A technical study on Fly ash in concrete as a replacement for cement and filler material

[a]Govind Kumar
[a]Post Graduate Student
Civil Engineering Department
Institute Of Tecnology &Management Lucknow - 227202 (U.P.)
[b]Vipin Kumar Kannaujiya
[b]Assistant Professor ,Department of Civil Engineering Shri Ram Swaroop Memorial Group of ProfessionalColleges Lucknow 226028U.P.India

Abstract: ***Fly ash, a waste generated by thermal power plants is as such a big environmental concern. The investigation reported in this paper is carried out to study the utilization of fly ash in cement concrete as a partial replacement of cement as well as an additive so as to provide an environmentally consistent way of its disposal and reuse.***

Keywords: Fly ash, concrete,Cement,concrete Compressive strength

---

1.Introduction:

Fly ash is very much similar to volcanic ashes used inproduction of the earliest known hydraulic cements about 2,300 years ago. Those cements were made near the small Italian town of Pozzuoli - which later gave its name to the term "pozzolan". A pozzolan is a siliceous or siliceous / aluminous material which when mixed with lime and water forms a cementitious compound. Fly ash is the best known, and one of the most commonly used, pozzolans in the world. Fly ash is the notorious waste product of coalbased electricity generating thermal power plants, known for its ill effects on agricultural land, surface and sub-surface water pollution, soil and air pollution and diseases to mankind. Researchers have proposed few ways of reusing fly ash for variety of application. One of the most common reuse of fly ash is in cement concrete. Fly ash particles are almost totally spherical in shape, allowing them to flow and blend freely in mixtures. In this experimental investigation, an attempt has been made to study the techno-economic analysis for the compressive strength of fly ash concrete. The fly ash is procured from Tanda Thermal Power Plant. This plant is located near Tanda city in Akbharpur District in U.P state. The

2.Experimental work

2.1 Properties of fly ash:

Various tests were done to find out the physical and chemical properties of fly ash which is illustrated in table 1

Table 1. Some physical properties of fly-ash

Sl. No.	Parameters	Properties
1	Shape	Spherical
2	Size	1-110µ
3	Colour	Grey brown
4	Specific gravity	1.90-2.56
5	Permeability (cm / sec.)	105-103
6	Optimum moisture content (%)	38-18
7	Max. dry density (gm / cc)	0.90-1.60
8	Plasticity	Non plastic

Table 2. Chemical composition of Neyveli Lignite fly ash (Sivagnanam et al., 2001), Bandel fly ash (Tripathi et al., 1997) and Tuticorin fly ash (Pillai, 2003)

Elemental constituents	Quantity (%)		
	At Neyveli	At Bandel	At Tuticorin
Silica as SiO_2	45 – 59	60.10	41.29 – 67.69
Iron as Fe_2O_3	0.6 – 4	6.90	3.13 – 6.71
Sulphur as SO_3	2.75	0.20	Traces
Magnesium as MgO	1.5 – 5	1.25	0.28 – 1.81
Calcium as CaO	5 – 16	1.53	0.44 – 2.24
Alumina as Al_2O_3	23 – 33	17.88	13.94 – 25.62
Titanium as TiO_2	0.5 – 1.5	1.73	Not recorded

2.2 Cement fly ash blends:

The fly ash is blended in cement at a constant rate of 20% by weight of cement in steps of 20%.The cement-fly ash blends are then tested for following properties: consistency, setting time, soundness, workability and compressive strength, as per IS 546- 2003.

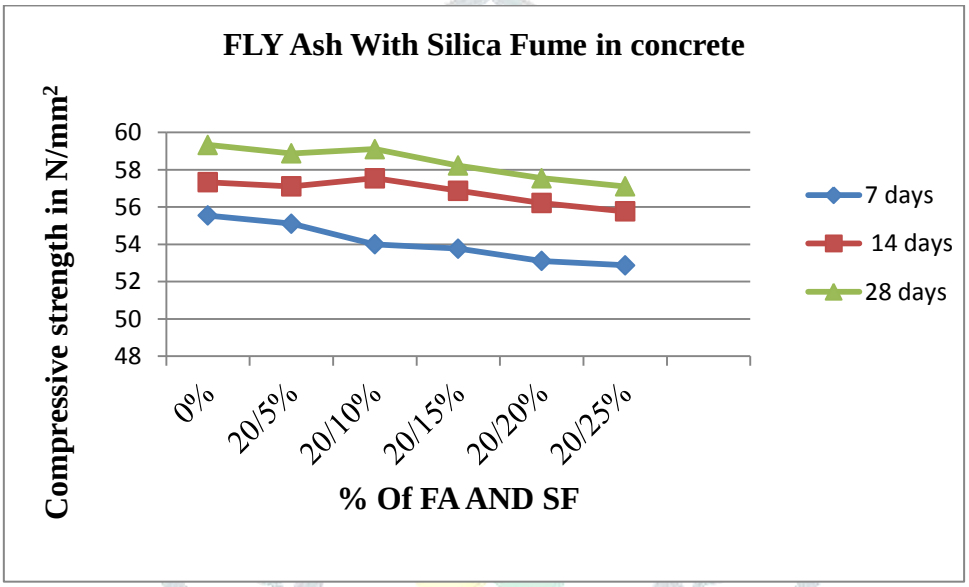
2.3 Concrete Mix Design:

In the present study, M50 grade with nominal mix as per IS 456-2000 was used. The water cement ratio of 0.45 is taken. Compressive strength determination: In this test sample of concrete is filled in the mould of size 15cm x 15cm x 15cm and top of mould is strike off. A total number of 18 cubes were casted. Fly ash is added in place of cement in concrete in 6 different percentages starting from 0%, and raised the becomes negligible for few days and after 28 days increases uniformly. Its final strength development is also maximum than any other fly ash blends. After 28 days of storage the concretes containing 20 % of fly ash, related to cement mass, gained a compressive strength about 6 % higher than the concrete addition for Ordinary Portland cement. For fly ash blends greater than 10% fly ash, the rates of strength development as well as final strengths both reduce with addition of fly ash. In long terms, concrete with higher proportions of fly ash gains comparable with that of pure concrete. The strength of concrete decreases with the increase in 20% of replacement of cement with fly ash at 28 days.

3. results and discussion:

3.1 Properties of fresh concrete:The various properties of fresh concrete are determined. Considering space limitations, here data sheet is not presented only results are discussed:The consistency of cement has increased with the addition of fly ash from 20% for 0% fly for 50% fly ash. It may be attributed to the increased specific surface area of cement – fly ash blend due to finer particles of the later. The initial setting time (IST) has increased from 155 minutes for 0% fly ash to 250 minutes for 50% fly ash. This may be attributed to the retardation of cement hydration due to fly ash. The workability of cement concrete mix has increased from 25 mm (for 0% fly ash) to 120 mm (for 25% fly ash). This may be attributed to the soothing effect of fine fly ash particles in the concrete mix. It is an encouraging result.

3.2 Compressive strength of fly ash concrete The characteristic compressive strength of various blends of concrete is presented in fig.



4. Conclusions

This study proves that NTPC Tanda fly ash can be successfully used in the cement concrete in minor amount as an additive. Considering the intangible cost of disposal problem of fly ash and hidden cost of environmental protection, the methodology appears to be indeed successful. Fly ash is actually a solid waste. So, it is priceless. If it can be used for any purpose then it will be good for both environment and economy. Use of this fly ash as a raw material in Portland cement is an effective means for its management and leads to saving of cement and economy consequently. Hence it is a safe and environmentally consistent method of disposal of fly ash. However the rate of strength development is less, Due to lesser rate of strength de ash finds specific application in mass concreting e. g. dam construction. It can be concluded that power plant waste is extensively used in concrete as a partial replacement for cement and an admixture.

REFERENCES

1. Marta Kosior-Kazberuk (2007) Strength Development of concrete with fly ash addition, Journal of Civil Engineering and Management, ISSN1822
2. Kulkarni V R (2007) Roll of fly ash in sustainable development, FAUACE.
3. Murlidharrao (2007) Utilization of fly ash at Raichur Thermal power station of Karnataka power Corporation Ltd, FAUACE.
3. Pachauri R K and P.V.Shridharan (1998) Looking back to Think ahead, TERI Publication, New Delhi.
4. Ramarao S (2007) Utilization of fly ash at Raichur Thermal power station, FAUACE.
5. Rajmane N P (2007) Fly ash based alt replacement of Portland cement, FAUACE.
6. Santhakumar A R (2008) Concrete Technology, Oxford University Press, New Delhi.
7. Shetty M .S.(2017) Concrete
8.Swamy, R. N. and Bouikni, A., Some engineering properties of slag concrete as influenced by mix proportioning and curing , ACI Materials Journal, Vol. 87, No. 3, May June 1190, pp. 210-220.