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METAKAOLIN AND FLYASH WITH PARTIAL REPLACEMENT OF CEMENT USING IN HPC

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Abstract: **Concrete is the most commonly used for construction. The need of high concrete is increasing day by day. The test for carried out on concrete specimens with 5,10,15,20,25% replacement of cement by metakoline and fly ash for all mix 10%.The addition of fly ash in concrete improves certain properties such as workability, later age strength development and few durability characteristics. Concrete is the high volume of fly ash and metakaolin as a partial replacement of ordinary Portland cement .The conventional concrete M60 was made using OPC 53 with metakaolin and fly ash. To evaluate optimize ratio and mechanical properties of metakaoline based on concrete and compare with conventional mix .From the optimization 20% cement replacement by metakaolin superior than all the mixes.**

The test to be conducted are:-

- **Compressive strength test**
- **Flexural strength test**

Keywords: **Metakaolin, flyash, high performance concrete, Compressive strength, Flexural strength.**

1. MATERIALS USED FOR TESTING

1.1 CEMENT:

In the most general sense of the world, cement is a binder, a substance which sets and hardens independently, and can bind other materials together. The most important use of cement is the production of mortar and concrete -the bonding of natural or artificial aggregates to form a strong building materials which is durable in the face of normal environmental effects.

1.2 AGGREGATES:

Aggregates are the important constituent in concrete. They give to the concrete, reduce shrinkage and effect economy, earlier, aggregate were considered as chemically inert materials, but now it has been recognized that some of the aggregate exhibits chemical bond at the interface of aggregate and paste. Aggregate constitute around 70% - 80% of the volume of the concrete. So the know about concrete it is essential that one should know more about the aggregates. Aggregates generally used are sand, gravel, crushed rock such as granite quartzite, etc . Artificial aggregates like broken brick, air cooled slag, etc have also foundvast application in concreting. Aggregate can mainly be classified into two categories, the coarse aggregates and the fine aggregates.

1.3 COARSE AGGREGATE:

The large, solids coarse aggregates particles from the basic structural members of the concrete. Aggregate of the size bigger than 4.75mm is concreted as coarse aggregate. The coarse aggregate gives the strength to the concrete when it hardens. Generally gravel, broken bricks, etc. are used as coarse aggregates.

1.4 FINE AGGREGATE:

Aggregate whose size 4.75mm and less is considered as fine aggregates. The void between the coarse aggregate particles are filled by the fine aggregates particles. Sand in most cases is used as the fine aggregate.

1.5 MIETAKOLINE:

Metakoline is a dehydroxylated form of the clay mineral kaolinite Metakaolin is a valuable admixture for concrete/cement applications. Rocks that are rich in kaolinite are known as china clay or kaolin, traditionally used in the manufacture of porcelain. The particle size of metakaolin is smaller than cement particles, but not as fine as silica fume.

1.6 FLYASH:

Fly ash, also known as flue-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. Ash which does not rise is termed bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired power plants, and together with bottom ash removed from the bottom of the furnace is in this case jointly known as coal ash. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide ($Si0_2$) (both amorphous and crystalline) and calcium oxide (CaO), both being endemic ingredients in many coal-bearing rock strata.

1.7 WATER:

The water is required for preparation of mortar, mixing of cement concrete and for curing work etc during construction work the quality and quantity of water has much effect on the strength of mortar and cement concrete in construction the water used for mixing and curing should be clean and free from injuries quantity of alkali , acid, oils, salt, sugar and organic materials. Vegetable growth and other substance that may be deleterious and two bricks, stone , concrete and steel. Portable generally consider satisfactory for mixing. The pH value of water should not less than 6.

2. MIX DESIGN DATA AND PROCEDURE

2.1 PARAMETERS FOR MIX DESIGN:

1. Target Strength - M60

2. Type of Cement - PPC 53

3. Maximum Nominal Aggregate Size - 20mm

4. Exposure Condition -Normal

5. Degree of Supervision - Good

6. Type of Aggregate -Crushed Angular

2.2 TEST DATA FOR MATERIALS:

1. Cement Used - Ultra Tech OPC 53 Gr.

2. Sp. Gravity of Cement - 3.15

3. Sp. Gravity of Water - 1

4. Sp. Gravity of Fine Aggregate - 2.6

5. Sp. Gravity of Coarse Aggregate - 2.64

6. Water absorption of 20mm. aggregate - 0.60%

7. Water absorption of 10 mm aggregate - 0.40%

8. Water absorption of sand - 1.20%

9. Specific gravity of Metakaolin -2.7

2.3 COMPRESSIVE STRENGTH TEST:

Compressive strength is capacity of a material or a structure to withstand axially directed pushing forces. When the limit of compressive strength is reached, materials are crushed. Concrete can be made to have high compressive strength.

2.4 PREPARATION FOR SPCIMENS:

In this study, a total 21 cubes each for the control and cement and sand replacement levels of 10%, 20%, 30% , 40%, 50% were produced respectively. For the compressive strength, 150mm x 150 mm x 150 mm cubes mould were used to cast the cubes and three specimens were tested for each age in a particular mix (i.e. the cubes were crushed at 7 and 28 days respectively).. All freshly cast specimen were left in the mould for 24 firs before being de mould and then submerged in water for curing until the time of testing.

Table No.1 Details of Specimens

SPECIMENS (%OF METAKOLINE AND FLYASH)	TESTING AGE (DAYS)
	No.of Cubes For 28 DAYS
0%	3
5%	3
10%	3
15%	3
20%	3
25%	3

Table No.2 Details of Specimens with mixing

SPECIMENS (%OF METAKOLINE AND FLYASH)	TESTING AGE (DAYS)
	7 DAYS
10%	3
20%	3

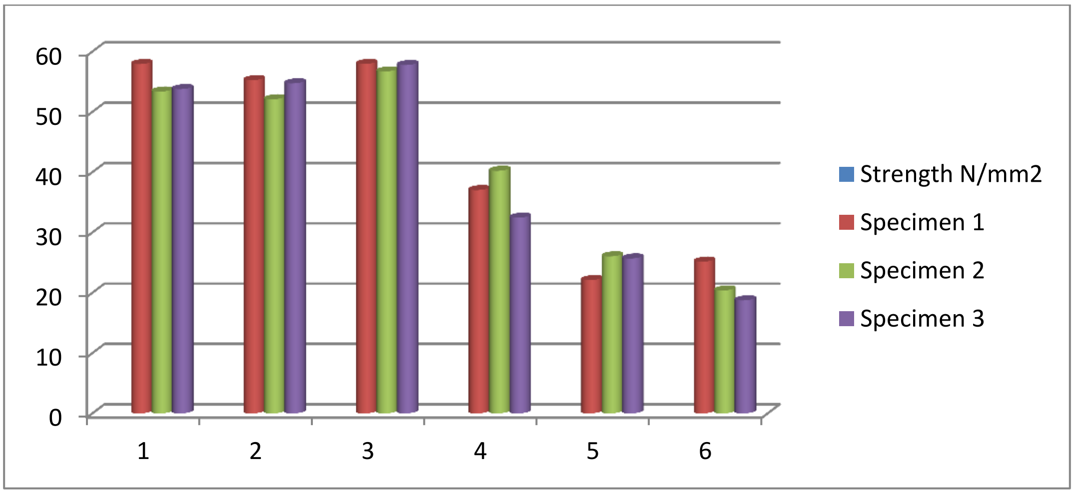
2.5 PROCEDURE:

- Place the mold on a firm, level surface.
- Form the test sample by placing concrete in mold, in three layers of approximately equal volume.
- Move the scoop around the top edge of the mould to ensure a symmetrically distribution of the concrete within the mold.
- Rod each layer with 25 stroke of the tamping rod. For layers 2 and 3 , the rod shall penetrate about 25mm into the underlying layer.
- Distribute the stroke uniformly over the cross-section of the mold.
- Close the voids left by the tamping by lightly tamping side of the mold.
- After the top layerhas been rodded, the surface will be struck off with a trowel and cover with saran wrap to prevent evaporation.
- Store the specimens undistributed for 24hrs in such a way as to prevent moisture loss and to maintain the specimen within a temperature range of 15°C - 27°C.
- Remove the test specimen from the mold between 20 and 48 hrstransfer carefully to the place of curing and testing.
- Place the specimen in water bath and store for the curing period.

Table No.3 AVERAGE CONCRETE STRENGTH

% OF METAKOLINE AND FLY –ASH REPLACEMENT	AVERAGE CONCRETE STRENGTH Mpa		
	28 DAYS		
	Specimen 1	Specimen 2	Specimen 3
0	57.92	53.36	53.77
10	55.25	52.08	54.73
20	57.94	56.70	57.76
30	37.033	40.22	32.45
40	22.098	26.04	25.69
50	25.16	20.38	18.74

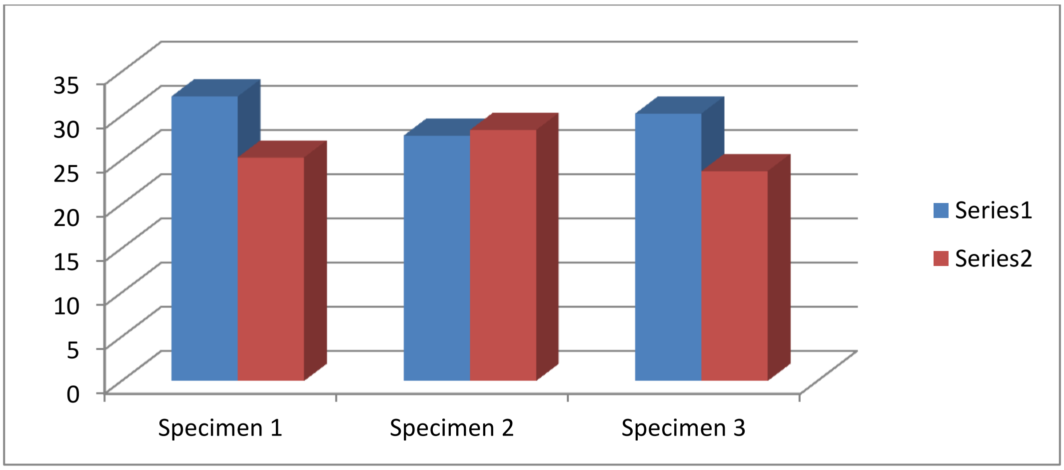
Graphical Representation Of Compressive Strength Of Concrete In 28 Days:



GRAPHICAL REPRESENTATION OF COMPRESSIVE STRENGTH OF CONCRETE IN 28 DAYS

Table No.4 Average Strength

% OF METAKOLINE AND FLY –ASH REPLACEMENT	AVERAGE CONCRETE STRENGTH Mpa		
	7 DAYS		
	Specimen 1	Specimen 2	Specimen 3
10	32.2	27.76	30.28
20	25.3	28.4	23.76



GRAPHICAL REPRESENTATION OF COMPRESSIVE STRENGTH OF CONCRETE IN 7 DAYS

3. ANALYSIS OF RESULTS

There is a significant improvement in the strength of concrete because of the high pozolonic nature of the metakaolin and fly ash and its voide filling ability. The compressive strength of mix M60 at 7 and 28 days age, with replacement of cement by metakaolin and sand by flyash was increased gradually up to an optimum replacement level of 20 % and then decreased. The maximun 7 and 28 days cube compressive strength of M60 grade with 20 % of metakaolin and flyash was 57.21 and 68.20 Mpa respt.

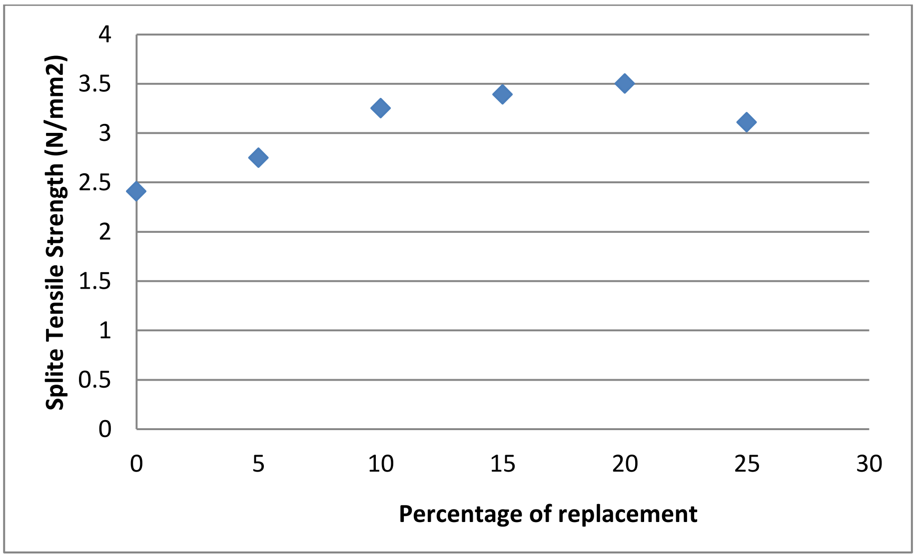
The compressive strength of M60 garde concrete with partial replacement upto 20%replacement of cement by metakaolin and flyash shows greater than the controlled concrete. The maximum compressive strength of concrete with metakaolin and fly ash depends on three parameters, namely the replacement level,water - cement ratio and chemical admixture. Cement and sand replacement upto 20% with metakaolin and flyash leads to increase in compressive strength and beyond 8% to 20%, then there is decrease in compressive strength for 7 and 28 days curing period.

4. FLEXURAL STRENGTH TEST

- This method is similar to AASHTO T177 and covers the procedure for determining the flexural strength of concrete by the use of simple cylindrical beam with centre point load.
- It is mainly done to check the testing of concrete specimen of cube 150 mm and cylindrical (150*300mm)

4.1 PROCEDURE:

- Place the cylindrical cube in the 1000kn capacity compression testing machine (CTM).which was casted by 10% replacement of cement by metakaolin and fly-Ash
- Repeat the above step by placing 20% replacement cubes in the CTM.
- A1000kn is load is applied at the cube which is placed in the CTM and flexural strength test is calculated.
- The value is then tabulated any graphical format.



5. CONCLUSION

The use of metakolin and fly-ash give rise to an increase in the strength as well as durability properties concrete with less cement compressibility is improvement to chemical attack. The chief reasons for this are reduce permeability and reduced level of calcium hydroxide.

Reinforcement corrosion is vastly reduced due to improved permeability, increase resistivity and improve the tensile strength.

Based on the conducted on the strength and compressibility characteristics metakolin and fly-ash with metakoaline and fly-ash as the replacement materials the following conclusion were drawn.

1. In mixes blended with high percentage metakaoline and fly-ash the water demand will be more. Because of greater fineness of metakoaline to maintain constant workability, use of plasticizer becomes necessary.
2. An optimum of 20% metakaolin and fly-ash gives better strength.
3. The gain in strength of metakolin and fly-ash concrete with ages is normal compared that of ordinary concrete.
4. Metakolin and fly-ash helps concrete in heavy better sulphate resistance, metakoline can be recommended as useful admixture to in hence the durability of concrete aggressive environment consisting of sulphate.
5. Cement replacement up to 20% with metakolin and fly-ash leads to increase in compressive strength, for M60 grade of concrete. from 30% there is decrease in compressive strength for 7 and 28 days curing period.
6. The maximum replacement level of metakoalin and fly-ash is 20% for M60 grade of concrete.

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