physical and chemical properties of fly ash from coal-fired power plants with reference to environmental impacts. *Residue Rev.*, 71, 83-120.

Phung, H.T., Lund, L. J. and Page, A. L. (1978). Potential use of Fly Ash as a Liming Material. In: Environmental Chemistry and Cycling Processes, Adriano, D.C. and I.L. Brisbin (Eds.). US Department of Commerce, Springfield, VA, pp: 504-515.