EXPERIMENTAL INVESTIGATION ON CONCRETE WITH PARTIAL REPLACEMENT OF COARSE AGGREGATE

G.Murali[1], K.R.Jayavelu[2],N.Jeevitha[3],M.Rubini[3]and N.R.Saranya[3]

Address for correspondence
[1]Assistant Professor,[2]Lecturer and [3]B.E.Final Year Students,Department of Civil Engineering, Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala Engineering College,Avadi,Chennai-62.

ABSTRACT:

The effects of shabath (a variety of cudappah) stone and the chemical admixture (supaflo) on concrete were investigated.Natural aggregate had been replaced with the waste shabath stone in four different percentages namely 10, 20, 30 &40 %. A comparison was made between the specimens of partially replaced coarse aggregate and the same set of specimens admixed with supaflo. The effects on compressive strength, split tensile strength and modulus of rupture were reported. Test results indicated that the replacement of coarse aggregate by 30% had attained a good strength in the two cases mentioned above.

KEY WORDS: *Shabathstone,Supaflo, Compressive strength, Flexural strength, Split tensile strength.*

1. INTRODUCTION

The high consumption of raw materials by the construction sector, results in chronic shortage of building materials and the associated environmentaldamage. In the last decade, construction industry has been conducted various researches on the utilization of waste products in concrete in order to reduce the utilization of natural resources.T.Sekar et al (2011), suggested that the compressive strength of concrete cubes made with ceramic insulator and glass insulator were found to be 16% and 26.34% lesser respectively than that of conventionalconcrete[1].Veera Reddy(2010), concluded that replacement of coarse aggregate by ceramic scrap in excess of 20%, leads to reduction of strength below conventional mix (MC)[2]. KamelK. Alzboon et al (2009) indicated that the using of slurry sludge as a source of water in concrete production has insignificant effect on compression strength, whereas it has a sharp effect on the slump values[3]. P. Turgutet al (2009) suggested that the replacement of Fine aggregate by fine glass (FG) at level of 20% by weight had a significant effect on the compression,tensionand flexure properties of concrete paving block samples as compared with the control sample[4].F.A. Olutoge(2010)concluded that increase in percentage of sawdust or palm kernel shells in concrete slabs led to a corresponding reduction in both flexural and compressive strength values. A weight reduction of 14.5% and 17.9% was achieved for sawdust and PKS replacement slabs respectively. It is also seen that the reduction in cost up to 7.43% can be achieved for every cubic meter of slab production with use of sawdust or palm kernel shell[5].NimaFarzadnia et al(2011),suggested that the materials are characterized by improved mechanical and durability properties resulting from the use of chemical and mineral admixtures as well as specialized production processes and also it reviews the incorporation of mineral admixtures in binary, ternary and quaternary blended mortars in concrete[6].

2. EXPERIMENTAL PROGRAM

2.1 MATERIALS

Cement: In this experimental investigationPozzolona Portland cement of 43 gradeisused.

Supaflo: It is a high range water-reducing admixture confirming to IS:9103. It is a non toxic brown liquid basedon Napthalene Formaldehyde Condensate. The physical properties of Supaflo are given in the table 1.

Fine aggregate: In this study locally available river sand which is free from impurities is used. The size of it is less than 2.36 mm. The specific gravity and fineness modulus of this fine aggregate where found to be 2.67 and 2.87 respectively. The percentage of passing is within the limits as per IS: 383-1970 [9].

Coarse aggregate: The coarse aggregate used here is 20mm in size, crushed angular shape and

free from dust. The specificgravity and fineness modulus was found to be 2.82 and 7.03respectively and the impact value was found to be 6.15%. The percentage of passing is within the limits as per IS: 383-1970 [9].

Waste stone: The wastes of shabathstone is used as the substitute for coarse aggregate. They have been cut manually into the required size of 20 -25mm approximately. The impact value was found to be 18.3 %.

Fig 1:ShabathStoneSource , Manual Cutting and Preparation of Aggregate

Table 1:

S.No	Properties	Results
1	Physical state	Brown Liquid
2	Specific Gravity	1.20±0.015 @ 27◦c
3	Chloride content	Nil as per IS456
4	Dosage	0.4%-1.2% by weight of cement

Properties of Chemical admixture (Supaflo)

.2.2 MIX PROPORTIONS

The concrete mix is designed as per IS 10262 – 2009 [8], IS 456-2000 [7] for the normal concrete. Finally the chemical admixture, Supaflo which is 0.8%by weightofcement is added to the concrete. The grade of concrete which we adopted is M25 with the water cement ratio of 0.45.

2.3 CASTING AND CURING

Two different sets of specimens are prepared using design mix.In the first set, the specimens are casted by varying the percentage of replacement of coarse aggregate by shabath stone starting from 0 to 40% with an increment of 10% by weight of coarse aggregate and they are represented as 10,20,30,40 respectively as shown in the table 2.In the second set, the former procedure is followed, in addition to that chemical admixture of 0.8% by weight of cement is added and they are designated asS10,S20,S30& S40 respectively. Cubes with size 150mm X150mm X150 mm, cylinders with 150mm diameter X 300mmheight and prisms of size100mmX100mmX500 mm are prepared. The samples aredemoulded after 24 hrs from casting and kept in a water tank for 28 days curing.

Table 2.Details of specimens

S.No	Specimen Description	Cubes (nos)	Cylinder (nos)	Prism (nos)
1	C.C (conventional concrete)	3	3	3
2	10 (10% replacement of C.A)	3	3	3

3	20 (20% replacement of C.A)	3	3	3
4	30 (30% replacement of C.A)	3	3	3
5	40 (40% replacement of C.A)	3	3	3
6	S10(10% replacement of C.A admixed with supaflo)	3	3	3
7	S20(20% replacement of C.A admixed with supaflo)	3	3	3
8	S30(30% replacement of C.A admixed with supaflo)	3	3	3
9	S40(40% replacement of C.A admixed with supaflo)	3	3	3

3. RESULT AND DISCUSSIONS

After a detailed study we have obtained the following results for compression, split tensile strength and flexure tests as shown in table 3.

Effect on compression:

As mentioned in the figure 2, the maximum compressive strength of concrete with 30% replacement of aggregate with or without chemical admixture has been found to be 26%and 56% higher than the conventional concrete. However the replacement of aggregate increasing upto 40% the concrete compressive strength has been significantly decreased when comparing with 30% replacing coarse aggregate. Hence the replacement of 30% aggregate is found to be optimised and effective to attain the strength of concrete.

Table 3: Behavioural Strengthsof Concrete

Properties	C.C	10	S-10	20	S-20	30	S-30	40	S-40
Compressive strength(N/mm^2)	26.0	26.5	27.8	27.5	28.8	32.8	41.1	29.3	38.2
Split tensile strength(N/mm^2)	2.72	2.88	2.96	3.03	3.18	3.31	3.48	3.13	3.26
Flexural strength(N/mm^2)	3.4	3.65	3.71	3.69	3.77	3.80	3.92	3.58	3.64

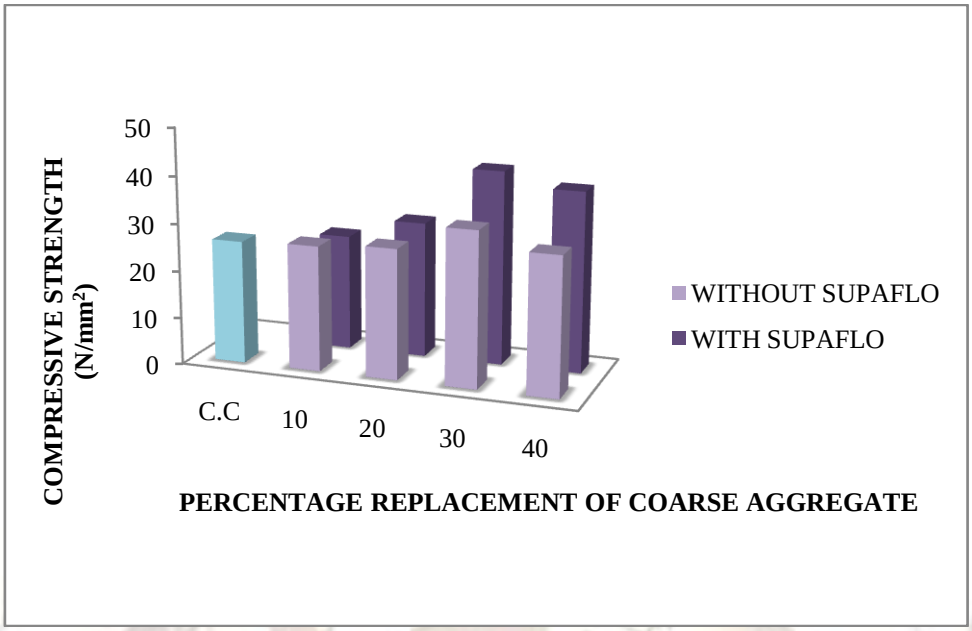

Fig 2: Compressive strength of concrete after 28 days of curing

Effect on Tension:

On the basis of the results shown in the fig.3, it is observed that the maximum difference of tensile strength was found to be 21.70% in case of 30% replacement of aggregate without chemical admixture and 28.30% with chemical admixtures. For specimens without chemical admixtures, the tensile strength hasbeen gradually increased as 5.88%, 11.40%, 21.70% and15.07%. Similarly for the specimens with chemical admixtures,theincreasing tensile strength were noted as 8.82% ,16.91%, 28.30% and 19.85% for the replacement of coarse aggregate with 10%, 20%,30% and 40% respectively. Hence it is clear that the replacement of coarse aggregatewith and without chemical admixture has a positive impact in the tension behaviour of concrete.

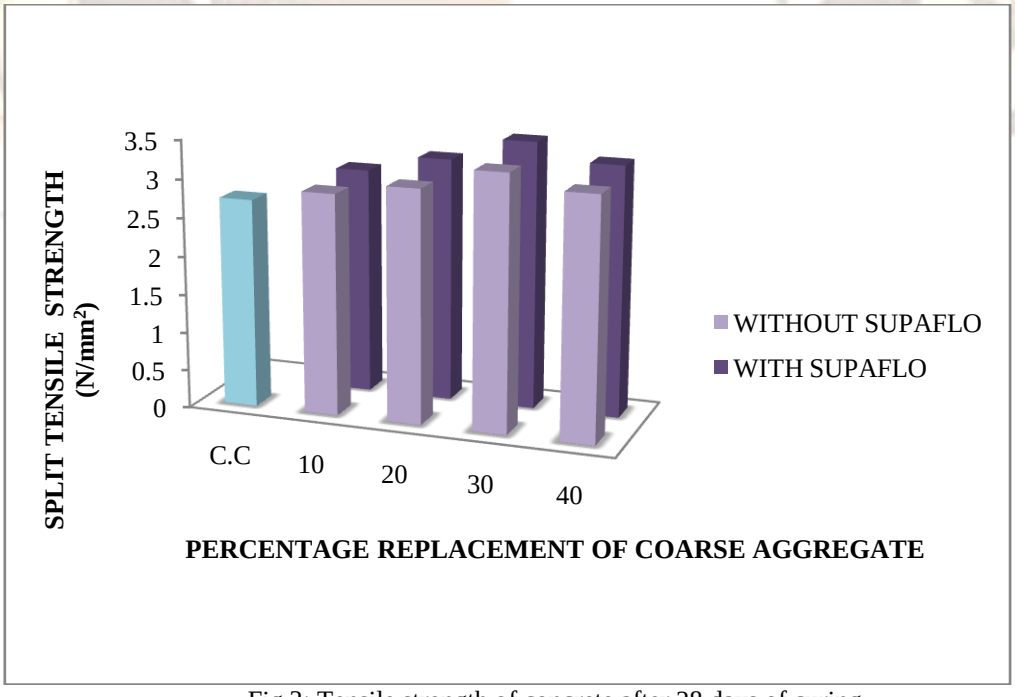

Fig 3: Tensile strength of concrete after 28 days of curing

Effect on Flexure:

It can be seen from fig.4 that the flexural strength of the conventional concrete has been found to be 3.4 N/mm^2 for conventional concrete. However when compared with conventional concrete the flexural strength has been increased up to 7.35%, 8.52% ,11.76% and 5.29% for 10%,20%,30% and 40% replacement of coarse aggregate without chemical admixtures. Similarly the flexural strength has increased upto 9.1%,10.88%,15.29% and 7.05% for 10%,20%,30% and 40% replacement of course aggregate with chemical admixture. This conclusion led to the fact that 30% replacing coarse aggregate can increase 15.29% flexural strength and further if the percentage of replacing coarse aggregate is increased, the flexural strength is decreased as shown in the fig.4.

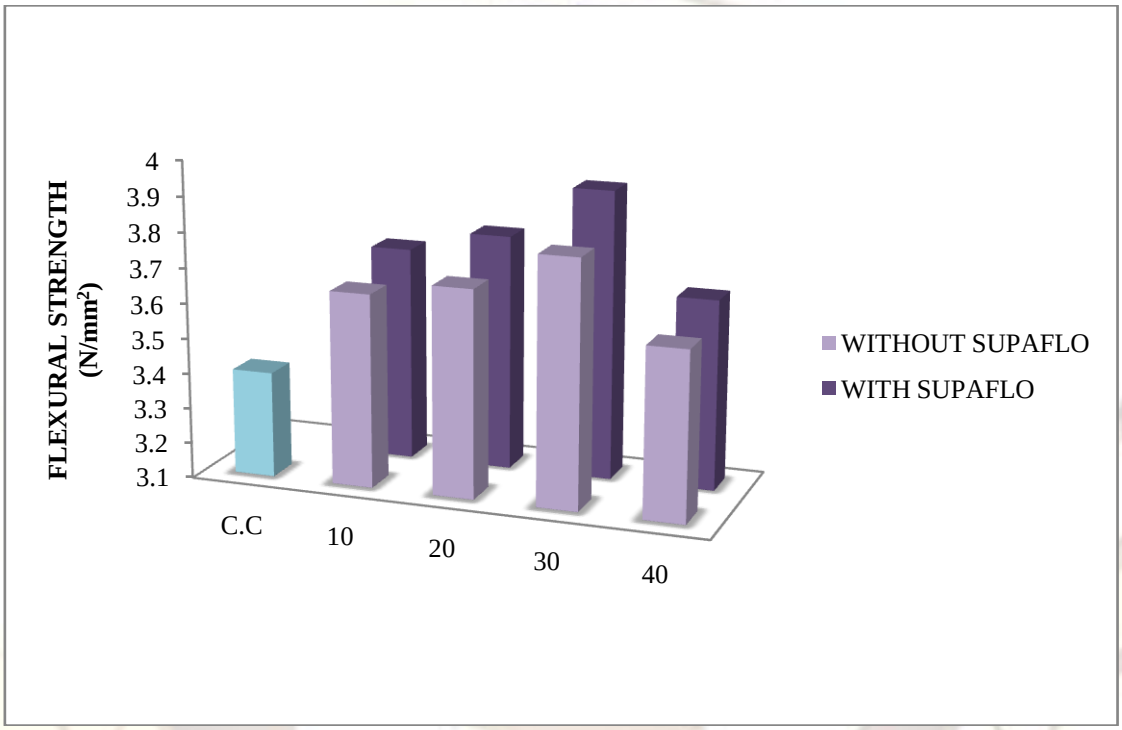

Fig 4: Flexural strength of concrete after 28 days of curing

Fig 5: Split tensile and flexural failure of concrete

4. CONCLUSION

Based on the results obtained from the experiment the following conclusions are drawn.

The maximum Compressive strength of concrete with and without chemical admixturecan be achieved by 30% replacement ofshabath stone was found to be 56% and 26% higher than the conventional concrete. Compare to the conventional concrete the tensile strength of 30% replacement of coarse

aggregate concrete was gradually increased upto 21.70% and 28.30% with and without chemical admixture respectively. Similarly the flexural strength of concrete was gradually increased upto 11.76% and 15.29% with partial replacement of 30% coarse aggregate, with and without chemical admixture respectively. From the above 3 cases the strength had decreased when the 40% of coarse aggregate was replaced. Hence replacement of coarse aggregate with 30%shabathstone was achieved good strength.

5. REFERENCE

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