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Partial Replacement of Cement & Fine Aggregates in Concrete & Durability study of Fly Ash & Quarry Dust

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Abstract: Due to calcinations CaCO_3 , CO_2 emissions Hence generated on the cement Production and fossil being responsible for about 5% CO_2 emissions. on partial replacement of fly ash class C on the cement can be reduced these type of CO_2 emissions on the hand same various researches can explained that these type of CO_2 fly ash can be partially replaced to the cement gives more compressive strength on the specimen. In this project ,durability of the concrete can be investigated when the partial replacement of fly ash class C and quarry dust on the cement and fine aggregates this project also reported that the test results of sulphate attack on the concrete cubes in curing process with water and H_2SO_4 solution this experimental investigation of partial replacements of fly ash class C and quarry dust has been chemically and physically characterized with the ratio of 10%, 20%, 30% and 30% weight of the cement and fine aggregates in concretes. Fresh concrete test like as compaction factor test and hardened concrete test like as compressive strength test ,split tensile strength test ,flexural strength test at the age of 28,60 90, days was obtained and also durability aspect of fly ash and quarry dust concrete for sulphate attack was tested the result indicates that fly ash class C and quarry dust improves concrete durability.

KEYWORDS: Fly ash class C, quarry dust , CO_2 , H_2SO_4 .

I. INTRODUCTION

OBJECTIVES :

The main objective is to study the influence of partial replacement of fly-ash and quarry dust in concrete subjected to different curing environments. To investigate the acid resistance (H_2SO_4) of M40 concrete at different curing periods of 28 days, 60 days, and 90 days of concrete specimens. To conduct the tests on both Fresh and hardened concrete. To investigate Compressive strength deterioration factor of fully immersed concrete specimens in fresh water and 5% sulphuric acid solution. To investigate the Split tensile strength deterioration factor of fully immersed concrete specimens in fresh water and 5% sulphuric acid solution. To investigate the Flexural strength deterioration factor of fully immersed concrete specimens in fresh water and 5% sulphuric acid solution.

II.LITERATURE SURVEY

Madhan Gopal and Naga Kiran (2013) In this study Fly Ash Based Geo polymer Concrete in Acidic Environment . The loss of compressive strength of conventional concrete is almost double the loss of compressive strength of geo polymer concrete in H_2SO_4 acid immersion at all ages. The percentage weight loss of Conventional concrete is more when compared to Geo polymer concrete. This is true for all the acids tried in this investigation. It is observed that the loss of compressive strength of Geo polymer concrete is more when compared to conventional concrete in MgSO_4 immersion. So Geo polymer concrete is sensitive to MgSO_4 . The weight loss of Geo polymer concrete is very low when Geo polymer concrete mixes are exposed to 5% acid attack.

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Vol. 6, Issue 5, May 2017

Kiran and Ratnam (2014) In this study Fly ash as a partial replacement of cement in concrete and durability study of fly ash in acidic (H_2SO_4) environment .The compressive strengths of concrete (with 0%, 5%, 10%, 15% and 20%, weight replacement of cement with FA) cured in different concentrations of (1%, 3%, and 5%) Sulphuric acid solution for 28, 60 and 90 days indicate that at 10% replacement there is increase in strength and beyond that the strengths decreased ,but at 20% replacement FA strength less than to normal concrete.

The strength decreases in acidic environment with age of concrete also with increasing of FA content in concrete In concrete cement can be replaced with 10% FA with maximum increase in strength beyond starts decreases.

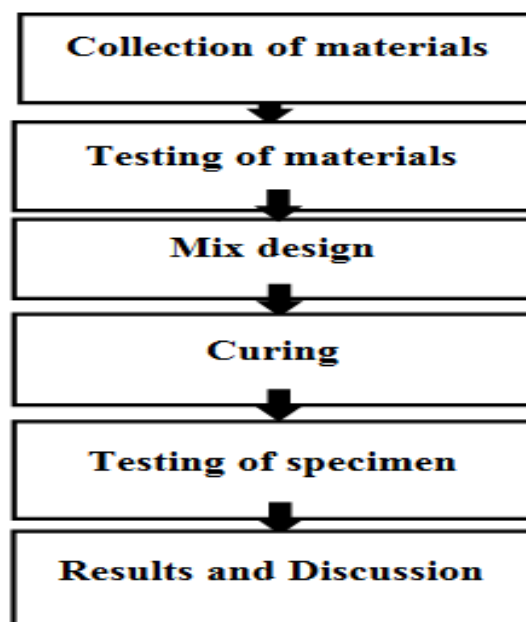
Lakshmidevi and Narasimha Rao (2015) In this study effect of fly ash and quarry dust on properties of concrete Fly ash consumes more water for consistency and workability. The concrete comprising 20% fly ash and 30% quarry dust is considered to be the optimum mix from compressive strength, tensile strength and modulus of elasticity of concrete point of view as well as from quality point of view. The partial replacement of cement by fly ash and sand by quarry dust in concrete not only enhances the strength of concrete, but also reduces the cost of production of concrete and at the same time, it also eliminates the environmental pollution and hazards caused due to the disposal of these waste by-products on land.

Yogesh Thorata (2016) in this Study On Concrete Properties By Partial Replacement Of Cement By Fly Ash, Alccofine Study shows the basic properties of Fly ash and Alccofine. Any adverse effect is does not caused on properties of fresh concrete by partially replacement. Due to this results shows that concrete giving good strength with partial replacement of Alccofine and Fly ash. As well as Alccofine and Fly ash is the good filler material in concrete.Thus,it is suitable to use Alccofine and Fly ash partially replaced with cement.

III. METHODOLOGY

This chapter explains the methods going to be use in this project. cement and fine aggregates replaced by various percentage 10%, 20%, 30% fly ash and 30 % quarry dust.

3.1Schematic Diagram Of Experimental Work



International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

IV. MATERIALS

4.1 Cement:

The color of cement is fine gray powder. The term word cement is find out from roman word opus cementium and it was made from crushed rock with burnt lime as binder.

4.2 Fine aggregate :

Sand is naturally obtained as a sea shore and desert. The mass of rock can be crushed into fine like material is known as sand.

4.3 Coarse aggregate :

Aggregate is mainly used filler for concrete and also used to reduce the weight of cement added in concrete. Aggregates are obtained from crushed angular material like limestone or granite.

4.4 Fly ash :

In the present studies fly ash (Class C type) having used
Specific gravity of fly ash = **2.65**

4.5 Quarry dust:

The quarry dust used throughout the experimental work is obtained from the quarry near dindigul, Tamil nadu. The quarry dust passing through 4.75mm and retained on 150 micron IS sieves .

4.6 Acids:

The acids are used in the investigation 5% H₂SO₄ acid mixing with water.

V.MIX DESIGN

The Mix design procedure should have considered in Indian standard guidelines for M40 grade. The casting specimen mould will be removing the after 24 hours and then cured under water for the period of 28days and 5% acid with water curing 60, and 90days. M40 concrete Mix design ratios (Cement : F.A : C.A) = 1 : 1.36 : 2.22

Table 5.1 Percentage Quantities Of Raw Materials :

Mix	Cement	Fly ash	F.A	Quarry dust	C.A
M1	100%	0%	100%	0%	100%
M2	100%	0%	70%	30%	100%
M3	90%	10%	70%	30%	100%
M4	80%	20%	70%	30%	100%
M5	70%	30%	70%	30%	100%

5.2 Tests for fresh concrete :

To study the workability of concrete will be conducting by slump cone test on fresh concrete.

a) Slump Flow Test

The slump flow test is used appraise the horizontal free flow of in the absence of obstructions. It was first developed in Japan for use in assessment of underwater concreting.

5.3 Tests for hardened concrete:

In hardened concrete destructive test such as compressive, split tensile and flexural strength and non destructive test such as Ultra sonic pulse velocity method and rebound hammer test are conducted.

5.3.1 Compressive strength tests:

The compression test is used to determine the hardness of cubical specimens of concrete. The strength of concrete specimen depends on cement, aggregate, w/c ratio, curing temperature, age and size of specimen. Mix design is the major factor that controls the strength of concrete. Cubes of size 100 mm x 100 mm x 100 mm are casted. The specimen should be given sufficient time for hardening approximately 24 hrs and then it should be cured for 28 days.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

After 28 days the specimen should be loaded in the compression testing machine upto its failure load. Compressive strength is calculated by the following formula,

Compressive strength = Load/cross-sectional area of the cube



Fig 5.3.a Compression testing machine

5.3.2 Split tensile strength tests:

This is an indirect test to determine the tensile strength of the cylindrical specimens. Split tensile strength tests were carried out on cylindrical specimens of sizes 150 mm diameter and 300 mm height at the age of 28 days curing using compression testing machine. The load was applied gradually till the specimens split and the readings were noted. The split tensile strength can be calculated using the formula,

$$F_t = 2p/\pi DL$$

Where f_t = Split tensile strength of the specimen in N/mm²

P = Maximum load in N applied to the specimen

D = Diameter of the specimen in mm

L = Length of the specimen in mm



Fig 5.3.b Spilt tensile strength

5.3.3 Flexural strength tests:

Flexural strength tests are carried out on the rectangular beams of size 100 mm x 100 mm x 500 mm at the age of 28 days curing using flexural strength testing machine to determine the flexural strength. The flexural strength of the beam is calculated by using the formula,

$$F_r = 3PL/bd^2$$

Where f_r = Flexural tensile strength of specimen in N/mm²

P = Maximum load in N

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 5, May 2017

L = Length of the specimen in mm
b = Width of the specimen in mm
d = Depth of the specimen in mm



Fig 5.3.c. Flexure strength

VI. TEST RESULTS

Table 6.1 Compressive Strength Tests

The compressive strength for 30% quarry dust constant and varying 10%, 20%, 30% fly ash is tabulated. The 28,60, and 90 days strength is 30% replacement of fly ash and quarry dust gives more strength as compared to conventional concrete.

Mix	Compressive strength N/mm ² 28 days (Water curing)	Compressive strength N/mm ² 60 days (Acid 5%)	Compressive strength N/mm ² 90 days (Acid 5%)
M1	43.55	36.96	32
M2	40.44	33.22	27.94
M3	33.70	27.73	25.3
M4	35.33	25.52	26.84
M5	41.33	34.32	30.36

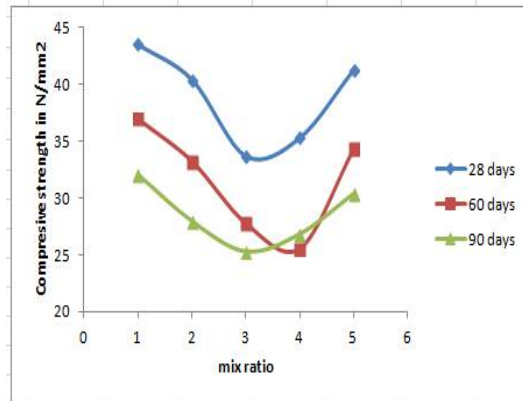
The 28,60,90 days compressive strength is plotted in graph below and its X axis is mix ratios and Y axis is compressive strength. The strength is increased as compared with conventional concrete.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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Vol. 6, Issue 5, May 2017



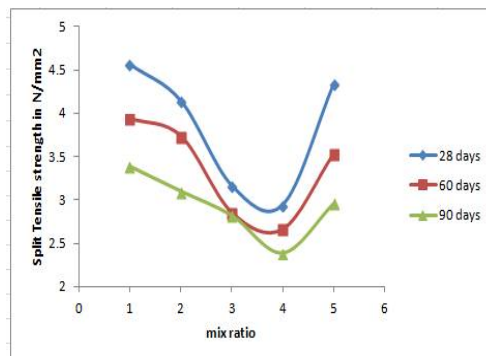
Graph 6.1.a

Table 6.2 Split Tensile Strength Tests

The split tensile strength is calculated as given formula and its values are tabulated. The strength is increased at all levels compared to conventional concrete.

Mix	Split tensile strength N/mm ² 28 days (Water curing)	Split tensile strength N/mm ² 60 days (Acid 5%)	Split tensile strength N/mm ² 90 days (Acid 5%)
M1	4.56	3.94	3.384
M2	4.14	3.74	3.10
M3	3.16	2.86	2.82
M4	2.94	2.67	2.39
M5	4.34	3.54	2.96

The split tensile strength is plotted as graph shown below. The strength is plotted for 28,60,90 days and its 90 days strength is acid attack decreased 30% replacement of fly ash and quarry dust as compared with conventional concrete.



Graph 6.2.1

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

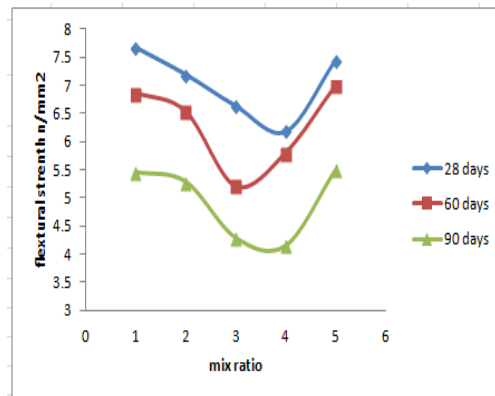
Vol. 6, Issue 5, May 2017

Table 6.3 Flexural Strength Tests

The flexure strength for 28,60,90 days strength is calculated and tabulated as below. The maximum flexure strength is achieved at all levels.

Mix	Flexural strength N/mm ² 28 days (Water curing)	Flexural strength N/mm ² 60 days (Acid 5%)	Flexural strength N/mm ² 90 days (Acid 5%)
M1	7.66	6.86	5.45
M2	7.19	6.53	5.28
M3	6.64	5.21	4.29
M4	6.19	5.80	4.15
M5	7.44	6.99	5.49

The flexure strength is plotted as graph shown below. The strength is increased at 28 days and it is attained a maximum flexure strength. The flexure is occurred at centre point of the prism. The strength is increased after 14 days as shown in graph.



Graph 6.3.1

VII. CONCLUSIONS

1. The compressive strengths of concrete with 0%,10%,20%,30%, replacement of cement with fly ash and 30 % replacement fine aggregates with quarry dust cured in different environment (fresh water and 5% sulphuric acid solution) for 28 ,60,90,days indicate that at 30% fly ash and quarry dust 30% replacement have strength equal to the normal concrete strength .

2. The split tensile strengths of concrete with 0%,10%,20%,30%, replacement of cement with fly ash and 30 % replacement fine aggregates with quarry dust cured in different environment (fresh water and 5% sulphuric acid solution) for 28 ,60,90,days indicate that at 30% fly ash and quarry dust 30% replacement have strength equal to the normal concrete strength .

3. The flexural strengths of concrete with 0%,10%,20%,30%, replacement of cement with fly ash and 30 % replacement fine aggregates with quarry dust cured in different environment (fresh water and 5% sulphuric acid solution) for 28 ,60,90,days indicate that at 30% fly ash and quarry dust 30% replacement have strength equal to the normal concrete strength .

4. In the concrete cement can be replaced with 30% fly ash ,30% quarry dust maximum increase in strength . due to slow pozzolanic reaction.

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Vol. 6, Issue 5, May 2017

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