

Review Article

# Trends in Utilization of Coal Fly Ash in India: A Review

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## I N F O

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## A B S T R A C T

A by-product after coal burning is kenneed as Coal Fly Ash (CFA) deemed to be environmentally perilous. However, fly ash has been used in numerous zones since previous few centuries. Overall, this review survey highlights the research that fixates on the trends of utilization of coal fly generated in India for engineering applications such as cement, concrete, soil stabilization, road base/ embankment, land reclamation, agriculture and much more.

**Keywords:** Coal Fly Ash, Generation, Utilization, Thermal Power Plants

## Background

As the Demand of electricity is increasing day by day, to achieve it, usage of coal is also increase in thermal power plant. This leads to tremendous increases in coal fly ash content which is generated by burning of coal as fuel in power plant. In India major power plants are using

coal as fuel though alternatives are being searched into since more than last 10 years, still till date there is no feasible replacement of coal available in India. Generally coal combustion by products has 80% of coal fly ash so this has led to increase in fly ash generation year by year to meet increasing demand of electricity as shown in Figure 1.

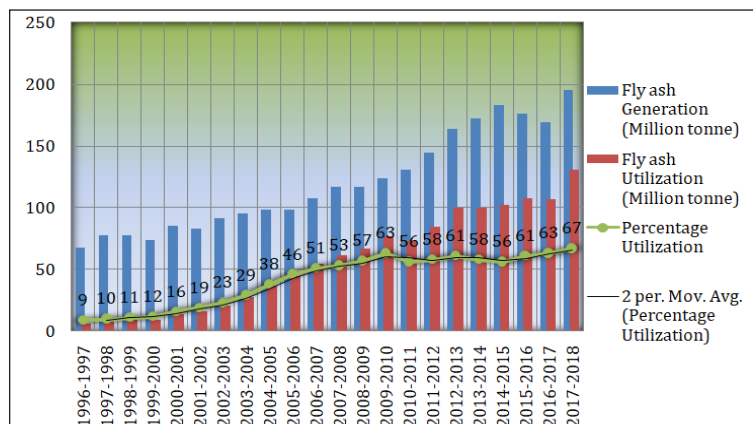


Figure 1. Year wise trend in fly ash generation<sup>15</sup>

As the thermal power plants are producing more electricity to meet the increasing demand, correspondingly the fly ash generation is also increasing parallel as shown in Figure 2. In fly ash several toxic elements with a concentration on the surface are high and having high mobility. Dry or wet is medium from where fly ash gets entry to the aquatic and terrestrial environment. Thus this is a crucial factor adding to pollution and is affecting the artful environment.

### Applications in Engineering Segments

Researchers have tried to use coal fly ash as admixture in

many engineering materials for its successful consumption. The Ministry of Environment and Forest, has issued a notification, in April 2003, making it mandatory to use of Coal Combustion Residuals in all types of constructions around 100 km radius of each thermal power station, thus helping to reduce environmental pollution as well. On Sep 14, 1999 MOEF & CC publish a notification that every thermal power plant in which coal is used as fuel shall provide coal fly ash free of cost for at least 10 years from date of notification released in public. Table 1, highlights some common applications in India:

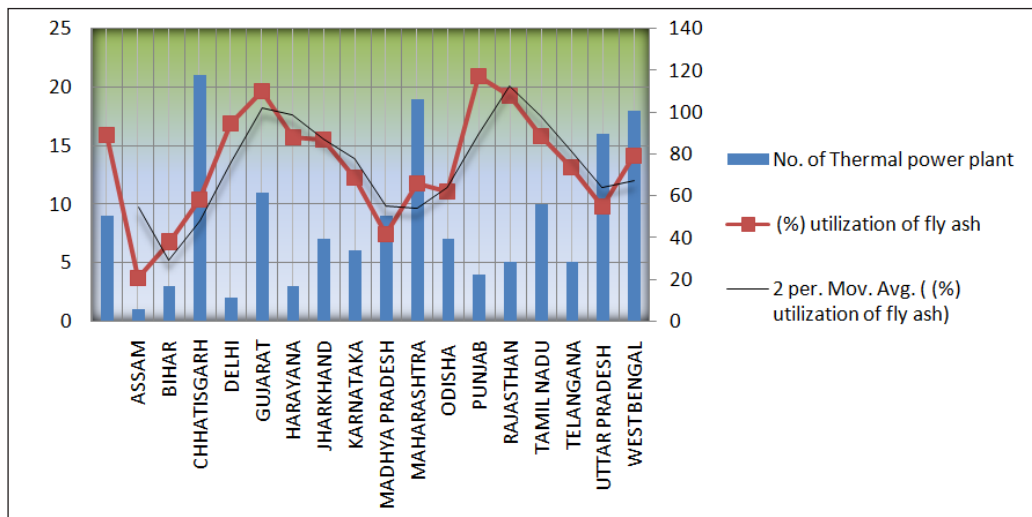


Figure 2.State wise utilization of fly ash<sup>16</sup>

Table 1.Fly ash utilization in different sectors

S. No.	Author	Problem Statement	Material used	Findings
1.	Mohammadinia A, Arulrajah A, Horpibulsuk S, Chinkulkijniwat A. (2017).	Effect of Fly Ash on Properties of Crushed Brick and Reclaimed Asphalt In Pavement Base Applications	Crushed Bricks For Road Pavement	15% Fly Ash Was Found To Be The Optimum Proportion For Pavement Bases.
2.	Gorai S. (2018).	Utilization of Fly Ash For Sustainable Environment Management	Fly Ash Alone or With Mixture of Limestone or Granite Has Been Used For Parking Lots	It Will Increases Compaction Characteristics, Shear Strength, Compressibility and Permeability
3.	Gorai S. (2018).	Utilization of Fly Ash For Sustainable Environment Management	90-95% Fly Ash, 5-10% Portland Cement And Sufficient Quantity of Water Has Been Used For Sanitary And Storm Sewer Pipes, Tunnels	It Can Be Used In Any Weather, Under Freezing Conditions.
4.	Basu M, Pande M, Bhadoria PBS. Mahapatra SC. (2009).	Potential Fly-Ash Utilization In Agriculture: A Global Review	Fly Ash Has Been Used In Agriculture Soil	Addition of 5% Coal Fly Ash Leads To Higher Speed Germination

5.	Dhadse S, Kumari P, Bhagia L.J. (2008).	Fly Ash Characterization, Utilization and Government Initiatives in India: A Review.	Waste Water Treatment	In Industries 95% - 100% Treatment of Wastewater Is Done Through Fly Ash.
6.	Asokan P, Saxena M, Asolekar SR. (2005).	Coal Combustion Residues- Environmental Implications and Recycling Points	Fly Ash Along with Silica, Alumina and Iron Are ,Major Chemical Constituents	22% of Fly Ash Is Used By Cement Industries as Raw Material It Provides Smooth Surface, Lower Water Permeability and Higher Resistance to Carbonation
7.	Alam J, Akhtar MN. (2011).	Fly Ash Utilization in Different Sectors In Indian Scenario	Asphalt Binder and Mineral (Both Class F and Class C)	It Increases Stiffness In Pavements And Improves Rusting Resistance And Increasing Mix Durability
8.	Kumar V, Singh G, Rai R. (2005).	Fly Ash Utilization Programme	Fly Ash In Chemical Fertilizer and Organic Materials	Efficiency of The Fertilizer is Increases Due To Fly Ash
9.	Kishor P et al. (2009)	Use Of Fly Ash In Agriculture: A Way To Improve Soil Fertility And Its Productivity	Fly ash in agriculture feild	Fly ash increase plant growth and nutrient uptake
10.	Ukwattage et al. (2013)	The use of coal combustion fly ash as a soil amendment in agricultural lands (with comments on its potential to improve food security and sequester carbon)	Fly ash is used in agriculture land	Where soil is inherent structural and nutrients are limited fly ash is used to enhance food security

Thus we find many scientific advances for fruitful utilization of fly ash in various engineering segments in recent years, the stats of which are represented in Table 2 and Table 3.

Here Table 2, represents fly ash in various engineering segments from year 2010-2014 and Table 3, represents fly ash in various engineering segments from year 2014-2019.

**Table 2. Fly Ash Utilization in India from 2010-2014**

Mode of utilization	2010-2011		2011-2012		2012-13		2013-14	
	MT	%	MT	%	MT	%	MT	%
Cement	35.47	48.5	38.08	44.74	41.33	41.18	39.17	39.32
Mine filling	6.04	8.26	7.74	9.1	10.34	10.89	11.2	12.27
Bricks & Tiles	4.61	6.3	5.83	6.86	9.98	9.94	12.23	11.79
Reclamation of low lying area	9.31	12.73	14.21	16.71	11.83	11.78	11.75	11.24
Ash Dyke Raising	---	---	5.86	6.89	10.93	10.89	10.32	10.36
Roads, flyovers & Embankments	8.52	11.65	5.54	6.51	6.02	6	4.98	5
Agriculture	1.27	1.74	0.88	1.03	2.5	2.49	2.88	2.89
Concrete	---	---	0.63	0.74	1.03	1.03	0.91	0.92
Others	7.91	10.82	6.28	7.38	6.41	6.39	6.19	6.22
Total Utilized/ (Total Generation)	73.13	100	85.05	99.96	100.37	100.59	99.63	100.01

Source: <http://www.cea.nic.in/tcd.html>, \*MT= Million Tonnes

Table 3. Fly Ash Utilization in India from 2014-2019

Mode of utilization	2014-15		2015-16		2016-17		2017-2018		2018-2019	
	MT	%	MT	%	MT	%	MT	%	MT	%
Cement	43.33	42.36	43.38	40.32	40.59	37.9	50.29	25.6	25.03	26.85
Mine filling	13.3	13	10.3	9.57	11.78	11	12.51	6.66	4.8	5.15
Bricks & Tiles	12	11.73	14.7	13.66	14.91	13.92	17.69	9.01	8.06	8.65
Reclamation of low lying area	11	10.75	12.5	11.62	11.04	10.31	20.57	10.48	9.01	9.66
Ash Dyke Raising	9.8	9.58	10.6	9.85	11.89	11.1	13.55	6.9	8.52	9.15
Roads	3.4	3.32	5	4.65	6.19	5.78	6.67	3.4	2.51	2.1
Agriculture	1.9	1.86	2.2	2.04	1.92	1.79	0.573	0.29	0.071	0.77
Concrete	0.76	0.74	0.78	0.72	0.76	0.71	1.29	0.66	0.0966	1.04
Hydro Power Sector	0.01	0	0.04	0.03	0.02	0.02	0.007	0.004	0	0
Others	6.86	6.71	8.12	7.55	7.98	7.45	8.68	4.42	4.43	4.76
Total Generation	102.33	55	107.62	60.8	107.1	63.28	131.83	67.42	62.53	539.37
Unutilized Fly Ash	81.68	44.39	69.38	39	62.16	36.72	64.57	32.87	29	31.28
Total	184		177		169.26		196.4		91.53	570.65

Source: Report on Fly ash generation at Coal/ Lignite based thermal power stations and its utilization in the country for year 2014-15, 2015-16 & 2016-17 by CEA Report, \*MT= Million Tonnes

Thus in this review work it is seen the demands of fly ash is gradually increasing as since 1996 and fly ash generated was 68 million ton and consumption was 6 million ton which in 2018 changed to 145 million ton production and 85 million ton utilization throughout the years.

### Conclusion

Also this waste product has now become an important raw material as it improving their properties of various engineering materials thereby increasing their life and avoiding their failure. In many industries fly ash is used as a raw material. It is recognize as a beneficial in various products like bricks, concrete, in agriculture soil, waste water treatment and many more. Fly ash quality or its size is depending on coal. Usage of fly ash will save environment which is getting polluted day by day and it will save land which is used in bricks production.

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