International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 08 | Aug 2021 www.irjet.net p-ISSN: 2395-0072

AN EXPERIMENTAL INVESTIGATION ON EFFECTIVE UTILIZATION OF USED FOUNDRY SAND AS REPLACEMENT OF SAND IN MORTAR

Sunil B S[1]

Assistant Professor, Department of Civil Engineering, Bheema Institute of Technology, Adoni, Andra Pradesh, India

---

Abstract - *In the present work an attempt is made to know the strength properties of mortar like compressive strength and tensile strength at different curing periods by replacing the fine aggregate by the used foundry sand from 0% to 100 % by weight for 1:3 mortar mixes keeping the water cement ratio as 0.5. Along with the strength, the density, water absorption, sorptivity, water retentivity tests were carried out. Finally the prism compressive strength and flexural bond strength for 1:3 mortar mixes were discussed. From the results obtained, there is no much difference upto 30% replacement of fine aggregate by the used foundry sand for most of the various properties of mortar. But there is sudden decrease in values from 40% replacement of sand since the used foundry sand has more voids in it which results in less density and strength. At the last the results were compared with the control mix and discussed*.

Key Words: **Compressive strength, Tensile strength, Sorptivity, Prism Compressive strength, Flexural bond Strength**

1.INTRODUCTION

The present work concerns the investigation of UFS utilization effect on mortar. In particular, the properties of mortars are investigated. The aim is to establish the quantity of used foundry sand so as to be able to be additional in combine without incorporating too much into the mortar mix while knowing the behavioural properties of mortar in terms of strength and workability. The fine aggregate (sand) was procured from Sakaleshpur and the used foundry sand was collected from Shimoga Piston Rings pvt ltd. This research is carried out to know the performance of mortar contain leftover foundry sands a substitute of fine aggregate (Sand).

1.1 OBJECTIVE

The main objectives of the Project are:-

1. To economize the cost of construction without compromising with quality.
2. To examine the utilization of Used Foundry Sand as very well aggregate and influence of UFS on top of the Compressive power of gun made by means of different replacement levels.
3. To check the suitability of Used Foundry Sand as an alternative building fabric.
4. To arrive at the optimum used foundry sand content for the mortar mixes.

2. TESTS AND RESULTS

In the present study, the tests were conducted both on fresh and hardened state of mortar for with and without used foundry sand. The specimens of 1:3 mortar mix were prepared for 3days, 7days and 28days keeping the w/c ratio of 0.5.

Following are the different tests conducted

1.Flow table test	2.Water Retentivity test
3.Compressive strength	4.Splitting tensile strength
5.Dry Density Test	6.Sorptivity Test

7.Prism Test 8.Flexural Bond Strength Test

2.1 Flow Table Test

Sl no	% of Replacement	Initial Dia (Di)	Final Dia (Df)	Flow Value (Df-Di)×100/Di
1	0	7	14.76	110.08
2	20	7	13.85	97.85
3	40	7	13.10	87.14
4	60	7	12.30	75.71
5	80	7	11.45	63.57
6	100	7	10.80	54.28

Table -1: Flow Values

2.2 Water Retentivity Test

The property of mortar to keep the water next to suction and vanishing is termed as water retentivity. It is determined by the flow of mortar when tested on masonry unit like brick.

Table -2: Water Retentivity

% Replace	Wt of wet mortar in (g)	Wt of dry mortar in (g)	Original water content	Water content retained	Water retained in %(after 1 hour)
0	400	396	80	76	95.0
10	400	392	80	72	90.0
20	400	386	80	66	82.5
30	400	379	80	59	73.7
40	400	378	80	58	72.5
50	400	374	80	54	67.5
60	400	371	80	51	63.7
70	400	370	80	50	62.5
80	400	365	80	45	56.2
90	400	364	80	44	55.0
100	400	363	80	43	53.7

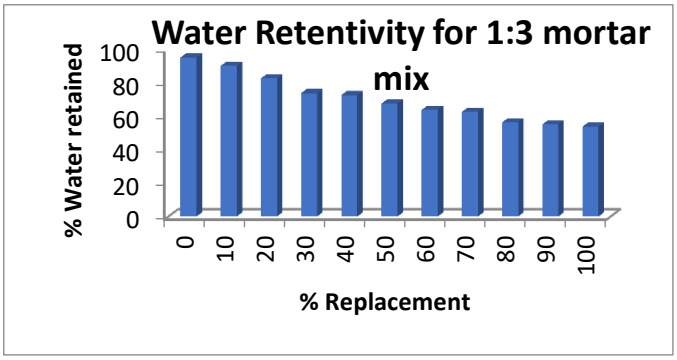

Chart -1: Water Retentivity

2.3 Compressive Strength Test

Compressive strength of the gun for the control mix and with the incorporation of used foundry sand for different curing periods is determined by preparing the mortar cubes by using the moulds of size (70.5*70.5) mm at different curing periods.

The load taken by the mortar cube is noted. Finally the compressive strength of the mortar is determined by dividing the load taken from the area of mortar cube and expressed in N/mm^2.

Table -3: Compressive Strength of Mortar at 28 days

% Replace	Load in kN			Area	Average compressive strength N/mm^2
	1	2	3		
0%	130	125	130	4984.36	25.73
10%	125	120	120	4984.36	24.40
20%	115	120	120	4984.36	23.74
30%	120	100	110	4984.36	22.72
40%	100	100	95	4984.36	19.72
50%	95	95	90	4984.36	18.72
60%	85	90	85	4984.36	17.40
70%	70	70	80	4984.36	14.70
80%	60	55	65	4984.36	12.02
90%	55	50	50	4984.36	10.36
100%	45	45	40	4984.36	8.70

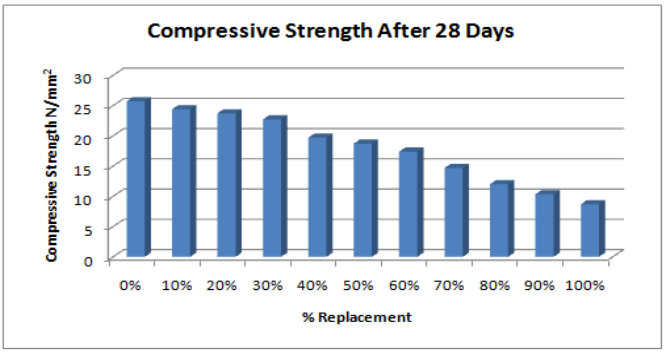

Chart -2: Compressive Strength

2.4 Split Tensile Test

Similarly, the tensile Strength of the mortar is determined by preparing the mortar cylinders of size (100*200) mm for different curing periods. The cylinders after the curing periods are then tested in compression testing machine to work out the tensile strength of mortar.

Table -4: Tensile Strength at 28 days

% Replace	Load in kN			Average Tensile strength N/mm²
	1	2	3	
0%	40	45	40	1.326
10%	35	35	40	1.166
20%	35	35	35	1.114
30%	30	35	40	1.112
40%	25	30	35	0.954
50%	30	25	30	0.901
60%	25	25	30	0.848
70%	25	20	20	0.689
80%	20	20	20	0.636
90%	25	10	15	0.53
100%	10	15	20	0.477

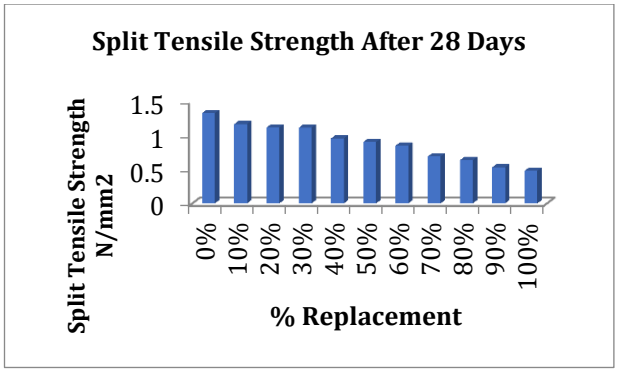

Chart -3: Tensile Strength chart

2.5 Dry Density Test

Table -5: Dry Density Values at 28 days

% REPLACE	Average mass gram	Volume cc	Density= Average mass/ volume g/cc
0%	812.00	351.89	2.31
10%	804.00	351.89	2.28
20%	793.33	351.89	2.25
30%	777.00	351.89	2.21
40%	769.00	351.89	2.18
50%	760.33	351.89	2.14
60%	752.33	351.89	2.13
70%	750.66	351.89	2.12
80%	738.33	351.89	2.09
90%	733.33	351.89	2.08
100%	727.66	351.89	2.06

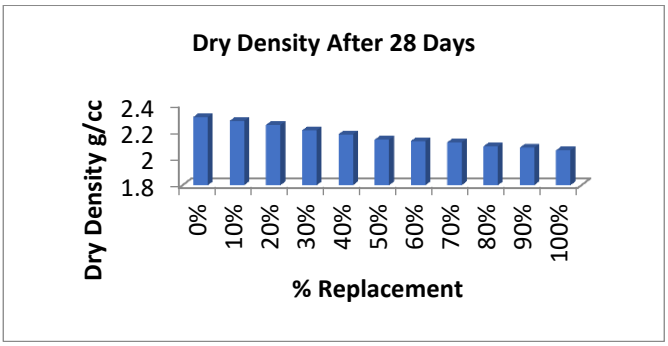

Chart -4: Dry Density Chart

The dry density test was carried out to the mortar cubes after 28 days of curing. As the percentage of used foundry sand increases the density is reduced. It may be due to the increase in the amount of voids in used foundry sand.

2.6 Sorptivity Test

Table -6: Sorptivity Values

% Replace	Dry weight (w1) g	Wet weight (w2) g	Sorptivity Value in 10^{-4} mm/min$^{0.5}$
0%	830	832	0.73
10%	817	820	1.09
20%	782	786	1.46
30%	777	781	1.46
40%	775	780	1.83
50%	773	779	2.19
60%	746	752	2.19
70%	736	743	2.56
80%	684	773	3.29
90%	657	669	4.02
100%	656	668	4.39

Sorptivity is the property of materials which characterizes the tendency of a porous material to absorb and transmit water by capillarity. The prepared cubes were oven dried at 85^{0}c temperature and initial weight is taken. The cube is then kept in water with water level not more than 5mm from the base of cube and the surface flow is prevented by sealing with non absorbant coating. The amount of water absorbed by the cubes in duration of 30 minutes was measured and the final weight is taken.

Sorptivity can be calculated by using the following formula.

$S=I/\sqrt{t}$ Where,

S= sorptivity in mm, t= elapsed time in minutes, I=Δw/Ad

Δw= change in weight = W_2-W_1

W1 = Oven dry weight of cylinder in grams

W2 = Weight of cylinder after 30 minutes capillary suction of water in grams

A= surface area of the specimen through which water penetrated

d= density of water

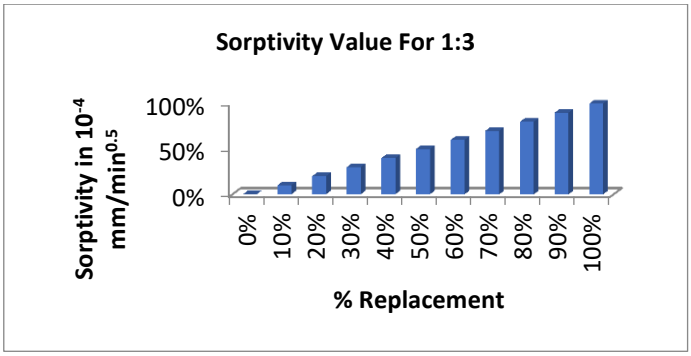

Chart -5: Sorptivity chart

2.7 Prism Test

The prism test is approved out to find the compressive strength of prism made with the 1:3 mortar mix by using used foundry sand as substitute for the well aggregate. The prisms having 5 bricks are casted and cured for 28 days. After 28 days of curative the prisms be experienced for compressive strength in universal difficult mechanism and the readings were recorded to calculate the compressive strength of prism.

Table -7: Compressive Strength of Prism after 28 days

% REPLACE	Load in kN	Compressive Strength in N/mm^2
0	38.0	1.70
10	36.0	1.61
20	35.0	1.56
30	32.5	1.45
40	28.0	1.25
50	26.5	1.18
60	25.0	1.11
70	24.0	1.07
80	23.0	1.02
90	21.5	0.96
100	18.0	0.80

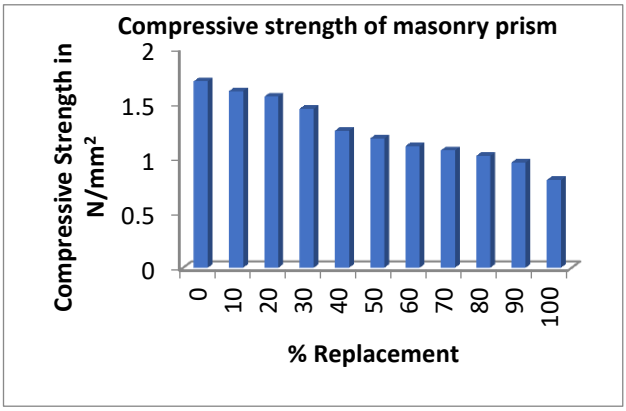

Chart -6: Compressive strength of Prism chart

2.8 Modified Wrench Test

In this study the testing example consists of a heap bond prism of 5 bricks and mortar of 1:3. The flexural bond strength was determined by means of modified bond wrench test put awake. The casted specimens are cured for 28 days and they are tested to find the flexural bond strength.

Table -8: Flexural bund Strength

% Replace	Flexural bond strength in N/mm²
0	0.389
10	0.387
20	0.358
30	0.336
40	0.242
50	0.236
60	0.236
70	0.230
80	0.208
90	0.207
100	0.203

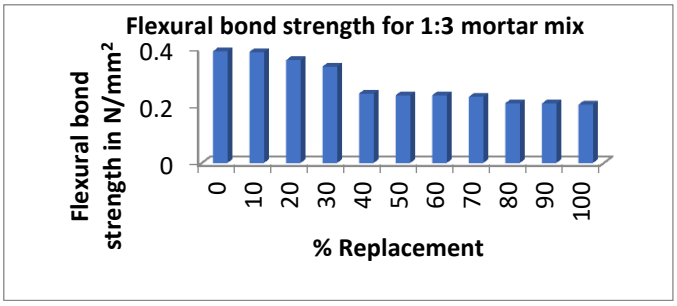

Chart -7: Flexural Bond Strength chart

3.0 RESULTS AND DISCUSSION

According to the test results following Results are derived.

- The flow value by the replacement of sand with used foundry sand a smaller amount than 40% does not affect the workability of the mortar considerably
- The mortar made with used foundry sand absorb more water content reducing the density of mortar. The percentage reduction in density of control mix mortar for 1:3 is 4.32%.
- In 1:3 mortar mix, the percentage reduction in strength upto 30% replacement of used foundry sand can be considerable since there is no much difference when compared to control mix, which has compressive strength of 25.73 N/mm².
- At 30% replacement the percentage reduction in compressive strength is 7.7% and after that sudden decrease in strength was observed in such a way that the percentage reduction was about 27.24%.
- A reduction in split tensile strength was also be observed in 1:3 mortar mix when compared to control mix at curing age of 28 days whose tensile strength is 1.32 N/mm².
- As in compressive strength here also upto 30% replacement doesn't affect the strength of 1:3, but later decrease in strength can be noticed in the range of 31.8% reduction in tensile strength of 1:3.
- The compression test on prism made with 1:3 mortar mix decreases as the percentage of used foundry sand increases. The compressive strength of masonry prism made with control mix was 1.70 N/mm².
- The flexural bond strength value for 1:3 mortar mix also decreases gradually as the percentage of used foundry sand increases. The flexural bond

strength of prism made with 1:3 mortar mix was found to be 0.38 N/mm^2.

4.0 CONCLUSIONS

The subsequent Conclusions were haggard from this learning

1. The incorporation of Used Foundry Sand decreases the Compressive Strength of Mortar than control Mortar mix.
2. By the use of used foundry sand, the cost of construction can be minimized.
3. Optimum increase in Compressive Strength of mortar was observed with some percentage of UFS, both at 7days, 14 days and 28 Days.
4. Used Foundry Sand can be conveniently used in making good mortar without compromising the Compressive Strength of Mortar upto 40% of replacement.
5. Porosity of mortar decrease with increase in used foundry sand.
6. As there is higher amount of voids present, the density of mortar made with used foundry sand is less than the control mix mortar.
7. Since the density of mortar is less, the water absorption increase as the percentage of used foundry sand increases.
8. Sorptivity of the mortar made with used foundry is much higher than the control mortar mix.
9. The compressive strength and flexural bond strength of prism is valued upto a certain percentage level used foundry sand. That is upto 40% substitute of fine aggregate by second-hand foundry sand can be best suited for the mortar with used foundry sand.

REFERENCES

1. TARUN R. NAIK, et al.,(1993) "Utilization of used foundry sand in concrete"
2. PATHARIYA SARASWATI C, RANA JAYKRUSHNA K "Application of waste foundry sand for evolution of low-cost concrete" International Journal of Engineering Trends and Technology (IJETT) – Volume 4 Issue 10 - Oct 2013 | ISSN: 2231-5381 Page 4281.
3. SMIT M. KACHA, ABHAY et al, "Use of used-foundry sand (ufs) in concrete" IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308
4. KHURAM RASHID , Prof. Dr. MUHAMMAD AKRAM TAHIR"Evaluation of Concrete Compressive Strength by incorporating Used Foundry Sand" American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936 Volume-03, Issue-02, pp-109-116
5. GURPREET SINGH, RAFAT SIDDIQUE, "Effect of waste foundry sand as partial replacement of sand on the strength, ultra sonic pulse velocity and permeability of concrete". Construction and Building Materials published by Science direct, Vol. 26 (2012), pp. 416-422.
6. DUSHYANT RAMESHBHAI BHIMANI, "Used foundry sand: opportunities for development of eco-friendly low cost concrete"International Journal of Advanced Engineering Technology E-ISSN 0976-3945IJAET/Vol. IV/ Issue I/Jan.-March., 2013/63-66.
7. VIPUL D. PRAJAPATI1, NILAY JOSHI2, PROF. JAYESHKUMARPITRODA (April-June, 2013) " used foundry sand: opportunities for developing of low cost rigid pavement" , International Journal of Advanced Engineering Research and Studies E-ISSN2249–8974 IJAERS/Vol. II/ Issue III/ /69-74.
8. EKNATH P.SALOKHE1, D.B.DESAI2 "Application of Foundry Waste Sand In Manufacture of Concrete" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN: 2278-1684, PP: 43-48 www.iosrjournals.org Second International Conference on Emerging Trends in Engineering (SICETE) 43 | Page Dr.J.J.Magdum College of Engineering, Jaysingpur