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EXPERIMENTAL STUDY ON STRENGTH PROPERTIES OF CONCRETE WITH PARTIAL REPLACEMENT OF CEMENT BY ALCCOFINE & REPLACE FINE AGGREGATE BY M SAND

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Abstract - *Many researches have been made to enhance the performance of the concrete by partially replacing cement by pozzolonic material and due to the scarcity river sand efforts are made to replace the same. Alccofine is new pozzolanic material which is bringing technical revolution in the construction. In the present wor, study is made on strength properties of concrete by replacing cement by Alccofine partially. A comparative study is made by using river sand and m sand separately. The mechanical properties studied here are compressive strength on concrete cubes at 7 & 28 days of curing and flexural strength on beams at 7 & 28 days of water curing. It is observed from the result that the alcoofine material increases the strength to a large extent at 20% replacement level of cement and there is no reduction in strength properties by replacing river sand by m sand.*

***Key Words*: River sand. M-Sand, Pozzolona, Alccofine, Compressive Strength, Flexural Strength**

1. INTRODUCTION

Conventionally concrete is a homogeneous material, fine aggregate and coarse aggregate and mix up with proportioned quantity of water. Concrete get hardened due to hydration process between the cement and water. Because of its mould ability, high compressive strength, Structural stability and economic consideration. Concrete is highly used construction material. These special properties have made concrete a prominent construction material.

Now a days high strength concrete, high durable concrete is getting prominent in the construction industry. High strength concrete is practically defined as concrete which exhibits higher strength properties. And the term durability of concrete refers resistance offered against chloride, sulphate & other environmental attacks, by boosting the durability of concrete we can increase life span of any concrete structure. In recent times so many experiment works are going on for improving properties of concrete, to enhance the concrete properties like strength, performance and durability, cement is replaced by other cementitious material. In general cement replacing agents are called as fine minerals or pozzolonas. Pozzolonas are the exclusive type of natural occurring materials or industrial waste products. By use of these pozzolonas in concrete mix we can replace some amount of OPC. Partial replacement of opc by these pozzolonas is gradually increasing. When these pozzolonas are used in the concrete mix, they reacts with calcium hydroxide (CaoH2)present in the hydrated cement paste at normal temperature and forms additional C-S-H gel which leads to reaction in porosity of both matrix and interfacial transition zone, Thus improving ultimate strength and water tightness of concrete. Pozzolonas like fly ash, furnace slag, silica fume are being adopted as partial alternatives. In addition to above pozzolonas, Alccofine is a one a such a material which can be used in a same line. Alccofine is having micro particle finer than GGBS, fly ash and, silica fume. Alccofine is produced in controlled way with unique machine to procure optimized particle size, this optimized particle size distribution is distinctive character which intensify performance of the concrete in fresh and as well as in hardened state. Mainly there are two types of Alccofine a)Alccofine1101 [low calcium silicate content] b)Alccofine1203[high calcium silicate content]

Fine aggregate is vital ingredient of the concrete mix which affects concrete performance, about 75% of total volume of the concrete is accomplished by fine aggregate and coarse aggregate. And hence procuring a good quality of aggregates is very important, very commonly used fine aggregate is natural river sand, since the requirements are increased and due to dearth of the river sand, the cost of the river sand is increased, so we are in the need of alternatives. Manufactured sand is the one which effectively replace the river sand.

Manufactured sand is a crushed stone aggregate, it is procured by passing the crushed stone through a vertical shaft impact crusher and by washing, it makes the aggregate particles to be compared with natural river sand. Required gradation and fineness modulus can be attained by endorsing a suitable screening system.

2.0 Objective of the study

Preeminent objectives are as follows a) To investigate influence of varying the percentage of Alccofine(0%, 5%, 10%, 15%, 20%) on compressive strength of M50 grade concrete.e

b) To investigate the influence of varying the percentage of Alccofine(0%, 5%, 10%, 15%, 20%) on flexural strength of M50 grade concrete.

3.0 Materials used in the Present study

3.1 Cement

Cement used in the ongoing work is ordinary Portland cement(OPC) of grade 43 [Brand Name-Ultratech] for all concrete mixes. Table shows tests conducted on the cement as per codal guide lines of BIS

Table 2 Physical properties of Cement

SL.NO	PROPERTY	Value	Standard values [IS 12269 (2013)]
1	Soundness (Le-Chatelier Method) (mm)	0.5	10 (Max)
2	Standard consistency (%)	30	Not specified
3	Intial setting time (min)	35	30 (min)
	Final setting time (min)	420	600 (min)
4	Compressive Strength (Mpa)		
	a) 3 days	22	22 (min)
	b) 7 days	33	27 (min)
	c) 28 days	46	43 (min)
5	Specific Gravity	3.1	Not specified

3.2 Coarse Aggregate

Coarse aggregate used in the ongoing work is having a maximum size of 20mm and it is Locally available. Table shows preeminent tests conducted on coarse aggregate as per BIS codal guidelines

3.3 Fine Aggregate

a) River Sand

The sand used for the experimental program was locally procured which is free from silt and organic matter

b) Manufactured Sand

M sand is obtained from local quarries & was confirmed to zone – II according to code of IS 383:1970.

3.4 Chemical Admixture

Super plasticizer Conplast SP430, a sulphonated naphthalene polymer based brown liquid is used as a chemical admixture. It has the capability to disperse in water immediately and it is used tor reduce the water content upto 29% without the loss of workability, and to achieve greater strength and superior quality of concrete. The specific gravity will be in the range of 1.190-1.210 and the dosage recommended is typically in the range of 0.5-1.5 litters per 100 kg of cement.

3.5 Supplementary Cementiotious Material

Alccofine 1203 is uniquely refined material based on slag of greater glass content with high reactivity procure by the granulation process under a controlled way. The primal matter contains primary ocf low carlcium silictates. Alccofine 1203 is trully ultra fine material because of its particle size distribution.[1200 cm2/gm] as a results it reduces the water content for a needed workability. And hence improves compressive strength.

Table 3 Physical Properties of Alccofine 1203

Sl.No	Test		Result
1	Particle Size Distribution(um)	d10	1.4
		d50	4.2
		d90	9.0
2	Bulk Density (kg/cub.m)		680
3	Specific Gravity		2.87

4.0 CONCRETE MIX DESIGN

The process of picking out suitable ingradients of concrete and discovering their relative quantities with objective of producing the required strength and durability and workability as economically as possible is termed the concrete mix design. Mix design is done as per IS 10262 (2009) guidelines

5.0 RESULTS AND DISCUSSIONS

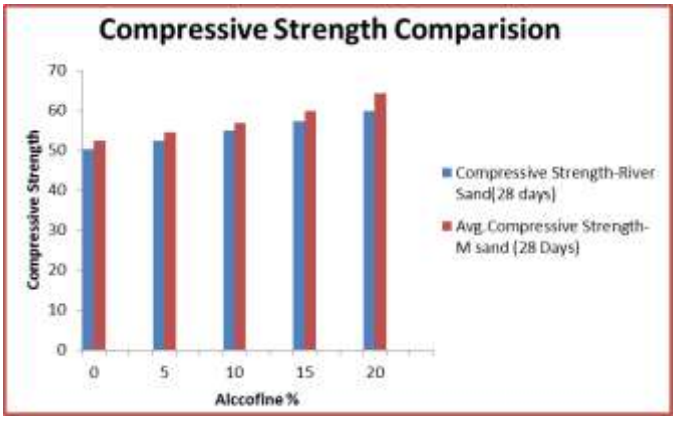
In the present work, a proportion for standard concrete mix design of M50 was carried out according to IS:10262-2009 recommendations. The mix proportions are presented below

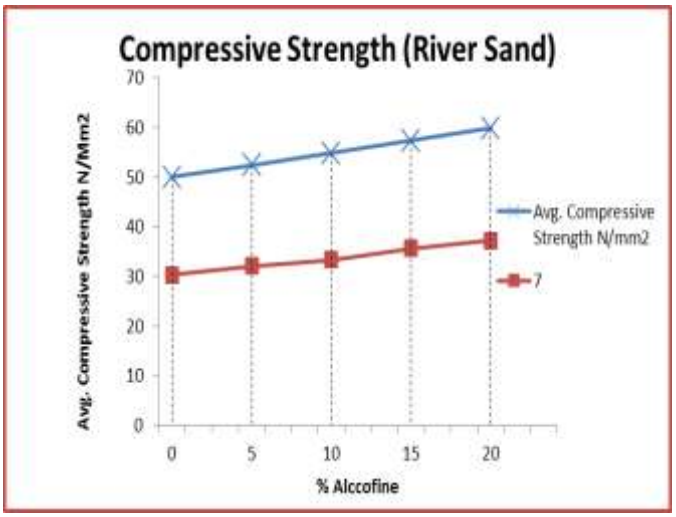
Table-3. Mix proportions of M50 Concrete

W/C ratio	Cement	Fine aggregate	Coarse aggregate	SP430
0.35	437.89 kg/m3	638.82 kg/m3	1209.19 kg/m3	8.75kg 2% of cement
0.35	1	1.45	2.76	

Table-6. Variation of compressive strength for different trail mixes

Alcc ofine %	River Sand		% incr ease	M Sand		% incr ease
	7 Days	28 Days		7 Days	28 Days	
0	30.66	50	-	30.96	52.3	-
5	32.14	52.42	4.84	32.89	54.96	5.1
10	33.33	54.81	9.62	34.37	57.93	10.76
15	35.37	57.33	14.66	36.59	60.89	16.43
20	37.18	59.84	19.68	37.63	63.41	21.25





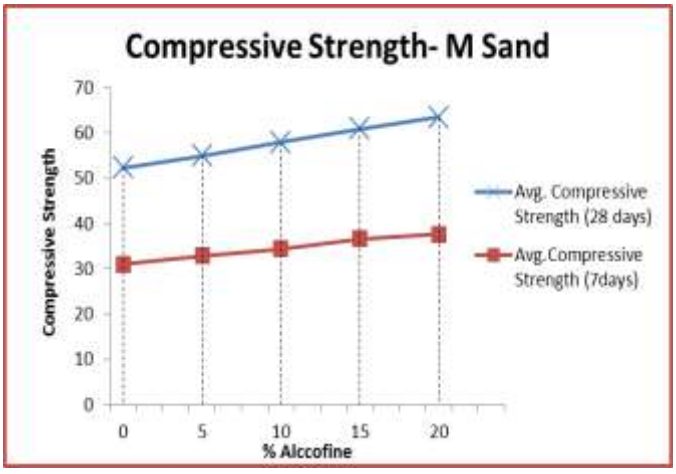
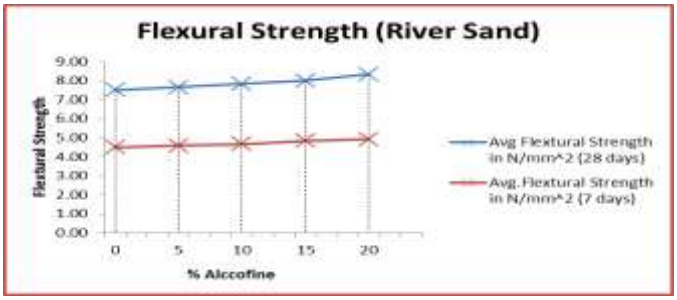
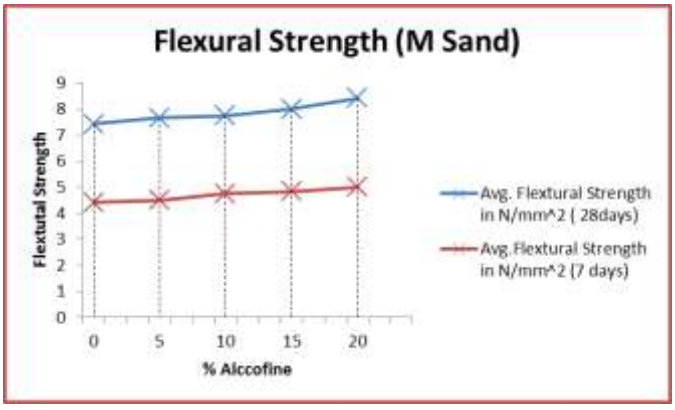
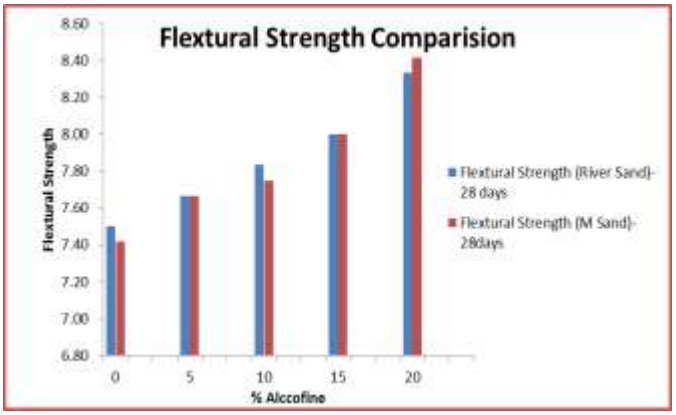


Table-6. Variation Of flexural strength for different trail mixes

Alcco fine %	River Sand		% incre ase	M Sand		% incre ase
	7 Days	28 Days		7 Days	28 Days	
0	4.50	7.5		4.41	14.83	
5	4.58	7.7	2.53	4.50	15.33	3.4
10	4.67	7.8	4.40	4.75	15.50	4.5
15	4.83	8.0	6.67	4.83	16.0	7.9
20	4.92	8.3	11.07	5.0	16.83	13.5







- From results, it is observed that for M50 grade concrete (River Sand), the compressive strength after 28 days of curing increases with increase in percentage of Alccofine. Percentage increase in compressive strength of concrete for 5%, 10%, 15%. and 20% of Alccofine (by volume of cement) with reference to conventional concrete is found to be 4.5%, 9.6%, 14.66% and 19.68% respectively.

- It is observed that for M50 grade concrete (M-Sand), the compressive strength after 28 days increase with increase in percentage of Alccofine. Percentage increase in compressive strength of concrete for 5%, 10%, 15%. and 20% of Alccofine (by volume of cement) with reference to conventional concrete is found to be 5.1%, 10.76%, 16.4% and 21.2% respectively

- Flexural strength for Concrete with river sand after 28 days of curing increases with increase in percentage of Alccofine. Percentage increase in flexural strength of concrete for 5%, 10%, 15%. and 20% of Alccofine (by volume of cement) with reference to conventional concrete is found to be 2.5%, 4.4%, 6.7% and 11% respectively, while that for M sand is 3.3%, 4.5%, 6.6% and 13% respectively

- It is observed that Addition of Alccofine results more compressive strength in concrete produced using M-Sand than concrete produced using river sand.

- It is observed that there is no much variation in flexural strength of concrete with river sand and M sand.

CONCLUSIONS

Following conclusions have been obtained from experimental study carried out to investigate the influence of Alccofine on Strength of M50 grade concrete which is designed as per code IS 10262-2009.

1. There is a remarkable increase in the strength properties of concrete with the replacement of cement by alccofine.
2. Concrete with M sand results in better strength charecteristics than that with river sand.

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