An Experimental investigation on Cement Concrete manufactured with Processed Sand as Partial Replacement to Manufactured Sand

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***Abstract*- Now a days the construction industry faces major problems is the easy availability of fine aggregate. Sand is a prime material used for preparation of concrete structures making nearly 40% of volume of concrete used in construction industry. The non-availability or shortage of river sand will affect the construction industry; hence there is a need to find the new alternative material to replace the present fine aggregate. Many researchers are finding different materials to replace sand, as a whole the studies main concerns on the environment and the construction. This paper deals with the possibility of fine aggregate to be replaced by processed sand in various proportions such as 0%, 20%, 40% and 60%. The aim of the project is to study the strength and durability performance of concrete made with fine aggregate and processed sand. The maximum compressive strength of concrete attained at 40% replacement of fine aggregate at 7, 14, and 28 days.**

***Index terms*- Processed sand, Fine aggregate, Compressive strength, Concrete.**

1. INTRODUCTION

Technology gets very important role in the improvement in new innovation and new materials are develops due to research and experimentation. Concrete is strong in compression and weak in tension the materials having some good advantages such as quality, strength, texture, material properties which give improves the performance.

Conventionally concrete is mixture cement, sand and aggregate. Properties of aggregate affect the durability and performance of concrete, so fine aggregate is an essential component of concrete. The most commonly used fine aggregate is natural river sand or pit sand. Fine and coarse aggregate constitute about 75% of total volume. It is therefore, important to obtain right type and good quality aggregate at site, because the aggregate form the main matrix of concrete or mortar

In past decade variable cost of natural sand used as fine aggregate in concrete increased the cost of construction. In this situation research began for inexpensive and easily available alternative material to natural sand. Some alternatives materials have already been used as a part of natural sand e.g. fly ash, slag limestone and siliceous stone powder were used in concrete mixtures as a partial replacement of natural sand. However, scarcity in required quality is the major limitation in some of the above materials. Now a day's sustainable infrastructural growth demands the alternative material that should satisfy technical requisites of fine aggregate as well as it should be available abundantly.

The present investigation of study the influence of addition waste materials. In this research work, the processed sand is used as a fine aggregate at different proportions (0%, 20%, 40% and 60%) by weight of cement will use. Evaluated and comparison of compressive strength, split tensile strength of concrete using M20 mix, water cement ratio 0.45 and test have been carried out as per recommended in relevant codes.

2. OBJECTIVES

- To investigate the application of Processed sand as fine aggregate.
- To replace the Fine aggregate by processed sand with the following percentages of 20%,40% and 60% using in M20 grade concrete.
- Fine aggregate can be replaced by the processed sand and the strength of concrete is to be tested and it is compared with conventional concrete with partially replaced concrete made of processed sand.

3. LITERATURE REVIEW

Priyanka A. Jadhav et.al (2012) has taken the review from his articles to determine the effect of water cement ratio on fresh and hardened properties of concrete with partial replacement of natural sand by manufactured sand using M20 mix. The concrete exhibits excellent strength with 60% replacement of natural sand, so it can be used in concrete as viable alternative to natural sand. Test results indicate the effectiveness of manufactured sand as a partial replacement of fine aggregate.

M Adams Joe et.al (2013)has done an experimental investigation on the effect of M-sand and determined that the M-sand is the perfect product for replacement for river sand by 100% in concrete by using high performance concrete and has gained 40 N/mm2 compressive strength in 28 days for 53 grade concrete.

P Daisy Angelin et.al (2015) 'Durability studies on concrete with manufacturing sand as a partial replacement of fine aggregate in HCL solution had anticipated that manufactured sand which can be utilized as an option fine aggregate in mortar and concrete. An endeavor had been completed in the current analysis to talk about the properties of concrete, workability and compressive strength of concrete, which was set up by supplanting natural sand with artificial sand at various level (0%, 20%,40%,60%,80% and 100%). The outcomes exhibit that the supplanting of natural sand with manufactured sand in order of 60% deliver cement of acceptable workability and compressive strength.

Biju Mathew et.al (2016) this paper presents a study conducted to determine the suitability of partial replacement of sand with laterite soil and manufactured sand in M20 grade concrete. The first phase is to find the maximum percentage of sand can replace with lateritic soil and manufactured sand for both M20 grade concrete. Concrete mixes containing 0,10,20,30, 40% sand replacement. Results show maximum of 20% replacement levels of sand by laterite attained workable concrete with satisfactory strength beyond that lateritic concrete is not workable and 40% replacement of sand by manufactured sand shows maximum strength. Mix proportion is taken as 1:1.5:3 based on the design result.

Xinxin Ding et.al (2017) Experimental study on long term compressive strength of concrete with manufactured sand had proposed test contemplates on compressive strength improvement of cement through manufactured sand. Impacts of stone powder substance on long standing compressive strength of concrete among various water-cement ratios, experiment comes about demonstrated that while substance of stone powder was under 13%, it fundamentally had affirmative connection with the long-standing compressive strength of manufactured sand concrete.

Dr. Dilip. K. Kulkarni et. al (2017) has determined the present work was to systematically study the effect of percentage replacement of manufactured sand by natural sand as 0%, 20%, 40%, 60%, 80% and 100% respectively on workability of concrete and the strength characteristics such as compressive strength, shear strength, of concrete. The study was carried out on M30 grade concrete with 0.45 water cement ratio. Manufactured sand can be used as fine aggregate, but it has to satisfy the technical requisites like workability and strength. On this aspect research on concrete with manufactured sand is scarce, so this paper an experimental investigation on properties of concrete produced with manufactured sand.

4. METHODOLOGY

4.1 Selection of material

- Cement
- Fine aggregate
- Coarse aggregate
- Processed sand

4.2 Testing of material

Cement [IS 4031-1968]
1 Fineness test
2 Standard consistency test
3 Specific gravity
4 Initial & final setting time

Fine aggregate
1 Specific gravity
2 Water absorption
3 Sieve analysis

Coarse aggregate (IS 2386 part 3, 1963)
1 Specific gravity
2 Water absorption
3 Sieve analysis
4 Impact test
5 Bulk density

Processed sand
1 Specific gravity
2 Water absorption
3 Sieve analysis

4.3 Concreting
The test cubes were casted in mix proportion of M20 grade by weight with water cement ratio of 0.45 respectively. The material was mixed in a hand mixer. First course aggregate and fine aggregate were added and mix thoroughly in a dry condition then cement and water added to get fresh concrete mix.

4.4 Casting of cubes
The cube mould was placed in position on an even surface. All the interior faces and sides were coated with mud oil to prevent the sticking of concrete to the mould. Concrete was poured into the mould using trowels. Hand compaction was done. The concrete was compacted into three layers.

4.5 Compaction
Hand operated compaction was done for all the cubes used in the test. The damping mild steel rods having were used to poke the concrete and to make compaction complete.

4.6 Curing of cubes
The test specimen was de mould after 24 hours of casting. The de mould specimen were immersed in the curing tank and store in place free from vibration and at a temperature of 270 C. the moulds were allowed to cure for 7 days, 14 days and 28 days.

4.7 Testing of cubes

Fig -1: Cube testing

Compressive strength test:
The compressive test is used to determine the hardness of cubical specimens of concrete. The test is carried out by placing the cube specimen in compressive testing machine. Then the load is applied until failure of cube along the vertical diameter. The failure load of the specimen is noted.

5. MATERIALS USED AND THEIR PROPERTIES

5.1 Cement
Cement is a binding material, which is the combination of raw material called calcareous and argillaceous materials. The most commonly used in an ordinary Portland cement. the type 1 is preferred according to IS 8112-1976, which is used for concrete structures. Out of the total production, ordinary Portland cement accounts for about 80-90%.

Fig -2: Cement
Table -1: Property test result for cement

Property test results for cement	
Property tests	Cement
Specific Gravity	3.14
Standard consistency	31%
Fineness of cement	8.3%
Initial Setting Time	40mins
Final Setting Time	215mins

5.2 Fine Aggregate

The material which is passed through 4.75mm IS sieve is termed as fine aggregate. The manufacturing sand is a substitute of river sand for concrete construction. The manufacturing sand is used as fine aggregate. M- Sand is produced from hard stone by crushing. The crushed sand is a cubical shape with ground edges, washed and graded to as construction materials. The size of manufacturing sand is less than 4.75 mm. The specific gravity and fineness modulus of this M- Sand where found to be 2.66 and 2.56 respectively. The percentage of passing is within the limits as per IS: 383:1970.

Fig -3: M-sand

Table -2: Property test result for M-sand

Property test results for m- sand		
Property tests	Fine Aggregate	Standard Value
Specific Gravity	2.45	2.65
Sieve Analysis	2.39	2
Water absorption	1.86%	-

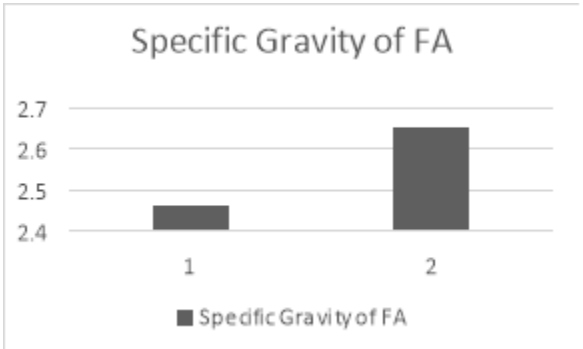

Chart -1: Specific gravity of FA

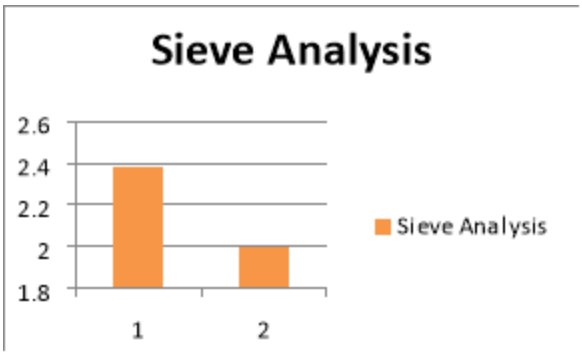

Chart -2: Sieve analysis of FA

5.3 Coarse aggregate

The material which is retained on IS sieve 4.75mm is termed as coarse aggregate. The nature of work decides the maximum size of the coarse aggregate, the maximum size of 20mm 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 as per Indian Standards Specification IS:2386-1963.

Fig -4: Coarse aggregate

Table-3: Property test results for coarse aggregate

Property test results for coarse aggregate	
Property tests	Natural coarse Aggregate
Specific Gravity	2.76
Fineness modulus	4.54
Impact value	15.9%
Bulk Density	1691kg/m^3

5.4 Processed sand

Processed sand is a substitute of river sand for concrete construction. Processed sand is produced from the wastage after sand processing, which is also known as engineered sand. The specific gravity and fineness modulus of the processed sand is 2.42 and 3.02.

Fig -5: Processed sand

Table -4: Property test result for processed sand

Property Test results for processed sand	
Property Tests	Processed sand
Specific gravity	2.61
Fineness modulus	3.02
Water absorption	1.61%

6. MIX DESIGN

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically possible. The main objective is to stipulate the minimum strength and durability. It also reveals the relation between aggregate and paste. The other condition being equal, for workable mixes the strength of concrete varies as an inverse function of the water/cement ratio. Since the quantity of water depend upon the amount of paste, it is important that as little paste as possible should be used and hence the importance of grading.

6.1 M_{20} Concrete Mix Design – IS 10262-1982

Table -5: Test data for material

Test data for material				
Property tests	cement	Coarse aggregate	Fine aggregate	Processed sand
Specific gravity	3.15	2.76	2.65	2.61
Water absorption	0.215%	4.69%	1.86%	1.61%

6.2 Mix Proportions

- Cement – 255 kg/m^3
- Water – 170 kg/m^3
- Fine aggregate – 383.5 kg/m^3
- Coarse aggregate – 765 kg/m^3
- Water /cement ratio – 0.45

7. CASTING OF SPECIMEN

Cubes: 150x150x150mm

The specimens were casted in the laboratory. Steel moulds were used for casting. Required quantities of cement, fine aggregate, coarse aggregate and bakelite is weighed and mix is prepared according to the M20 mix proportions. The mix is poured into the cube mould and compacted by using tamping rod. The specimen is kept for 24 hours and curing is done for 28 days.

8. TESTING OF SPECIMENS

Compressive strength test:

The compressive test is used to determine the hardness of cubical specimens of concrete. The cubes specimens were casted for the comparison of test result of processed sand added specimens. One set of specimens were taken out of the curing tank at the 7 days period of completion the remaining specimens are taken after the 14 and 28 days period of completion. The processed sand added in concrete at four different ratios they are 0%, 20%, 40%& 60% the test results of the conventional specimens are compared with Processed sand added specimens.

Fig-6: Compressive strength

Table-5: Test results of conventional concrete

Test days	Strength of cubes in N/mm^2
7 days	13
14 days	19.11
28 days	21.6

Table-6: Test results of partial replacement of fine aggregate with processed sand

% of Fine aggregate with processed sand	Strength of cubes in N/mm^2		
	7 days	14 days	28 days

20%	25	25.22	26.2
40%	26.61	27.43	28.44
60%	18.22	19.11	21.7

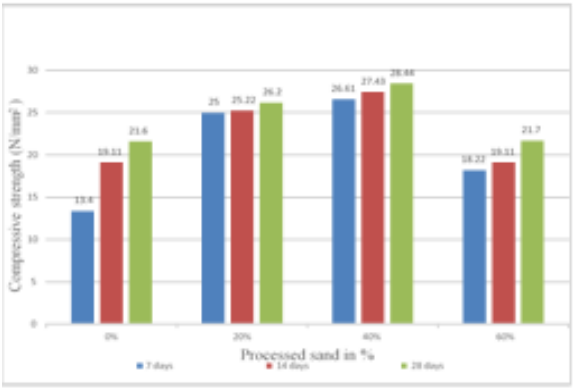

Chart -3: Compressive strength test

9. RESULT & DISCUSSION

- The performance of partially replacement of fine aggregate with Processed sand in M20 grade concrete in quite encouraging up to 40% replacements nearly achieves the target mean compressive strength.
- Accordance with the graphical representation it is very clearly known that 40% replacement of fine aggregate with waste processed sand.

10. CONCLUSION

- Addition of Processed sand improves the compressive strength. Maximum value of cube compressive strength and split tensile strength of cylinder in concrete attains by mix 40% of Processed sand the result varies depends on their mix proportions of concrete and its properties of Processed sand.
- Compressive strength decreases when the percentage of replacement of processed sand increases by 60%.

11. ACKNOWLEDGEMENT

The authors thanks Anumol N, Ayyappan V, Daniel Jayakumar P and Saran Kumar M the students of final year Civil Engineering, Rathinam Technical Campus, Eachanari, Coimbatore for their support in bringing out this article.

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