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Improving Strength Properties of Concrete Using Foundry Sand

R.Lavanya[1] and S.Kumarswamy[2]

[1,2] Assistant professor, department of civil engineering, [1,2] Samskruti College of engineering and technology, Hyderabad - 501301 Email id:lavanyame14@gmail.com,kumarnani157@gmail.com

ABSTRACT:

In the previous couple of years varied analysis and modification has been done to provide concrete that has the required properties. Concrete is one in all the foremost common materials utilized in the development trade. This space of analysis within the concrete was introducing manufactory sand within the standard concrete. Generation of waste manufactory sand as byproduct of the metal casting industries causes environmental issues attributable to its correct disposal. Therefore its usage in building materials, construction and in different fields is crucial for reduction of environmental issues. This analysis was applied to provide AN eco – friendly concrete. This paper demonstrates the doable use of waste manufactory sand as a partial replacement by fine mixture. AN experimental investigation was applied on concrete containing waste manufactory sand within the vary of (0%, 10%, 20%, 30%, and 40%) by the burden for M30 grade of concrete. Material was tested and compared with typical concrete in terms of strength. These tests were applied on customary cube, cylinder and beam for seven and fourteen and twenty eight days to work out the properties of concrete. The aim of this analysis was to grasp the behavior and strength properties of concrete once addition of manufactory sand in numerous proportion by tests like compressive strength by cube specimen, split tensile by cylindrical specimen and flexural strength by beam model. The analysis was a resource for exploring the potential use of manufactory sand as another to virgin raw materials.

Key words – foundry sand, compressive strength, split tensile strength, flexural strength.

1. INTRODUCTION

The current space of analysis within the concrete is introducing manufactory sand within the normal concrete. Manufactory sand is prime quality silicon dioxide sand with uniform physical characteristics. It's a byproduct of metal and nonferrous metal casting industries, wherever sand has been used for hundreds of years as a molding material thanks to its thermal physical phenomenon. It's a byproduct from the assembly of each metal and nonferrous metal castings. Indian foundries manufacture someone.71 million loads of waste manufactory sand every year (metal world, 2006). The hefty disposal expense has created the present observe of WFS disposal in landfills less favorable. Besides the money burden to the foundries, land – filling WFS additionally creates them to blame for future environmental prices, redress issues and regulation restrictions. This issue is more and more addressed by alternate choices of reusing WFS beneficially. Useful reuses of WFS in type of application associated with infrastructure engineering and rehabilitation works. The use of this material is additionally eco – friendly since it helps in reducing the emission to the atmosphere by the minimization of the cement (pc) consumption. A number of the researchers have according the potential use of manufactory sand in several technology applications. These alternate applications supply price savings for each foundries and user industries and environmental advantages at the native and national level.

2. LITERATURE REVIEW

Rafat siddique et al. (2008) presented the results of associate experimental investigation applied to gauge the mechanical properties of concrete mixtures within which fine mixture (regular sand) was part replaced with used factory sand (UFS). Fine mixture was replaced with 3 percentages (10%, 20%, and 30%) of UFS by weight. Tests were performed for the properties of recent concrete compressive strength, cacophonous enduringness, flexural strength, and modulus of physical property was determined at twenty eight, 56, and twelve months. Check result indicated a marginal increase within the strength properties of plain concrete by the inclusion of UFS as partial replacement of fine mixture (sand) which are often effectively employed in creating sensible quality concrete and construction materials.

Bai et al. (2003) used neural networks to predict workability of concrete incorporating metakaolin and ash. The prediction mirrored the result of graduated variation in pozzolanic replacement inPortland cement up to fifteen MK and four-hundredth solfa syllable. The results showed that the models are reliable and correct and illustrate however neural networks are often accustomed beneficially predict the workability parameters of slump, compacting issue and vebe time across a good vary of PC-FA-MK compositions. On the idea of the models developed, effects of MK and solfa syllable on workability were analyzed and ISO-slump maps were aforethought for w/b zero.25, 0.4 and 0.5. Through this, it's doable for designer to provide mixtures with varied mix compositions.

Rafat siddique and EI- Hadj kadri (2011) dealt with the result of factory sand (FS) and metakaolin (MK) on the close to surface characteristics of concrete. a bearing concrete having cement content 450 kg/m and w/c of zero.45 was designed. Cement was replaced with 3 percentages (5%, 100 percent and 15%) of metakaolin weight, and fine combination was replaced with two hundredth factory sand. Tests were conducted for initial surface absorption, sorptivity, water absorption and compressive strength at the ages of fifty three, 56, and eighty four days.

H. Merve Basar and Nuran Deveci Aksoy (2012) studied the potential re- use of weight and natural {process natural action|action|activity} /stabilization (s/s) process was applied to any or all concrete mixtures. 3 aspects were investigated for qualification of WFS – primarily based –RMC, i.e.the waste factory sand (WFS) in prepared – mixed concrete (RMC) production. Regular sand was replaced with 5 share (0%, 10%, 20%, 30%, and 40%) of WFS by mechanical, natural process and small – structural properties. numerous tests for the mechanical and physical performance of the natural action product were dole out, additionally the} result indicated the addition of WFS as partial replacement of sand reduced the strength performance and density and also exaggerated the water absorption magnitude relation of the concrete mixtures. Withal, the concrete having 2 hundredth WFS exhibited nearly similar result with the management one. The findings of this analysis counsel that WFS is effectively used in creating sensible quality RMC as a partial replacement of fine mixture with no adverse mechanical, environmental and small – structural impacts; but, the partial replacement shouldn't exceed 2 hundredth.

Gurpreet singh and rafat siddique (2011) carried out AN experimental investigation to judge the strength and sturdiness properties to mixtures, during which natural sand was partial replaced with (WFS). Natural sand was 5 shares (0%, 5%, 10%, 15%, and 20%) of WFS by weight. Compressive take a look at and cacophonous lastingness take a look at where dole out to judge the strength properties of concrete at the age of seven, 28, and ninety one days. Take a look at result indicates a marginal increase in strength properties of plain concrete by inclusion of WFS as a partial replacement of fine mixture.

3. Material properties

Physical characteristics of waste foundry sand: waste mill sand is often sub angular to form. When being employed within the mill method, a major variety of sand agglomerations from. Once these square measure weakened, the form of individual sand grains is clear. Inexperienced sands square measure generally black, or gray, not inexperienced with chemicals guaranteed sand is often a medium tan or off- white in color.

Fig 1: foundry sand

Physical properties: typical physical properties of waste foundry sand from green sand systems are given in table 1.

Table 1: physical properties of waste foundry sand (WFS) and natural sand (BIS: 383- 1970)

Properties	Normal sand	Foundry sand
Specific gravity	2.68	2.18
Absorption (%)	1.2	0.42
Moisture content (%)	0.16	0.11
Fineness modulus	2.64	1.89
Fine particles less than 0.07mm (%)	0.5	0.8

Chemical composition: chemical composition of the waste manufactory sand relates on to the metal moulded at the manufactory. This determines the binder that was used, moreover because the flammable additives. Typically, there's some variation within the manufactory sand chemical composition from manufactory to manufactory. Sands made by one manufactory, however, won't possible show important variation over time. The manufactory and may impact its performance. Waste manufactory sand consists primarily of oxide sand, coated with a skinny flim of burnt carbon, residual binder (bentonite, coal, resins) and mud. Oxide sand is deliquescent and consequently attracts water to its surface. This property may lead to wet – accelerated injury.

Waste foundry sand economics: The success of mistreatment waste mill sand depends upon economic science. Very cheap line problems are price, accessibility of the waste mill and accessibility of comparable natural aggregates within the region. If these problems will be with success resolved, the fight of mistreatment waste mill sand can increase for the foundries and for the top users of the sand. This can be true of any recycled material.

Waste foundry sand engineering characteristics: since waste metalwork's sand has nearly all the properties of natural or factory-made sands, it will usually be used as a sand replacement. It is used directly as a fill material in embankments. It is used as a sand replacement in hot combine asphalt, flow in a position fills, and Portland cement concrete. It may be mingling with either coarse or fine aggregates and used as a road base or sub base material.

4. Experimental investigation

Cement: the table three as per IS 4031 (part II) – 1988 and chemical properties to IS: 12269 – 1987 was used. It had been tested standard hydraulic cement (ultra technical school cement) of fifty three grades orthodox for its physical properties as per IS: 12269 .fineness of cement by hand sieving methodology = 100 percent. Properties of cement shown in.

Table 3: properties of cement

S.NO	PROPERTY	VALUE
1	Normal consistency	26%
2	Initial setting time	40 minutes
3	Final setting time	8 hours
4	Specific gravity	3.14
5	Fineness of cement	3%

Fine aggregate: The domestically offered stream sand was used as fine mixture within the gift investigation. The sand was free from clayey matter, salt and organic impurities. The sand was tested for varied properties like relative density, bulk density etc., and in accordance with IS 2386 – 1963.Properties of fine aggregate shown in the table 4.

Table 4: properties of fine aggregate

S.NO	PROPERTY	VALUE
1	Specific gravity	2.62
2	Bulking absorption	1%
3	Bulking of sand	11.9%
4	Fineness modulus	2.565

Coarse aggregate: the native supply was used as coarse combination. it had been machine crushed angular granite metal of twenty metric linear unit nominal size from free from impurities like dirt, clay particles and organic matter etc. the physical properties of coarse combination were investigated in accordance with IS 2386 – 1963. Properties of course shown in the table 5.

Table 5: properties of coarse aggregate

S.NO	PROPERTY	VALUE
1	Specific gravity	2.6
2	Water absorption	0.50%
3	Fineness modulus	2.29
4	Crushing value	12.42%
5	Impact value	11.2%
6	Flakiness index	35.85%
7	Elongation index	45.45%

Water : regionally on the market water used for combination and hardening that is potable and free from injurious quantity of oils, acids, alkalis , salt, sugar, organic material or different substance which will be injurious to concrete or steel.

Mixes: The present experiment is meted out to research strength properties of concrete mixes of grade M30 within which fine mixture (river sand) is to be partly replaced with waste factory sand. Fine mixture is replaced with four percentages (10%, 20%, 30%, and 40%) of WFS by weight.

Mixing, casting, curing, and testing: The required range of specimens for varied mixtures was forged. Continuous natural process was maintained up to age of seven, 14, 28 days. Mixing, casting, curing, testing were meted out as per the specification.

5. RESULT AND DISCUSSION

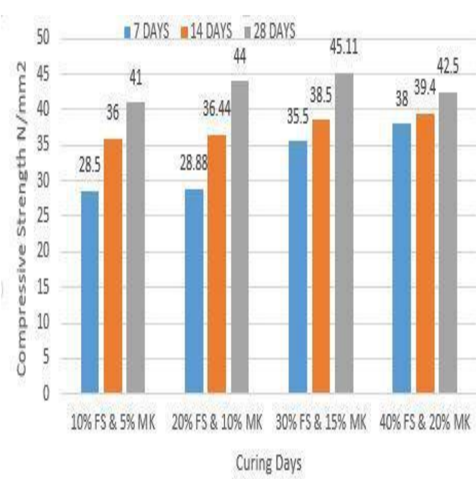
The study was conducted to search out out the influence of waste factory sand to enhance the strength and properties of concrete. The results of following parameters were studied. Compressive strength split enduringness, flexural strength at numerous share replacement of fine combination with factory sand on concrete.

Compressive strength split enduringness, flexural strength of concrete will increase with increase of waste factory sand up to four-hundredth. it absolutely was the utmost replacement level. Use of factory sand in concrete reduces the assembly of waste through the metal casting industries. I.e. it's associate degree eco-friendly artifact. Application of this study ends up in develop in construction sector and innovative artifact.

Compressive strength: cube specimens were tested for compression and supreme compressive strength was firm from failure load measured victimization compression testing machine. The typical price of compressive strength of three specimens for every class at the age of seven days, fourteen days and twenty eight days are tabulated in the table 6.

Table 6: compressive strength of specimen

SPECIMEN	7 DAYS	14 DAYS	28 DAYS
10% FS	28.5	36.0	41.0
20% FS	28.88	36.44	44
30% FS	35.5	38.5	45.11
40% FS	38	39.4	42.5

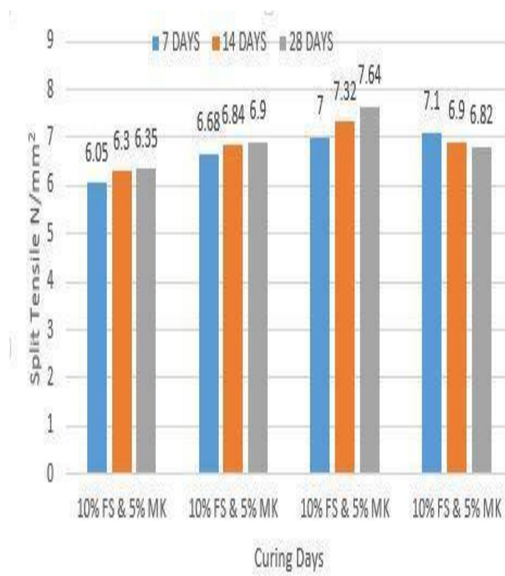


There is a considerable improvement in the compressive strength of concrete with inclusion and increase in the percentage of waste foundry sand up to 40%. It is observed that the compressive strength increased with increasing age of curing. The maximum compressive strength was achieved by 40% replacement fine aggregate with foundry sand.

Split tensile strength: cylinder specimens were tested for splitting tensile strength. The test was carried out according to IS: 5816 – 1970(10). In this test compressive line loads were applied along a vertical symmetrical plane, which causes splitting of specimen. The average values of 3 specimens for each category at the ages of 28 &56 days are tabulated in the table 4. The increase in the splitting tensile strength of various concrete mixtures over plain concrete is also tabulated in table 7.

Table 7: Split tensile strength of specimen

SPECIMEN	7 DAYS	14 DAYS	28 DAYS
10% FS	6.05	6.3	6.35
20% FS	6.68	6.84	6.9
30% FS	7.0	7.32	7.64
40% FS	7.1	6.9	6.82

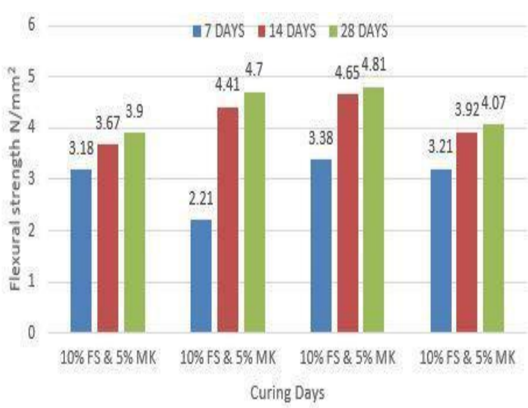


There is a considerable improvement in the split tensile strength of concrete with inclusion and increase the percentage of waste foundry sand up to 40%. It is observed that the split tensile strength increased with increasing age of curing. The maximum strength was achieved with 40% of foundry sand.

Flexural strength: prism specimens were tested for flexural strength. The tests were carried out confirming to IS: 5161S – 1959(8). The specimens are tested under two – point loading. The average value of 3 specimens for each category at the age of 28 days is tabulated in the table 8.

Table 8: flexural strength of specimen

SPECIMEN	7 DAYS	14 DAYS	28 DAYS
10% FS	3.18	3.67	3.9
20% FS	2.21	4.41	4.70
30% FS	3.38	4.65	4.81
40% FS	3.21	3.92	4.07



Increase in strength of various concrete mixtures over the plain concrete is also tabulated in the table 5. There is considerable increase in the flexural strength of concrete with the inclusion of foundry sand.

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