Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 12, December : 2023

A STUDY ON STRENGTH AND DURABILIITY PROPERTIES OF CONCRETE USING GRANITE SLURRY AS CEMENT RELACEMENT PARTIALLY

[1]G RAVITEJA,[2]D IBRAHEEM KHALEELULLA,
[1]Student,[2]ASSISTANT PROFESSOR
Department of Civil Engineering
PVKK Institute of Technology (PVKKIT),Anantapuramu

ABSTRACT

The granite industries in India produce a vast amount of by-product slurry waste that could be used in green mortar production suitable for construction purposes. This study highlights the effect of the chemical constituents of granite waste powders on the compressive strength of the green concrete produced. The experiment was based on replacing the same proportions of sand and cement in the green concrete mixes with powders after dissolving it in the water content. This paper reports the experimental study which investigated the influence of 100% replacement of cement with granite slurry. Design mix of M25 grade concrete with replacement of 0%, 25%, 50%, 75%, and 100% of quarry dust organized as M1, M2, M3, M4 and M5 respectively have been considered for laboratory analysis viz. slump test, compaction factor test, compressive strength ,split tensile strength and flexural strength of hardened concrete. In the present paper, the hardened properties of concrete using quarry dust were investigated and durable properties sorptivity, water absorption, were determined.

Key words: Granite slurry, compressive strength ,split tensile strength, flexural strength,sorptivity.

I. INTRODUCTION:

1.1 GENERAL:

Rapid industrial development causes serious problems all over the world. Currently India has taken a major initiative on developing the infrastructures such as express highways, power projects and industrial structures etc., to meet the requirements of globalization, in the construction of buildings and other structures.

Concrete plays the key role and a large quantum of concrete is being utilized in every construction practices. River sand, which is one of the constituents used in the production of conventional concrete, has become very expensive and also becoming scarce due to depletion of river bed. In the present study, the hardened and durable properties of concrete using granite slurry were investigated. Also, the use of granite slurry as replacement of cement decreases the cost of concrete production. This paper reports the experimental study which investigated the influence of 100% replacement of cement with granite slurry. Design mix of **M_{25}** grade concrete with replacement of 0%, 25%, 50%, 75%, and 100% of quarry dust organized as M1, M2, M3, M4 and M5 respectively have been considered for laboratory analysis viz. slump test, compaction factor test, compressive strength ,split tensile strength and flexural strength of hardened concrete. In the present paper, the hardened properties of concrete using quarry dust were investigated and durable properties sorptivity, water absorption, were determined

In the construction industry river sand is used as an important building material and the world consumption of sand in concrete generation alone is around 1000 million tons per year making it scarce and limited. The excessive and non scientific methods of mining sand from the river beds has led to lowering of water table and sinking of bridge piers.

The current focus of construction industry should be to partially or completely replace natural sand in concrete by waste material with out compromising the quality of the end product. In the recent past good attempts have been made for the successful utilization of various industrial by products (such as fly ash, silica fume, rice husk ash, foundry waste) to save environmental pollution. In addition to this, an alternative source for the potential replacement of natural aggregates in concrete has gained good attention. As a result reasonable studies have been conducted to find the suitable material.

This project present a recent study carried out locally to study the feasibility of using coarse aggregates, granite slurry, and potable water in concrete. The concrete is expected to achieve a 28,56,90 and 180days compressive strength of not less than 20MPa. The effect of replacing the cement with granite slurry on the properties of concrete is reported. Properties include specific gravity, compressive strength, water absorption, density, Fineness modulus.

Granite cutting slurry concrete is important it helps to promote sustainable development in the protection of natural resources. Granite cutting slurry concrete is useful to be applied as many types of general bulk fill bank protection, sub – basement, road construction, noise barriers and embankment.

Granite cutting slurry concrete can applied to new concrete for pavements, shoulders, median barriers, sidewalks, curbs and gutters, and bridge foundations. It can also be applied to structural grade concrete, soil-cement pavement bases, lean concrete and bituminous concrete.

1.2 **GRANITE CUTTING SLLURY:**

Granite cutting slurry can be defined as residue, tailing or other non-voluble waste material after the extraction and processing of granite rocks to form fine particles less than 4.75mm. Granite cutting slurry, is a by-product from the crushing process during quarrying activities is one of materials that have recently gained attention to be used as concreting aggregates, especially as fine aggregates. Granite cutting slurry basically has the same physical characteristics to sand as the size and its properties are approximately very close to sand. Physically, granite cutting slurry has smooth, long, angles, sharp at corner and grey in color. The surface of granite cutting slurry is smoother than sand. Theoretically, the rough surface will lead to high bind compared to smooth surface. The fineness of granite cutting slurry is defined as particles that retained using 4.75mm, 2.36mm, 1.18 mm, 0.6mm, 0.3mm and 0.15mm sieves.

- Granite cutting slurry can be defined as residue, tailing or other non-voluble waste material after the extraction and processing of granite rocks to form fine particles less than 4.75mm.
- Granite cutting slurry, a by-product from the crushing process during quarrying activities is one of materials that have recently gained attention to be used as concreting aggregates, especially as fine aggregates.

1.2.1Advantages of Granite Cutting Slurry:

- Granite cutting slurry can reduce cost of construction.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 12, December : 2023

- it was proved that using granite cutting slurry is cheaper than sand.
- Granite cutting slurry is known to increase the strength of concrete over concrete made with equal quantities of river sand.
- Granite cutting slurry has partially rough, sharp and angular particles, and as such causes a gain in strength due to better interlocking.

1.2.2 Disadvantages of Granite Cutting Slurry:

- Granite cutting slurry causes reduction in the workability of concrete.
- It causes increase the bleeding effect due to excess maintain workability.

1.2.3Basic Properties of Granite Cutting Slurry:

- Granite cutting slurry basically has the same physical characteristics to cement and sand as the size and its properties are very close to cement and sand.
- Physically, granite cutting slurry has smooth, long, angles, sharp at corner and grey in colour.
- The surface of granite cutting slurry is partially rough than sand.
- Theoretically, the rough surface will lead to high bind compared to smooth surface.
- The fineness of granite cutting slurry is defined as particles that retained using 4.75mm, 2.36mm, 1.18 mm, 0.6mm, 0.3mm and 0.15mm sieves.

Table 1.1 Properties of granite cutting waste

Description	Values
Specific gravity	2.53
Size of particle	90 microns
Fineness modulus	2.43

1.3 Objectives

The main objectives of the present research work are:

- ➢ To examine the aggregate properties of ceramic waste.
- ➢ To compare the properties of ceramic aggregate with natural aggregate.
- ➢ To study the feasibility of ceramic waste aggregate usage into the concrete.
- ➢ To study the effect of acid on ceramic aggregate concrete in fresh state.
- ➢ To study the effect of acid on ceramic aggregate concrete in hardened state.
- ➢ To study the strength loss, weight loss characteristics of concrete.

Thus, needful conclusions have been drawn based on the experimental results. A new concrete composition is produced with replacing cement by granite quarry dust at 0, 5,10, 15, and 20%, All test results of granite waste concrete are compared with reference concrete by which it concludes the suitability of granite waste into the concrete.

II. LIETARATURE REVIEW

Several industrial wastes, such as flyash , quarry dust waste, recycled aggregate, used soft drink bottle caps as fibre reinforced concrete have been tried by various researches. The results have been encouragingly increased in terms of improvement in strength parameters like compressive strength, split tensile strength and flexural strength.

B.Vidivelliet.al., [2] had studied on flyash concrete using SEM analysis as partial replacement to cement and had reported a significant increase of 20% compressive strength respectively.

LalitGamashtaet.al., [3] developed the

concrete strength by using masonry waste material in concrete mix in construction to minimize the environmental damages due to quarrying. It is highly desirable that the waste materials of concrete and bricks are further reutilized after the demolition of old structures in an effective manner especially realizing that it will help in reducing the environmental damages caused by excessive reckless quarrying for earth materials and stones. Secondly, this will reduce pressure on finding new dumping ground for these wastes, thus further saving the natural environment and eco-systems. Durability, reliability and adequate in service performance of these reused waste materials over the stipulated design life of designed structures are of paramount importance to Structural Designers. This paper critically examines such properties in reused concrete and brick masonry waste materials and suggests suitable recommendations for further enhancing life of such structures, thereby resulting in sufficient economy to the cost of buildings.

M.L.V. Prasad et.al., [4] had studied mechanical properties of fiber reinforced concretes produced from building demolished waste and observed that target mean strength had been achieved in 100% recycled concrete aggregate replacement.

M. Mageswari et.al., [5] using the combination of waste Sheet Glass Powder (SGP) as fine aggregate and Portland cement with 20% optimum replacement of fly ash as cementations binder offers an economically viable technology for high value utilization of industrial waste. Using of SGP in concrete is an interesting possibility for economy on waste disposal sites and conservation of natural resources. Natural sand was partially replaced (10%, 20%, 30%, 40% and 50%) with SGP and 20% optimum replacement of fly ash in Portland cement. Compressive strength, Tensile strength (cubes and cylinders) and Flexural strength up to 180 days of age were compared with those of concrete made with natural fine aggregates. Fineness modulus, Specific gravity, Moisture content, Water absorption, Bulk density, Percentage of voids, Percentage of porosity (loose and compact) state for sand and SGP were also studied. The test results indicate that it is possible to manufacture low cost concrete containing SGP with characteristics similar to those of natural sand aggregate concrete provided that the percentage of SGP as fine aggregate up to 30% along with fly ash 20% optimum in cement replacement can be used respectively.

Ustev.Jet.al., [6] determined the performance of concrete made with coconut shell as a replacement of cement. Cement was replaced with coconut shell in steps of 0%, 10%, 15%, 20%, 25% and 30%. The results obtained for compressive strength was increased from 12.45 N/mm^2 at 7days to31.28 N/mm^2 at 28 days curing and it met the requirement for use in both heavy weight and light weight concreting.

Amitkumar D. Ravalet.al., [7] explained the compressive strength by replacing cement with ceramic waste and utilizing the same in construction industry.

Dr. G.Vijayakumaret.al., [8] had found that use of glass powder as partial replacement to cement was effective.

AnkitNileshchandra Patel et.al., [9] examined the possibility of using stone waste as replacement of Pozzolana Portland Cement in the range of 5%, 10%, 30%, 40% and 50% by weight of M 25 grade concrete. They reported that stone waste of marginal quantity as partial replacement to the cement had beneficial effect on the mechanical properties such as compressive strength values for 7, 14, 28 days were less than the ppc cement.

VenkataSairam Kumar et.al., [10] investigated the effect of using quarry dust as a possible substitute for cement in concrete.

Partial replacement of cement with varying percentage of quarry dust (0%, 10%, 15%, 20%, 25%, 30%, 35%, 40%) by weight of M 20, M 30 and M 40 grade of concrete cubes were made for conducting compressive strength. From the experimental studies 25% partial replacement of cement with quarry dust showed improvement in hardened of concrete.

Jayeshkumaret.al., [11] studied the performance of fly ash as partial replacement of cement. The values of compressive strength and split tensile strength are found by partial replacement of cement with varying percentage of 0%, 10%, 20%, 30% and 40% by weight of cement of M 25 and M 40 mix. The compressive strength of the samples was recorded at the curing age of 7, 14, 28 days and for split tensile strength of the sample were conducted test on age of 56 days. It was observed that the compressive strength was better on age of 14 days than the other proportions of cement.

DebarataPradhanet.al., [12] determined the compressive strength of concrete in which cement was partially replaced with silica fume (0%, 5%, 10%, 15%, and 20%). The compressive strength test was conducted on age of 24 hours, 7 days and 28 days for 100 mm and 150 mm cubes. The results indicated that the compressive strength of concrete increased with additional of silica fume up to 20% replaced by weight of cement further addition of silica fume was found that the compressive strength may increase or decrease.

III. MATERIALS

In this present investigation the following materials were used.

- Puzzlona Portland cement (43 grade).
- Fine Aggregate (sand).
- Coarse Aggregate (20mm gravel).
- Granite cutting slurry
- Water.

3.1 CEMENT:

Cement is a fine, grey, and dry powder. It is mixed with water and aggregate materials such as sand, gravel, and crushed stone to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens. The ordinary portland cement contains two basic ingredients namely argillaceous and calcareous. In argillaceous materials clay predominates and in calcareous materials calcium carbonate predominates.

Ordinary Portland cement was used for casting cubes and cylinders for all concrete mixes. The cement was of uniform colour i.e. grey with a light greenish shade and it was free from any moisture and hard lumps.

Cement is a well-known building material and it has occupied an indispensable place in construction works. There is a variety of cements available in the market and each type is used under certain conditions due to its special properties. The cement commonly used is Ordinary Portland Cement, and the fine and coarse aggregates used are those that are usually obtainable, from nearby sand, gravel or rock deposits. In order to obtain a strong, durable and economical concrete mix, it is necessary to understand the characteristics and behavior of the ingredients. Although all materials that go into a concrete mixture are essential, cement is the most important constituent in concrete because it is usually the delicate link in the chain. The function of cement is first to bind the sand and coarse aggregates together, and second, to fill the voids in between sand and coarse aggregate particles to form a compact mass. Although cement constitutes only about 10 per cent of the volume of the concrete mix, it is the active portion of the binding medium and the

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 12, December : 2023

only scientifically controlled in gradient of concrete.

Cement is an extremely ground material having adhesive and cohesive properties, which provide a binding medium for the discrete ingredients. It is obtained by burning together, in a definite proportion, a mixture of naturally occurring argillaceous (containing alumina) and calcareous (containing calcium carbonate or lime) materials to a partial fusion at high temperature (about 1450°C). The product obtained on burning, called clinker, is cooled and ground to the required fineness to produce a material known as cement. Its inventor, Joseph Aspdin, called it Portland cement because when it hardened it produced a material resembling stone from the quarries near Portland in England.

3.1.1 Basic Components of Cement:

SiO_2	17-25 %
Al_2O_3	4-8%
Fe_2O_3	0.5-0.6 %
CaO	61-63 %
MgO	0.1-4.0 %
SO_3	1.3-3.0 %
$Na_2 + K_2O$	0.4-1.3 %
Cl	0.01-0.1%
IR	0.6-1.75 %

There are four major compounds in cement and these are known as C_2S, C_3S, C_3A & C_4AF, and their composition varies from cement to cement and plant to plant. In addition to the above, there are other minor compounds such as MgO, TiO_2, Mn_2O_3, K_20 and N_2O.

They are in small quantity. Of these K_2O and Na_2O are found to react with some aggregates and the reaction is known as Alkali Silica Reaction (ASR) and causes disintegration in concrete at a later date.

The silicates C_3S and C_2S are the most important compounds and are mainly responsible for the strength of the cement paste. They constitute the bulk of the composition.C_3A and C_4AF do not contribute much to the strength, but in the manufacturing process they facilitate combination of lime and silica, and act as a flux.

3.1.2 Chemical Compounds in Cement:

S no	Compound	Composition as %
1	C_3S	48-52 %
2	C_2S	22-26 %
3	C_3A	6-10 %
4	C_4AF	13-16 %
5	Free lime	1-2 %

Initial setting time = Not be less than 30 Min

3.2FINE AGGREGATE:

The sand used for the experimental programmed was locally procured and conformed to Indian Standard Specifications IS: 383-1970. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust. The aggregates were sieved through a set of sieves of 4.75,2.36,1.18, 600µ, 300µ, 150µ,75µ, and pan to obtain sieve analysis.

3.3COARSE AGGREGATE:

The broken stone is generally used as a coarse aggregate. The nature of work decides the maximum size of the coarse aggregate. Locally available coarse aggregate having the maximum size of 20 mm was used in our work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested per Indian Standard Specifications IS: 383-1970. The aggregates were sieved through a set of sieves of 80mm,40mm,20mm, 12.5mm, 10mm, 4.75mm and pan to obtain sieve analysis.

3.4 GRANITE CUTTING SLURRY: The granite cutting slurry is the by product which is formed in the processing of the granite stones which broken downs into the coarse aggregates of different sizes. The physical and chemical properties of granite cutting slurry obtained by testing the sample as per the Indian Standards are listed in the table

Table3.1.3 PHYSICAL PROPERTIES OF GRANITE CUTTING SLURRY

Property	Granite cutting slurry	Test method
Specific gravity	2.54 – 2.6	IS 2386 (part-III) – 1963
Bulk density(kg/m3)	1720 – 1810	IS 2386 (part-III) – 1963
Absorption	1.2 – 1.5	IS 2386 (part-III) – 1963
Moisture content (%)	--------	IS 2386 (part-III) – 1963
Fine particles less than 0.075 mm (%)	12 – 15	IS 2386 (part-III) – 1963
Sieve analysis	Zone – II	IS 383 - 1970

Table3.1.4 CHEMICALPROPERTIES OF QRANITE CUTTING SLURRY:

Constituents	Granite cutting slurry (%)	Test method
Sio2	62.48	IS 4032-1968
Al203	18.72	
Fe2o3	6.54	
Cao	4.83	
Mgo	2.56	
K20	3.18	
Tio2	1.21	
Loss of ignition	0.48	

3.5 TESTS CARRIED ON MATERIALS:

The following tests should be conducted for evaluating the characteristics of raw materials based Indian Standard Code limits for Mix Design.

1 CEMENT:

a) Determination of fineness of cement by dry sieving

b) Determination of compressive strength of cement

c) i) Determination of consistency of cement paste

ii) Determination of initial setting time of cement

iii) Determination of final setting time of cement

d) Determination of specific gravity by pycnometer method.

2) TESTS ON AGGREGATES:

a) Determination of sieve analysis

b) Determination of water absorption

c) Determination of Flakiness Index
d) Determination of Elongation Index
e) Determination of Impact value
f) Determination of specific gravity &Bulk Density.

3) WATER:

a)Table for out-put characteristics of water

CEMENT:

- **DETERMINE THE FINENESS OF THE CEMENT BY DRY SIEVING(AS PER IS:4031,IS:12269,&IS:8112)**

1. Test sieve- cylindrical frame of 150-200mm diameter with 90 µ mash sieve of oven stain less steel. As per IS:460(part-1)
2. A tray fitting beneath the sieve frame with lid fitting above it shall be provided to avoid loss during sieving
3. Weight balance –capable of weighing up to 100g to nearest 10mg.

PROCEDURE:

1. Take a 100g of cement and place it on the 90µ sieving being carefully to avoid loss.
2. Fit the lid over the sieve.
3. Agitate the sieve by swirling and linear movement until no more finer material pass to it
4. Remove and weigh the residue, as a percentage-R1
5. Gently brush all the fine material off the base into the tray.
6. Repeat the same procedure using fresh 100g sample.
7. Let the percentage be R2.
8. Take the mean of two.
9. If the result differs by 1 percent carry out 3rd test as R3 and finally take mean of three.

INFERENCE:

As per IS:2269 the fineness of cement by dry sieve analysis is should not exceed 10%

- **DETERMINATION OF COMPRESSIVE STRENGTH OF CEMENT(ASPER IS:4031,IS:12269&IS:8112)**

APPARATUS:

1) Vibration machine (IS:10082-1982)
2) Poking rod(IS:10082-1982)
3) Cube mould shall be 70.6mm size confirming to IS:10082-1982
4) Gauging trowel shall have steel blade100 to150mm in length with straight edges weighing 210&+10
5) Balance the permissible variation at a load of 1000g shall be+1g
6) Graduate glass cylinder of 150 to20ml cylinder capacity.

MATERIAL:

Standard sand : 600g(grade1,2,3 each 200gms)

Cement :200g

Water : (p/4+3) percent of combined mass of cement and sand.

PROCEDURE:

1) Take a mixture of cement and sand on non porous plate mix it dry with trowel for one min then with water until the mixture is of uniform color.
2) The quantity of water to be used shall be as above.
3) The time of mixing shall be not less than 3min ,if the time exceed 4min repeated their after by taking fresh cement .

INFERENCE:

S.NO	Grade of ppc cement	After 3days of curing	After 7 days	After 28 days
1	33 Grade	16	22	33
2	43 Grade	23	33	43
3	53 Grade	27	37	53

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 12, December : 2023

1)DETERMINATION OF CONCISTANCY OF CEMENT PASTE(AS PER IS:4031,IS:12269,&IS:8112)

APPARATUS:

1. Vicars apparatus (IS:5513-1976)
2. Weighing balance accuracy-0.01 gm
3. Gauge trowel (IS:10086-1982)-shall have steel blade of 100 to150mm in length straight edges weighing 210+10gms

PROCEDURE:

1. The sample of cement to be taken 300gm
2. The temperature of room shall be maintained at 27c
3. Prepare a paste of weighed quantity of cement sample by taking water 29% that of cement quantity (300gm x 0.29)
4. The care should be taken that the time of gauging is not less than 3 to5 mm .Gauging should be completed before any sign of setting occurs
5. Fill the vicatsmould this paste the mould place on non porous plate
6. After completely filling the mould, smoothen the surface of the paste making it level with the top of the mould.
7. Under the rod bearing plunger lower the plunger gently to touch the surface of the test block, and quickly release, allowing it to sink in to the paste.
8. Penetration should be between 5 to7mm from the bottom of the vicatsmould when the cement paste tested. If not repeat the procedure by increasing the water by 0.5%.

TABLE :7.1(b) OBSERVATIONS:

1	%of water	25	25.5	26	26.5	27	27.5	28	28.5	29	29.5
2	Intial reading	50	50	50	50	50	50	50	50	50	50
3	Final reading	37	35	32	29	25	21	18	16	13	9
4	Height of Penetrated	37	35	32	29	25	21	18	16	13	9

RESULT: Standard consistency of cement is 30%.

1) **DETERMINATION OF INTIAL SETTING TIME OF CEMENT(AS PER IS:4031,IS:122695, & IS:8112)**

APPARATUS:

1. Vicars apparatus (IS:5513-1976)
2. Weighing balance accuracy-0.01 gm
3. Gauge trowel (IS:10086-1982)-shall have steel blade of 100 to150mm in length straight edges weighing 210+10gms

PROCEDURE:

1. Potable or distilled water should be used in preparing the paste
2. The sample of cement to be taken as 300g.
3. The temperature of room shall be maintained at 27 c.
4. The care should be taken that the time of gauging is not less than 3 to5mm. gauging should be completed before any sign of setting occurs.
5. Fill the vicatsmould by this paste the mould place on non porous plate.
6. After completely filling the mould ,smoothen the surface of the paste ,making it level with the top of the mould.
7. The mould is slightly shaken to expel the air.
8. Immediately after the moulding, place the test block in the moist closer or moist room and allow it to there except

when determinations of time of setting are being made.

9. Under the rod bearing plunger lower the plunger gently to touch the surface of the test block and quickly.
10. Release allowing it to sink into the paste initially the needle will complete pierce the test block.
11. Prepare a neat cement paste by gauging cement paste by gauging the cement with 0.85 times the water required to give a paste of standard consistency.
12. Repeat this procedure until the needle, when brought in contact with test block and released as described above.

RESULT:

As per test the initial setting time of the cement is 55 minutes.

2) DETERMINATION OF FINAL SETTING TIME OF CEMENT(AS PER IS:4031, IS:12269 & IS: 8112)

1) Replace the needle of the vicats apparatus by the needle with an angular attachment.
2) The cement shall be considered as finally set when upon applying the needle gently to the surface of the test block, the needle makes an impression thereon , with the attachment fails to do so.
3) The period elapsing between the time at which the water added to the cement and the time at which the needle makes an impression on the surface of the test block while the attachment fails to do so shall be the final setting time.

RESULT:

Final setting time of cement is 510 minutes.

- **DETERMINATION OF SPECIFIC GRAVITY OF CEMENT(AS PER IS:2386,PART-III)**

APPARATUS:

1 Le-chatler bottle (or) specific gravity bottle.
2 Weigh balance with capacity not less than 3 kg accuracy 0.5.
3 Kerosene free from water content.

PROCEDURE:

1 Weigh the bottle dry. Let the mass of empty bottle be W1.
2 Fill the bottle with distilled water and weight of bottle with water be W2.
3 Wipe dry the specific gravity bottle and fill it with kerosene and weight let this weight be W3.
4 Pore some of the kerosene out introduce a weighed quantity of cement(about 50gm)in to the bottle. Roll bottle gently in inclined position until no further are bubbles rise to surface. Fill the bottle to the top with kerosene and weigh it. Let this weight be W4.
5 From these data calculated the specific gravity of the cement.

CALCULATION:

SPECIFIC GRAVITY = (W2 –W1) / [(W4 – W1) – (W3 – W2)].

TABLE: 3.1.5 specific gravity of cement (c)

1	Air temperature ^{o}c	27^{0}c	27^{0}c	27^{0}c
2	Mass of cement used (gm)	63	63	63
3	Intial	0	0	0

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 12, December : 2023

	reading of flask (ml)			
4	Final reading of flask (ml)	20.4	19.6	20
5	Volume of cement particles (ml)	20.4	19.6	20
*06	Specific gravity	3.09	3.21	3.15

RESULT:

The specific gravity of given cement is 3.15.

TESTS ON AGGREGATES:

A) SIEVE ANALYSIS OF COARSE AGGREGATE (20 mm)(AS PER IS: 2386(PART-1), IS:383)

APPARATUS:

1. Sieve set of sizes 80mm, 63mm, 40mm,20mm,12.5mm, 10mm,4.75mm,2.36mm,pan.
2. Weight balance – the balance or scale shall be such that it is readable and accurate to 0.1% of the weight of the test sample.
3. Hot air oven.

PROCEDURE:

1) Minimum weight taken for test is 10kg.
2) Then material should be taken from sample by quartering method is 2kg.
3) Carry out sieving by hand shake each sieve in order 80mm,63mm,40mm,20mm,12.5mm,10 mm,4.75mm,2.36mm,so that the material is kept moving over the sieve surface in frequently changing directions.
4) The particle of length which cannot pass through the corresponding size is taken as retained by the sieve sizes.
5) Find the total mass material retained on the sieve sizes.

RESULT:

Sieve analysis of course aggregate - 3.28

3.1.6 Sieve analysis of CA

S. No.	Sieve No.	Mass Retained (gms)	Retained, %	Passing, %	Cumulative % retained
1	80mm	-	0	100	0
2	40mm	-	0	100	0
3	20mm	784	39.2	60.8	39.2
4	12.5mm	692	34.6	26.2	73.8
5	10mm	412	20.6	5.6	94.4
6	4.75mm	83	4.15	1.45	98.55
7	2.36mm	29	1.45	0	100
8	PAN	0	0	0	100
				ΣC =	505.95

Fineness Modulus of fine aggregate = ΣF/100 = 505.95/100 = **5.06%**

B) DETERMINATION OF WATER OBSORPTION FOR AGGREGATE(AS PER IS:2386,PART – III)

APPARATUS:

1) Weighing balance of capacity not less than 3 kg accuracy should be 0.5gms.
2) Hot air oven.
3) A stout water tight container in which the basket may be freely suspended.
4) Two dry soft absorbent cloths each than 75X45 cm.
5) A shallow tray of area not less than 650 cm^2.

PROCEDURE:

1) Soak the aggregate in water for 24 hours.
2) If the aggregate is coarse aggregates wipe off the excess moisture using a trowel until the sample is just moist but not dry (SSD)
3) If the aggregates is fine aggregates drain the water spread the wet aggregates on shallow pan and air dry it at room temperature till fine particles no longer stick to a clean glass rod inserted inside a heap of the sand in above is at saturated dry condition (SSD).

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 12, December : 2023

4) Take a known quantity of aggregate at ssd condition say 1kg.
5) Dry it an oven at 100 to 110°c at 24 hrs +30 mins.
6) Find the dry weight of the aggregates.
7) Calculate the amount of moisture lost from aggregates.
8) This amount of moisture lost will be the amount of water aggregate can absorb.
9) Both the coarse and fine aggregates absorb water this water will not be available to make a cement paste during mixing of material for concrete.
10) Absorption of coarse aggregates is normally in the range of 0.5 to 1%.
11) Absorption of fine aggregates is normally in the range of 1 to 1.5%.

RESULT:

Table 3.1.7 Water absorption of aggregate - 20%

Sl.No.	Details	Sample 1	Sample 2
1	Weight of dry sample(gms)	994	995
2	Weight after SSD (gms)	1000	1000
3	Water absorption (%)	0.6	0.5
4	Average water absorption (%)	0.55	

C) DETERMINATION OF FLAKINESS INDEX(AS PER IS:2386,PART – III)

APPARATUS:

1) Balance – the permissible variation at a load of 1000g shall be +1g.
2) Metal gauge.
3) Sieves 63mm,50mm,40mm,31.5mm,25mm,20 mm,16mm,12.5mm,10mm.

SAMPLE:

A quantity of aggregate shall be taken sufficient to provide the minimum number of 200 pieces of any fraction to be tested.

PROCEDURE:

1) The test sample shall be dried to constatnt weight at a temperature of 110^0c + 5^0c and weighed to the nearest 0.1%.
2) Then the each sample shall be gauged in turn for thickness on a metal gauge.
3) The total amount passing the gauge shall be weighed to an accuracy of at least 0.1% of weight of the sample.
4) The flakiness index is an empirical factor expressing the total material passing through the slots of the thickness gauge as the percentage of the mass of the sample taken for testing.

RESULT:

Flakiness index of aggregate - 3.4

D) DETERMINATIONOF ELONGATION INDEX

APPARATUS:

1) Balance – the permissible variation at a load of 1000g shall be +1g.
2) Metal gauge.
3) Sieves , 63mm,50mm,40mm,31.5mm,25mm,20 mm,16mm,12.5mm,10mm.

PROCEDURE:

1) The test sample shall be dried to constatnt weight at a temperature of 110^0c + 5^0c and weighed to the nearest 0.1%.
2) Then the each sample should be gauged in turn for thickness on a metal gauge.
3) The total amount passing the gauge shall be weighed to an accuracy of at least 0.1% of the weight of the sample.

RESULT:

Elongation index of aggregate – 4.2

E) DETERMINATION OF IMPACT VALUE FOR COARSE AGGREGATE (AS PER IS:383)

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 12, December : 2023

APPARATUS:

1) IS sieve sizes 12.5mm,10mm,2.36mm.
2) Weight balance of capacity 500gm with an accuracy of 0.1gm.
3) Oven with temperature between 100°c to 110°c.
4) Tamping rod of length 230mm and 10mm diameter.
5) Cylindrical steel cup with internal diameter 102mm.
6) Cylindrical steel cup with a depth 50mm.
7) Impact machine.

PROCEDURE:

1) Take a sample from the various places sieve it from 12.5mm to 10mm.
2) Sample retained on 10mm collect it and wash well and put in to oven temperature from 100°c to110°c up to 4 hrs.
3) Remove the sample from oven and cool at well.
4) Fill the sample in standard manner in 3 layers with 25 stokes each uniformly.
5) Then fill the sample again in impact value cup and tamp again 25 stokes.
6) Fall the hammer freely from height of 38cm +0.5cm.
7) Total number of blows should be 15 with not less than 1 sec.
8) Then the sample sieve through 2.36mm sieve.
9) Weight the sample retained on 2.36mm sieve and passing separately.

CALCULATION:

Impact value (%) = [Weight of passing (gm) / Total weight of sample(gm)].

TEST RESULTS:

The aggregate impact value shall not be exceed 45% by weight for aggregate used for concrete other than for wearing surface and 30% by weight for concrete for wearing surface such as run way, roads and pavements.

Table 3.1.8 Impact value of CA

Sl.No.	Details	Trail – 1	Trail – 2
1	Weight of sample filling the metal measure (gm)	320	320
2	Weight of sample retained on 2.36mm IS sieve.	236	235
3	Aggregate impact value (%)	26.25	26.56
4	Average impact value (%)	26	

F) DETERMINATION OF BULK DENCITY FOR COARSE AGGREGATELOOSE BULK DENCITY (AS PER IS:2386 PART – III)

APPARATUS:

1) Weight balance – a balance sensitive to 0.5% of the weight of the sample to be weighed.
2) Container for bulk density size is as follows.

PROCEDURE:

Take a dry sample of aggregate,

1) The cylindrical measure is filled loosely in container.
2) Measure the weight of the aggregate just enough to fill the calibrated container.
3) The measure is carefully struck off level using tamping rod as a straight edge.
4) Note the volume of the calibrating container.

CALCULATION:

The net weight of aggregate on the measure is determined and the bulk density is calculated in kg/lit as follows,

Bulk density = [Net weight of the aggregate(kg) / Capacity of container(lit)].

Percentage of voids = [(Gs – Y)/Gs] X100.
Where,
Gs = Specific gravity of aggregate,
Y = Bulk density (kg/lit).

RESULT:

Loose bulk density of aggregate,

Table 3.1.9 Bulk density of aggregate

Volume of the container(V)	0.014	Cu.m
Weight of the container (W_1)	8.400	Kgs
Weight of container + aggregate (W_2)	28.930	Kgs
Loose bulk density: (W_2 – W_1)/V	1466	Kgs/Cu.m

WATER:

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Quality of water affects the concrete . It is necessary for us to go in to the purity
quality of water. If water is fit for drinking it is fit for making concrete also. Some specifications require that if the water is not obtained from source that as proved satisfactory.

To know the safe measures of water quality, it should be tested at the laboratories before under taking it for construction.

Sl. No.	Sample	Name of the test Conducted	Ascertain value	Permissible limits As per IS:456:2000	Result
1		Acids	30 mg/lit	Should not more than 50 mg/lit	Safe
2		Alkalinity	150 mg/lit	Should not more than 250 mg/lit	Safe
3		Salts	750 mg/lit	Should not more than 2000 mg/lit for RCC & Should not more than 1000 mg/lit forb PCC.	Safe
4		Organics	100 mg/lit	200 mg/lit	Safe
5		In – organics	50 mg/lit	3000 mg/lit	Safe
6		Sulphates	50 mg/lit	400 mg/lit	Safe
7		Chlorides	50 mg/lit	2000 mg/lit	Safe
8		Suspended matter	200 mg/lit	200 mg/lit	Safe
9		Sugar	Absent		Safe
10		Ph value	6.5	Should not less than 6	Safe

INFERENCE:

As per IS 456 – 2000 it(Water sample) has been satisfied all the permissible values so this sample may be used for construction and mixing purpose.

Generally the potable water is considered satisfactory for concrete works.

IV. RESULTS AND DISCUSSION

4.1COMPRESSIVESTRENGTHTESTRESULTS

Theresultsofthecompressivestrengthtestsconductedonconcretespecimensofdifferentmixescuredatdifferentagesarepresentedanddiscussedinthissection.Thecompressivestrengthtestwasconductedatcuringagesof28,56and90days.Thecompressivestrengthtestresultsofallthemixesatdifferentcuringagesareshownin Table.Variationofcompressivestrengthofallthemixescuredat28,56and90daysisalsoshowninFig.-showsthevariationofcompressivestrengthofconcretemixesw.r.tcontrolmix(100%OPC), 28,56and90daysrespectively.

Table 4.1 Compressivestrengthofmortar at28days

Sl.No.	1	2	3	4	5
GCS%	0	5	10	15	20
Avg. Compressivestrength	33.92	33.36	32.72	29.16	26.7

ItisclearfromtablethatCompressivestrengthofmortardecreaseswithincreaseinpercentageofGCS.

Resultonconcrete

Table 4.2 Characteristicstrengthofconcreteat56days

Sl.No.	1	2	3	4	5
GCS %	0	5	10	15	20
Avg.Compressivestrength	35.76	34.56	34.10	30.79	27.55

Thecompressive strength result at 56 days is shows about the increase the values of the strength when compared with the 28 days strength result the increase in strength at 0% is about 10 % of its strength and as at replacement of 5% the strength of cement is increase about 12% and at the replacement value 10% there is increase in the strength of 11% and at the replacement level of 15% there is increase in strength of 9% only and final replacement of the concrete by granite slurry is the values are decreased.

Table 4.3Characteristicstrengthofconcreteatw/c0.44after 90days

Sl. No.	1	2	3	4	5
GCS %	0	5	10	15	20
Avg. Compressive strength	36.60	35.96	34.84	31.93	26.98

Thecompressive strength result at 90 days is shows about the increase the values of the strength when compared with the 56 days strength result the decrease in strength at 0% is about 8 % of its strength and as at replacement of 5% the strength of cement is decrease about 11% and at the replacement value 10% there is decrease in the strength of 9% and at the replacement level of 15% there is increase in strength of 11% only and final replacement of the concrete by granite slurry is the values are decreased.

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 12, December : 2023

Table 4.4Compressive strength of concrete in N/mm^{2}at different curing periods

GCS	Compressive		
	28days	56days	90days
0	33.92	35.76	36.60
5	33.36	34.56	35.96
10	32.72	34.10	34.84
15	29.16	30.69	31.93
20	26.7	27.55	26.98

Fig.4.1Compressive strength of concrete in N/mm^{2}at different curing periods

Table.4.5 Characteristicstrengthofconcreteatw/c0.45at 28 days

GCS	Compressive strength
	28days
0	35.11
5	33.01
10	31.85
15	26.43
20	24.60

The compressive strength result at 56 days is shows about the increase the values of the strength when compared with the 28 days strength result the increase in strength at 0% is about 10 % of its strength and as at replacement of 5% the strength of cement is increase about 9% and at the replacement value 10% there is increase in the strength of 7% and at the replacement level of 15% there is increase in strength of 6% only and final replacement of the concrete by granite cutting slurry is the values are decreased.

Table 4.6 Characteristicstrengthofconcreteatw/c0.45at 90 days

GCS	Compressive strength
	56days
0	37.44
5	34.84
10	32.70
15	27.19
20	25.12

Thecompressive strength result at 90 days is shows about the increase the values of the strength when compared with the 28 days strength result the increase in strength at 0% is about 9 % of its strength and as at replacement of 5% the strength of cement is increase about 6% and at the replacement value 10% there is increase in the strength of 4% and at the replacement level of 15% there is increase in strength of 3% only and final replacement of the concrete by granite cutting slurry is the values are decreased. ItisclearfromtablethatCompressivestrengthofmortardecreaseswithincreaseinpercentageofGCS.

Table 4.7 Characteristicstrengthofconcreteatw/c0.45

GCS	Compressive strength		
	28days	56days	90days
0	35.11	37.44	37.96
5	33.01	34.84	35.01
10	31.85	32.70	32.90
15	26.43	27.19	27.82
20	24.60	25.12	25.17

Thecompresiive strength result at 56 days is shows about the increase the values of the

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 52, Issue 12, December : 2023

strength when compared with the 28 days strength result the increase in strength at 0% is about 10 % of its strength and as at replacement of 5% the strength of cement is increase about 9% and at the replacement value 10% there is increase in the strength of 7% and at the replacement level of 15% there is increase in strength of 6% only and final replacement of the concrete by granite bagasse ash is the values are decreased.

ItisclearfromtablethatCompressivestrengthofmortardecreaseswithincreaseinpercentageofGCS.

Thecompressive strength result at 90 days is shows about the increase the values of the strength when compared with the 28 days strength result the increase in strength at 0% is about 9 % of its strength and as at replacement of 5% the strength of cement is increase about 6% and at the replacement value 10% there is increase in the strength of 4% and at the replacement level of 15% there is increase in strength of 3% only and final replacement of the concrete by granite slurry is the values are decreased. ItisclearfromtablethatCompressivestrengthofmortardecreaseswithincreaseinpercentageofGCS.

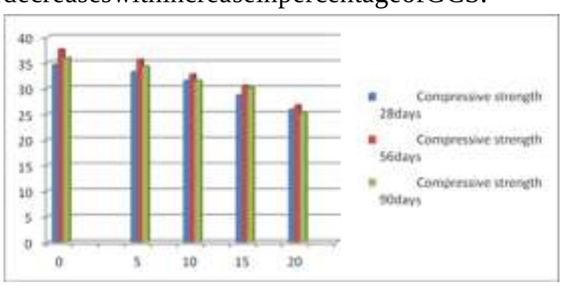

Fig.4.2 Compressive strength variation at different curing periods

4.2SPLITTINGTENSILESTRENGTHTESTRESULTS

Theresultsofthesplittingtensilestrengthtestsconductedonconcretespecimensofdifferentmixescuredatdifferentagesarepresentedanddiscussedinthissection.Thesplittingtensilestrengthtestwasconductedatcuringagesof28,56and90days.Thesplittingtensilestrengthtestresultsofallthemixesatdifferentcuringagesareshownin Table-4.2.Variationofsplittingtensilestrengthofallthe mixescuredat28,56and90days.Figure shows thevariationofsplittingtensilestrengthofconcretemixesw.r.tcontrolmix(100%OPC)after28,56and90daysrespectively.

Table4.8Split tensilestrengthofconcreteatw/c0.44after28days

GCS	Split tensile strength
	28days
0	3.36
5	3.04
10	2.96
15	2.54
20	2.21

The average split tensile strength of concrete is decreases with increase in percentage of sugar cane bagasse ash. At the replacement level of 5% the value of split tensile strength decrease by 4% and at the replacement level 10% the value reduced to 11% and the replacement level the value of strength at 15% decreases to a13% when compared with nominal concrete

SBA	Split tensile strength
	90days
0	3.61
5	3.27
10	3.14
15	2.79
20	2.37

Table4.9Split tensilestrengthofconcreteatw/c0.44after56days

The average split tensile strength of concrete is decreases with increase in percentage of sugar cane bagasse ash. At the replacement level of 5% the value of split tensile strength decrease by 4% and at the replacement level 10% the value reduced to 10% and the replacement level the value of strength at 15%

decreases to a12% when compared with nominal concrete mix.

SBA	Split tensile strength
	56days
0	3.59
5	3.12
10	3.10
15	2.71
20	2.35

Table 4.10Split tensilestrengthofconcreteatw/c0.44after90days

V. CONCLUSIONS

The use of Granite cutting slurry as replacement of cement at different water cement ratio was studied and after research work is done, the following conclusions were done.

1. From the results of the compressive strength the 5 % replacement level gives the more approximate values for the concrete with w/c ratio 0.44 and 0.45 when compared with the nominal (0%) mix concrete. from this we can conclude that the replacement level is safe.
2. The compressive strength of mortar prepared with Granite cutting slurry as partial replacement of cement decreases with increase in percentage of Granite cutting slurry .
3. The results of concrete work revealed that, the compressive strength, split tensile strength, flexural strength and density of concrete containing Granite cutting slurry have shown reduction. As the water cement ratio increases, they decreases slightly.
4. Since Granite cutting slurry is a by-product material, its use as a cement replacing material reduces the levels of CO2 emission by the cement industry and also saves a great deal of virgin materials. In addition its use resolves the disposal problems associated with it in the sugar industries.
5. Concrete with partial replacement of cement by Granite cutting slurry were economical and have slightly less density thus can be used at the place at which strength is of less importance and economy and low density concrete density is required.
6. Water absorption values are low at 5 % replacement and more at 20% replacement .
7. RCPT values are shown as the moderate at every replacement values.

SCOPEFORFUTURERESEARCH

Basedonthepresenttrendofusingdifferentpercentageofbindersinconcrete,thepossibilityofresearchinthe followingareascanbeexplored.

1. Durabilitypropertiessuchassulphateresistance, chloridepenetration,carbonationandpermeabilitycanbestudied.
2. MicrostructurepropertiesofconcretecontainingRHAindifferentproportionaspartialreplacementofcementwithdifferenttypesoffibrescanbestudied.
3. Non-destructive tests like Drying shrinkage and UPV, And Destructive tests can be studied

REFERENCES

[1]. http://www.cement.org/

[2] B.Vidivelli and M. Mageswari, Study on flyash concrete using SEM analysis, J. ofEnviron. Res. Develop., **5**(1), 46-52,**(2010).**

[3] LalitGamashta and SwarnaGumashta, Reuse of concrete and masonry waste materials in construction to minimize environmental damages due to quarrying, J.of Environ. Res. Develop. **1**(1), 65-67,**(2006).**

[4] M.L.V. Prasad and P. Rathish Kumar, Mechanical properties of fiber reinforced concretes produced from building demolished

waste, J. of Environ. Res.Develop. **2**(2), 180-187,**(2007).**

[5] M. Mageswari* and B. Vidivelli, Innovative concrete using flyash and waste sheet glass, J. of Environ. Res. Develop. **4**(2), 476-483,**(2009).**

[6] Utsev, J. T., Taku, J. K., Coconut Shell Ash As Partial Replacement of Ordinary Portland Cement In Concrete Production, Inter.l J. Scientific & Tech. Res.,**1**(8), 86-89, **(2012).**

[7] Amitkumar D. Raval, Dr.Indrajit N. Patel, Prof. JayeshkumarPitroda, Ceramic Waste: Effective Replacement Of Cement For Establishing Sustainable Concrete, Inter. J.Engineering Trends and Tech. (IJETT), **4**(6),2324-2329, **(2013).**

[8] Dr. G.Vijayakumar, Ms H. Vishaliny, Dr. D. Govindarajulu, Studies on Glass Powder as Partial Replacement of Cement in Concrete Production, Inter. J. of Emerging Tech. andAdvan. Engineering,**3**(2), 153-157,**(2013).**

[9] AnkitNileshchandra Patel, JayeshkumarPitroda, Stone Waste: Effective Replacement Of Cement For Establishing Green Concrete, Inter. J. Innovative Tech.and Exploring Engineering,**2**(5), 24-27,**(2013).**

[10] VenkataSairam Kumar N., Dr. B. PandurangaRao, Krishna Sai M.L.N., Experimental study on partial replacement of Cement with quarry dust, Inter. J.**2**(3), 136-137, **(2013).**

[11] Prof. JayeshkumarPitroda, Dr. L.B.Zala, Dr.F.S.Umrigar, Experimental investigations on partial replacement of cement with fly ash in design mix concrete, Inter. J. ofAdvanced Engineering Tech.,**3**(4), 126-129,**(2012).**

[12] DebabrataPradhan, D. Dutta, Influence of Silica Fume on Normal Concrete, Int. J. ofEngineering Res. and Application, **3**(5), 79-82, **(2013).**

[13] N. K. Amudhavalli, Jeena Mathew, Effect of silica fume on strength and durability parameters of concrete, Inter. J.Engineering Sciences & Emerging Tech.,**3**(1), 28-35, **(2012).**

[14] Md. Moinul Islam and Md. Saiful Islam, Strength Behaviour of Mortar Using Fly Ash as Partial Replacement of Cement, ConcreteResearch Letters,**1**(3), 98-106,**(2010).**

[15] D.Gowsika, S.Sarankokila, K.Sargunan, Experimental Investigation of Egg Shell Powder as Partial Replacement with Cement in Concrete, Inter. J. Engineering Trendsand Tech.,**14**(2), 65-68,**(2014).**

[16] Ghassan K. Al-Chaar, MouinAlkadi and Panagiotis G. Asteris, Natural Pozzolan as a Partial Substitute for Cement in Concrete, The Open Construction and Building Tech. J.,**7**, 33-42,**(2013).**

[17] BirukHailu, AbebeDinku, Application of sugarcane bagasse ash as a partial cement replacement material, J. EEA, **29**, 1-12, **(2012).**

[18] SeyyedehFatemehSeyyedalipour, DaryoshYousefiKebria, NimaRanjbarMalidarreh, GhasemNorouznejad, Study of Utilization of Pulp and Paper Industry Wastes in Production of Concrete, Int. J. EngineeringRes. and Applications,**4**(1), 115-122,**(2014)**.

[19] Faseyemi Victor Ajileye, Investigations on Microsilica (Silica Fume) As Partial Cement Replacement in Concrete, Global J. res. inengineering Civil And Structural engineering,**12**(1), 17-23,**(2012)**

[20] Prof. Vishal S. Ghutke, Prof. PranitaS.Bhandari, Influence of silica

fume on concrete, IOSR J. Mech. and CivilEngineering, 44-47,**(2014).**

[21] Dilip Kumar Singha Roy1, AmitavaSil, Effect of Partial Replacement of Cement by Silica Fume on Hardened Concrete, Inter. J.Emerging Tech. and Advanced Engineering,**2**(8), 472-475,**(2012)**.

[22] Mohamed Elchalakani, ElgaaliElgaali, Sustainable concrete made of construction and demolition wastes using recycled wastewater in the UAE, J. Advanced ConcreteTech.,**10**, 110-125,**(2012).**

[23] Marcia Silva and Tarun R. Naik, Sustainable Use of Resources – Recycling of Sewage Treatment Plant Water in Concrete,Coventry University and The University of Wisconsin Milwaukee Centre for By-products Utilization, Second International Conference on Sustainable Construction Materials and Technologies,**(2010).**

[24] Girardi.F and Di Maggio.R, "Resistance of concrete mixtures to cyclic sulfuric acidexposure and mixed sulfates: Effect of the type of aggregate", Cement and Concrete Composites, (2011), Vol-33, PP 276-285.