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Influence of Silica Sand as Fine Aggregate in Fibre Reinforced Concrete

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ABSTRACT

The usage of alternative fine aggregate like silica sand is a natural step in solving a part of depletion of river sand. The research on alternative material for concrete making commenced earlier than half a century. Concrete made from silica sand as fine aggregate was studied for workability, compressive strength. Silica sand is made from crushing of quartz stone. Similarly, observe of its durability will make sure more dependability in its utilization. So here on this assignment, silica sand were used as substitute of fine aggregate for making concrete of M-20, with w/c ratio 0.45. The proportion substitute could be 100% with natural fine aggregates. For making M20 concrete opc-53 grade cement is used. Cubes has been casted and tested compressive strength.

1. Introduction

Every year lots of tones of waste substances are disposed at the valuable land which ends within the occupation and degradation of valuable land. Reducing of natural assets is a common phenomenon in developing countries like india because of fast urbanization & industrialization regarding construction of infrastructures.

Silica sand is acquired from the raw material (locally available in industries). After washing the raw material the silica sand is separated by sieve size 1.18 of raw material. Raw material is washed for taking away the clay material that's beneficial in making the tiles. Within the raw material approximately 10% is clay that's provided to the ceramic factories. From the raw material unique size of silica sand are separated by means of various size of sieve. Sand size of 30 mesh to 80 mesh (500 micron) is used inside the glass industries. Sand size 1.18mm to 600 micron can be utilized in making concrete blend as the partial substitute of fine aggregate. Almost about 200 tones of silica sand is acquired day by day after washing the raw material. Once in a while it's far used within the glass factories in any other case they unload them returned into the mines.

1.1 Steel Fiber Reinforced Concrete (Sfrc):

Steel fiber reinforced cement is a composite material having filaments as the more fixings,scattered constantly at abnormal in little charges, i.e. Within the location of 0.3p.cand 2.5% by means of volume in plain cement sfrc items are produced by means of including steel filaments to the elements of cement inside the blender and by means of replacing the green cement into molds. The item is then compacted and cured by the standard techniques. Isolation or balling is one of the issues skilled amid mixing and compacting sfrc. This should be maintained a strategic distance from for uniform appropriation of strands. The power required for mixing, passing on, putting and completing of sfrc is marginally better. Utilization of container blender and fiber gadget to useful resource higher mixing and to lessen the arrangement of fiber balls is fundamental. Extra fines and proscribing maximum intense length of totals to 20mm sometimes, bond substance of 350kg to 550kg for every cubic meter are meter are commonly required.

In a big part of the sector applications experimented with thus far, the span of the filaments shifts among 0.25 mm and 1.00mm in breadth and from 12 mm to 60 mm lengthy, and the fiber content went from zero.3 to two.5 percentage by way of quantity. Better demanding situations of fiber up to 10% have likewise been examined. Growth of steel filaments up to 5% by way of extent increased the flexural quantity to around 2.5 times that of plain concrete.

Innovation for this produce of sfrc light, medium and massive duty sewer vents covers has been created in india by way of structural engineering research center, chennai. Area explores extraordinary avenues concerning 2% of fiber content material confirmed that sfrc runway chunks may be around one a big part of the thickness of plain solid sections for the same wheel stack scope.

1.2 Advantages of Steel Fiber Reinforced Concrete

- Reinforcing concrete with steel fibers outcomes in durable concrete with a excessive flexural and fatigue flexural strength, advanced abrasion, spelling and effect resistance.
- The removal of traditional reinforcement, and in a few cases the reduction in phase thickness can make contributions to some substantial productivity enhancements. Steel fibers can supply substantial price financial savings, collectively with decreased fabric quantity, extra rapid construction and decreased labor charges.
- The random distribution of steel fibers in concrete guarantees that crack free pressure accommodation happens all through the concrete. As a result micro cracks are intercepted earlier than they increase and impair the overall performance of the concrete.
- Steel fibers are a far more most economical design opportunity.

1.3 Disadvantages

- Steel fibers will not float on the surface of a properly finished slab, however, rain damaged slabs allow both aggregate and fibers to be exposed and will present as aesthetically poor whilst maintaining structural soundness.

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- Fibers are capable of substituting reinforcement in all structural elements (including primary reinforcement), however, within each element there will be a point where the fiber alternative's cost saving and design economies are diminished.
- Strict control of concrete wastage must be monitored in order to keep it at a minimum. Wasted concrete means wasted fibers.

1.4 Effects of Steel Reinforced Concrete

Filaments are typically utilized as a part of cement to control breaking because of both plastic shrinkage and drying shrinkage. They like wise lessen the porousness of cement and in this way decrease seeping of water. A few sorts of strands created more prominent effect, scraped area and smash protection in concrete. For the most part filaments don't expand the flexural quality of cement thus can't supplant minute opposing or auxiliary steel support. Without a doubt, a few filaments really lessen the quality of cement. The measure filament added to the solid blend is communicated as a level of aggregate volume of the composite (cement and strands), named volume part (V f). V f regularly extends from 0.1% to 3%. Perspective proportion (1/d) is figured by isolating fiber length (1) by it distance across (d). Filaments with a non round cross area utilize a comparable width for the count of perspective proportion. Increment in the angle proportion of the fiber more often then not sections the flexural quality and the Sturdiness of the grid. Be that as it may, filaments which are too long tend to ball in the blend and make workability issues. Some current research demonstrated that utilizing strands in concrete has restricted impact on the effect protection of materials. This finding is essential since generally, individuals feel that the pliability increment when concrete is strengthened with strands. The outcomes additionally showed out that the utilization of miniaturized scale filaments offers better effect protection contrasted and more drawn out strands.

1.5 Steel Fibers in Concrete can improve:

- Crack, impact and fatigue resistance
- Shrinkage reduction
- Toughness- by preventing/delaying crack propagation from micro cracks to macro-cracks.

1.6 Applications

The primary sever civil engineering properties with the software program of SFRC have been achieved within the 1960s. However the, benefits of material have been not actually liked until a decade later. Considering the fact that that point, SFRC has decided sever applications on a winder scale. Furthermore the software of SFRC is usually growing. First of all, SFRC became used to construct runways of airport. In america,28 runways built of SFRC modified by 0. 3-2.0% of steel fiber of distinction kinds had been completed between 1972and1980 (lankard 1975). At some point of those 14 years of statement of the development tasks, most effective scarce cracks and neighbourhood damage had been located. Within the u.s., fiber strengthened concrete is used to restore surface of motorways and airports further to construct dams and canals (lankard 1975). These days it has been shot crate with the addition of metallic fiber that's gaining increasingly more recognition amongst constructors. Risky slopes, landslides, and road embankments were secured (SFRS), the mesh whose attachment and laying are time-ingesting, may be deserted. With traditional spraying of shot crate on to mesh, it often occurs that vibrate as spraying reasons grain of sand hit it. This in flip, hinders an exquisite bond many of the mesh and shot crate.

With the software of SFRS the dearth of fabric during the laying segment is reduced by means of 1/2 of in comparison with shot crate with out fibers. The utility of SFRS permits one to keep away from those technological troubles and extra over creates a opportunity of creating thinner sprayed layers, which concurrently are greater proof towards cracks.

1.7 Objectives of Study

Nowadays it is steel fiber that is for the maximum element used to strengthen cement and defeat the problem of weak point. This paper portrays the maximum charming usage of steel fibers fortified cements (SFRC) anywhere during the sector. Right off the bat, the creator reveals the improvement of steel filaments and SFRC. Additionally the paper covers the current importance of SFRC in structural constructing.

2. Literature Review

1)Vishnumanohar A (2015), carried out an experimental investigation on use of "Finely graded silica" (Eco sand, i.e. waste material from cement manufacturing process) as partial replacement of fine aggregate in concrete. Tests were carried out to find out the physical and chemical properties of finely graded silica and this finely graded silica was replaced with fine aggregate partially (15%,30%,45% & 60%). A mix of M25 and M40 concrete was selected for the replacement. The result obtained for M40 grade of concrete was 56.1 N/mm2 at 28th day and for M25 concrete was 32.07 N/mm2 at 28th day on 15% replacement of fine aggregate by ecosand. This shows that the maximum strength was achieved by 15% of fine aggregate replacement with eco sand in concrete. While increasing the percentage of eco sand the compressive strength value was getting decreased. From the SEM analysis, it was inferred that at a 15% replacement the mix remains homogeneous as the micro pores are filled and the transition zone was densified.

2)Sudhahar A (2012), carried out an investigation of extracted silica sand (EDS) wastes as fine aggregate in concretes and mortars. M25 grade of concrete has been used for study and it has been concluded that 15.5% of increase in compressive strength has been achieved with 50% replacement of fine aggregate with EDS on 28th day. Also the use of EDS is found to improve the packing quality inside the concrete and thus improves its permeability and durability.

3)L. Evangelista, J. De Brito, (2007)

They had studied on the use of fine recycled aggregates to partially or globally replace natural fine aggregates in the production of structural concrete. Six concrete mixes containing various contents of the fine recycled concrete 0, 10, 20, 30, 50, and 100% as a replacement to the fine sand were prepared. The results of the following tests are reported: compressive strength, split tensile strength, modulus of elasticity and abrasion resistance. From the result, it is reasonable to assume that the use of fine recycled concrete aggregates does not jeopardize the mechanical properties of concrete, for the replacement ratios up to 30%.

4)Rafat Siddique, Geert De Schutter, (2009):

They had studied on the use of used foundry sand in large volume; research is being carried out for its possible large-scale utilization in making concrete as partial replacement of fine aggregate. They evaluate the mechanical properties of concrete mixtures in which fine aggregate was partially replaced with used foundry sand. Fine aggregate was replaced with three percentages 10, 20 and 30% by weight. Compressive strength, splitting, flexural strength and modulus of elasticity were determined at 28, 56, 91 and 365 days. Increased in compressive strength varied between 8% and 19% depending upon UFS percentage and testing age, whereas it was between 6.5% and 14.5% for splitting – tensile strength, 7% and 12% for flexural strength and 5% and 12% for modulus of elasticity.

5)Her-Yung Wang, (2009):

They had studied the use of LCD glass as the Partial replacement of fine aggregate in concrete. The different mix designs were regulated by the ACI method with 0, 20, 40, 60 and 80% LCD glass sand replacements investigation:their engineering properties were determined.

Test results revealed that, when compared to the design slump 15cm, the 20% glass sand concrete for the three different mix designs kept good slump and slump flow. Furthermore, a slump loss ranging from 7 to 11 cm was observed for specimens with 60% and 80% glass sand replacements were higher of 28 and 35 MPa. The test results indicate that the addition of 20% LCD glass sand to concrete satisfies the slump requirements and improves the strength and durability of concrete.

6)Farid Debieb, Said Kenai, (2008):

They had studied recycling and reuse of building rubble present interesting possibilities for economy on waste disposal sites and conservation of natural resources. Either natural sand, coarse aggregates or both were partially replaced 25, 50, 75 and 100% with crushed brick aggregates. Compressive and flexural strengths up to 90 days of age were compared with those of concrete made with natural aggregates. Porosity, water absorption, water permeability and shrinkage were also measured. The result indicates that it is possible to replace 25% of coarse aggregate and 50% of fine aggregate gives results similar to natural aggregate.

3. Methodology

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

Table 1 .Methodology of experiment.

S.NO	% OF FIBRES	COMPRESSIVE STRENGTH					
		FINE AGGREGATE			SILICA SAND		
		7	14	28	7	14	28
1	0	3	3	3	3	3	3
2	1	3	3	3	3	3	3
3	2	3	3	3	3	3	3
4	3	3	3	3	3	3	3

In each batch 3cubes, were casted. Totally 72 cubes, were casted during entire experimentation.

3.1 Materials

The materials used this experimental work are cement, sand, water, steel fiber, and super plasticizer.

3.1.1. Cement

Ordinary port land cement of 53grade was used in this experimentation conforming to I.S-12269-1987.

Fig 2.Bharathi 53 grade cement.

3.1.2 Fine Aggregates

Locally open sand zone2 with specific gravity 2.65, water absorption 2% and fineness modulus 2.92, changing in accordance with I.S.-383-1970. It is the aggregate the lion's share of which passes 4.75mm IS sifter and contains simply such an extraordinary measure of coarser as is permitted by detail.

Fig 3. Fine aggregate.

3.1.3 Silica Sand

Silica sand is one of the most common varieties of sand found in the world. It is used for a wide range of applications, and can be purchased from various suppliers throughout the world. Silica sand is used in industrial processing, to make glass, as fill, and to create molds and castings.

Sand is the general term for broken down granules of minerals or rocks, technically between about one-sixteenth of a millimeter to two millimeters in diameter, falling between silt and gravel in the spectrum of sizes. There are many varieties of sand in the world, each with their own unique composition and qualities. The white sandy beaches of iconic tropical destinations, for example, are made up primarily of limestone that has been broken down, while many black sands are either volcanic in origin or contain magnetite. Other sands have high levels of iron in them, and so are rich and yellow in color.

The most common mineral in the Earth's continental crust is quartz, and most silica sand is made up of broken down quartz crystals. Silica is another name for silicon dioxide, SiO_2, of which quartz is a specific latticed structure. So silica sand is quartz that over the years, through the work of water and wind, has been broken down into tiny granules. These granules can be used for many different purposes, and can be found in most non-tropical regions of the world.

Fig 4.silica sand.

3.1.4 Coarse Aggregate

Squashed shake stones of 10mm measures having specific gravity of 2.70, fineness modulus of 2.73, conforming to IS383-1970 Aggregates are idle granular material, for instance, sand, shake or pounded stone that are a last out come in their own right. They are moreover the unrefined materials that are a fundamental settling in concrete. For a nice strong mix, aggregates ought to be spotless, hard, strong particles free of expended chemicals or coating of soil and other fine materials that could cause the rot of concrete.

Fig 5 .Coarse aggregate.

3.1.5 Water

By and large consumable water should be utilized. This is to ensure that the water is shoddy loosened from such pollutions as suspended solids, natural depend and broke down salts, which may furthermore antagonistically influence the home of the solid, particularly the setting, solidifying, vitality, solidness, pit expense, and numerous others.

Fig 6 . Water pouring in cement mix.

3.1.6 Steel Fibre

Stainless steel wire of 0.5mm distance across has been utilized as a part of the arrangement of SFRC. The steel fiber of length 40mm and of perspective proportion 80 has been utilized as a part of this exploratory work. All the steel filaments are tied down, snared, disintegrated fit as a fiddle.

Fig 7. Steel fibres in concrete.

The run of the mill distance across lies in the scope of 0.25-0.75mm snare end steel strands are being utilized as a part of this under taking. Length of these strands is 30mm and the angle proportion of 55. Thickness of steel fiber is 7900kg/cum

4 Results

4.3.Compressive Strength Of Concrete:

4.3.1.Normal Fine Aggregate

Table 4.Compressive strength of concrete (fine aggregate).

S.NO	% OF FIBRES	COMPRESSIVE STRENGTH		
		7 DAYS	14 DAYS	28 DAYS
1	0%	21.96	28.74	32.3
2	1%	24.219	31.56	35.1
3	2%	26.42	33.579	36.9
4	3%	25.04	31.759	34.6

Compressive Strength Graph Variation

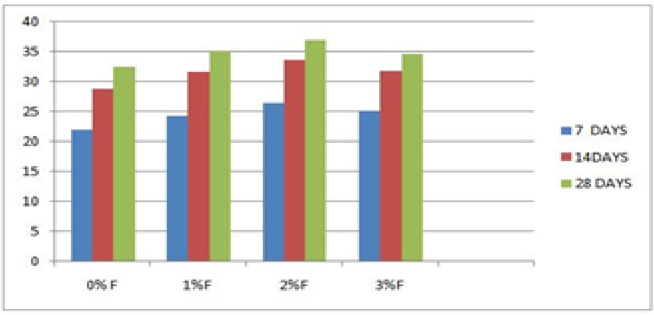

Fig 8 . Compressive strength graph variation of normal fine aggregate.

4.3.2. Silica Sand

Table 5 .compressive strength of concrete(silica sand).

S.NO	% OF FIBRES	COMPRESSIVE STRENGTH		
		7 DAYS	14 DAYS	28 DAYS
1	0%	36.4	43.1	45.5
2	1%	37.2	43.8	46.4
3	2%	38.69	43.9	47.18
4	3%	38.72	44.1	47.81

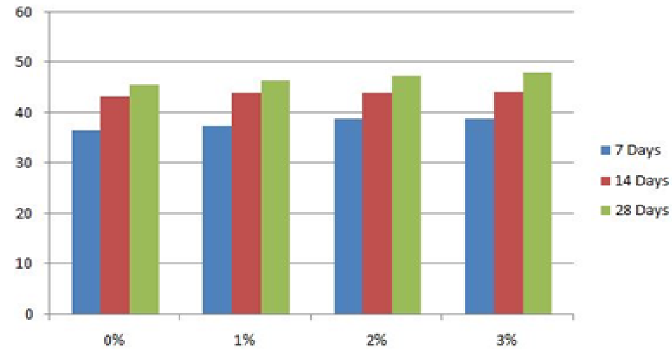

Fig 9. Compressive strength graph variation of silica sand.

4.1 Workability of Concrete with Normal Fine Aggregate

Table 2.Results on workability tests.

Sl.no	Test	Results	IS code used	Acceptable limit
1	Slump cone test	10 cm	AASHTO T 119	Less than 20 cm
2	Compaction factor test	0.911	IS 5515	Medium
3	Vee bee consistency test	20.45 sec	IS:1199	Medium

4.2 workability of Concrete With Silica Sand & Normal Fine Aggregate:

Table 3 .Results on workability tests with silica sand & Normal Fine Aggregate.

Sl.no	Test	With SILICA SAND	With NORMAL FINE AGGREGATE	IS code used	Acceptable limit
1	Slump cone test	10 cm	10 cm	AASHTO T 119	Less than 20 cm
2	Compaction factor test	0.81	0.911	IS 5515	Medium
3	Vee bee consistency test	24.6 sec	20.45 sec	IS:1199	Medium

4.3.3. Graph Results:

- 7days Compressive Strength Graph Variations Of Normal Fine Aggregate And Silica Sand:

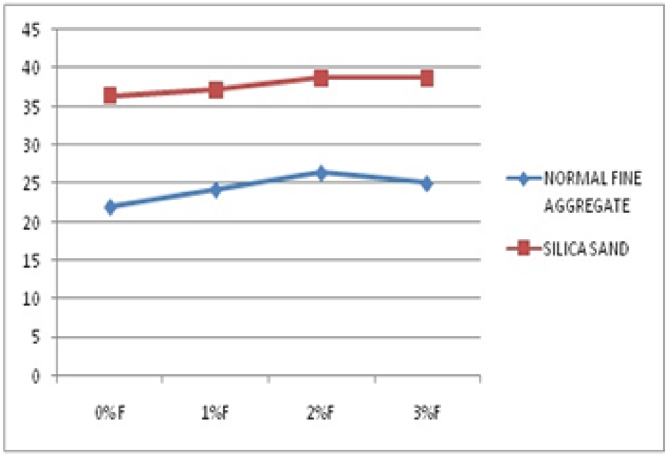

Fig 10 . 7 days compressive strength graph variations.

- 14 Days Compressive Strength Graph Variations Of Normal Fine Aggregate And Silica Sand:

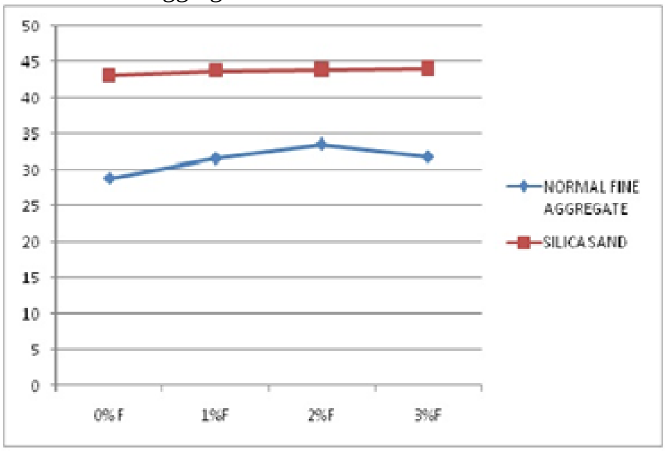

Fig 11. 14 days compressive strength graph variations.

- 28 Days Compressive Strength Graph Variations of Normal Fine Aggregate And Silica Sand :

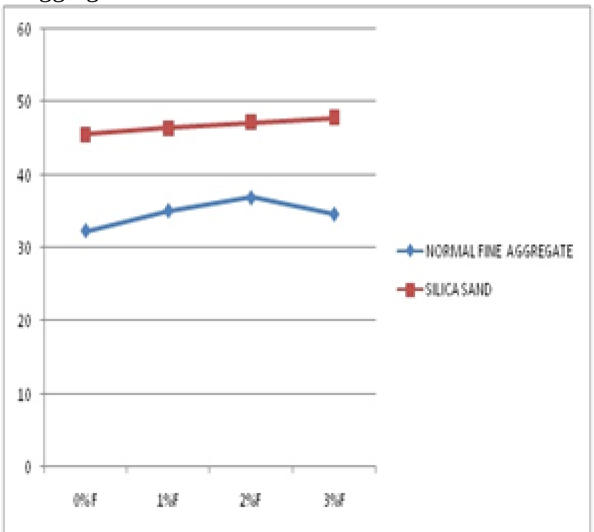

Fig 12. 28 days compressive strength graph variations.

4. Conclusion

Based totally on experimental studies for concrete made with complete replacement of fine aggregate by means of silica sand are performed, the test outcomes display certainly that quartz sand as a partial replacement of fine aggregate has useful consequences of the mechanical properties concrete & the subsequent conclusions are drawn at 28 days.

- The workability of silica sand is acceptable when compared to normal fine aggregate.
- As the % of fibres are increasing the compressive strength of silica sand concrete also increasing when compared to normal fine aggregate.
- Economically silica sand and normal fine aggregate are almost same.
- Silica sand can be used as fine aggregate which will act as good fillery material.
- Finally we can conclude that the replacement of silica sand with normal fine aggregate in concrete will give the beneficial results.

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