Journal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 15, Issue. 1 : 2024
ISSN : **1906-9685**

EXPERIMENTAL STUDY ON STRENGTH BEHAVIOR OF CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT WITH SILICA FUME AND COARSE AGGREGATES WITH RUBBER PIECES

[1]N P Annapurna, [2]D Ibraheem Khaleelulla, *[1]Student,[2]Assistant Professor Department Of Civil Engineering PVKKIT, Anantapur*

ABSTRACT

A very large amount of waste rubber tire are being generated each year all around the world. Being non biodegradable in nature their recycling is not easy. On burning they produce very toxic and harmful smoke. So the only option is to dump them to landfills. It is also not a proper solution as it takes a lot of space and stockpiles of waste rubber leads to soil pollution and contaminate water bodies along with ground water. Statistics show that every year more than 500 million tires are discarded to landfills, and the estimation is about 5000 million tires would be discarded by 2030. Many research studies has shown that the waste rubber tires could be used in concrete. Concrete with rubber tire has shown reduction in compressive and flexural tensile strength but they do possess some positive aspects as they have better toughness, impact resistance, thermal and sound properties. The main objectives of this study is to investigate the strength properties of M30 grade concrete by replacing cement with silica fume and rubber tyre aggregates (RTA). The percentage of silica fume and rubber tyre used as 0%SF+0%RT, 5%SF+10%RTA, 10%SF+20%RTA, 15%SF+30%RTA, 20%SF+40%RTA.

INTRODUCTION

1.1 General

The recent growth of automobile industry and use of vehicles has increased the production of tires all through the world. This has lead to large accumulation of used tires. The major problem of these tires is their disposal. Million of tires are discarded each year causing environmental risk to pollution. It is estimated that each year about 1000 million tires end their service life and more than 500 million among them are discarded to landfills. A future estimation is that the number of waste tire discarded yearly would reach 1200 million. And there could be as many as 5000 million of stockpiled discarded tire throughout the world. In 2008, the global production of waste tire was about one billion and production of new tires was about 1.5 billion. Rubber Manufacturer's Association in one of their statement say that every year about 75 million of waste tires are stockpiled in US itself and more than 230 million are produced. In India also there would be about 112 million of discarded tire per year after retreading twice. These waste tires are non-biodegradable in nature and on burning produces very harmful and toxic gases dangerous to health. So, a maximum amount of these waste tires are thrown to landfills causing very adverse effect on environment.

A very small amount of rubber from the tire gets abraded after its whole service life, this means that a whole of rubber is discarded. Their disposal in landfill also has some adverse effect on nature. Along with occupying a very large space in a landfill their decomposition also creates a variety of issues making it unfeasible to decompose. Waste tire rubber own shape allows it to store water for a long period causing a breeding place for mosquitoes and other insects. It also causes contamination of underground water and above ground water and also spoils the fertility of soil by destroying many beneficial bacteria present in soil. [Wikipedia] Research in the past has shown that these waste tire rubbers could be used in concrete. In literatures, the term "Rubberized Concrete" or "Rubber Modified Concrete" is used for concrete made with mixing waste tire rubber particles into plain concrete. A lot of properties gets enhanced by replacing some components of concrete with waste tire rubber particles making it suitable for use in a particular work. Many countries have made it compulsory to use waste tire rubber in their construction work. In this way it could be proved to be a means of sustainable development. Waste tire rubber particles have been used in concrete in three different forms

[1]. Shredded or Chipped rubber It's size vary from 2- 20 mm. It is used to partially replace coarse aggregates.

[2]. Crumb rubber- It's size vary from 4.75- 0.425 mm. It is generally used to partially replace fine aggregates.

[3]. Ground rubber- It is in the powder form. It's size is less than 0.425 mm. It is used to partially replace cement content.

1.2 Background information

Concrete has been around for a long time, the originally known utilization of a material looking like cement was by the Minoan civilization around 2000 BC. During the beginning phases of the Roman Empire around 300 BC the Romans found that blending a sandy volcanic debris in with lime mortar made a hard water opposition substance which we currently know as concrete. The transcendent kind of concrete utilized in present day concrete is Portland concrete, different sorts of concrete accessible incorporate; Blended concrete, which is like Portland concrete yet may contain materials, for example, fly debris slag or silica smolder; High early strength concretes, which as the name proposes gains strength significantly speedier then Portland or mixed concretes; Low warmth concretes, utilized when cutoff points are put on the warmth of hydration of the solid; Shrinkage restricted concretes; Sulfate opposing concretes; Colored concretes; Masonry concrete.

Aims of this project

Made sand offers a feasible answer for the diminishing accessibility of normal sand. Notwithstanding, before fabricated sand can be broadly utilized there are a couple of issues which should be survived. The main issue that should be defeated is the helpless functionality of produced sand. At the point when this issue has been beaten then it will go far to giving made sand a superior standing in the development business. The point of this venture is to examine the impacts that changing measures of admixtures have on cement containing produced sand rather than regular sand. Ideally the aftereffects of the venture will show that a solid blend containing made sand and no common sand can accomplish a high strength and a decent usefulness using a superplasticiser.

Objectives of the study:

For the current study the following conclusions were made

1. Determine the workability, strength of M30 grade concrete containing silica fume and rubber tyre aggregates.
2. To compare the test results with conventional mix concrete.
3. To determine the concrete strength values for different percentages of silica fume and rubber tyre aggregates.
4. Determine compressive strength, split tensile strength and flexural strength of concrete

LITERATURE REVIEW

A. Khan., S. Danish., S. Arif., S. Ramzan., M. Mushtaq (2013)

This paper, through trial study and scholarly sources researches the usage of elastic waste in creating Green Concrete (GC). The regular total (sand) of Conventional Concrete (CC) is supplanted as 10%, 20% and 30% with coarse and fine elastic total. The examples were tried in lab after a particular time on different angles including pressure strength and results were contrasted and one another and furthermore with Conventional Concrete Mix (CCM). The paper infers that primary and non-underlying rubber treated cement can be created by utilizing explicit amount of elastic waste in position of fine and coarse totals in regular cement. The critical target of this examination is to discover a productive answer for using elastic waste for better climate and furthermore to give activity to concerned government association for outlining successful enactment for the utilization of rubber treated cement in building and development businesses. It uncovers from compressive strength's trial of rubber treated cement (RC) that it very well may be delivered for different use in building and development Industries. RC won't just save the common elements of cement coming about natural maintainability however reusing of elastic waste will likewise contribute towards better climate. The substitution of 10 % of fine total (sand) of Conventional Concrete (CC) with Fine Crumb Rubber (FCR) is valuable for creating Structural Concrete. In this manner utilization of CCR cement ought to be supported for utilize with the goal that greatest utilization of waste elastic could be accomplished.

K. C. Panda, P. S. Parhi and T. Jena (2012)

In this investigation an endeavor has been made to recognize the different properties important for the plan of solid blend in with the coarse tire elastic chips as total in a precise way. In the present exploratory examination, the M20 grade concrete has been picked as the reference solid example. Scrap tire elastic chips, has been utilized as coarse total with the substitution of customary coarse total. Droop esteem is diminished as the level of substitution of scrap tire elastic expanded. So decline in usefulness. The compressive strength is diminished as the level of substitution expanded, however elastic cement grew marginally higher compressive strength than those of without elastic cement. The split elasticity is expanded with diminished level of scrap tire elastic. Abatement in compressive strength, split elasticity and flexural strength of the example. Absence of legitimate holding among elastic and concrete glue lattice.

G.SenthilKumaran, NurdinMushule, M.Lakshmipathy (2008)

This examination surveys the practicality of utilizing waste tires as chips and filaments with various sizes in cement to improve the strength just as ensuring the climate. Likewise it surveys the expected application in the field by misusing its novel attributes and properties. In this examination, we diagram the utilization of rubber treated cement in underlying and non-primary individuals and show how it is appropriate for the solid, its uses, obstructions and advantages and approach to future investigation. An exploration is in progress utilizing the evaluation of concrete 53, to improve the strength, fine sand and coarse total of a mix of 10mm and 20mm. The waste tire elastic will be utilized as chips and strands by mostly supplanting the coarse total by 0, 5, 10, 20 and 25%.Recycling innovation for concrete has fundamentally evolved in the new years, making the material adequately recyclable. It is clear that from the above conversation, the decrease of compressive and elasticity can be expanded by adding some super plasticizers and modern squanders as fractional substitution of concrete will build the strength of waste tire elastic adjusted cement. Numerous examinations uncover that there will be increment in strength upgrades just as ecological points of interest. The future NGC utilizing waste tire elastic could give one of the ecological cordial and monetarily suitable items. Despite the fact that issues remain with respect to the expense of creation and mindfulness among the general public the squanders can be changed over into a significant item But further exploration is expected to expand execution against fire.

El-Gammal, A., A. K. Abdel-Gawad, Y. El-Sherbini, and A. Shalaby (2010)

In this paper the thickness and compressive strength of cement using squanderer tire elastic has been researched. Reused squander tire elastic has been utilized in this investigation toreplace the fine and coarse total by weight utilizing various rates. The consequences of this paper shows that despite the fact that, there was a huge decrease in the compressive strength of cement using waste tire elastic than typical solid, concrete using waste tire elastic exhibited a flexible, plastic disappointment as opposed to weak disappointment. An aggregate of 4 fundamental blends were projected. One control blend and three solid combinations. The control combination was intended to have a water concrete proportion of 0.35 with concrete substance of 350 kg/m3. To build up the rubber treated solid combinations, tire elastic was utilized to supplant the total by weight. In the originally rubber treated solid combination, the chipped elastic completely supplanted the coarse total in the blend. While, in the other two solid combinations, the tire elastic supplanted the fine total by 100% and half of fine total weight. Concrete gave utilizing chipped elastic a role as a full substitution to coarse total shows a critical decrease in the solid strength contrasted with the control example. Notwithstanding, critical malleability was seen before disappointment of the examples. Concrete gave utilizing chipped elastic a role as a full substitution to coarse total shows a critical decrease in the thickness of cement contrasted with the control examples. Concrete gave utilizing scrap elastic a role as a full substitution to sand shows a critical decrease in the solid strength contrasted with the control example. In any case, critical pliability was seen before disappointment of the examples. Concrete gave utilizing morsel elastic a role as a full substitution to sand shows a huge expansion in the solid strength contrasted with the solid gave utilizing chipped elastic a role as a substitution to coarse total. There was no critical expansion in the solid compressive strength and the solid thickness when diverse level of scrap elastic, as a substitution to sand, was utilized in the solid blend. It is prescribed to test concrete with various level of morsel elastic going between (10% up to 25%) to contemplate its impact on the solid strength.. It is prescribed to utilize concrete in the creation of checks, streets, solid squares, and non-bearing solid divider.

T. SenthilVadivel& R. Thenmozhi (2012)

In this Study, our current examination means to research the ideal utilization of waste tire elastic morsels as fine total in solid composite. A sum of 90 3D shapes, chambers and bar examples were projected with the substitution of fine total by destroyed elastic morsels with the extent of 2, 4, 6, 8, and 10% by weight and contrasted and 18 ordinary examples. New and solidified properties of cement like functionality, compressive strength, elasticity and flexural strength were recognized lastly it is suggested that 6% substitution of waste tire elastic total with fine total will gives ideal and most secure substitution in solid composites. Compressive strength diminishes when the level of substitution of destroyed fine elastic morsels increments. Split elasticity diminishes at the limit of 25% when elastic morsels replaces up to 10% in fine total. Flexural strength of solid increments when elastic scraps increments up to 6%. It is distinguished that the evaluation of solid assumes the significant part in the flexibility execution of elastic supplanted Concrete. Droop test results show no adjustment in functionality taking all things together the level of substitution of elastic morsels. Thus no impact in consistency during elastic supplanted concrete. 6% substitution of waste tire elastic demonstrates uncommonly well in pressure, tractable and flexural strength and follow the arch of the ordinary examples all the tests in both the evaluations. Thus it is suggested that 6% substitution of waste tire elastic total with fine total will gives ideal and most secure substitution in solid composites. Further it is proposed to utilize this solid composite for lintel radiates, floor pieces, and ribs where burden conveying limit not administering the plan.

II. MATERIALS AND METHODOLOGY

3.1 GENERAL:-

An experimental investigation has been planned to study the effect of nano aluminium oxide (Al203), silica fume on concrete by varying the percentage of cement replacement with silica fume and constant percentage of nano Al203. Six mixes of concrete were prepared including one nominal mix. 9 cubes, 9 cylinders and 9 beams were cast for each mix and are cured for 3, 7 and 28 days. Tests were conducted on the specimens to find the strength variations in concrete. This experimental programmed has been planned and carried out in four stages.

Stage 1: Procurement of materials and their testing.
Stage 2: Mixing and workability of concrete.
Stage 3: Moulding of specimens and curing.
Stage 4: Testing of specimen.

3.2 DESCRIPTION OF MATERIALS USED:-

3.2.1. Cement:

The crude materials needed for assembling of Portland concrete are calcareous materials like limestone or chalk, and argillaceous material like shale or mud. There are two cycles known as wet and dry cycles relying on whether the blending and crushing of crude materials is done in wet or dry condition. The crude materials utilized for the assembling of concrete comprise of for the most part of lime, silica, alumina and iron oxide. These oxides connect with each other in the oven at high temperature to frame more unpredictable mixtures. The substance responses that happen among concrete and water is alluded as hydration of concrete. The hydration of concrete can be imagined twoly. The first is through arrangement component in which concrete break down to create overly immersed arrangement from which the hydrated items get hastened. Second is that water assaults concrete mixtures beginning from the surface to the inside of mixtures with time. The response of concrete with water is exothermic. The response frees a significant amount of warmth. This freedom of warmth is called warmth of hydration.

In this examination Ordinary Portland concrete of 53 evaluation (ACC concrete) has been acquired and has been utilized. The different tests on this material is led and brought about 4.3.

Figure .1: OPC 53 grade cement

3.2.2. Aggregates:

Totals are the significant constituents in cement. They offer body to the solid, decrease shrinkage and impact economy. Totals are dormant granular materials like sand, rock or squashed stone that are a final result in their own crude materials. They are additionally the crude materials that are a fundamental fixing in cement. For a decent solid blend, totals should be perfect, hard, solid particles liberated from assimilated synthetic compounds or coatings of earth and other fine materials that could cause the disintegration of concrete.

Aggregates are divided into two categories from the consideration of size.

i).Coarse aggregate

ii). Fine aggregate

3.2.2.1.coarse aggregate

Coarse totals are particles more noteworthy that 4.75mm however by and large reach between 9.5mm to 37.5mm in distance across. They can either be from essential ,auxiliary or reused sources. Essential or virgin totals are either land or marine-won. Rock is a coarse marine-won total, land-won coarse totals incorporate rock and squashed stone. Rock comprise most of coarse total utilized in cement with squashed stone making up the greater part of the rest of.

In this investigation coarse total of ostensible sizes of 20mm, 12mm are utilized.

Figure .2: 20mm coarse aggregates

3.2.2.2. Fine aggregate:

Fine total are fundamentally sands won from the land or the marine climate. Fine totals by and large comprise of common sand or squashed stone with most particles going through a 4.75mm sifter.

The fine total utilized in this investigation is stream sand which is acquired from neighborhood organization and appeared in figure 4.4. The essential tests on these materials are directed and brought about 4.3.

Figure .3: Fine aggregate

3.2.3. Water:

Water is a significant element of concrete as it effectively takes part in the substance response with concrete. Since it assists with framing the strength giving concrete gel, in the amount and nature of water is needed to be investigated cautiously. C3S requires 24% of water by weight and C2S requires 21%. It has additionally been assessed that on a normal 23% of water by weight of concrete is needed for synthetic response with Portland concrete mixtures .This 23% of water synthetically joins with concrete and, along these lines, it is called bound water. It has been additionally assessed that about 15% by weight of concrete is needed to top off the gel-pores.

In this way, an absolute 38% of water by weight of concrete is needed for the total synthetic response and to consume the space inside gel-pores.

Nature of water influences the strength, it is vital for us to go into the immaculateness and nature of water. A well known measuring stick to the reasonableness of water for blending concrete is that, if water is good for drinking it is good for making concrete. Carbonates and bi-carbonates of sodium and potassium impact the setting season of concrete. Salts of Manganese, Tin, Zinc, Copper and Lead cause a stamped decrease in strength of cement. A turbidity breaking point of 2000ppm has been recommended.

Locally accessible consumable new water which is liberated from centralizations of help and natural substances has been utilized in this trial program for blending and relieving.

3.2.4. Silica Fume:

Silica rage, likewise alluded to as microsilica or dense silica seethe, is another material that is utilized as a fake pozzolanic admixture. Dense silica seethe is essencially silicon dioxide in noncrystalline structure. It has circular shape. It is incredibly fine with molecule size under 1 micron and with a normal measurement of about 0.1 micron, around multiple times less than normal concrete particles. Silica seethe has explicit surface zone of around 20,000 m2/kg, as against 230 to 300 m2/kg.

Miniature silica is the most usually utilized mineral admixture in high strength concrete. It has become the picked top choices for high strength concrete and is a decent pozzolan and can be utilized amazingly, Adding to the solid blend will drastically improve the functionality, strength and impermiability of cement blends while making the solid sturdy to synthetic assaults, scraped area and support consumption, expanding the compressive strength. There is a developing interest in the creation of cement blends, superior cement, and high strength, low porousness concrete for use in scaffolds, marine climate, and atomic plants.

Properties of Silica Fume:

Little molecule size, high surface region and high silicon content are the properties of silica seethe that make it so special. Anyway the round or circular state of silica rage particles has an extraordinary importance in the stream capacity of blend for both stubborn cast capable and Portland concrete based cements. The normal molecule sizes of Portland concrete and a lot more modest than some other part in hard-headed castable. This submicron size permits the silica smoke to make up for the open shortcomings in cements and obstinate castable. The submicron size permits the silica smoke to make up for the open shortfalls in cements and stubborn castable consequently diminishing the penetrability of the final results. Planners utilize the size to build up the blends that stream very well through control of network. The surface territory of silica rage represented an issue for fashioners in the beginning of exploration. They found that in the request to wet this huge surface zone, substantially more water expected to get a similar droop as blends without silica seethe. This issue was tackles using super plasticizers likewise know as high reach water decreasing specialists (HRWRA). Most super plasticizers can be categorized as one of the accompanying substance definition polyacrylates, sulphonated naphthalene-formaldehyde concentrates, sulphonated melamine formaldehyde thinks, polycarboxylates and altered lignosulfates. With the expansion of these synthetic added substances, silica seethe concrete has progressed a long ways past the assumptions for early fashioners considering more prominent adaptability in plan, shapes and exhibitions. Truth be told, today Portland concrete based cements fusing pozzolanas, for example, silica smoke and fly debris in blend with super plasticizers known as elite cements (HPC).

Figure .4: Silica Fume

4.2.5 Rubber tyre aggregates

The piece tire rubbers are cut into totals with assistance of slicing machine and slicing to most extreme ostensible sizes equivalent to 20mm. The supplanting of normal totals with elastic totals will in general diminish the thickness of the solid. This decrease is owing to the lower unit weight of elastic total contrasted with standard total. The unit weight unit weight of rubber treated solid blends diminishes as the level of elastic total increments. Recovered elastic has been gotten from karnool locale and cut into little pieces.

Figure 5: Rubber aggregates

4.2.6. Superplasticizers: (High range water reducers)

Superplasticizers comprise a generally new class and improved variant of plasticizer, the utilization of which was created in Japan and Germany during 1960 and 1970 individually. They are synthetically unique in relation to typical plasticizers. Utilization of superplasticizers allows the decrease of water to the degree upto 30% without diminishing usefulness as opposed to the conceivable decrease up to 15% if there should arise an occurrence of plasticizers.

The utilization of superplasticizer is polished for creation of streaming, self leveling, self compacting and for the creation of high strength and elite cement.

In this study, CONPLAST SP430 has been used in concrete mix to have high workability.

Figure 6: superplasticizer

3.3. BASIC TESTS ON MATERIALS:

3.3.1. Fineness of cement:

Fineness of cement has a great effect on the rate of hydration and hence the rate of gain of strength. Fineness of cement increases the rate of heat. Finer cement offers a great surface area for hydration and hence faster the development of strength. Increase in fineness of cement also increases the shrinkage of concrete and hence creates cracks in structures.

Procedure:

Weight 100 gms of the given cement and sieve it continuously for 15 minutes on I.S.Sieve No.9 (90μ). Air set lumps may be broken down by fingers but nothing should be rubbed on the sieves. Find the residue on the sieve after the sieving is over and report the value as a percent of the original sample taken.

Observations and calculations:

Table 3.1: Observations of fineness of cement test.

Trial no.	1	2	3
Weight of cement in gms	100	100	100
Wt. Of residue on sieve in gms	2.5	2.3	2.4
Amount retained (%)	2.5%	2.3%	2.4%

Amount retained = (2.5+2.3+2.4)/(3*100)*100 = 2.4%

Fineness of cement = 2.4%

EXPERIMENTAL INVESTIGATION

4.1 Scheme of experimental program:

The details of number of blocks to be tested while the experimentation process is given in the below table:

Table 4. 1 : No Blocks Required For the Experiment

% SF+%RT	Compressive strength of concrete			Split tensile strength of concrete			Flexural strength of concrete		
	7days	14days	28days	7days	14days	28days	7days	14days	28days
0%SF+0%RT	3	3	3	3	3	3	3	3	3
5%SF+5%RT	3	3	3	3	3	3	3	3	3
10%SF+10%RT	3	3	3	3	3	3	3	3	3
15%SF+15RT	3	3	3	3	3	3	3	3	3
20%SF+20%RT	3	3	3	3	3	3	3	3	3
25SF+25RT	3	3	3	3	3	3	3	3	3
Total	54 Cubes			54 cylinders			54 Prisms		

In each batch 3cubes, 3 cylinders and 3 prisms were casted. Totally 54 cubes, 54 cylinders and 54 prisms were casted during entire experimentation.

4.2 SHAPE AND DIMENSIONS OF THE BLOCKS:

Fig 7 : Cube 150mmX150mmX150mm

Fig 8 : Cylinder 150mm Diameter and 300mm Height

Fig 9 : Prism of 150mmX150mmX700mm

Shape and Dimensions of the Blocks

The shape and dimensions specified for the blocks for different tests are given below table

Table 4. 2 : Shape and Dimensions of Blocks

Type of test	Shape of block	Length(m)	Breadth(m)	Height(m)	Diameter(m)	Volume of block (m^3)
Compressive strength	Cube	0.15	0.15	0.15	--	0.00375
Split tensile strength	Cylinder	--	--	0.30	0.15	0.00530
Flexural strength	Square prism	0.1	0.1	0.7	--	0.00700

Curing the test specimens

After casting the specimens allow the specimens to hardening process for 24 hours at least after hardening process de mould the test samples carefully without any damage for the various trials of municipal solid waste replacement. Now submerge the de moulded specimens in curing tank generally for this study adopted water submerged curing (WSC) for 7 days, 14 days, 28 days age for strength calculations.

Curing of specimens for 7 days, 14 days and 28 days age

Compressive strength of concrete

This test was directed according to (IS516-1959). The 3D squares of standard size 150x150x150mm were utilized to locate the compressive strength of cement. Examples were set on the bearing surface of CTM, of limit 200T without erraticism and a uniform pace of stacking applied till the disappointment of the block. The greatest burden was noted and the compressive strength was determined.

Compressive strength testing procedure from IS516-1959:

Placing the Specimen in the Testing Machine:

The bearing surface of the testing machine will be cleaned off and any free sand are other material taken out from the surface the example which are to be in contact with the pressure platens. On account of shapes, the examples will be set in the machine in such a way that the heap will applied two inverse sides of the 3D square as cast, that isn't to the top and base. The hub of the example will be deliberately lined up with of push of the roundly situated platen. No pressing will be utilized between the essences of the test example and the steel platen of the testing machine. As the circularly situated square is welcomed bear on the example, the versatile segment will be pivoted tenderly by hand so that uniform seating might be gotten.

Testing of specimen at 7 days curing

The heap will applied without stun and expanded constantly at a pace of around 140kg/cm2/min until the obstruction of the example to be expanding load separates and no more noteworthy burden can be maintained. The greatest burden applied to the example will at that point be recorded and presence of the solid and any strange highlights in the sort of disappointment will be noted.

RATE OF LOADING:

The heap will be applied without stun and expanded ceaselessly at an ostensible rate inside in the reach 1.2 N/mm/min to 2.4N/mm/min. (IS 5816 (1999))maintain the rate, when changed, until disappointment one physically controlled machines as disappointment is moved toward the stacking rate will diminish; at this stage the controls will be worked to keep up according to as conceivable the predefined stacking rate. The greatest burden applied will at that point be recorded. The presence of concrete and any abnormal highlights in the kind disappointment will be noted.

Split tensile strength testing at 14 days curing

Flexural Strength of concrete

Flexural strength testing procedure from IS516-1959:

Placing the specimen in testing machine:

Testing Square prism for flexural strength

The bearing surfaces of the supporting and stacking rollers cleaned off, and any free sand or other material eliminated from surface of the example where they are to may contact with the rollers. The example will at that point be set in the machine in such a way that the heap will be applied to the highest surface as cast in the form, along two line separated 13.3cm separated the hub of the example will be painstakingly lined up with the hub of stacking gadgets. No pressing will be utilized between bearing surface of the example and rollers. The heap will be applied without stun and expanding ceaselessly at a rate to such an extent that outrageous fiber stress increments roughly

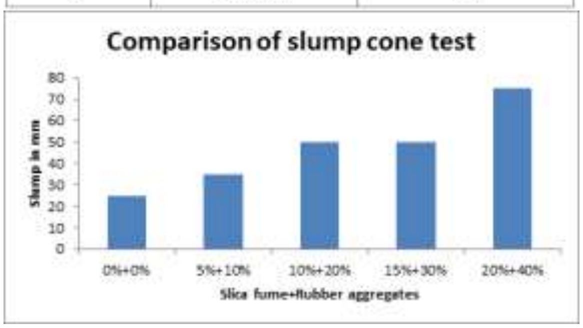
7kg/cm2 that is at the pace of stacking of 400kg/min for the 15cm examples and the pace of 180kg/min for 10cm example. The heap will be expanded until example comes up short, and the greatest burden to the example during the test will be recorded. The appearance of the broke essences of concrete and any abnormal highlights in the kind of disappointment will be noted.

RESULTS AND ANALYSIS

Workability of concrete

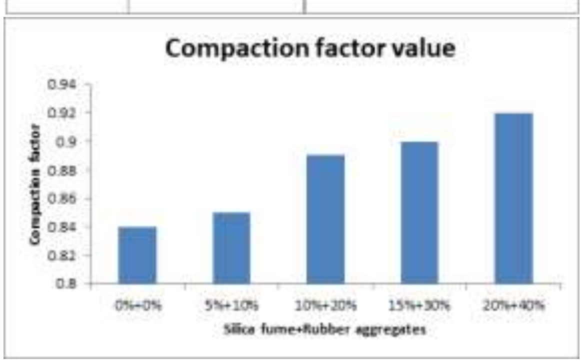
Slump cone test

S. No	%SF+%RTA	Slump in mm
1	0%+0%	25
2	5%+10%	35
3	10%+20%	50
4	15%+30%	50
5	20%+40%	75



Compaction factor test

S. No	%SF+%RTA	Compaction factor value
1	0%+0%	0.84
2	5%+10%	0.85
3	10%+20%	0.89
4	15%+30%	0.9
5	20%+40%	0.92

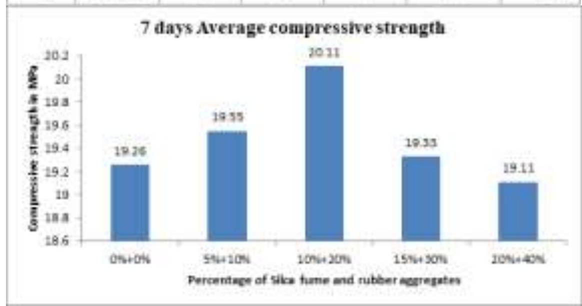


Strength of concrete

Compressive strength

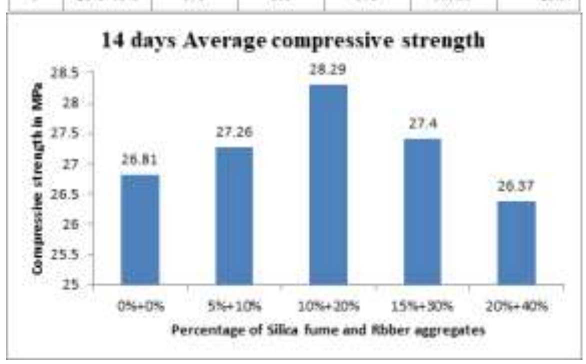
7days

S. No	%SF+%RTA	7 days Compressive load in kN for Trial 1	7 days Compressive load in kN for Trial 2	7 days Compressive load in kN for Trial 3	7 days Average Compressive load in kN	7 days Average compressive strength in N/mm2
1	0%+0%	430	440	430	433.33	19.26
2	5%+10%	440	440	440	440	19.55
3	10%+20%	450	455	455	452.5	20.11
4	15%+30%	430	440	435	435	19.33
5	20%+40%	420	430	430	426.66	19.11



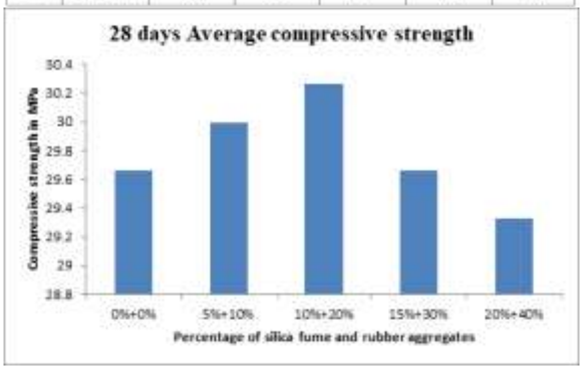
14days

S. No	%SF+%RTA	14 days Compressive load in kN for Trial 1	14 days Compressive load in kN for Trial 2	14 days Compressive load in kN for Trial 3	14 days Average Compressive load in kN	14 days Average compressive strength in N/mm2
1	0%+0%	600	610	600	603.33	26.81
2	5%+10%	620	610	610	613.33	27.26
3	10%+20%	630	640	640	636.66	28.29
4	15%+30%	620	610	620	616.66	27.4
5	20%+40%	590	600	590	593.33	26.37



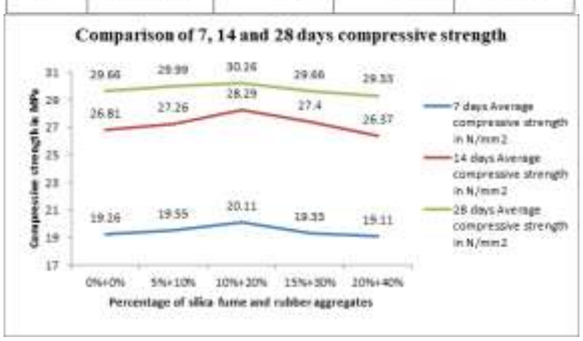
28 days

S. No	%SF+%RTA	28 days Compressive load in kN for Trial 1	28 days Compressive load in kN for Trial 2	28 days Compressive load in kN for Trial 3	28 days Average Compressive load in kN	28 days Average compressive strength in N/mm2
1	0%+0%	670	665	670	668.33	29.66
2	5%+10%	680	670	680	676.66	29.90
3	10%+20%	695	695	695	695	30.26
4	15%+30%	670	660	660	663.33	29.66
5	20%+40%	660	650	655	655	29.33



Comparison of compressive strength values

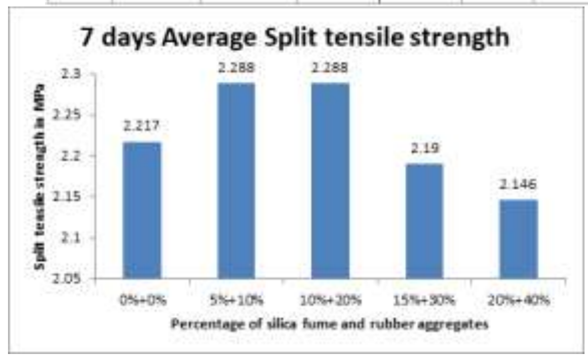
S. No	%SF+%RTA	7 days Average compressive strength in N/mm2	14 days Average compressive strength in N/mm2	28 days Average compressive strength in N/mm2
1	0%+0%	19.26	26.81	29.66
2	5%+10%	19.55	27.26	29.99
3	10%+20%	20.11	28.29	30.26
4	15%+30%	19.33	27.4	29.66
5	20%+40%	19.11	26.37	29.33



Split tensile strength

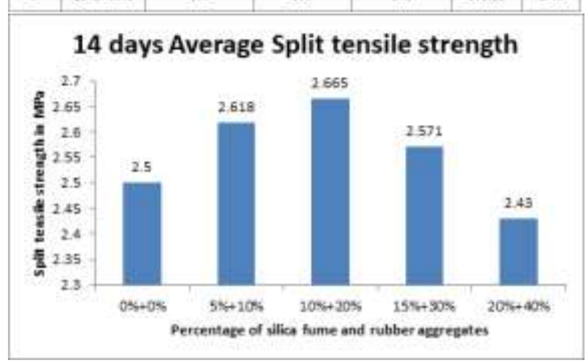
7days

S. No	%SF+%RTA	7 days Tensile load in kN for Trial 1	7 days Tensile load in kN for Trial 2	7 days Tensile load in kN for Trial 3	7 days Average Tensile load in kN	7 days Average Split tensile strength in N/mm2
1	0%+0%	155	160	155	156.66	2.217
2	5%+10%	160	165	160	161.66	2.288
3	10%+20%	165	160	160	161.66	2.288
4	15%+30%	155	155	155	155	2.19
5	20%+40%	150	155	150	151.66	2.146



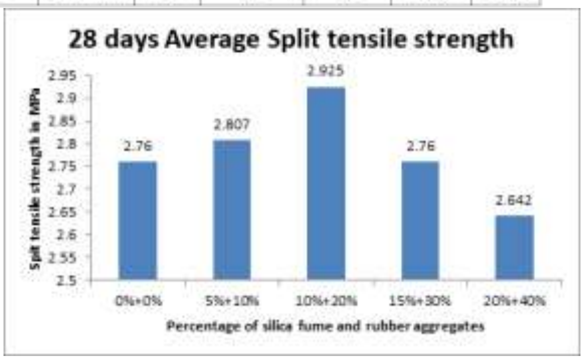
14days

S. No	%SF+%RTA	14 days Tensile load in kN for Trial 1	14 days Tensile load in kN for Trial 2	14 days Tensile load in kN for Trial 3	14 days Average Tensile load in kN	14 days Average Split tensile strength in N/mm2
1	0%+0%	180	175	175	176.66	2.5
2	5%+10%	185	185	185	185	2.618
3	10%+20%	190	185	190	188.33	2.665
4	15%+30%	180	180	185	181.66	2.571
5	20%+40%	175	170	170	171.66	2.43



28 days

S. No	%SF+%RTA	28 days Tensile load in kN for Trial 1	28 days Tensile load in kN for Trial 2	28days Tensile load in kN for Trial 3	28 days Average Tensile load in kN	28 days Average Split tensile strength in N/mm2
1	0%+0%	195	195	195	195	2.76
2	5%+10%	200	195	200	198.33	2.807
3	10%+20%	210	205	205	206.66	2.925
4	15%+30%	195	200	190	195	2.76
5	20%+40%	190	185	185	186.66	2.642



CONCLUSIONS

Eco friendly, Green Concrete has been promoted worldwide to encourage Sustainable Development in the field of Construction where huge amount of concreting works are carried out. Utilizing silica fume and rubber waste as a partial replacement for Cement and coarse aggregates provides a significant role in its disposal due to its adversarial effects. When investigated for partial replacement the following highlights were noted:

1. From the observations, it is noted that unit weight of beam and cylindrical specimen's has been reduced upto increasing the percentage of chipped rubber into concrete. From this test it has to be concluded that rubberized concrete is used in the light weight structures and restricted to the structural application.
2. Silica fume and rubber aggregates concrete has been highly effective in increasing the workability of the fresh concrete easing the placement of concrete.
3. A gradual increase in the workability was promisingly observed in Slump Cone and Compaction Factor Test.
4. For Compressive strength the optimum replacement of cement were observed for 10%silica fume+20% rubber aggregates. Further increase in Silica fume and rubber aggregates reduced the Compressive Strength.
5. For Split Tensile strength and Flexural Strength the optimum replacement of cement were observed for 5%silica fume+20% rubber aggregates mix. Further increase in Silica fume and rubber aggregates showed a gradual drop.

Upon careful examination, a suitable proportion where optimum results in strength characteristics were obtained at 5%silica fume+20% rubber aggregates mix. Further investigation over Silica fume and rubber aggregates with extensive chemical characteristics could be tested for replacement in cement with higher proportion.

REFERENCES

1. K. C. Panda, P. S. Parhiand T. Jena "Scrap-TyreRubber Replacement for Aggregate in Cement Concrete: Experimental Study" 31(2012). ISSN 0974-5904, Volume 05, No. 06 (01) December2012, P.P.1692-1701.
2. G.SenthilKumaran, NurdinMushule And M.Lakshmipathy "A Review on Construction Technologies that Enables Environmental Protection: Rubberized Concrete" 1 (1): 40-44, 2008 ISSN 1941-7020.
3. El-Gammal, A., A. K. Abdel-Gawad, Y. El-Sherbini, And A. Shalaby "Compressive Strength of Concrete Utilizing Waste Tire Rubber" (JETEAS) 1 (1): 96-99 (2010).
4. Mohammad Reza Sohrabi, Mohammad Karbalaie"An Experimental Study of Crumb Rubber containing Concrete" Vol: 11 No: 03 (2011)
5. T.SenthilVadivel & R. Thenmozhi"Experimental Study on Waste Tyre Rubber Replaced Concrete - An Eco-friendly Construction Material" Vol: 8(6): 2966-2973, (2012).
6. N. J. Azmi, B. S. Mohammed, H. M. A. AlMattarneh"Engineering Properties of Concrete Containing Recycled Tire Rubber" ICCBT 2008 - B - (34) – pp373-382.
7. M.A. Aiello, F. Leuzzi, "Waste tyre rubberized concrete: Properties at fresh and hardened state, Waste Management". 30 (2010) 1696-1704.
8. Parveen, SachinDaas, Ankit Sharma "Rubberized Concrete: Needs of Good

Environment" Volume 3, Issue 3, March 2013) 192.
9. A.M. Ghaly, J.D. Cahill Iv, "Correlation of strength, rubber content, and water to cement ratio in rubberized concrete", Canadian Journal of Civil Engineering. 32 (2005) 1075-1081. 10.Is: 456 – 2000 (Fourth Revision) Indian Standard Plain and Reinforced Concrete Code of Practic
10. Deepika Rana1, Dr. G. P. Khare2, Mr. Dushyant Kumar Sahu3, "EXPERIMENTAL STUDY OF STRENGTH PROPERTY OF CONCRETE USING NANOSILICA", Volume: 05 Issue: 01 | Jan-2018, IRJET.
11. P Jaishankar and C Karthikeyan, "Characteristics of Cement Concrete with Nano Alumina Particles", IOP Conf. Ser.: Earth Environ. Sci. 80 012005.
12. S. Subburaj1 , P. Pon Dhivakar1 , M. Sathish Krishnan1 and M. Murugan2, :" EXPERIMENTAL STUDY ON STRENGTH PROPERTIES OF CONCRETE BY USING NANO SILICA", International Journal of Scientific & Engineering Research, Volume 7, Issue 5, May-2016
13. Karthikeya Rao.U1 and G.Senthil Kumar2," An Experimental Study on Strength Parameters of Nano Alumina and GGBS on Concrete", INTERNATIONAL JOURNAL FOR RESEARCH IN EMERGING SCIENCE AND TECHNOLOGY, VOLUME-3, ISSUE-4, APR-2016
14. Ehsan Mohseni and 2Konstantinos Daniel Tsavdaridis, "Effect of Nano-Alumina on Pore Structure and Durability of Class F Fly Ash Self-Compacting Mortar", American Journal of Engineering and Applied Sciences 2016, 9 (2): 323.333
15. Jitendra Patil1, Dr. Umesh Pendharkar2, "Study of Effect of Nanomaterials as Cement Replacement on Physical Properties of Concrete", International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 01 | Jan-2016.