INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 5)
Available online at: www.ijariit.com

Experimental studies on the strength of cement concrete with partial replacement of coarse aggregate with ceramic tiles and cement with silica fume

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ABSTRACT

Analysis of incorporated concrete was done in fresh state as well in hardened state to evaluate different properties of concrete I.e. testing and comparing the results of various mixes for workability, compressive strength, tensile strength and flexural strength and analyzing for the best mix composition, to mix design concrete of grade M25, to find out the different composition of mixes by partial replacing cement with silica fume and coarse aggregate with ceramic tiles. 5%,10% & 15% (M25) incorporation was used as partial replacement of coarse aggregate with ceramic tiles and cement with silica fumes, from all the results and experimental approach it is concluded that concrete formed with over silica fumes and ceramic tiles aggregate and cement showed benefit performance as compared with the concrete made up of natural aggregate and cement obtained from local resources.it reduces the cost of concrete by reduces the cost of concrete by reducing the aggregate cost and produces economic infrastructure system.it has been observed that use of waste materials results in the formation of lightweight concrete uses of such waste material will not only cut down the not only cut down the cost of construction but will also contribute in safe disposal of waste materials. Apart from the environmental benefits, the addition of such wastes also improves certain properties of resultant concrete. Cubes of concrete were prepared and tested to study the compressive strength, tensile strength flexual strength, and analyzing for the best mix composition. As it takes a lot more money to make new ceramic tiles, than the cost incurred in the process of recycling it but in this process, we are using there ceramic tiles for the beneficial use of the concrete as well as in the construction site, as we all know that ceramic tiles are widely used in the household and other construction site, it has considered as it is very economical in nature.

Keywords— *Experimental, Investigation, Concrete waste, Ceramic tiles waste, Silica fume, Coarse aggregate, Fine aggregate*

1. INTRODUCTION

1.1 General

2. In this project a brief of material and the methodology of the project is defined. This explains the working ability and success of the project. The use of waste material as aggregates in civil engineering packages is useful as it reduces the environmental impact and economic cost of quarrying operations, processing, and shipping. Reuse of construction and demolition waste is becoming increasingly more appropriate due to growing hauling prices and tipping costs for putting this fabric into landfills. In latest years, sustainable creation initiatives have also made reuse of creation and demolition particles (as aggregates and otherwise) an appealing alternative when thinking about design alternatives for many types of structures. Incorporating these aggregates into cement material is practical, as cement material are non-homogeneous composites that allow material of different sizes and compositions to be bound in a cement matrix.

1.2 Principle of concrete

Concrete is the most important building material used in the construction industry globally. Concrete pro the use of waste material as aggregates in civil engineering packages is useful as it reduces the environmental impact and economic cost of quarrying operations, processing, and shipping. Reuse of construction and demolition waste is becoming increasingly more appropriate due to growing hauling prices and tipping costs for putting this fabric into landfills. In latest years, sustainable creation initiatives have also made reuse of creation and demolition particles (as aggregates and otherwise) an appealing alternative when thinking about design alternatives for many types of structures. Incorporating these aggregates into cement material is practical, as cement material are non-homogeneous composites that allow material of different sizes and compositions to be bound in a cement matrix. Has become expensive over the years due to increased demand of construction. This has led to an increase in the rates of the materials used to make concrete i.e. aggregates and cement.

Since it's clearly know and understood that the rising cost of concrete production has impaired the construction enterprise, a look at on the alternative effortlessly available options (like silica fume and ceramic tiles) to aggregates justifies the studies. Also, from environmental factor of view, recycling of these wastes could help within the safety of environment i.e. Exploitation of everyday granitic aggregates via quarrying could be drastically reduced

2. MATERIAL USED

2.1 Cement

A cement is a binder, a substance utilized in production that sets and hardens and may bind different substances collectively. The research will be majorly dealing with the analysis of the properties of silica fume and ceramic tiles to be used as coarse aggregates and cement in concrete. The crushed clay waste was obtained from chimney and west management places. To design concrete mixes the use of silica fume and ceramic tiles as aggregates to establish the available and economic feasibility of the silica fume and ceramic tiles as Aggregates.

2.2 Coarse aggregates

Coarse aggregates are debris more than four.75mm, Furthermore, manufacturing of not unusual aggregates and stones (tough and gadget cut stones) by means of quarrying could be very pricey economically. Quarrying creates an unfriendly environment via leaving land excavated and rocks blasted which could lead to sinking of an area of land and in a few cases earth tremors due to disturbance of the rock strata. For instance the Jharkhand area in Jharia district wherein production of system reduce constructing stones with the aid of mining is the commonplace pastime; this has caused degradation of surroundings. Reclaiming land degraded by using quarrying is also a high priced process and takes time to in entire method.

2.3 Ceramic Tiles

Incorporating these aggregates into cement material is practical, as cement material are non-homogeneous composites that allow material of different sizes and compositions to be bound in a cement matrix. Has become expensive over the years due to increased demand of construction. This has led to an increase in the rates of the materials used to make concrete i.e. aggregates and cement.

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2.4 Fine aggregates

Fine aggregate quarrying creates an unfriendly environment via leaving land excavated and rocks blasted which could lead to sinking of an area of land and in a few cases earth tremors due to disturbance of the rock strata. For instance the Jharkhand area in Jharia district wherein production of system reduce constructing stones with the aid of mining is the commonplace pastime; this has caused degradation of surroundings. Reclaiming land degraded by using quarrying is also a high priced process and takes time to in entire method.

3. LITERATURE REVIEW

3.1 General

These chapter consist of literature review in the field of silica fume, ceramic tiles and other admixtures enhancing the concrete properties.

3.2 Silica fume

Waheeb A. AI-Khaja (2007) The take a look at investigates the efficiency of silica fume in influencing the compression power, drying shrinkage and compression creep of high electricity concrete at steady laboratory conditions. The silica fume and plain concrete mixes used in this investigation had the same workability and water to cement ratio carried out by way of the usage of an amazing plasticizing admixture. The consequences indicate that the compression strength of silica fume concrete is eighteen.3% higher than simple concrete at an age of approximately 1 month. Shrinkage and creep of plain concrete were considerably reduced by means of the use of silica fume, given a 1-month reduction in stress of 34.9% and 18.Five% for shrinkage and creep, respectively, leading. To a discount in the total deformation of 20.8%. Thus, concrete made with silica fume as a part of the cementitious cloth is useful for numerous concrete structural packages, specifically for pre-stress concrete individuals where pre-stress losses are particularly prompted by creep and shrinkage, and an increase in concrete strength at an early age is desirable.

S. Wild, B.B. Sam, and J.M. Khan (2008) Existing DATA on the relationships between temperature, pozzolanic activity and cement hydration are reviewed with emphasis on The found effects establish that relative power varies at once with CSF content material and that the strength enhancement at early curing, which is finished by growth in curing temperature, is an end result of improved response charge between Ca $(OH)_2$ and CSF.

Rostami, K. Behfarnia (2009) This studies changed into carried out to take a look at the impact of using silica fume on permeability of alkali activated slag concrete via substitution of 3 degrees of silica fume which includes Reuse of construction and demolition waste is becoming increasingly more appropriate due to growing hauling prices and tipping costs for putting this fabric into landfills. In latest years, sustainable creation initiatives have also made reuse of creation and demolition particles (as aggregates and otherwise) an appealing alternative when thinking about design alternatives for many types of structures. Incorporating these aggregates into cement material is practical, as cement material are non-homogeneous composites that allow material of different sizes and compositions to be bound in a cement matrix. Has become expensive over the years due to increased demand of construction. This has led to an increase in the rates of the materials used to make concrete i.e. aggregates and cement.

Rostami, K. Behfarnia (2011) This studies emerge as finished to have a check the effect of the use of silica fume on present of a activated some concrete through the use the usage of subject of three lines of silica fume which incorporates five weight, 10 weight and 15 weight of some. The consequences of varieties of caring conditions collectively with water caring and care beneath people cowl were additionally example. Time period and final water about, present of chloride ion and intensity of present of water have been measured to have observe the perfect. The effect of those factors on compression still have come to be example and the relation among compression electricity and passing electric powered fees and depth of water present have come to be moreover even. To evaluation the use of silica fume on inner developments of common, samples have been placed thru Scanning Electron Microscopy (SEM)

M. Rostami, K. Behfarnia (2015) this research modified into completed to test the example of using silica fume on present of alkali activated slag common via way of substitution of three levels of silica fume collectively with five weight, ten weight and five of some. The effects of styles of care situations which includes water care and common below plastic cowl have been furthermore example. Time period and final water absorption, penetration of chloride ion and intensity of penetration of water have been measured to have a have a have a take a look at the present. The effect of these factors on compressive power turn out to be examined and the relation among compare power and passed electric power present charges and intensity of water people become furthermore example

3.3 Ceramic ties

J. Anderson and T.K. Aun (2007) With the The importance of sustainability and recycling has turn out to be increasingly acknowledged and understood in academia and enterprise during the last several a long time. Reuse of construction and demolition waste is becoming increasingly more appropriate due to growing hauling prices and tipping costs for putting this fabric into landfills. In latest years, sustainable creation initiatives have also made reuse of creation and demolition particles (as aggregates and otherwise) an appealing alternative when thinking about design alternatives for many types of structures. Incorporating these aggregates into cement material is practical, as cement material are non-homogeneous composites that allow material of different sizes and compositions to be bound in a cement matrix. Has become expensive over the years due to increased demand of construction. This has led to an increase in the rates of the materials used to make concrete i.e. aggregates and cement.

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Anatase (2009) Anatase is one among a common and favorable material use inside the manufacturing enterprise because of its distinctiveness and purposeful performances to human and surroundings. Reuse of construction and demolition waste is becoming increasingly more appropriate due to growing hauling prices and tipping costs for putting this fabric into landfills. In latest years, sustainable creation initiatives have also made reuse of creation and demolition particles (as aggregates and otherwise) an appealing alternative when thinking about design alternatives for many types of structures. Incorporating these aggregates into cement material is practical, as cement material are non-homogeneous composites that allow material of different sizes and compositions to be bound in a cement matrix. Has become expensive over the years due to increased demand of construction. This has led to an increase in the rates of the materials used to make concrete i.e. aggregates and cement.

Timellini, R. Resca and M.C. Bignozzi (2013) quarrying creates an unfriendly environment via leaving land excavated and rocks blasted which could lead to sinking of an area of land and in a few cases earth tremors due to disturbance of the rock strata. For instance the Jharkhand area in Jharia district wherein production of system reduce constructing stones with the aid of mining is the commonplace pastime; this has caused degradation of surroundings. Reclaiming land degraded by using quarrying is also a high priced process and takes time to in entire method.

Bohdan Stawiski and Tomasz Kania (2014) has expensive over the years due to increased demand of construction. This has led to an increase in the rates of the materials used to make concrete i.e. aggregates and cement. Since it's clearly know and understood that the rising

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4. RESULTS AND DISCUSSION

4.1 General

Experimental value and procedure of the performed experiment are noted.The results are the comparison of performed experiment of CTM reading obtain after 7, 14 and 28 days.

4.2 Mix design of concrete

Characteristics strength =M25
Target men strength =25+1.65*4
According to IS 456,
Maximum water cement ratio =0.45
We have adopted 0.40 w/c ratio
Minimum cement content according to IS456 =300KG/m3
Nominal maximum size of aggregate =20mm
According to 10262:2009 maximum water cement ratio =186g
For 50 * 75mm slump = 186+3% of 186 = 191.58KG/m3
Water cement ratio is 0.4 so, cement comes to be 478.98KG/m3
478.95 KG/m3 > 300KG/m3

According to zone of site for fine aggregate
Coarse aggregate=w/c*0.4=0.62
Fine aggregate=1-0.62=0.38KG/m3
For pump able type of concrete (IS 10262:2009)
Values should be reduced by 10%
Mixing calculation per unit the volume of concrete

a. Volume of cement -1m3 =191.58*1/1000 =0.191 m3
b. Volume of super plasticizer =0.64*1/1.145*1000 =0.005 m3
c. Volume of all in aggregate =a-(b+c) =1-(0.15+0.191) =0.659 m3

Mass of coarse aggregate = (e)*vol. of coarse aggregate*specific gravity of coarse aggregate*1000 = 0.659*0.56*2.87*1000
= 1059.14KG

Mass of fine aggregate = (e)*volume of fine aggregate *specific gravity of fine aggregate*1000 = 0.659*0.47*2.53*1000
= 733.59 KG

So the ratio comes out to be= 1:1.53:2.2

4.3 Result

- The reading obtain from 7 days of concrete cube of 150mm^3 on the CTM machine were:

1. 392
2. 401
3. 368

Average of 3 value comes to be 387 KN/cm^2
The value obtained with replacement 5% on the 7 days are average of 3 value comes to be 15.5 KN/cm^2
The value obtained with replacement 10% on the 7 days are average of 3 value comes to be 14.2 KN/cm^2
The value obtained with replacement 15% on the 7 days are average of 3 value comes to be 20.44 KN/cm^2

- The reading obtain from 7 days of concrete cylinder of 150mm^3 on the CTM machine were:

1. 86.7 KN/cm^2
2. 94.3 KN/cm^2
3. 110 KN/cm^2

Average of 3 value comes to be 94.6 KN/cm^2
The value obtained with replacement 5% on the 7 days are average of 3 value comes to be 1.8 KN/cm^2
The value obtained with replacement 10% on the 7 days are average of 3 value comes to be 1.6 KN/cm^2
The value obtained with replacement 15% on the 7 days are average of 3 value comes to be 2.2 KN/cm^2

- The reading obtain from 7 days of concrete beam of 150mm^3 on the CTM machine were:

1. 9.9 KN/cm^2
2. 10.2 KN/cm^2
3. 12.3 KN/cm^2

Average of 3 value comes to be 10.3 KN/cm^2
The value obtained with replacement 5% on the 7 days are average of 3 value comes to be 6.2 KN/cm^2
The value obtained with replacement 10% on the 7 days are average of 3 value comes to be 5.4 KN/cm^2
The value obtained with replacement 15% on the 7 days are average of 3 value comes to be 6.8 KN/cm^2

- The reading obtain from 14 days of concrete cube of 150mm^3 on the CTM machine were:

1. 475
2. 350
3. 360

Average of 3 value comes to be 395 KN/cm^2
The value obtained with replacement 5% on the 14 days are average of 3 value comes to be 21.5KN/cm^2
The value obtained with replacement 10% on the 14 days are average of 3 value comes to be 14.3KN/cm^2
The value obtained with replacement 15% on the 14 days are average of 3 value comes to be 23.1KN/cm^2

- The reading obtain from 14 days of concrete cylinder of 150mm^3 on the CTM machine were:

1. 117 KN/cm^2
2. 122.7 KN/cm^2
3. 125 KN/cm^2

Average of 3 value comes to be 121.5
The value obtained with replacement 5% on the 14 days are average of 3 value comes to be 1.8KN/cm^2
The value obtained with replacement 10% on the 14 days are average of 3 value comes to be 1.6KN/cm^2
The value obtained with replacement 15% on the 14 days are average of 3 value comes to be 2.2KN/cm^2

- The reading obtain from 14 days of concrete beam of 150mm^3 on the CTM machine were:

1. 13.6
2. 13.3
3. 15

Average of 3 value comes to be 13.96
The value obtained with replacement 5% on the 14 days are average of 3 value comes to be 8.1KN/cm^2
The value obtained with replacement 10% on the 14 days are average of 3 value comes to be 5.5KN/cm^2
The value obtained with replacement 15% on the 14 days are average of 3 value comes to be 7.5KN/cm^2

- The reading obtain from 28 days of concrete cube of 150mm^3 on the CTM machine were:

1. 402 KN/cm^2
2. 490 KN/cm^2
3. 510 KN/cm^2

Average of 3 value comes to be 467 KN/cm^2
The value obtained with replacement 5% on the 28 days are average of 3 value comes to be 28.7KN/cm^2
The value obtained with replacement 10% on the 28 days are average of 3 value comes to be 21.2KN/cm^2
The value obtained with replacement 15% on the 28 days are average of 3 value comes to be 32.7KN/cm^2

- The reading obtain from 28 days of concrete cylinder of 150mm^3 on the CTM machine were:

1. 160 KN/cm^2
2. 155 KN/cm^2
3. 140 KN/cm^2

Average of 3 value comes to be 151.5 KN/cm^2
The value obtained with replacement 5% on the 28 days are average of 3 value comes to be 3.26KN/cm^2
The value obtained with replacement 10% on the 28 days are average of 3 value comes to be 3.36KN/cm^2
The value obtained with replacement 15% on the 28 days are average of 3 value comes to be 4.1KN/cm^2

- The reading obtain from 28 days of concrete beam of 150mm^3 on the CTM machine were:

1. 12.4 KN/cm^2
2. 13.5 KN/cm^2
3. 10 KN/cm^2

Average of 3 value comes to be 11.9
The value obtained with replacement 5% on the 28 days are average of 3 value comes to be 9KN/cm^2
The value obtained with replacement 10% on the 28 days are average of 3 value comes to be 9.5KN/cm^2
The value obtained with replacement 15% on the 28 days are average of 3 value comes to be 11.25KN/cm^2

4.4 Compression strength

4.4.1 Calculation of strength of cube

Size of Cube = 150*150 mm.
Area of cube = 100^2 mm.
Compression Strength = Load (in Newton)/ Area of Cube (in mm)

Table 1: Compressive strength

Days	(Mix design) Without Replacement	(Ceramic tiles and silica fume) With Replacement (5%)	(Ceramic tiles and silica fume) With Replacement (10%)	(Ceramic tiles and silica fume) With Replacement (15%)
7 Days	15.4	15.5	14.2	20.44
14 Days	18.5	21.4	14.3	23.1
28 Days	30.5	28.7	21.2	32.7

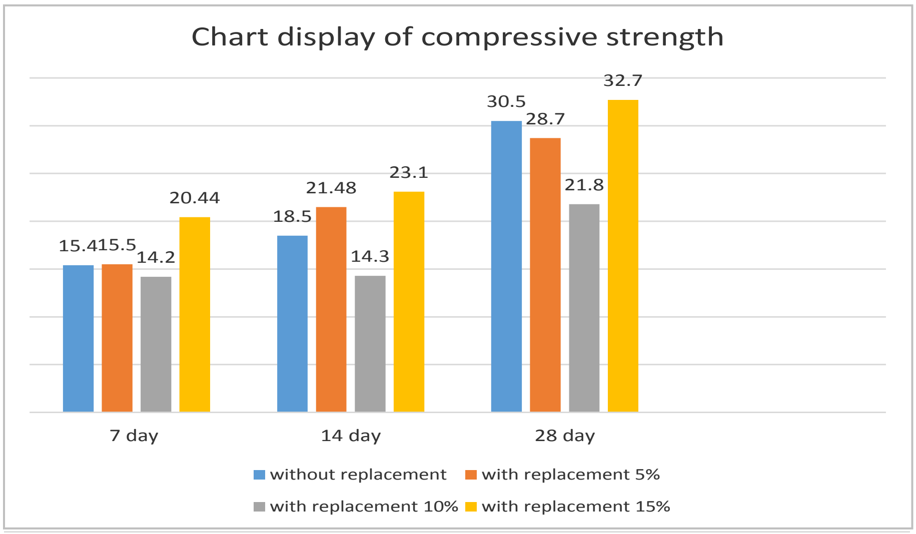

Fig. 1: Graph showing display strength

4.5 Split tensile strength

Split tensile strength=2p/3.14*D*L

Calculation of strength of cylinder.

Size of cylinder=300*150(L*D)

Table 2: Split tensile strength

Days	(Mix design) Without Replacement	(Ceramic tiles and silica fume) With Replacement (5%)	(Ceramic tiles and silica fume) With Replacement (10%)	(Ceramic tiles and silica fume) With Replacement (15%)
7 Days	1.2	1.8	1.6	2.2
14 Days	1.7	2.7	2.3	3.1
28 Days	2.3	3.26	3.36	4.1

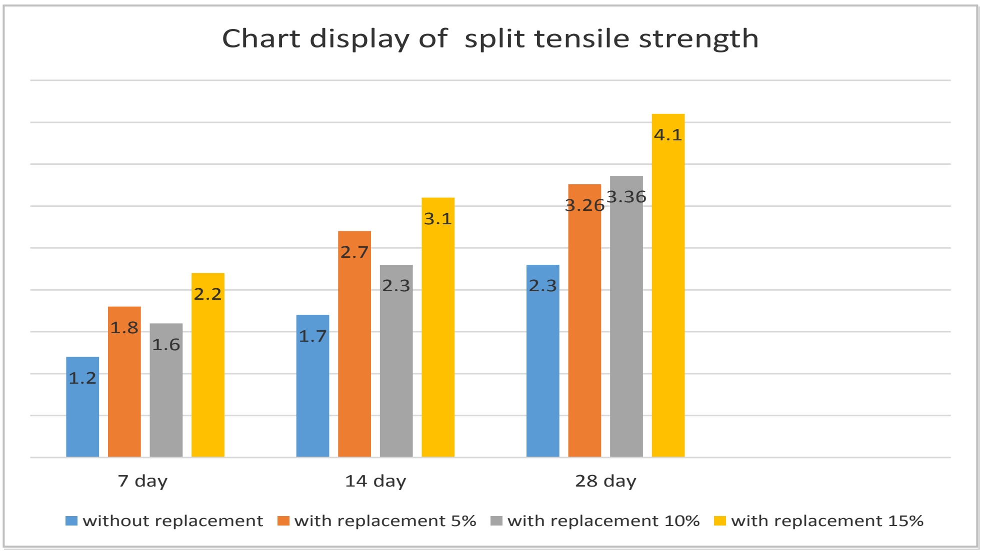

Fig. 2: Graph showing display of split tensile strength

4.6 Flexural strength

Calculation of strength of beam

Size of beam=500*100*100

Flexural strength=3pa/bd^2

Flexural strength=p.l/bd^2

Shortest distance from support flexural point of beam= 11mm<a<13.3mm

Table 3: Flexural strength

Days	(Mix design) Without Replacement	(Ceramic tiles and silica fume) With Replacement (5%)	(Ceramic tiles and silica fume) With Replacement (10%)	(Ceramic tiles and silica fume) With Replacement (15%)
7 Days	5	6.2	5.4	6.8
14 Days	7	8.1	5.5	7.5
28 Days	6	9	9.5	11.25

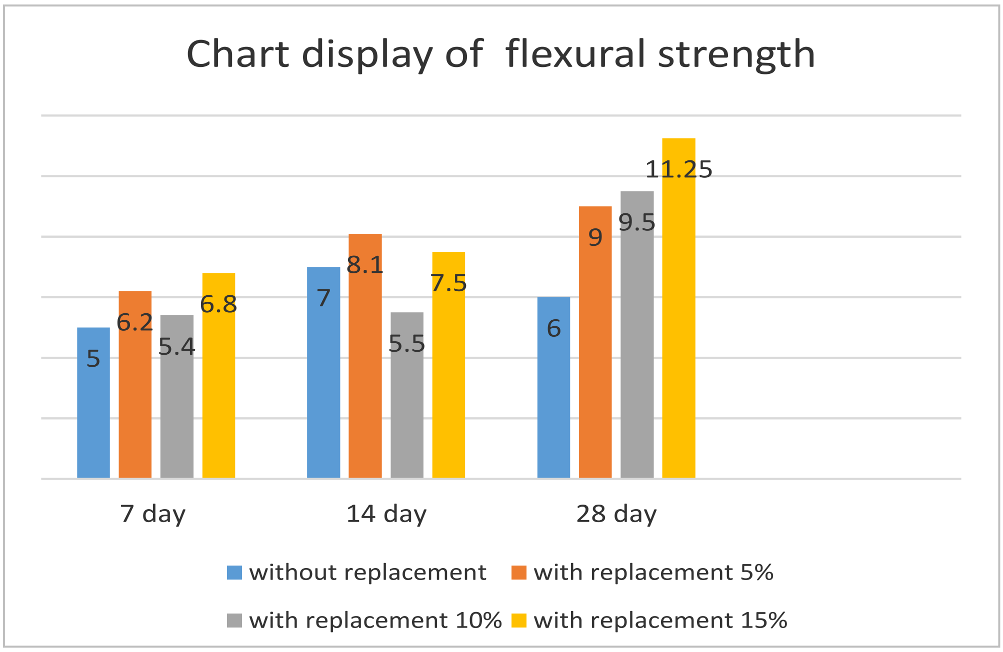

Fig. 3: Graph showing display of Flexural strength

5. CONCLUSION

Clean, silica fume and crushed Ceramic Tiles waste products provide satisfactory aggregates which can be used to produce good quality concrete of medium to high strength depending on the source of aggregate. It is found that Compression strengths of up to 24.5N/mm2 can be attained by replacing 5%, 10% and 15% of clay aggregates with normal aggregates. Compression strengths for blended aggregates ranging from 80% to 97% of concrete made with normal aggregate can be achieved. This significant strength is attributed to the particle shape and roughness of the replaced aggregates which provides satisfactory bond strength.

Clay aggregates produce concrete with comparatively lower densities. This indicates that there can be significant reduction of dead loads (self-weight) of fully compacted concrete. Weight reduction of up to 9% of normal aggregate concrete can be attained. The concern in the use of clay aggregates is their water absorption characteristic. This affects the workability of concrete. Therefore; these aggregates must be saturated for some time and surface dried before they can be used in concrete making. Another disadvantage is the production of too much dust particularly during crushing. This is due to their high crushing values. When using clay aggregates, grading should be done impeccably.

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