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Introduction

- Fly ash is a heterogeneous by –product material produced in the combustion process of coal used in power station.
- It is a fine grey coloured power.Having spherical glassy particles.
- The range of particle size is between 10 to 100 micron.
- Fly ash is one of the numerous substances that cause air, water and soil pollution, disrupt ecological cycles and set off environmental hazards.

- The fly ash is disposed off either in the dry form or mixed with water and release in slurry into locations called ash ponds.
- Four countries, namely, china, india, united state and poland alone produce more than 270 million tons of fly ash each year.

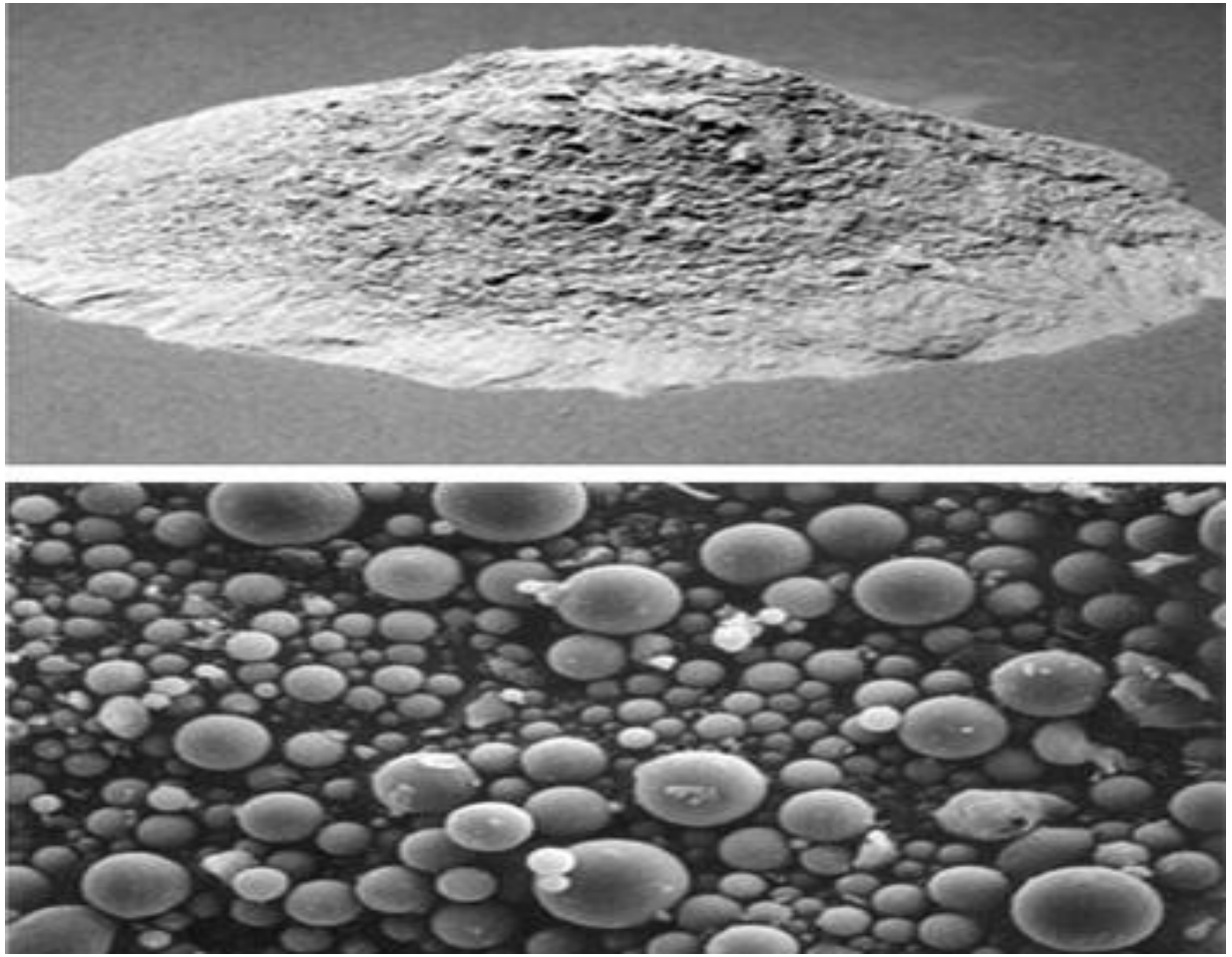
Objective

- Reduced heat of hydration.
- Increse the workability of concrete.
- Permeability and corrosion protection.
- Reduced alkali-aggregate reation.

Fly ash

- Fly ash is a fine, glass powder recovered from the gases of burning coal during the production of electricity.

- These particles solidify as microscopic, glassy spheres (see fig.1) that are collected from the power plant‘s exhaust before they can —fly away — hence the product‘s name: fly ash. Chemically, fly ash is a pozzolana.



Fly ash: the modern pozzolana

1. Class C fly ash:-

- Normally produced from the combustion of lignite or sub-bituminous coals.
- Possesses cementitious properties in addition to pozzolanic properties.
- This fly ash generally contain more than 20% lime (cao)

2. Class F fly ash:-

- Normally produced from the combustion of bituminous or anthracite coals
- This fly ash is pozzolanic in nature, and contains less than 20% lime (cao).

Salient advantage of using fly ash in cement concrete

- Reduction in heat of hydration and thus reduction of thermal cracks and
- improves soundness of concrete mass.
- Improved workability / pumpabilty of concrete
- Reduced requirement of cement for same strength thus reduced cost of
- Concrete.

Environmental benefits of fly ash use in concrete

- Use of fly ash in concrete imparts several environmental benefits and thus it is eco-friendly.
- It saves the cement requirement for the same strength thus saving of raw materials such as limestone, coal etc. Required for manufacture of cement.
- Manufacture of cement is high-energy intensive industry.
- In the manufacturing of one tonne of cement, about 1 tonne of **CO_2** is emitted and goes to atmosphere.
- Less requirement of cement means less emission of result in reduction in greenhouse gas emission.

Material

- The following material are used :-

1. Cement
2. Coarse aggregate
3. Fine aggregate(sand)
4. Fly ash
5. Water

➢ **Cement** IS:12269 (2013)

- Ordinary portland cement, 53 grade shall be manufactured by intimately mixing together calcareous and argillaceous and/or other silica, alumina or iron oxide bearing materials, burning them at a clinkering temperature and grinding the resultant clinker so as to produce a cement capable of complying with this standard.

Test	Result	IS Criteria
Fineness test	7%	IS:4031 1996
Initial setting time	35 min	
Final setting time	182 min.	

➢ **Aggregate** IS: 2386 (1963)

- The usual range employed is between 9.5mm and 37.5mm in diameter. - Fine aggregates are usually sand or crushed stone that are less than 9.55mm in diameter. Typically the most common size of aggregate used in construction is 20mm. A larger size, 40mm, is more common in mass concrete.

Test	Result	IS Criteria
Aggregate size	20mm	IS:2386(Part IV) 1963
Specific gravity	2.84	
Impact Value test	21.50%	
Crushing value test	15%	

➢ **Sand** IS :383 (1970)

- The fine aggregates within each of these grading zones are suitable for making concrete, but to make concrete of high strength and durability, the mix proportions should be chosen according to the grading characteristics of the fine aggregates used; the ratio of fine to coarse aggregate being reduced as the fine aggregate becomes finer from grading zones I to IV.

Test	Result	IS Criteria
Quality of sand	Natural sand	IS:2386(Part IV) 1963
Sieve analysis	Zone 3	
Specific gravity	2.74	
Particle size and shape	Round, < 4.75mm	

MIX DESIGN:-

- The mix design was according to the weight method. The mix proportion was to be assumed as **1 : 1 : 2 (Cement / sand / aggregate).**
- Their mix proportion is shown in table no.4 for various proportion of FLY ASH replacement with cement.
- There were 12 numbers of cubes in which 3 cubes for 0 % FLY ASH, 3 cubes for 10 % FLY ASH, 3 cubes for 20 % FLY ASH and 3 cubes for 30 % FLY ASH for one stage of testing 28 days.
- The coarse aggregate content per cubic meter was 1800 kg/m^3 and sand has specific gravity about 2.65.
- Specific gravity used was 3.15, 2.40 and 2.790 for cement, fly ash and coarse aggregate.

COMPOSITION BY WEIGHT FOR PROPORTION (1:1:2)

% of FLYASH	NUMBER OF CUBES	CEMENT (Kg)	FLYASH (kg)	SAND (kg)	COARSE AGGREGATE (kg)	WATER (kg)
0 %	3	5.490	0.000	6.5407	13.851	**2.196**
10 %	3	4.941	0.549	6.5407	13.851	**1.9764**
20 %	3	4.392	1.098	6.5407	13.851	**1.7568**
30 %	3	3.843	1.647	6.5407	13.851	**1.5372**
SPECIFIC GRAVITY		**3.15**	**2.40**	**2.65**	**2.709**	**1.00**

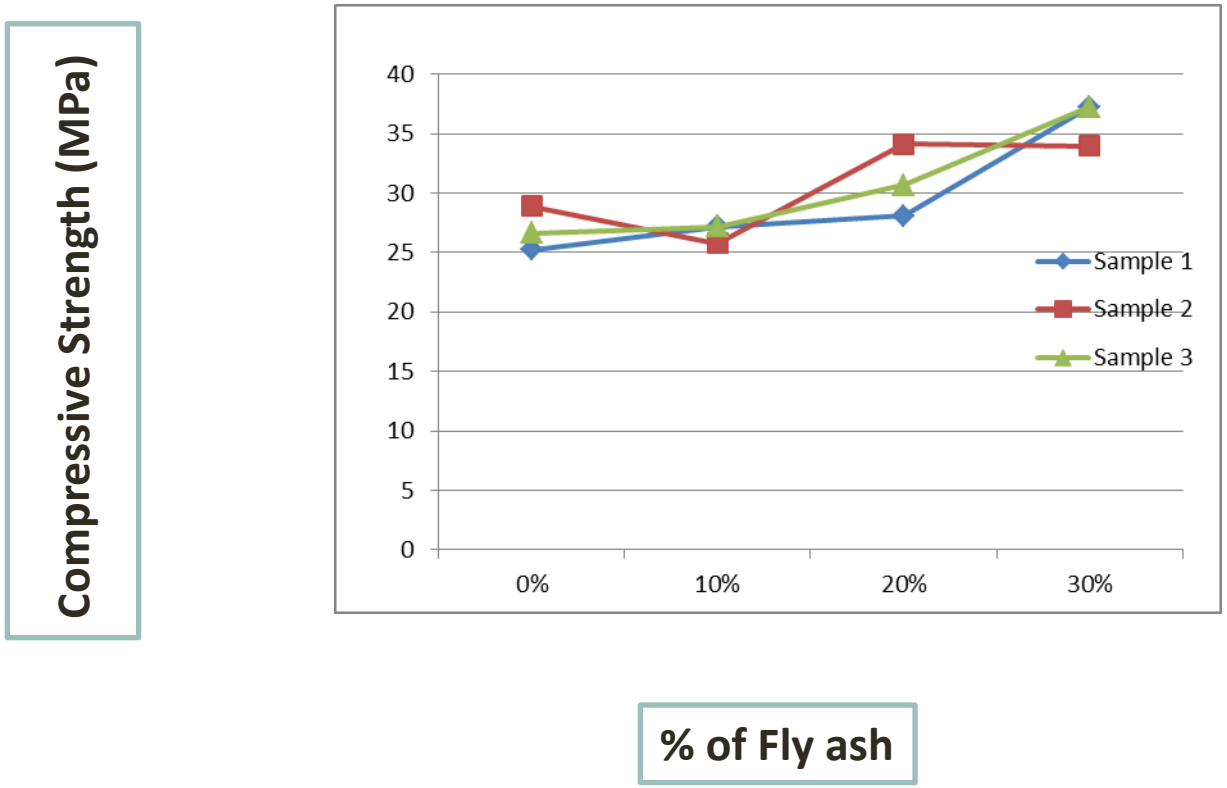
Mixing, casting and compaction process

- Mixing and casting
- Compaction
- Concrete specimen

EXPERIMENTAL RESULTS

- At a w/c ratio of 0.40 all mixes show superior strength to the control sample; higher replacement levels of fly ash result in better early and ultimate strengths according to the w/c ratio.
- 30% fly ash mixes show identical performance during the duration of the testing with a maximum strength of 37.24 N/mm^2 at 28 days.
- 10% fly ash mixes shows lower early strengths compared to 30%fly ash and 20%fly ash concrete after 28 day.
- 30% fly ash mixes shows highest compressive Strength after 28 days of 37.24 N/mm^2.

Mix. FLY ASH%	No of specimen	w/c ratio	Compressive Strength (MPa)	Avg. Comp. Strength
0 %	1	0.40	25.24	25.62
	2	0.40	28.88	
	3	0.40	26.62	
10 %	1	0.40	27.20	26.72
	2	0.40	25.77	
	3	0.40	27.20	
20 %	1	0.40	28.08	30.95
	2	0.40	34.13	
	3	0.40	30.66	
30 %	1	0.40	37.24	36.14
	2	0.40	33.95	
	3	0.40	37.24	



Sample-1 = 10% Fly ash replace
Sample-2 = 20% Fly ash replace
Sample-3 = 30% Fly ash replace

Work plan

Month	Schedule of work
July	Get the basic information about project
August	1st informative presentation
September	Getting materials
October	Mid term examination
November	Material testing
December	University examination
January	Collect material
February	Cast of cubes
March	Collect data
April	

Literature review

- **Bhanumathidas, &kalidas, (2002)** with their research on indian fly ashes reported that the increase in groundfineness by 52% could increase the strength by 13%. Whereas, with the increase in native fineness by 64% the strengthwas reported to increase by 77%. Looking in to the results it was proposed that no considerable improvement ofreactivity could be achieved on grinding a coarse fly ash. Authors also uphold that the study on lime reactivity strengthhad more relevance when fly ash is used in association with lime but preferred pozzolanic activity index in case of blending with cement.

- **Subramaniam, Gromotka, Shah, Obla& Hill, (2005)** investigated the influence of ultrafine fly ash on the early age property development, shrinkage and shrinkage cracking potential of concrete. In addition, the performance of ultrafine fly ash as cement replacement was compared with that of silica fume. The mechanisms responsible for an increase of the early age stress due to restrained shrinkage were assessed; free shrinkage and elastic modulus were measured from an early age. In addition, the materials resistance to tensile fracture and increase in strength were also determined as a function of age. Comparing all the test results authors indicated the benefits of using ultrafine fly ash in reducing shrinkage strains and decreasing the potential for restrained shrinkage cracking.

- **Chatterjee,(2011)** reported that about 50 % of fly ash generated is utilised with present efforts. He also reported that,one may achieve up to 70% replacement of cement with fly ash when high strength cement and very high reactive flyash is used along with the sulphonated naphthalene formaldehyde superplasticizer. He reported improvement in fly ashproperty could be achieved by grinding and getting particles in submicrocrystalline range.

CONCLUSION

- Compression test confirm that at the same w/c ratio, compressive strength of concrete according to the replacement level of cement with FLY ASH.
- Experimental results show that 10%FLY ASH has lower strength after 28 days than 20%and 30%, 30% FLY ASH gain higher compressive strength then other.
- As in table, we can clearly see that by replacing cement with 30% of FLY ASH, compressive strength is increased about 10.52 %.

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- 3. Gambhir, M.L., Concrete Technology, Third Edition-2004.

- **Is Code:**

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- Is: 3812(part 1):2003 Pulverised Fuel Ash—specification.
- (For Use As Pozzolana In Cement, Cement Mortar And
- Concrete).
- Is:3812(part 2):2003 Pulverised Fuel Ash—specification.(For Use
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THANK YOU