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AN EXPERIMENTAL STUDY ON STRENGTH OF CONCRETE WITH PARTIAL REPLACEMENT OF COARSE AGGREGATE AND FINE AGGREGATE WITH RCA AND SILICA FUME

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Abstract: Now a days increase in population increases the demand of concrete for construction purpose and Aggregates are the important constituents in concrete. Re-use of demolition waste avoids the problem of waste disposal and is also helpful in reducing the gap between demand and supply of fresh aggregates. This research deals with partial replacement of natural coarse aggregates (NCA) with recycled coarse aggregates (RCA) of age group 15, 25 & 35 years in different proportions like 20%, 30%, 40%. For this, M20 grade of concrete is adopted. Curing of specimens were done for 7days and 28 days to attain the maximum strengths. Partial replacement of fine aggregate with Silica Fume at 5%, 10%, 15% were done to gain more strength. After casting the specimens of RCA with Silica Fume replacement, curing was done and the specimens were tested for compressive and tensile strengths.

Obtained results of compressive and tensile strengths of RCA concrete mix were compared with conventional concrete. In this direction, an experimental investigation of compressive and tensile strength was undertaken to use RCA as a partial replacement in concrete. It was observed that the concrete with recycled aggregates of 15,25, & 35 years age group achieved maximum compressive strength and Split tensile strength at 40% Replacement of NCA with 15yrs RCA, at 15 % replacement of NCA with 15yrs RCA and replacement of Fine aggregate with Silica Fume, at 30 % for Replacement of NCA with 25yrs RCA, at 15% for Replacement of NCA with 25yrs RCA and replacement of Fine aggregate with Silica Fume, at 20 % for Replacement of NCA with 35yrs RCA.

Keywords: Natural Coarse Aggregate, Recycled Coarse Aggregate, Silica Fume.

Introduction

General:

Generally, concrete consists of essentially 3 components: water, sand or gravel, and cement, each of which has its own distinctive characteristics and longevity.
In addition, the use of natural aggregates should be limited in order to address this shortage and expensive fine accumulation of well-deserved substitute products.

The recycling of old concrete into an aggregate is a relatively quick operation, requiring the splitting, removal or grinding of existing concrete into a specified consistency and size content. Previous experiments have shown that such RCA can succeed in using natural gross aggregates to manufacture standard and highly resistant concrete. By providing possible diversion of valuable goods out of waste streams, reducing energy expenditure in production of new products, conserving natural resources and alleviating emissions the use of such recycled materials provides several environmental advantages.

The specialized RCA weight is less than natural aggregates, since the adhered RCA mortar has a greater water absorption ability. The consistency of the primary concrete crushed depends heavily on the properties of concrete manufactured with RCA. The first section of the chapter discusses the amount and age of the recycling of RCA and its impact on RCA concrete mechanical properties.

Different inspectors found that RCA concrete has fewer physical and mechanic properties than traditional NCA concrete.
The usage in the building industry of demolished concrete Silica Fume is more holistic, as it helps to stabilize the climate. The use of these waste materials in the building industry is however, extremely difficult, in particular in the manufacture of concrete. There must be significant research attempts to explore the technical properties of concrete made from such toxic waste. Present study is aimed at studying the properties of cement containing industrial waste, including demolished concrete and Silica Fume.

Cement has sticky and cohesive properties that allow it to bind the fragment of minerals to a firm mass. The ingredient for motor and ground cement is typically often manufactured from lime stone by slimming and calcining to create fine powder, which is blended with the intern. Cement is often available for general use in the globe. The mixture of the standard Portland cement and not more than 65% of granular slag are characteristic of the Portland slag cements. It is widely accepted that the hardness of slag cement was marginally less within the first 28 days than the hardening rate of ordinary Portland cement, but after that it improved so that the strength of 12mounts would be nearly or even higher than that of Portland cement. The cement is more resistant to sulfate than the cement of Portland.

Fine Aggregates:

As the unit is sieved to a sieve of 4.75mm, the unit was called as a fine unit across it. The fine aggregate is natural sand and this group also contains silt and clay. The purpose of the fine aggregate is to fill the vacuums in the ground compound and to serve as an agent.

In this scheme, industrial waste from the Silica Fume factories will substitute sand. Compare it to sand, it is really fine stuff. The gravity is extremely specific.

Coarse Aggregates:

If the aggregate is tamed by a sieve of 4.75 mm, the preserved aggregate is referred to as a coarser aggregate. Based in certain circumstances, the overall scale aggregate used. 20 mm aggregates are typically used for average resistance and 40 mm used for high resistance concrete.

Objective of the study:

1. The main objective is to study the strength of concrete with partial replacement of coarse aggregates with recycled coarse aggregates.

2. The strength of Recycled aggregates of age groups (10,20&30 years) are examined and by depending upon the achieved strength values, the use of recycled aggregates in construction works is preferred upto some extent.(i.e partial replacement)

3. And to attain better strength, partial replacement of fine aggregate is done with Silica Fume of three percentages (i.e 5%, 10%, 15%&20%).

4. The specimens were casted according to specifications and those strength values have been examined which are cast for 7days and 28days curing of M20 grade.

Methodology and Results

Cement: We performed a significant number of experiments on cement, in order to know the cement specifications. The cement used is

Portland slag cement (PSC) in compliance with IS: 455–1989 These measures include precise intensity, fineness, accuracy, and beginning and finish time, compressive strength and fitness. The test results are as follows,

Portland Slag Cement Test Results:

S.no	Tests	As per code IS(455:1998)	Results
1	Fineness	>90%	96%
2	Specific Gravity	3.0-3.15	3.12
3	Normal Consistency	28%-36%	34%
4	Soundness	<10mm	1 mm
5	Initial Setting Time	>30 min	40 min
6	Final Setting Time	<650 min	572 min

Aggregate Test Results for NCA

S.No	Property	Results	As per IS code(2386 part IV)
1	Impact Test	26.25%	20%-30%
2	Crushing Test	26.10%	Below 30%
3	Specific Gravity	2.62	2.5-3.0

Aggregate Test Results for RCA

S.No	Property	15 years old	25 years old	35 years old	As per IS (2386 part IV)
1	Impact Test	19.68%	17.15%	14.33%	Below 30%
2	Crushing Test	17.45%	17.05%	16.64%	Below 30%
3	Specific Gravity	2.70	2.64	2.64	2.5-3

Test Results of Fine Aggregate

S.no.	**Property**	**Sand**	**Silica Fume**	As per IS 383:1970
1	Specific Gravity	2.64	2.61	2.5-3
2	Sieve Analysis	2.48	2.43	-

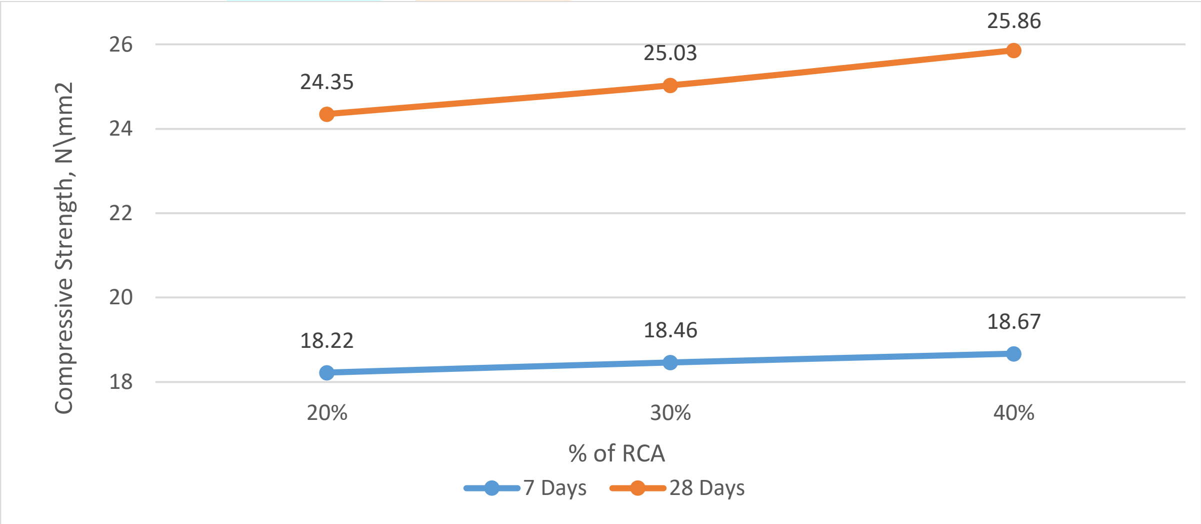
COMPRESSIVE STRENGTH TEST

Concrete is a composite substance consisting of the composite material (cement), sand and coarse aggregates combined with the required water proportion. Concrete for all forms of construction in present days is commonly used building material

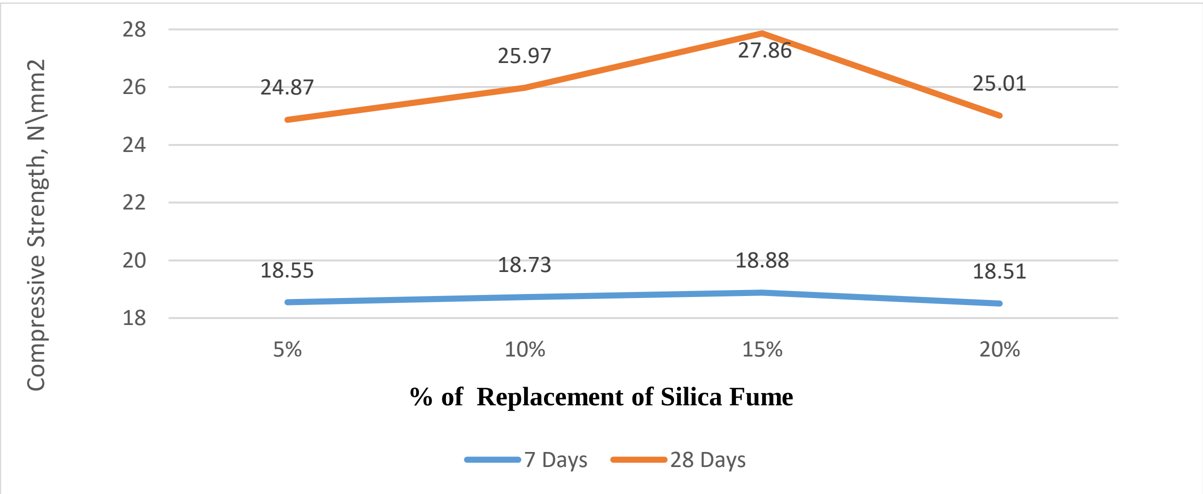
For concrete, separate replacements of recycled aggregates are done for 7, 28 days of curing, measures such as compressive strength and divided tensile strength. The specimens are tested for seven, 28 days and 20%, 40% for reclaimed coarse aggregate replacement rather than natural coarse aggregate, and 10% for Silica Fume replacement 15% instead of natural river sands. 10% for Silica Fume.

Compressive Strength (MPa) = Failure load (N) / cross-sectional area (mm2)

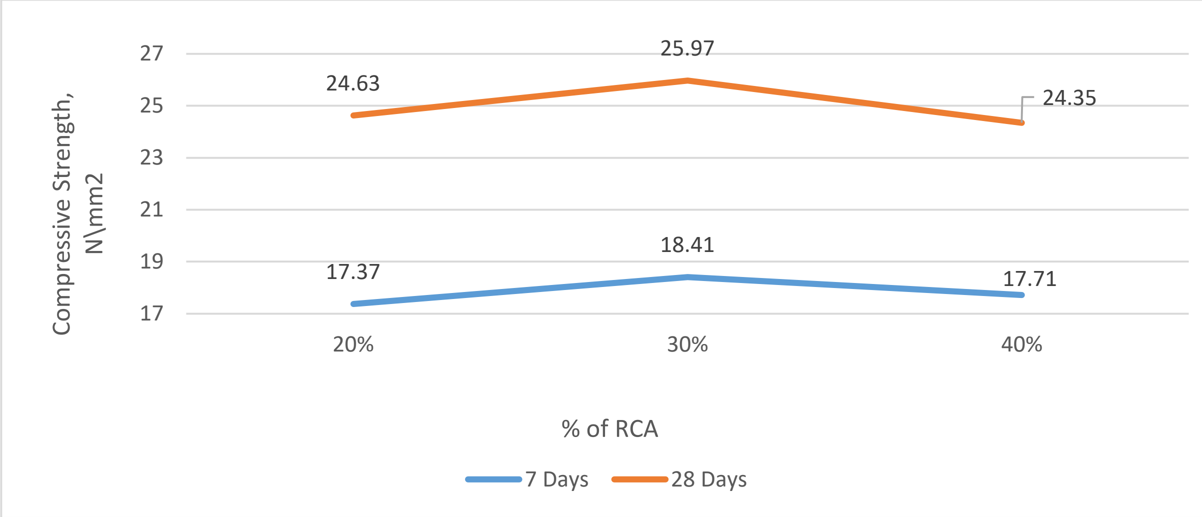
Compressive Strength for Replacement of NCA with 15yrs RCA



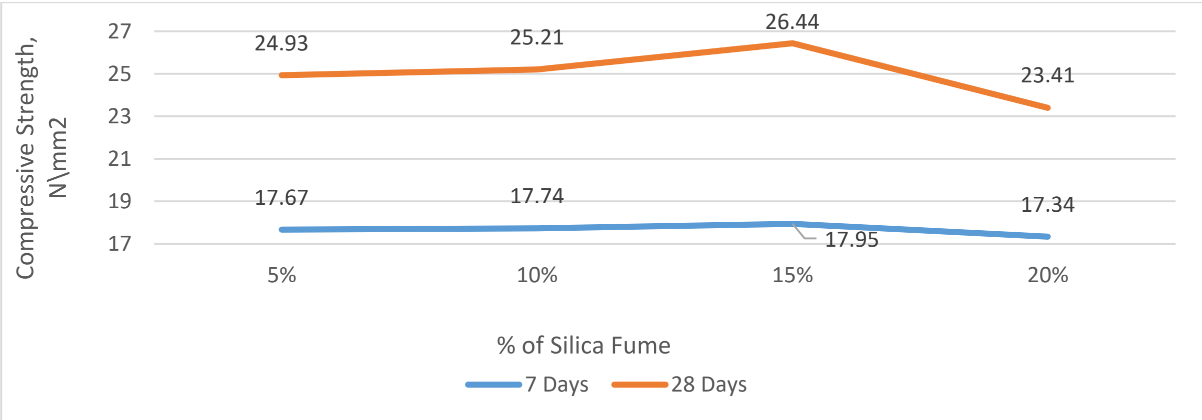
Compressive Strength for Replacement of NCA with 15yrs RCA and replacement of Fine aggregate with Silica Fume



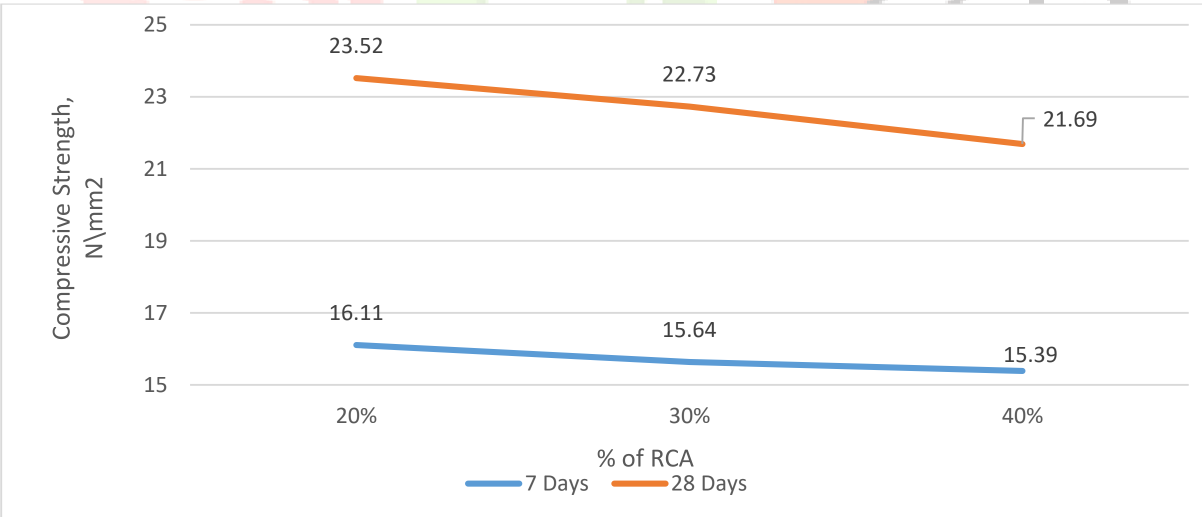
Compressive Strength for Replacement of NCA with 25yrs RCA



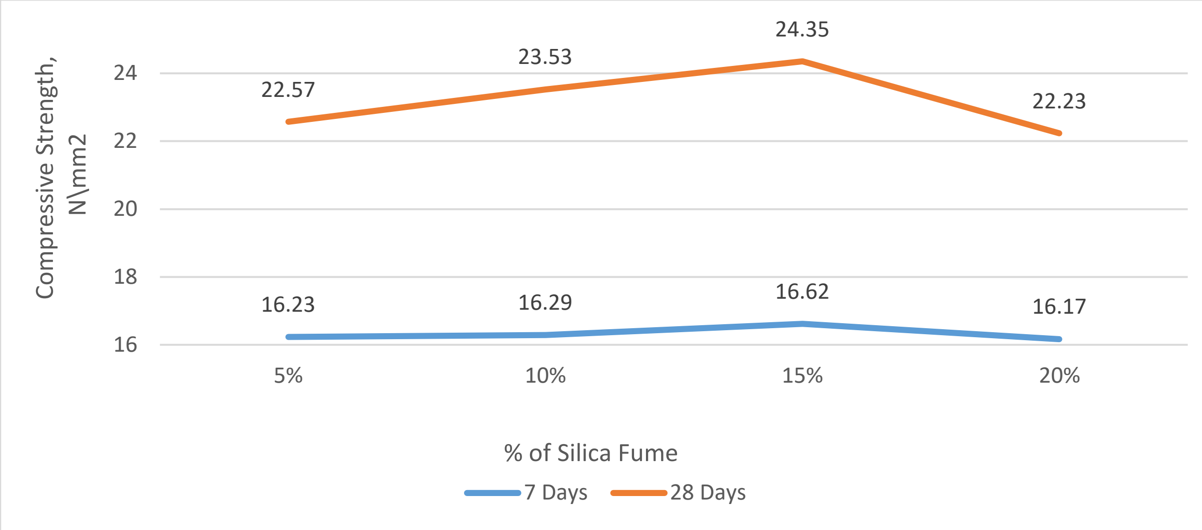
Compressive Strength for Replacement of NCA with 25yrs RCA and replacement of Fine aggregate with Silica Fume



Compressive Strength for Replacement of NCA with 35yrs RCA



Compressive Strength for Replacement of NCA with 35yrs RCA and FA with Silica Fume



SPLIT TENSILE STRENGTH:

The tensile strength of concrete is very low and hence it is not taken into account the design of reinforced concrete.

But it is an important property which affects the extent and width of cracks in the structure

According to IS: 456-2000 the tensile strength of concrete can be calculated from the compressive strength using the compressive strength using the following reaction

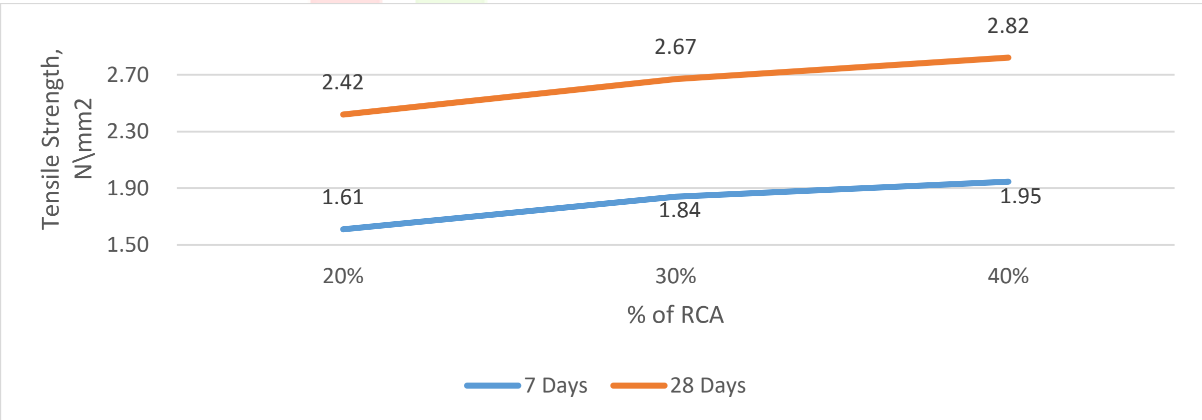
fcr= 0.7 x (fck)1/2 N/mm2

Where fckis the characteristic compressive strength of concrete

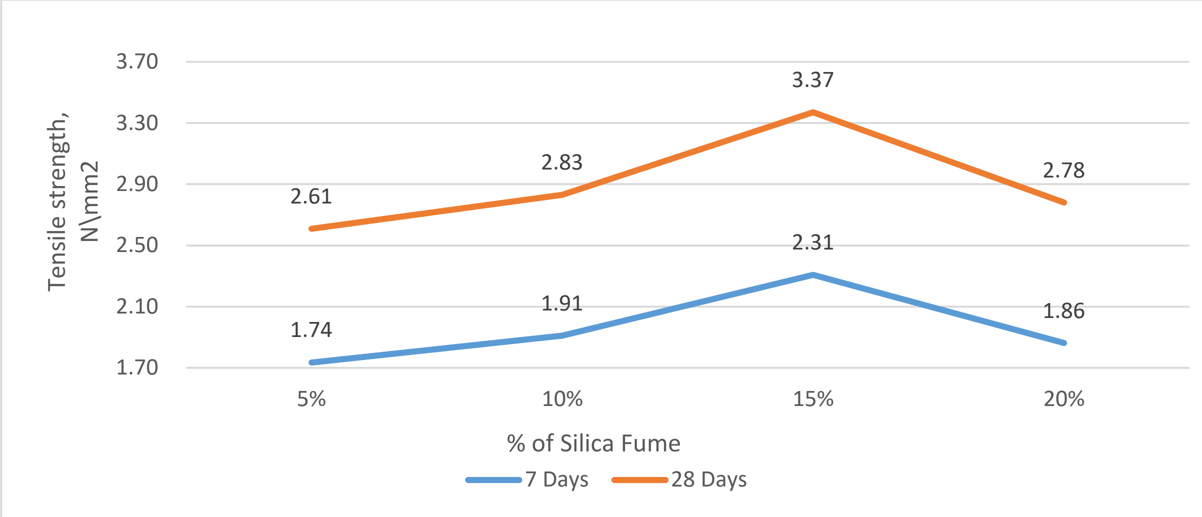
Concrete specimen cylinders are used to determine the split tensile strength of concrete and were tested as per IS: 516-195917.

The load applied without shock and increased continuously at a nominal rate within the range 1.2N/mm2 to 2.4N/mm2 until failure of specimen, the failure at the load is noted

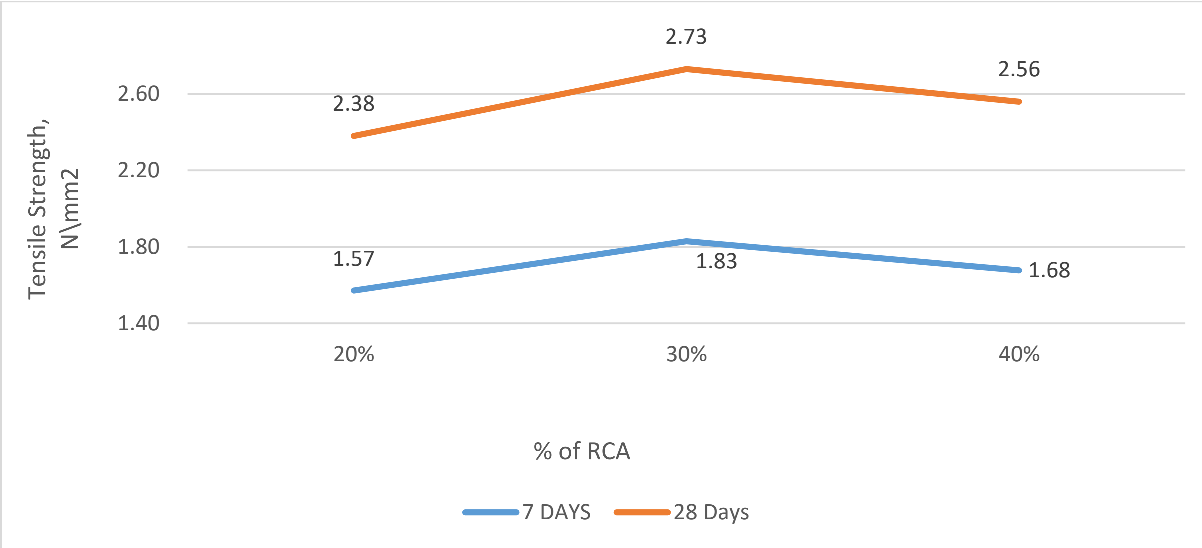
Split Tensile Strength for Replacement of NCA with 15yrs RCA



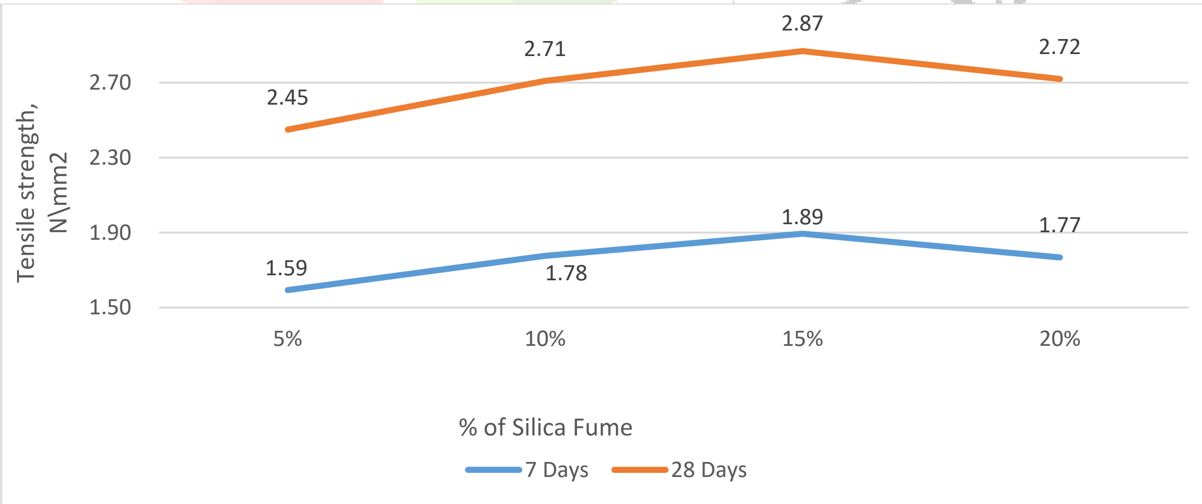
Tensile Strength for Replacement of NCA with 15 Years RCA and FA with Silica Fume



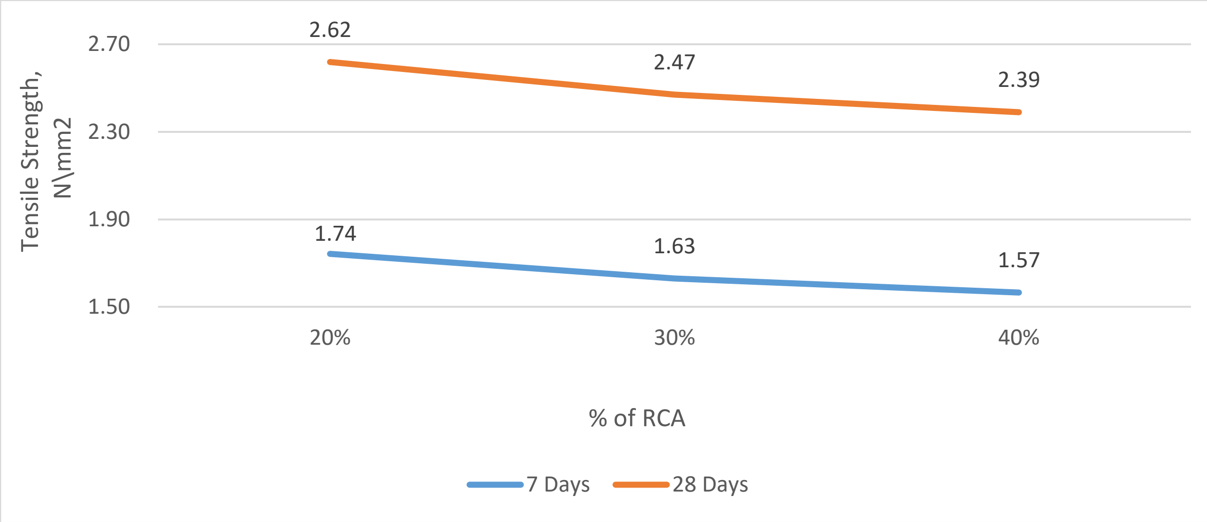
Tensile Strength for replacement of NCA with 25 Yrs RCA



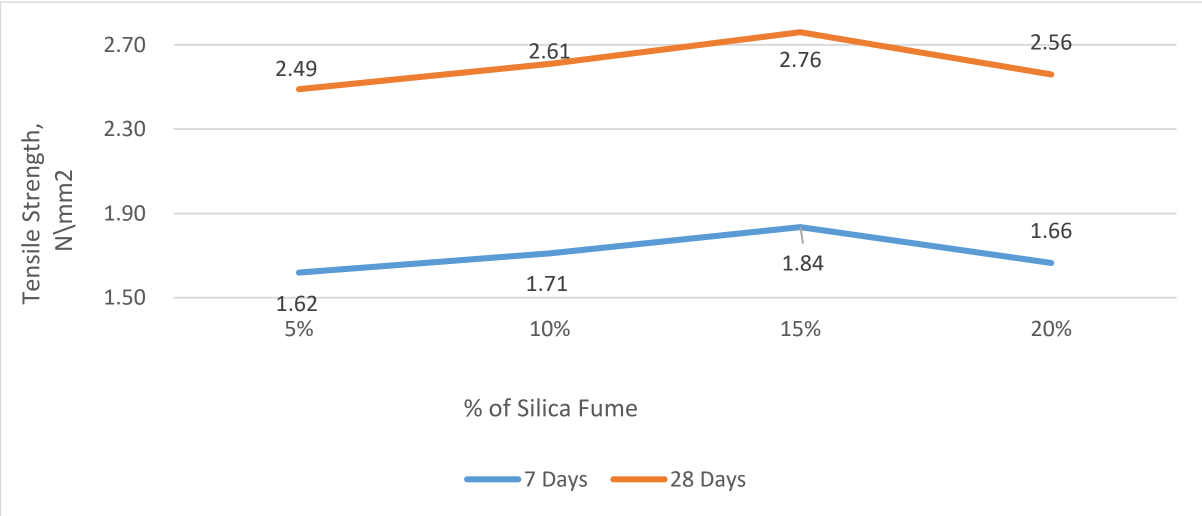
Tensile Strength for Replacement of NCA with 25 years and replacement of Fine aggregate with Silica Fume



Tensile Strength for Replacement of NCA with 35 Yrs RCA



Tensile strength with replacement of NCA with 35 years RCA and Fine aggregate with Silica Fume



CONCLUSIONS

Based on the analysis of experimental results and discussions there upon the following

Conclusions are made.

1. The compressive strength and tensile strength of the cement in recyclable form and of the Silica Fume concrete as partial substitute components were compared and found that the strength of the concrete is marginally lower than that of the Silica Fume substituted by concrete in recycled form.

2. With the rising percentage of Silica Fume, the compressive strength increases by weight of a small aggregate up to 15 percent and of recycled aggregate by weight up to 40%..

3. The split tensile strength increases to 15% by weight of finely aggregated and recycled aggregate up to 40% by weight of ground aggregate with increasing percentage of Silica Fume.

4. The compressive strength results indicate that the tensile force separated by 7, 28 days, which cures 15% fine aggregate replacement with a Silica Fume and 40% coarse aggregate replacement with a recycled one, reflects the optimum percentage of M20 concrete.

5. The following benefits can be obtained by using Silica Fume:

i. Cost reduction

ii. Utilization of waste material is possible in construction by using Silica Fume a partial replacement material for fine aggregate in concrete.

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