Durability Study of Concrete using Waste Foundry Sand

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Abstract: ***In*** **this experimental investigation compressive strength of concrete, split tensile strength, water absorption and effect of alternate heating and cooling, alternate wetting and drying test on concrete for partial replacement of foundry waste sand various level such as 0%, 15%, 30%, 45%, 60% and 75% in place of fine aggregate was done for M25 grade of concrete.**
In order to make the sustainable development and find the alternative solution for fine aggregate this investigation is carried out.

Keywords: Waste foundry sand, water absorption, compressive and split tensile strength,heating and cooling,alternate wetting and drying

I. INTRODUCTION

In order to make the sustainable development and find the alternative solution for fine aggregate this investigation is carried out.

With the aim of resolving these two problems, attempt is made to utilize 100% of foundry waste sand in the preparation of concrete. Beneficial use can limit our nation's carbon manufacturing and consumption of virgin material and result in financial gains.

II. MATERIALS USED

A) In this investigation OPC 43 grade Ordinary PortlandCement used for all concrete mixes.
Physical properties of the cement are as follows:
Specific gravity: 3.12
Normal consistency: 35%
Initial setting time 30 minutes
Final setting time 240 minutes

B) The sand used in this investigation is ordinary river sand. The sand confirms to grading zone- III
Physical properties of the fine aggregate are as follows:
Specific gravity: 2.59
Fineness modulus: 2.89%
Bulk density 1690kg/m^3
Water absorption 2.0%

C) The coarse aggregate used in the investigation is 20mm
Physical properties of the coarse aggregate are as follows:
Specific gravity: 2.7
Fineness modulus: 6%
Bulk density 1650kg/m3
Water absorption 1.14%

D) **Foundry sand:** foundry sand was procured from shree lakshmi foundry sand harihara.
The physical properties of waste foundry waste sand are as follows:
Specific gravity: 2.35
Water absorption 0.43%
Moisture content varies from 0.1- 9.8

III OBJECTIVES OF THE WORK

To study the strength behavior of concrete by Partially replacing fine aggregates with waste foundry sand in the interval of 0%, 15%, 30%,45%,60%, and 75% for a single M25 grade concrete with a constant w/c ratio of 0.45 and with a variable slump

IV MIX DESIGN

M25 grade of concrete was designed as per IS:10262-2019. The trailcasting was carried by 0%, 15%, 30%, 45%, 60% and 75% of FWS

V EXPERIMENTAL RESULT AND DISCUSSION

A. slump test:

Fig 1: Slump test set up

Table1:Results of Slump values of concrete with six mixes.

Sl.no	Mix combination	Slump value (mm)
1	Mix1	72
2	Mix2	65
3	Mix3	69
4	Mix4	62
5	Mix5	53
6	Mix6	43

VI HARDENED STATE CONCRETE PROPRTIES

A. Compressive strength test:

Fig 2: Testing cubes under UTM machine

Table 2 : Compressive strength test results

Sl.no	% of variation	W/C ratio	Avg. compressive strength at 3 days (N/mm2)	Avg. compressive strength at 7days (N/mm2)	Avg. compressive strength at28 days
1	0	0.45	18	24.8	31.35
2	15	0.45	19	25	30.33
3	30	0.45	19.3	25.6	28.33
4	45	0.45	18.2	25.1	27.22
5	60	0.45	17	24.9	26.1
6	75	0.45	16.5	23.22	24.3

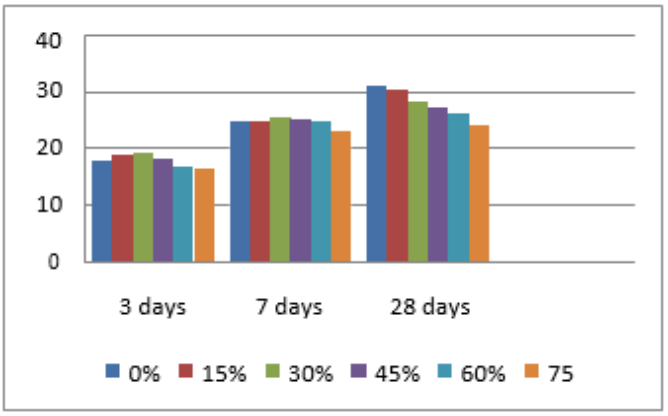

Fig 3 : Compressive strength comparison Graph

B Tensile strength test:

Table 3 : Tensile strength test results

Sl.no	% of variation	W/C ratio	Tensile strength at 7 days (N/mm2)	Tensile strength at 28 days(N/mm2)
1	0	0.45	2.44	5.11
2	15	0.45	2.56	5.23
3	30	0.45	2.68	5.34
4	45	0.45	2.71	5.40
5	60	0.45	2.3	4.78
6	75	0.45	2.11	4.70

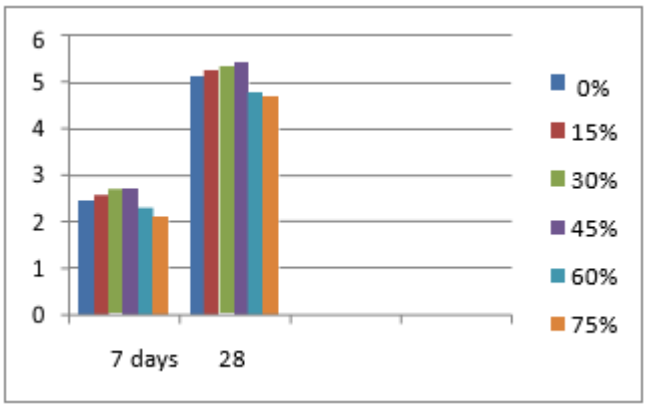

Fig 4. Tensile strength comparison Graph

DURABILITY TEST

A. *Water absorption:*

Table 4: result of water absorption test

Sl.no	Mix combination	Average % of water absorption
1	Mix 1	1.444
2	Mix 2	2.34
3	Mix 3	1.96
4	Mix 4	1.94
5	Mix 5	1.77
6	Mix 6	1.6

B. *Heating and cooling test:*

After curing the specimens are subjected to heating and cooling for a period of 20days (20cycles) to check the durability.

Table 5 : Results of heating and cooling test

Sl.no	Mix combination	Avg. compressive strength N/mm^2
1	Mix 1	39.63
2	Mix 2	37.11
3	Mix 3	38.15
4	Mix 4	32.19
5	Mix 5	30.14
6	Mix 6	28.3

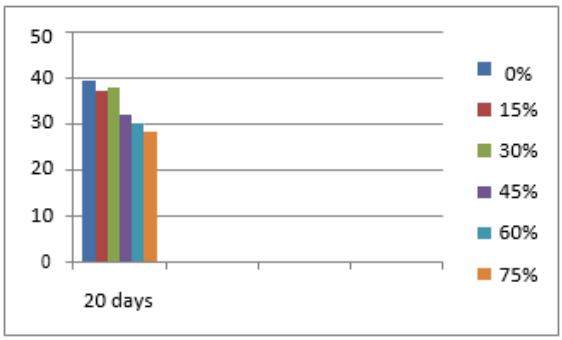

Fig 5. heating and cooling comparison Graph

C. Alternate wetting and drying test:

The specimens were cast and cured for 3, 7 and 28 days, after curing the specimens are subjected to alternate wetting and drying for a period of 20 days to check the durability.

Table 6 : results of alternate wetting and drying test

Sl.no	Mix combination	Avg. compressive strength N/mm^2
1	Mix 1	40.19
2	Mix 2	35.18
3	Mix 3	43.31
4	Mix 4	34.19
5	Mix 5	30.12
6	Mix 6	29.9

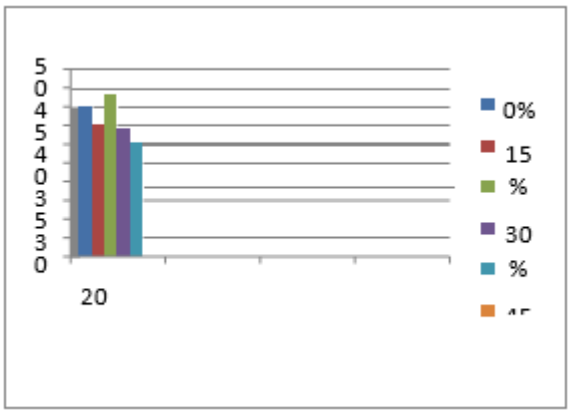

Fig 6. Alternate wetting and drying test results comparison

CONCLUSIONS

- Use of foundry sand in concrete reduces the production of waste.
- In this study , more compressive strength is received at 30% and Split tensile strength increases with increase in waste foundry sand and there after it decreases .
- Effect of alternative wetting and drying is marginal for all the mixes (0% to 75%) but the Mix 3 (43.33%) having highest value compare to all other Mixes ,from Mix 3 onwards as the percentage of foundry sand increases strength of concrete will be decreases.
- Effect of heating and cooling is marginal for all mixes but Mix 1 having a highest value compare to all other mixes

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