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EXPERIMENTAL INVESTIGATION BY PARTIAL REPLACEMENT OF FINE AGGREGATE WITH FOUNDRY SAND AND ADDITION OF HYBRID FIBER IN CONCRETE

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ABSTRACT

Concrete is the most important component used in the construction industry throughout the world. Studies have been carried out to investigate the possibility of utilizing a broad range of materials as a partial replacement material for fine aggregate in the production of concrete. Foundry sand is a waste from ferrous and non- ferrous metal industry. The addition of hybrid fiber used in this project is to increase strength of concrete. Fine aggregate is replaced by foundry sand as 60%, 70% and 80%. Hybrid fiber in a suitable combination may potentially improve the overall properties and performance of concrete. Steel and polypropylene fiber is used as hybrid fiber. SF 0.5% & PF 0.5%, SF 0.75% & PF 0.75%, SF 1% & PF 0.5% and SF 0.5% & PF 1% were added together to form hybrid fiber concrete. Compressive strength and Split Tensile strength for 7, 14 and 28 days were tested.

Key words: Cement, Aggregate, Foundry Sand, Crimped Steel fiber, Polypropylene fiber, Strength characteristics.

1INTRODUCTION

Concrete is the most popular material in construction. Conventional concrete have good compression strength, it's a construction material that consists of cement, coarse aggregate, fine aggregate and chemical admixture.

The concrete industry is constantly looking for supplementary material with the objective of solid waste disposal problems. Hints the reuse of waste material has emphasized. The potential applications of industry by- product in concrete are as partial aggregate replacement or as partial cement replacement, depending on their chemical composition and grain size.

II. MATERIAL USED

A. Cement

Cement is a powdery substance made by clay lime mixed with water to form mortar or mixed with sand,

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gravel and water to make concrete. OPC is important type of cement. Portland cement set and become adhesive due to a chemical reactions b/w the dry ingredients and water.OPC 53 grades was used.

B. Fine Aggregate

Fine aggregate is to make the concrete dense, by filling voids of coarse aggregate and reduce the Shrinkage of cement and makes an economical mix. Natural sand or crushed stone dust is used as a fine aggregate in concrete mix. Fine aggregate is passed through I.S sieve No.480 (4.75mm).

C. Coarse aggregate

Crushed stone of size 20mm are used as coarse aggregate. The ideal coarse aggregate should be clean, inert, cubical and angular. For this investigation locally available crushed angular aggregate is used.

D. Water

Water is required for the cement to hydrate and solidify. Water having qualities of potable water was used in the experiment.

E. Chemical admixture

Type: super plasticizer

F. Foundry sand

Foundry sand is high quality silica sand with uniform physical characteristics. It is a by product of the ferrous and non ferrous metal casting industry, where sand has been used for centuries as a molding material because of its unique engineering properties. In modern foundry practice, sand is typically a recycled and reuse through many production cycles. Industry estimate are that approximately 100 million ton are used in production annually.

FIG 2.1 FOUNDRY SAND

G. Hybrid fiber

A hybrid fiber concrete is use of two or more types of fibers in a suitable combination may potentially improve the overall properties of concrete and also result in performance concrete.

a)Crimped steel fiber

crimped steel fiber are low carbon, cold drawn steel wire fibers designed to provide concrete with temperature and shrinkage crack control, enhanced flexural reinforcement improved shear strength and increase the crack resistance of concrete.

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FIG 2.2 CRIMPED STEEL FIBER

b) Polypropylene fiber

Polypropylene fiber are tough but with low tensile strength and modulus of elasticity. They have plasticstress-straincharacteristics. It can be used in concrete to improve the tensile strength of concrete. In post cracking stage, as the fibers are pulled out, energy is absorbed and cracking is reduced. [6] discussed about E-plane and H-plane patterns which forms the basis of Microwave Engineering principles.

FIG 2.3 POLYPROPYLENE FIBER

III.MATERIAL PROPERTIES

A: Physical properties of foundry sand

Sl .No	Properties	Result
1	Specific gravity	2. 77
2	Water absorption	0.43%
3	Bulk relative density	2592kg/m^3
4	Plastic limit	Non plastic

B: Chemical properties of foundry sand

Sl .No	Constituent	%
1	SiO_2	67.21
2	Al_2O_3	4.28
3	Fe_2O_3	3.32
4	CaO	0.15
5	MgO	0.23
6	K_2O	0.45
7	Na_2O	0.47
8	TiO_2	0.48

C: Properties of crimped steel fiber

Property	Values
Length	15 to 40mm
Aspect ratio	30 to 60 mm
Diameter	0.45 to 0.8 mm
Appearance and clear form	Clear, bright

D: Properties of polypropylene fiber

Property	Values
Length	12mm
Aspect ratio	6
Diameter	2mm
Appearance and clear form	Clear,brightand white in colour

IV MIX DESIGN

A.MIX RATIO

Cement	FA	CA	Water
405.74	705.46	1236	153.8
1	1.73	3.05	0.38

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B: TRAIL MIXES

Conventional Mix

Mix 1[100% cement+100% Fine Aggregate+100%CourseAggregate]

Nominal Mix II

F1).60%Foundrysand+1% Hybrid fiber [0.5(s)+0.5(pp)]

F2).60%Foundrysand+1.5% HybridFiber [0.75(s)+0.75(pp)]

F3).60%Foundry sand+1.5% Hybrid Fiber [1(s)+0.5(pp)]

F4).60% Foundry sand +1.5% Hybrid Fiber [0.5(s)+1(pp)]

Mix III

F5).70% Foundry sand +1% Hybrid Fiber [0.5(s) +0.5(pp)]

F6).70% Foundry sand+1.5% Hybrid Fiber [0.75(s) +0.75(pp)]

F7).70% Foundry sand+1.5% Hybrid Fiber [1(s) +0.5(pp)]

F8).70%Foundry sand +1.5% Hybrid Fiber [0.5(s) +1(pp)]

Mix IV

F9).80%Foundry sand+1% Hybrid Fiber [0.5(s) +0.5(pp)]

F10).80% Foundry sand +1.5% Hybrid Fiber [0.75(s) +0.75(pp)]

F11).80% Foundry sand+1.5% Hybrid Fiber [1(s) +0.5(pp)]

F12).80%Foundry sand +1.5% Hybrid Fiber [0.5(s) +1(pp)]

V TEST ON CONCRETE

A. COMPRESSIVE STRENGTH TEST

The Compressive strength characteristics of the concrete is calculated for 7, 14, 28 days.

Compressive strength = P/A (N/mm^2).

B. SPLIT TENSILE STRENGTH TEST

The Split tensile strength characteristics of the concrete is calculated for 7, 14, 28 days

Split tensile strength of concrete = $2P/\pi$ d L

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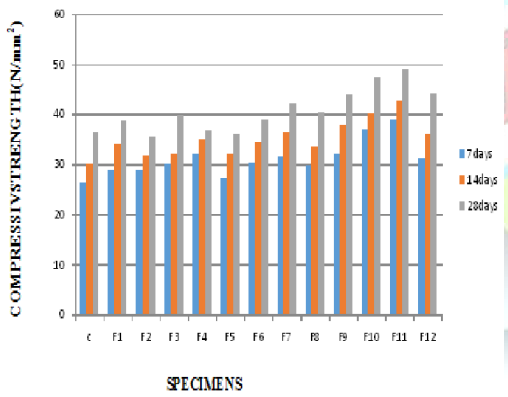
VI RESULT AND DISCUSSION

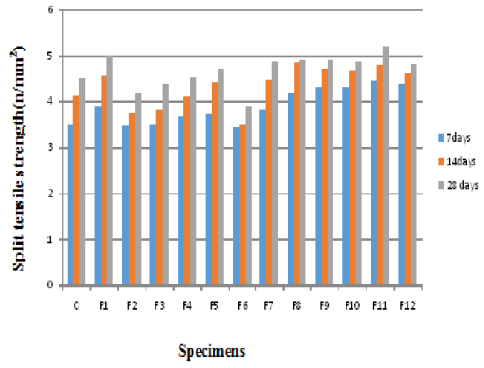
COMPRESSIVESTRENGTH TEST RESULT(N/mm^2)

S.NO	Mix	7 days	14 days	28 days
1	Cc	26.2	30.1	36.46
2	F1	29.0	34.2	38.62
3	F2	28.9	31.7	35.64
4	F3	30.1	32.1	39.8
5	F4	32.1	35.0	36.6
6	F5	27.1	32.1	36.1
7	F6	30.2	34.3	39.1
8	F7	31.4	36.5	42.1
9	F8	29.7	33.4	40.3
10	F9	32.1	37.8	43.8
11	F10	36.9	40.16	47.7
12	F11	38.8	42.71	49.1
13	F12	31.2	36.17	44.2



SPLIT TENSILE STRENGTH RESULT(N/mm^2)

Sl. No.	Mix	7 Days	14 Days	28 Days
1	CC	3.5	4.12	4.50
2	F1	3.9	4.56	5.00
3	F2	3.46	3.77	4.2
4	F3	3.5	3.80	4.4
5	F4	3.67	4.10	4.52
	F5	3.73	4.43	4.71
7	F6	3.43	3.5	3.9
8	F7	3.82	4.47	4.87
9	F8	4.2	4.85	4.92
10	F9	4.29	4.70	4.90
11	F10	4.31	4.68	4.89
12	F11	4.45	4.78	5.20
13	F12	4.40	4.62	4.83



VII CONCLUSION

1. Based on this experimental, it is found that foundry sand waste can be used as an alternative material to the fine aggregate.
2. Addition of hybrid fiber increase compressive and split tensile strength of concrete.

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3. Use of foundry sand in concrete is economical.
4. The compressive and split tensile strength of concrete reaches the satisfactory value at a replacement level of 80% of foundry sand and 1.5% of hybrid fiber (1%s+0.5%p).
5. Compressive strength of concrete of cube at the end of 28 days for conventional concrete and replacement concrete are 36.46 N/mm^2 and 49.1N/mm^2 respectively.
6. The average increase in the compressive strength is 34%.
7. Split tensile strength of concrete of cylinder at the end of 28 days for conventional concrete and replacement concrete are 4.50 N/mm^2 and 5.20N/mm^2 respectively.
8. The average increase in the split tensile strength of concrete is 15%.

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