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Recent Trends for Ash Disposal and Utilisation

Kanak Sharma, Harshit Nishad, Ketan Chakarvarty, Prof. Yogesh Chandra

Department of Mechanical Engineering, ABES Engineering College, Ghaziabad, Uttar Pradesh, India

ABSTRACT

In thermal power plant coal is being burnt and residue is left as ash. This ash is classified as bottom ash and fly ash. The ash generated below the furnace of thermal power plant is bottom ash which is around 20% of total ash and rest of 80% is fly ash. Bottom Ash is a coarse component of coal burnt ash and is not as useful as fly ash, because bottom ash remains toxic when recycled. But the fly ash when recycled, renders the toxic material and makes it safe for use. Fly Ash is a residue of coal combustion which is obtained from the coal based thermal power plant. It has been observed that the quality of ash produced is extremely good.

They are fineness having low unburnt carbon and have high pozzolanic activity. It can be use as Pozzolana in manufacturing of building products like fly ash based bricks, cement, tiles, etc. It has advantage in agricultural industry as well as in the roads and embankment construction. The ash is a commodity that could help the company for producing wealth in long run if utilized in right direction. Fly ash is also considered as resource materials and the considerable amount of minerals can be extracted from it. This paper presents review on utilization of fly ash, that how it can be utilized in different applications, their properties and if proper utilization and disposal is not done, how it can affect our environment and life.

KEYWORDS: *Ash Utilisation, Recent trends , Ash application, ash disposal, ash disposal trends , recent ash disposal, environmental friendly, reclamation*

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INRODUCTION

Fly ash is a byproduct generated by the generation of power with coal. For the generation of heat pulverized coal is burnt with this burning of coal leaves some residue is left which contains 80% of fly ash and 20% of bottom ash. The fly ash thus generated is carried away by flue gases which further gets collected at economizer, air pre-heater and ESP hoppers. And the ash collected in water impounded hopper below the boiler is clinker type and is called bottom ash. In thermal power plant a huge quantity of fly ash is generated which can pollute air, water and soil if not managed properly. Also, fly ash is a resource material so sustainable ash utilization is a key concern.

In India about 536.34 million tons of coal is consumed in thermal power plants and produce 145044.80 MW power. This produces 176.74 million tons of fly ash out of which only 63.79% is utilized for different purposes such as production of cement, construction of roads and embankments, mine filling, agriculture, making bricks, tiles and building materials.

Fly ash generation and utilization in different countries

S. NO.	Country	Annual Ash Production, MT	Ash Utilization%
1	India	112	62
2	China	100	45
3	USA	75	65
4	Germany	40	85
5	UK	15	50
6	Australia	10	85
7	Canada	6	75
8	France	3	85
9	Denmark	2	100
10	Italy	2	100
11	Netherland	2	100

This huge amount of fly ash generated if not properly utilized in right direction then it will become hazardous to our environment. Therefore, continuous efforts are being made so that maximum residue of this coal can be utilized and that too in right way.

Classes of Fly Ash

Fly Ash can be categorized into two namely, Class F and Class C fly ash. These classes are being differentiated on the basis of the amount of calcium, silica, alumina and iron content present in fly ash. The properties of fly ash also depends upon the content of coal burnt. They may be anthracite, bituminous and lignite.

Class 'F' fly ash

Class 'F' fly ash has polozzolanic properties and contain less than 7% of lime (CaO) . They are used in production of cementitious compounds and geopolymer. Geoploymer is formed by adding chemical activator to fly ash. Cementitious compound is produced by reaction occurred between silica and alumina of fly ash with water. Class 'F' fly ash is obtained from the old anthracite and bituminous coal.

Class 'C' fly ash

Sub-bituminous coal and lignite is burnt to produce Class 'C' fly ash. Generally it contains 20% lime (CaO) and in addition to have pozzolanic properties it also has some self-cementing properties. Unlike Class 'F', it does not require an activator also alkali and sulphate contents are generally higher in Class 'C' fly ash.

Figure 2. Examples of Class C and Class F fly ash.

Class 'C' and Class 'F' Fly Ash

Rules Of Fly Ash In India

Government of India is also concerned for the proper utilization of fly ash so as to avoid the impact of fly ash to our surroundings. The Ministry of Environment & Forest (MoEF) issued notification for fly ash utilization in 14, September1999.

After that as per the requirements notifications were amended on 3rd Nov2009.

The major projects for the use of fly ash were given and it was divided by the distance i.e., Within 100 Km radius and 50 Km radius of Thermal Power Plant.

Within radius of 100 Km:

- In the construction projects for building products like cement concrete, blocks, tiles and fly ash based bricks.
- In construction of embankment and roads.
- Reclaiming the low lying areas.

Within radius of 50 Km:

- In open cast mines for the back filling and also in underground back filling

Utilization of Fly Ash in past few years

Fly Ash Utilization in Different Areas

Fly ash is being utilized in different fields due to its oxide rich property. Different attempts are made for the management of fly ash. Even in the field of technology developments are made so as to make the productive utilization and safe sound management of fly ash. Research is doing in this field and even the studies has been done on fly ash so as to know it's properties and further helps in converting this byproduct into wealth.

Different areas in which fly ash is currently being used:

CEMENT

Portland Pozzolana Cement (PCC) is manufactured using fly ash where it acts as pozzolanic material. Up to 35% of fly ash can be directly be substituted for cement as blending material. Fly Ash helps in improving the quality and durability characteristic of the resulting concrete.

Asphalt Concrete

Asphalt Concrete is commonly used to surface the roads. It contains asphalt binder and mineral aggregate. ASTM D242 has outlined some specifications which fly ash should meet before using it in asphalt pavment. The mineral filler helps to provide contact between the aggregated particles and also helps in filling up the voids. Here fly ash acts as mineral filler, and both Class 'F' and Class 'C' fly ash are good material filler.

The hydrophobic property of fly ash provides resistance to striping, improves rutting resistance and also the stiffness of asphalt matrix is increased.

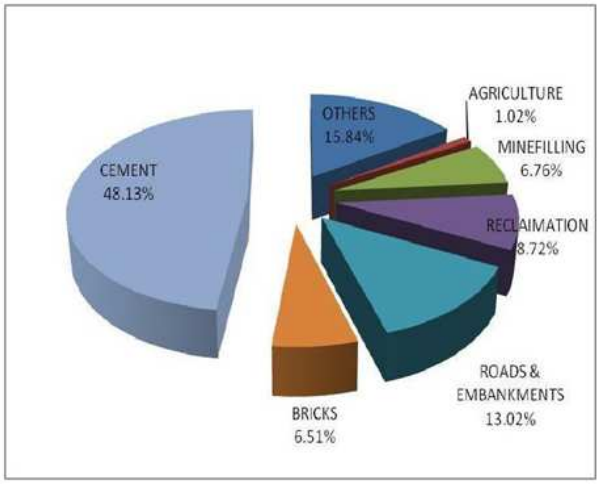
Bricks & Tiles

Bricks can be manufactured using several techniques from fly ash. One method is mixing the fly ash and clay in 1:1 and then firing in kiln at about 1000C. Another method is making the mixture of fly ash with Plaster of Paris by adding the required amount of water. Further it is allowed to get dry. This second method reduces air pollution as it does not require any amount of heat.

Road & Embankments

Fly ash has several different advantages using it in construction of roads and an embankment is also one of them. By doing this we can save top fertile soil, avoids creating of low lying areas, and avoids recurring expenditure of soil. The fly ash used for embankment purpose is generally Class 'F' fly ash.

Modes of Fly Ash Utilization



Land Reclamation

Reclamation of land can also be done by using fly ash. It has been seen that the use of fly ash helps to save the fertile top soil. It has been observed that fly ash was being used since last many years for the reclamation process which has increased from 4.17 million tons to 11.04 million tons in year 2014-15. Utilization of fly ash for reclamation constitute to about 10.77% of total utilization.

Agriculture

Fly ash is also being used in agriculture sector as it has micronutrients. It helps the crops to uptake the vital nutrients/minerals and is considered as a potential growth improver. The advantage of fly ash in agriculture is soil modifier,moisture retaining capacity, fertility, development of roots, soil binding and stores carbohydrate.

Increase in Crops Yield

Crops	% Yield Increase
Wheat, Mustard, Rice	6-18
Pearl, Millet	32
Seed Cotton, Gram, Soybean	10-46
Sunflower, Groundnut	10-26
Paddy	31
Sugarcane	32
Vegetable	15
Banana	30

Roller Compacted Concrete (RCC)

Fly ash particles have spherical shape which increases the workability of cement and reduces water demand. Due to this property they have a great advantage in roller compacted concrete dams and hence the heat of hydration lowers down allowing thicker placements to occur. RCC is used in Ghatghar Dam Project in Maharashtra, India. By using this processed fly ash 70% of the replacement values can be attain.

Geopolymer

Geoplymer acts as binder in concrete and its properties can be enhanced by adding fly ash. Hence it possesses pzzolanic property such as OPC, high alumina, and silicate. Also the compressive strength increases, creep and shrinkage reduces and has good resistance to acid.

Fly Ash - Hazards to environment and life

Although this fly ash obtained from the power thermal stations have a lots of advantages and is beneficial to us in many ways, but it has a major impact on our environment and life. It is cited to be the world's one of the major sources of pollution affecting general aesthetics of environment in terms of air, water, soil, heath hazard and land use and thus leads to environmental danger.

Disease due to presence of heavy metals in fly ash

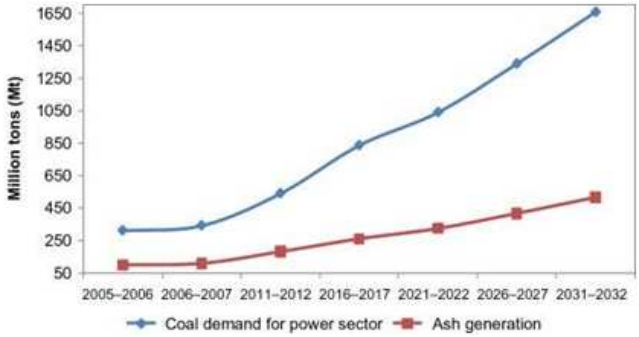
Metal	Disease
Nickel (Ni)	Respiratory problem, Lungs cancer
Cadmium (Cd)	Anemia
Antimony (Sb)	Gastroenteritis
Arsenic (As)	Skin Cancer
Chromium (Cr)	Cancer
Lead (Pb)	Anemia

Future Aspects

There is a great scope of fly ash in many different applications and the maximum use of this fly ash helps in making a step towards the safe environment. By utilizing the fly ash we can minimize its harmful effects which may occur during its disposal.

There are some future aspects of fly ash such as:

- In manufacturing of nano concrete-aggregate (NACA).
- Production of artificial sand using palletization process.
- Recovery of value added mineral from fly ash.
- Mechanical activation can be done so that the use of fly ash can be maximize by the reduction of its size.



These are the fields on which we can do research and work towards them so as to maximize the use of fly ash to reach the target of 100% fly ash utilization. Fly ash is good for the use as it contains nutrients and several other minerals in them. They are the wealth generator and can also be used for producing green buildings, materials, roads and used for agricultural and constructional purpose

Conclusion

In past few decades, Fly Ash was one of the major sources of pollution. Due to its granulometric, morphology, filtration properties and mineral composition it can have negative influence on environment. But now, although it has several negative impacts if its utilization and disposal is not done in right direction. Fly Ash is considered as a valuable substance as it has certain advantageous characteristic due to which it has been used in several applications. It has become an important raw material in various fields such as construction, agricultural crop, waste lands, domestic and waste water treatment, and recovery of heavy metals, reclamation and many more. Fly ash gives the good result in almost every aspect such as good strength, economic feasibility and environmental friendly. In year 2009-10 highest level of fly ash utilization was achieved of about 62.6%. But in later years it was reduced to 55.69% in 2014-15. Now it's high time to undertake research and develop our knowledge in order to change the fly ash reuse to utilize 100% of flyash. This will help to ensure the more effective management of fly ash and consciously reduce environmental damage.

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