

Experimental Investigation of Partial Replacement of Sand by Using Sapindus Mukorossi (Inside Nuts)

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ABSTRACT: Concrete is the most material being used in infrastructure development throughout the world. Sand is a prime material used for preparation of mortar and concrete and which plays major role in mix design. Natural or river sand is weathered particles of rocks and are various grades or size depending upon the amount of wearing. Now a day's good sand is not readily available, it is transported from a long distance. Those resources are also exhausting very rapidly. 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 river sand, such that excess river erosion and harm to environment is prevented. Many researchers are finding different materials to replace sand. This study aimed to investigate the suitability of using crushed inside nuts of Sapindus mukorossi (soap nut without top shell) in concrete. Sapindus mukorossi is a species of tree, crushed Sapindus nuts was crushed in the laboratory and added partial sand replacement. Three replacement levels, 2.5%, 5%, 7.5%, and 10 % were compared with the control. The test on concrete showed that the mechanical properties (compressive, flexural and split tensile strengths) of concrete

KEYWORDS: Concrete, Sapindus, compressive strength, flexural strength, split tensile strength.

I.INTRODUCTION

Concrete is one of the oldest and the most widely used construction material in today's world. It is easily obtainable, relatively cheap, strong, and durable. On the other hand, the concrete industry is one of the major consumers of the natural resources. The annual concrete production is estimated as 11 billion metric tons, 70-75% of the number is aggregate (mostly natural rock); 15% is water; and 10-15% is cementations binder. The demand for aggregate is enormous in liberalization, privatization and globalization, and in the construction of important infrastructure projects like expressways, airport, nuclear plants etc. the increased extraction of coarse and fine aggregate from the natural resources is required to meet this high demand. The increasing use of natural fine aggregate creates an ecological imbalance. Thus, partial replacement of fine aggregate is vital in construction industries. replacement of sand by ceramic waste in concrete, this investigated by G.Sivaprakashet.al.[1]. Researcher and engineers have come out with their own ideas to decrease or fully replace the use of river sand and use recent innovation such as M- sand (manufactured sand), robot silica or sand. partial replacement on sand with crushed brick in concrete, this investigated by M.Usharani.al.[2]. stone crusher dust, filtered sand treated and sieved silt removed from reservoir as well as dams besides sand from other water bodies now a day's sustainable infrastructure growth require the alternative material that should satisfy technical requisites of fine aggregate as well as it should be available locally with large amount.

II.MATERIAL PROPERTIES

2.1 Cement:

Cement may be prescribed as material with adhesive and cohesive properties which make it capable of bonding material fragments into a compact whole. The most commonly used cement in construction today is Portland cement and hence ordinary Portland cement of 53 grades has been selected for the investigation. It is dry, powdery and free of lumps. The cement according to the Indian specification must satisfy the IS code 12269- 1987

Table 2.1 Physical properties of (OPC) cement

Property	IS code (IS: 12269-1987)
Specific gravity	3.15
Consistency	29%
Initial setting time	30 minutes
final setting time	600 minutes
Fineness modulus	8%

2.2 Fine aggregate:

Fine aggregate is an essential component of concrete. Those fractions from 4.75mm to 150mm microns are termed as fine aggregate. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent. The natural fine aggregate are the river sand which is the most commonly used natural material for the fine aggregates that's is used, but the recent social factor that created a shortage of the material created a great problem in the construction sector.

Table 2.2 Physical properties of fine aggregate

Properties	Result
Specific gravity	2.62
Water absorption	0.94

2.3 Coarse aggregate:

The fractions from 20mm to 4.75mm are used as coarse aggregate. Machine crushed angular granite metal of 20mm nominal size from the local sources was used as coarse aggregate. The coarse aggregate chosen for concrete was typically angular in shape, well graded, and smaller than maximum size suited for concrete. The physical properties of coarse aggregate were investigated in accordance with IS383-1963.

Table 2.3 Physical properties of coarse aggregate

Properties	Result
Specific gravity	2.72
Water absorption	0.4



2.4 Sapindus mukorossi:

Sapindus mukorossi is a species of tree in the sapindaceae family. The fruit is commonly known as Indian soapberry or wash nut, and like other species in the genus Sapindus, it is called soapberry. It is also a native of western coastal Maharashtra- Kohan and Goa in India. Sapindus mukorossi, known as Rita or reetha tree in Nepal, is a deciduous tree that is grown in the lower foothills and midhills of the Himalayans, up to altitudes of 4000 feet. It is tolerant to reasonably poor soil, can be planted around farmer’s homes, and one Rita tree can produce 30-35kg of fruit per year.

Table 2.4 Physical properties of Sapindus mukorossi

Properties	Result
Specific gravity	2.63
Water absorption	19

2.5 Super plasticizer:

Super plasticizers are high range water reduced agent which is capable of removing excess water that does not take part in hydration process without alternating the strength of the concrete. Super plasticizer confirmed by IS: 9103-1999. Super plasticizer are used to reduce the amount of water by 12% to 30% while maintaining certain level of consistency and workability for reduction in w/c ratio.

III. TESTING ON FRESH CONCRETE

3.1 Slump cone test: It is one of the best methods for finding workability of fresh concrete. More specially, it measures the consistency of the concrete in that specific batch. It is also used to determine consistency between individual batches. The test is popular due to the simplicity of apparatus used and simple procedure.



3.2 Vee-Bee consistometer: Vee – bee consistometer test is to determine the workability of freshly mixed concrete. The Vee- bee test gives an indication about the mobility and the compatibility aspect of the freshly mixed concrete.



3.3 Flow table test: The flow table test or flow test, also known as the slump flow test, is a method to determine consistency of fresh concrete. Flow table test is also used to identify transportable moisture limit of solid bulk cargoes. It is used primarily for assessing concrete that is too fluid(workable) to be measured using the slump test, because the concrete will not retain its shape when the cone is removed.



IV.MIX DESIGN

4.1 General: Based on the water quantity, cement, fine aggregate and coarse aggregate required for design mix of M40 were calculated based on the procedure given in IS code method in IS: 2009. The final mix ratio was 1:2.35:3.3 without replacement and 1:1.76:3.3 for with replacement and with water cement ratio of 0.4. The measurement of material was done by weight using electronic weighing machine. Water was measured in volume. Concrete was placed in moulds in layers. The cast specimens were removed from moulds after 24 hours and the specimen were kept for water curing.

Table 4.1(a) Mix proportion without partial replacement

Sl.NO	Ingredient	Kg/m ³	Proportion
1	Cement	350	1:2.35:3.3
2	Water	140	
3	Fine aggregate	825	
4	Coarse aggregate	1164	
5	Chemical admixture	7.1	
6	Water-cement ratio	0.4	

Table 4.1(b) Mix proportion with partial replacement

Sl.NO	Ingredient	Kg/m ³	Proportion
1	Cement	350	1:1.76:3.3
2	Water	140	
3	Fine aggregate	618.75	
4	Coarse aggregate	1164	
5	Chemical admixture	7.1	
6	Water-cement ratio	0.4	

V.MECHANICAL PROPERTIES

5.1 Compressive strength test:

The cube compressive strength of concrete was determined by conducting test on 150 mm × 150 mm × 150 mm cube specimens were tested on compression testing machine and the values obtained.

5.2 Split tensile strength test:

Concrete has relatively high compressive strength, but significantly lower tensile strength. As a result, without compensating, concrete would almost always fail from tensile stresses- even when loaded in compression. The practical

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implication of this is that concrete elements subjected to tensile stresses must be reinforced with materials that are strong in tension.

5.3 Flexural strength test:

Flexural strength is one measure of the tensile strength of concrete. It is a measure of a un reinforced concrete beam

or slab to resist failure in bending, Flexural strength = $\frac{Pl}{bd^2}$



VI.RESULTS AND DISCUSSION

6.1 General:

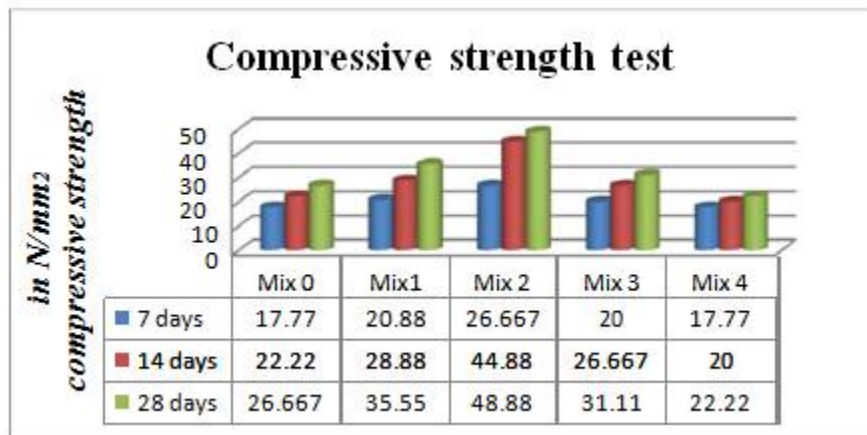
This chapter deals with the results obtained from the various experiments conducted to access mechanical properties. The aim of study is to determine the compressive strength and split tensile strength and flexural strength. So the results of test specimens are presented.

6.1.1 Compressive strength test:

The compressive strength of replacement of sapindus mukorossi is arrived. The compressive strength value for replacement of Sapindus in table.

Table 6.1.1 Compressive strength of cubes with partial replacement of Sapindus

S.NO	Mix No	Compressive Strength in N/mm ²		
		7 days	14 days	28 days
1	M0 - 0%	17.77	22.22	26.66
2	M1 -2.5%	20.88	28.88	35.55
3	M2 -5.0%	26.66	44.88	48.88
4	M3 -7.5%	20	26.66	31.11
5	M4 -10%	17.77	20	22.22



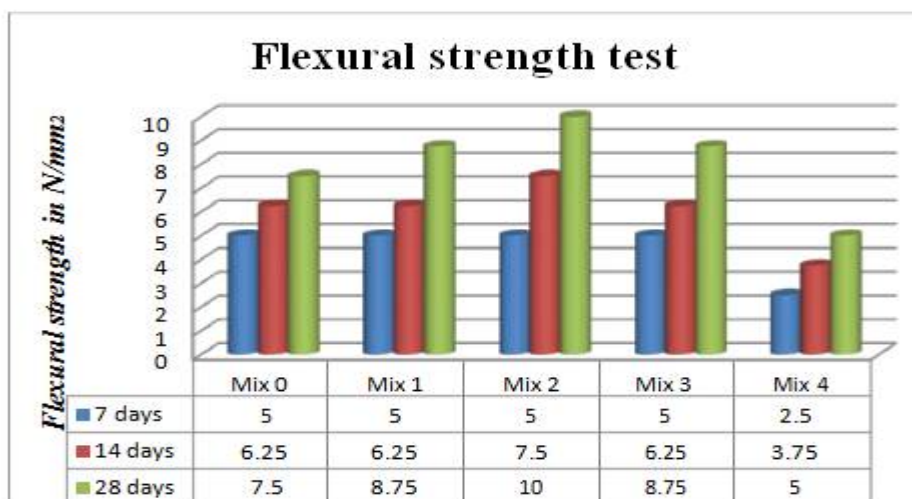
6.1.2 Flexural strength test:

The flexural strength of replacement of Sapindus mukorossi is arrived.

Table 6.1.2 Flexural strength of beams with partial replacement of Sapindus

S.NO	Mix No	Flexural strength N/mm ²		
		7 days	14 days	28 days
1	M0 - 0%	5	6.25	7.5
2	M1 -2.5%	5	6.25	8.75
3	M2 -5.0%	5	7.5	10
4	M3 -7.5%	5	6.25	8.75
5	M4 -10%	2.5	3.75	5

Flexural strength test

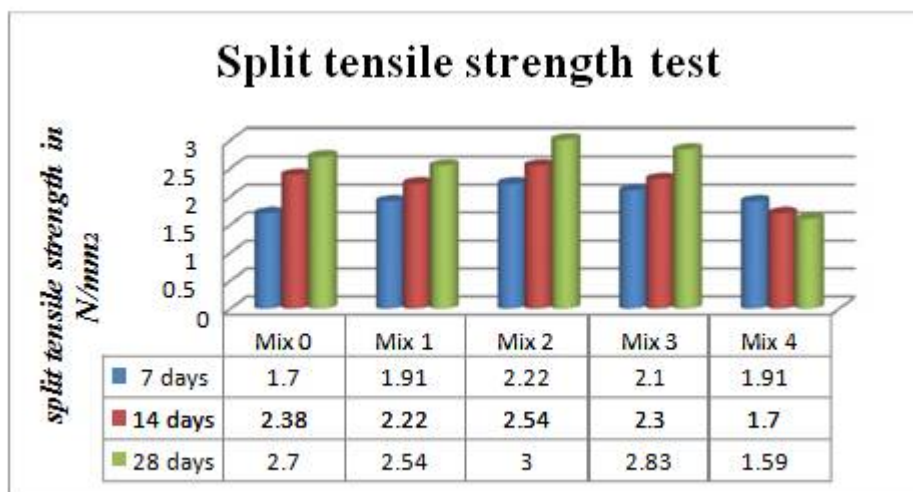


6.1.3 Split tensile strength test:

The variation of split tensile strength at 28 days with different percentage of Sapindus mukorossi. From the results it was observed that the maximum split tensile strength was obtained for mix of 5% replacement of Sapindus.

Table 6.1.3 Split tensile strength of cylinder with partial replacement of Sapindus

S.NO	Mix No	Split tensile strength N/mm ²		
		7 days	14 days	28 days
1	M0 - 0%	1.7	2.38	2.70
2	M1 -2.5%	1.91	2.22	2.54
3	M2 -5.0%	2.22	2.54	3
4	M3 -7.5%	2.1	2.3	2.83
5	M4 -10%	1.91	1.7	1.59



VII.CONCLUSION

Followings conclusion and recommendation are made based on the study conducted

1. The test result shows clearly that the resized Sapindus mukorossi inside nut can be used as replacement materials for river sand in concrete.
2. The concrete with 2.5%, 5% and 7.5%, 10% replacement satisfies the compressive strength of M40 grade however higher percentage of resized Sapindus mukorossi inside nut increase the strength of normal concrete
3. In this experimental investigation 2.5%, 5% partial replacement of sand by resized Sapindus mukorossi inside nut considerably increase the compressive strength and also 7.5%, 10% partial replacement of sand by resized Sapindus mukorossi inside nut decreases the compressive strength.

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4. From this experimental investigation it is evident that the strength of concrete considerably increased in the replacement of sand with the resized Sapindus mukorossi.
5. Resized Sapindus mukorossi inside nut substitution generally result in favorable outcomes and is highly recommended for all concrete mixes.

The replacement of sand with resized Sapindus mukorossi inside nut shows an improved in compressive strength of concrete as well as decreased in compressive strength.

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