International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

COPY RIGHT

ELSEVIER SSRN

IJIEMR Transactions, online available on 23rd Nov 2019. Link :http://www.ijiemr.org/downloads.php?vol=Volume-08&issue=ISSUE-11

Title **MECHANICAL PROPERTIES OF CONCRETE USED INCORPORATING USED FOUNDRY SAND**

Volume 08, Issue 11, Pages: 306-315.

Paper Authors

CH SIVA KOTESWARA RAO , M NAGESWARA RAO

AM Reddy Memorial College of Engineering & Technology, Petlurivaripalem

USE THIS BARCODE TO ACCESS YOUR ONLINE PAPER

To Secure Your Paper As Per UGC Guidelines We Are Providing A Electronic Bar Code

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

MECHANICAL PROPERTIES OF CONCRETE USED INCORPORATING USED FOUNDRY SAND

CH SIVA KOTESWARA RAO 1*, M NAGESWARA RAO 2*

1. II. M.Tech , Dept of CIVIL, AM Reddy Memorial College of Engineering & Technology, Petlurivaripalem.
2. Asst. Prof, Dept. of CIVIL, AM Reddy Memorial College of Engineering & Technology, Petlurivaripalem.

Abstract:
An extraordinary inadequacy of stream sand which is all things considered used as a fine aggregate in concrete has been affecting the improvement part. The deficiency has provoked the taking off expense of sand, increasing advancement costs. WFS is a significant consequence of metal tossing industry and adequately used as a land filling material for quite a while. With a true objective to use the WFS in considerable volume, investigate are being finished for its possible broad scale use in making concrete as deficient substitution of fine aggregate. Foundry sand includes in a general sense of silica sand, secured with a thin film of devoured carbon, remaining latch (bentonite, sea coal, gums) and deposit. Foundry sand can be used in concrete to upgrade its quality and other quality components. Foundry Sand can be used as an inadequate substitution of fine sums or total substitution of fine aggregate and as useful extension to achieve particular properties of concrete.

INTRODUCTION

Concrete is the primary piece of any development work which is made out of rock or pulverized stones, sand and hydrated bond and so forth it has been utilized over a century in all development work. As the outcome attributable to concrete is ideal, concrete is the primary development in our development industry. Concrete predominantly comprise of bond, fine total, coarse total, water and now a days admixtures are utilized. One of this principle constituent's fine total is the part which has been utilized in expansive amount everywhere throughout the world. The overall utilization of fine sand is the world over is high and furthermore this interest is expanding step by step. To defeat this interest is the principle question emerges before our development industry. While on the opposite side the ventures has created on extensive amount. Metal industry is one of them. Metal industry has many waste item, and at a specific period this squanders are not utilized further. This waste created is the fundamental natural issue. One of the waste produced from metal businesses which can be useful to conquer the interest fine sand is 'foundry sand'. Foundry sand is formally

dressed estimated; excellent silica sand will undoubtedly frame a shape for throwing of ferrous and nonferrous metal. This sand is better than fine sand. Consumed foundry sand is utilized ordinarily in metal throwing process, when it is never again utilized it is expelled from foundry as waste foundry sand. This waste foundry sand is valuable to defeat the interest issue of fine sand. The substitution of fine sand in development industry will lead it to sparing, ecological inviting, light weight and high quality cement**.**

Foundry sand:

A foundry is an assembling office that produces metal castings by pouring liquid metal into a preformed shape to yield the coming about solidified cast. The essential metals cast incorporate iron and steel from the ferrous family and aluminum, copper, metal and bronze from the nonferrous family. Foundry sand is top notch silica sand that a result from the generation of both ferrous and nonferrous metal castings. The physical and compound attributes of foundry sand will depend in extraordinary part on the sort of throwing process and the business division from which it starts. In the throwing procedure, shaping sands are reused and reused numerous occasions. Inevitably, be that as it may, the reused sand debases to the point that it can never again be reused in the throwing process. By then, the old sand is dislodged from the cycle as result; this side-effect is named as Waste Foundry Sand (WFS).WFS is the real issue in the administration of foundry squander.

Need for the Present Work:

Alluding to the article "Options in contrast to stream sand" announced in the every day daily paper "THE HINDU" dated April 21, 2007 "Property in addition to" release, expresses that: An intense lack of waterway sand has been influencing the development area. The shortage has prompted the soaring cost of sand, heightening development costs. The circumstance has dashed the fantasies of numerous in the lower-and center salary gatherings to claim a house. There were learns about the exhaustion of stream sand and the requirement for logical administration and misuse of the accessible asset. Following the deficiency of waterway sand, some examination establishments are creating options that can be utilized for development.

Squander foundry sand speaks to the most astounding measure of strong squanders produced by foundries. The staggering expense of land-filling and the potential employments of waste foundry sand in development purposes have provoked investigation into their valuable reuse. Ferrous and nonferrous metal throwing enterprises deliver a few million tons of result on the planet. In India, around 2 million tons of waste foundry sand is created yearly. WFS is real side-effect of metal throwing industry and effectively utilized as a land filling material for a long time. Be that as it may, utilization of waste foundry sand for arrive filling is turning into an issue because of quick increment in transfer cost. With an end goal to utilize the WFS in huge volume, looks into are being completed for its conceivable huge scale use in making

concrete as incomplete substitution of fine total. And furthermore the expanded rates of concrete dashed every one of the divisions. By utilizing materials like Metakaolin (MTK) in valuable to bond will give some help to the development.

Along these lines an endeavor has been made in the present investigation to assess the quality properties of solid blends in which fine total (waterway sand) was in part supplanted with Waste Foundry Sand and concrete with Metakaolin.

Objectives:

- To examine the impact of waste foundry sand as a halfway substitution of fine total on quality properties of M40 review of cement
- To locate the ideal incentive for substitution of bond by Metakaolin solid blend.
- To examine the impact of Metakaolin as a substitution of bond and waste foundry sand as a substitution of fine total on quality properties of twofold mixed cement.

LITERATURE REVIEW

This part manages the survey of writing identified with quality properties of cement produced using Waste Foundry Sand as a substitution of fine total and impact of Metakaolin on quality properties of cement with double mix.

Sanjay N. Patil, Anil K. Gupta, Subhash (2005) exhibited the aftereffect of a test examination the utilization of Metakaolin which is having great pozolanic movement and is a decent material for the creation high quality cement. which is getting fame as a result of its constructive outcome on different properties of cement displayed the aftereffects of a test examination did to assess the mechanical properties of solid blends in which fine total (general sand) was mostly supplanted with squander foundry sand. Fine total was supplanted with three rates (10%, 20%, and 30%) of WFS by weight. Tests were performed for the properties of new concrete. Compressive quality, part rigidity, flexural quality, and modulus of versatility were resolved at 28, 56, 91, and 365 days. Test outcomes demonstrated a peripheral increment in the quality properties of plain cement by the incorporation of WFS as incomplete substitution of fine total (sand) and that can be successfully utilized in making great quality cement and development materials.

Siddique, El-Hadj Kadri and Rachid Bennacer (2010) exhibited the plan of cement blends made with squander foundry sand as fractional substitution of fine totals up to 40%. Different mechanical properties are assessed (compressive quality, and split rigidity). Solidness of the solid with respect to protection from chloride infiltration, and carbonation is likewise assessed. Test outcomes show that modern side-effects can create concrete with adequate quality and solidness to supplant typical cement. Compressive quality, and split-rigidity, was resolved at 28, 90 and 365 days. Similar quality advancement of foundry sand blends in connection to the control blend i.e. blend without foundry sand was watched. Along these lines, demonstrating successful utilization of foundry sand as a substitute

material, as halfway substitution of fine totals in concrete

Gurpreet Singh and Rafat Siddique (2011) completed an exploratory examination to assess the quality and toughness properties of solid blends, in which regular sand was incomplete supplanted with (WFS). Regular sand was supplanted with five rate (0%, 5%, 10%, 15%, and 20%) of WFS by weight. Pressure test and part elasticity test were completed to assess the quality properties of cement at the age of 7, 28 and 91 days. Test outcomes demonstrate a minimal increment in quality properties of plain cement by incorporation of WFS as a halfway substitution of fine total.

Neelam Pathak and Rafat Siddique (2012) examined the utilization of spent foundry sand and fly fiery debris on the properties of Self-Compacting-Concrete (SCC, for example, compressive quality, part rigidity, modulus of versatility, quick chloride penetrability, porosity and mass misfortune when presented to lifted temperatures. The impact of fly fiery debris as halfway substitution of bond, and spent foundry sand as incomplete substitution of sand on the properties of SCC is explored. Utilizing Ordinary Portland bond, an expansion of around 24– 25% in compressive quality, 18–22% in part rigidity was seen at 28 days when fly fiery debris content was diminished from half to 30%. The rate of part rigidity and modulus of flexibility misfortune was higher than that of the compressive quality misfortune at raised temperatures and with the expansion in level of fly cinder.

Basic Appraisal of Literature Review

- Writing papers close peripheral increment in the quality properties of cement with the consideration of WFS.
- Squander Foundry Sand has been utilized with admixtures, for example, Metakaolin to think about sturdiness properties of cement and with Fly cinder to examine properties of self-compacting concrete.
- Metakaolin fuse in solid outcomes in critical enhancements in the functionality of cement, alongside the compressive quality.

MATERIALS

The word solid originates from the Latin word "concretus" which means reduced or consolidated. Concrete was utilized for development in numerous antiquated structures. Concrete is a composite material made out of rock or pulverized stones (coarse total), sand (fine total) and hydrated bond (cover). Concrete, in the broadest sense, is any item or mass made by the utilization of an establishing medium. For the most part, this medium is the result of response between pressure driven bond and water. For cement to be great solid it must be agreeable in its solidified state and furthermore in its new state while being transported from the blender and put in the formwork. The prerequisites in the new state are that the consistence of the blend is to such an extent that the solid can be compacted and furthermore that the blend is

sufficiently durable to be transported and set without isolation.

To the extent the solidified state is viewed as, the typical necessity is an acceptable compressive quality. Numerous properties of cement are identified with its compressive quality, for example, thickness, im-porousness, toughness, protection from scraped area, protection from affect, elasticity, and protection from sulfates

The coarse total are granular materials acquired from rocks and pounded stones. They might be additionally gotten from manufactured material like slag, shale, fly fiery debris and earth for use in light-weight concrete.

Aggregate:

The sand got from stream beds or quarries is utilized as fine total. The fine total alongside the hydrated concrete glue fill the space between the coarse total. The essential properties of total are as per the following.

- Shape and surface
- Estimate degree
- Dampness content
- Particular gravity
- Toughness

Cement: In present day solid, concrete is a blend of lime stone and dirt warmed in an oven to 1400 - 1600ºC. The kinds of bond allowed according to Seems to be: 456 - 2000, Plain and Reinforced – Concrete Code of Practice.

Normal Portland bond affirming to IS: 269 - 1989,

Portland slag concrete affirming to IS: 455 - 1989,

Quick solidifying Portland bond affirming to IS: 8041 - 1990,

Water: The water ought to fulfill the necessities of Section 5.4 of IS: 456 - 2000. "Water utilized for blending and relieving will be perfect and free from damaging measures of oils, acids, antacids, salts, sugar, natural materials or different substances that might be harmful to cement and steel".

Admixtures: IS: 1343 - 1980 permits to utilize admixtures that comply with IS: 9103 - 1999, Concrete Admixtures – Specification. The admixtures can be comprehensively partitioned into two sorts: concoction admixtures and mineral admixtures.

- The normal substance admixtures are as per the following.
- Air-entraining admixtures
- Water diminishing admixtures
- Set impeding admixtures

Set quickening admixtures:

Water diminishing and set hindering admixtures

Water diminishing and set quickening admixtures.

The regular mineral admixtures are as per the following.

- Fly powder
- Ground granulated impact heater slag
- Silica smoke
- Rice husk powder
- Metakaolin
- These are cementitious and pozzolanic materials.

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Waste Foundry Sand (WFS):

Strong waste administration has turned out to be one of the worldwide natural issues, as there is persistent increment in mechanical side-effects and waste materials. Because of absence of land filling space and its consistently expanding cost, use of waste material and side-effects has turned into an appealing option in contrast to transfer. Squander foundry sand (WFS) is one of such mechanical side-effect.

Ferrous and non-ferrous metal throwing enterprises create a few million tons of side-effect on the planet. In India, around 2 million tons of waste foundry sand is created yearly. WFS is major side-effect of metal throwing industry and effectively utilized as a land filling material for a long time. Be that as it may, utilization of waste foundry sand for arrive filling is turning into an issue because of fast increment in transfer cost.

Metal foundries utilize a lot of sand as a major aspect of the metal throwing process. Foundries effectively reuse and reuse the sand ordinarily in a foundry. At the point when the sand can never again be reused in the foundry, it is expelled from the foundry and is named "Squander Foundry Sand".

Foundry industry delivers a lot of side-effect material amid throwing process. The ferrous metal throws in foundry are solid metal and steel, non-ferrous metal are aluminum, copper, metal and bronze. More than 70% of the aggregate result material comprises of sand since form comprise for the most part of trim sand, which is effortlessly accessible, reasonable, protection from warm harm and effectively reinforced with cover and other natural material in shape. Foundry industry utilize top notch particular size silica sand for their embellishment and throwing process. These WFS is dark in shading and contain extensive measure of fines. The run of the mill physical and substance property of WFS is needy upon the sort of metal being poured, throwing process, innovation utilized, kind of heaters (acceptance, electric bend and dome) and sort of completing procedure (crushing, impact cleaning and covering).

MIX DESIGN

Concrete Mix Design:

Mix design for a concrete of M40 grade is given below:

DESIGN STIPULATIONS:

A	Characteristic compressive strength required 40 N/mm^2 in the field at 28 days	40 N/mm^2
B	Maximum size of aggregate	20 mm (angular)
C	Degree of workability	0.80 C.F.
D	Degree of quality control	Good
E	Type of exposure	Mild

TARGET MEAN STRENGTH OF CONCRETE:

For a resistance factor of 1.65 and utilizing Table 1 of IS 10262, the objective mean quality for the predefined trademark 3D shape quality is 40 + 5.0 X 1.65= 48.25 N/mm2

SELECTION OF WATER CEMENT RATIO:

The free water-cement ratio required for the target mean strength of 48.25 N/mm2 is 0.40. This is lower than the maximum value of 0.60 prescribed for 'Mild' exposure in Table 5 of IS: 456-2000.

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

SELECTION OF WATER AND SAND CONTENT:

For 20 mm ostensible most extreme size total and sand fitting in with evaluating Zone II, water content per cubic meter of cement = 180 kg and sand content as level of aggregate total by total volume = 25 percent.

No modifications are required since fine total has a place with Zone II.

Assurance OF CEMENT CONTENT

Water concrete proportion = 0.40

Water = 180 lit

Concrete =180/0.40 =450 kg/m3

This concrete substance is sufficient for gentle introduction condition, as per Table 5 of IS: 456-2000.

DETERMINATION OF COARSE AND FINE AGGREGATE CONTENT

For the predefined most extreme size of total of 20 mm, the measure of entangled air in the wet cement is 2 percent Considering and applying conditions from 3.5.1 of I.S. 10262

$$V = \left(W + \frac{C}{Sc} + \frac{1}{P} X \frac{fa}{Sfa}\right) X \frac{1}{1000}$$

$$0.98 = \left(180 + \frac{450}{3.14} + \frac{1}{0.25} X \frac{fa}{2.53}\right) X \frac{1}{1000}$$

$$F_a = 415.35 \text{ kg/m}^3$$

$$Ca = \frac{1-P}{P} X\, fa\, X \frac{Sca}{Sfa}$$

$$Ca = \frac{1-0.25}{0.25} X\, 415.35\, X \frac{2.72}{2.53}$$

$$Ca = 1340 \text{ Kg/m}^3$$

The mix proportion then becomes:

Water	Cement	Fine Aggregate	Coarse Aggregate
180	450	415	1340
0.40	1	0.92	3.0

Trial and error method:

The mix proportion used is

Water	Cement	Fine Aggregate	Coarse Aggregate
160	400	440	1420
0.40	1	1.1	3.5

EXPERIMENTAL PROGRAMME

In the present test program standard 3D shapes of size (150x150x150mm) fitting in with IS: 10086-1982 were threw and tried for compressive quality, standard chambers of size 150mm width and 300mm stature complying with IS: 10086-1982 were threw and tried for part elasticity and standard shafts (100x100x500mm) were threw and tried for finding the flexural quality property of plain bond concrete and parallel mixed cement.

Materials:

The materials utilized in this trial contemplate were bond, fine total, coarse total, water, squander foundry sand, Metakaolin and super plasticizer.

CEMENT:

Standard Portland concrete (Ultra tech bond) of 53 review affirming to IS: 12269-1987 was utilized. It was tried for its physical properties according to IS 4031 (section II)-1988. The points of interest of test outcomes are given in Table

Aggregate

The size, shape and degree of the total assume a critical job in accomplishing an

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

appropriate cement. The flaky and prolonged particles will prompt blocking issues in bound zones. The sizes of totals will rely on the measure of rebar dispersing.

The coarse total decided for Concrete was commonly rakish fit as a fiddle, all around evaluated, and littler than greatest size suited for ordinary cement; run of the mill traditional cement ought to have a most extreme total size of 20mm. Degree is a vital factor in picking a coarse total. Hole evaluated coarse total elevates isolation to a more noteworthy degree than the very much reviewed coarse total

Fine Aggregate:

The locally accessible stream sand was utilized as fine total in the present examination. The sand was free from clayey issue, salt and natural pollutions. The sand was tried for different properties like particular gravity, mass thickness and so forth., and as per IS 2386-1963. The fine total was adjusting to standard determinations. The points of interest of test outcomes are given in Table.

RESULTS AND DISCUSSIONS

Results got from exploratory examination to ponder the quality properties of plain cement blends in which fine total is supplanted by squander foundry sand at different rates are exhibited here for talk they are contrasted and the double mixed cement. The examination was led to discover the impact of Metakaolin and waste foundry sand on quality properties of plain concrete.

- The impacts of following parameters were contemplated.
- The different rate supplanting of fine total with squander foundry sand on a portion of the quality properties of plain concrete.
- The ideal rate supplanting of Metakaolin with bond and different rate supplanting of fine total with squander foundry sand on a portion of the quality properties of paired mixed cement.

Test Results of Plain Concrete:

Different tests were done to research the impact of supplanting of fine total with squander foundry sand in various extents on functionality, compressive quality, split elasticity and flexural quality on plain concrete. The substitution level of waste foundry sand was taken at 0%, 10%, 20%, 30%, 40%, half and 60%.

The test aftereffects of the trial examinations performed on Plain Concrete are organized in the Test outcomes are additionally indicated graphically in the Figures

Table: Workability of Plain Concrete with Various Percentages of Waste Foundry Sand

S.No.	Mix ID	Slump (mm)
1	WFS0	70
2	WFS10	64
3	WFS20	59
4	WFS30	52
5	WFS40	44
6	WFS50	32
7	WFS60	21

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

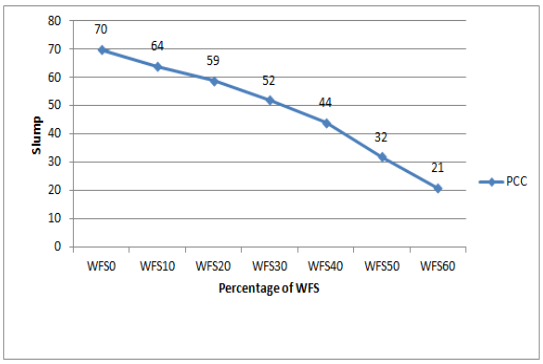

Figure 10 Workability of Plain Concrete with Various Percentages of Waste Foundry Sand

As the waste foundry sand rate expanded in the solid the functionality was diminished. This might be because of the void filling activity of the waste foundry sand as it is better than the fine total, which gives a high union to the blend. Blend with increment in squander foundry sand content has a tendency to end up unforgiving, sticky and firm. At half supplanting of fine total with squander foundry sand the solid blend ended up brutal.

Compressive Strength Test:

Block examples were tried for pressure and extreme compressive quality was resolved from disappointment stack estimated utilizing pressure testing machine. The normal estimation of compressive quality of 3 examples for every classification at 7 years old days, 14 days and 28 days are arranged in the Table The relative compressive quality of different cement blends at various ages is appeared in the figure

Figure:Testing of Cube Specimen in CTM

Table Compressive Strength of Various Concrete Mixes with Replacement of Fine Aggregate over Waste Foundry Sand at Different Ages

S.No.	Mix ID	Compressive Strength (MPa)		
		7 days	14 days	28 days
1	WFS0	32.6	42.4	52.07
2	WFS10	33.09	43.4	52.27
3	WFS20	33.32	43.8	53.15
4	WFS30	33.65	44	53.71
5	WFS40	34.22	44.5	54.74
6	WFS50	34.12	44.2	51.18
7	WFS60	32.03	43.1	46.43

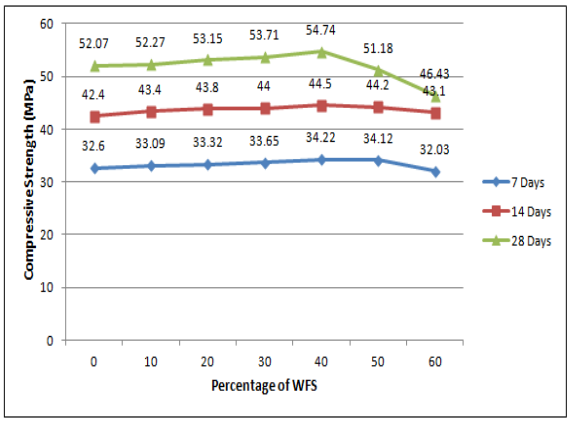

Figure Compressive Strength of Various Concrete Mixes with Replacement of Fine Aggregate over Waste Foundry Sand at Different Ages

Around 63% of the 28 days quality was accomplished in 7 days. Compressive quality of 32.88 MPa for control blend was accomplished at 7 long periods of relieving. There was negligible increment in the compressive quality of cement blends with increment in the level of waste foundry sand. The compressive quality of cement blends expanded up to 40% supplanting of fine total with squander foundry sand. With additionally increment in the level of waste foundry sand the compressive quality began to diminish. Most extreme compressive quality of 34.22 MPa was accomplished with 40% supplanting of fine total with squander foundry sand at 7 days.

CONCLUSION

- At the point when level of waste foundry sand was expanded past 40% the blend began losing its functionality.
- At the point when concrete supplanted with Metakaolin for mortar 3D shapes quality expanded upto 10 % substitution and after that diminished. In this way, 10 % substitution is ideal here.
- Supplanting of fine total with squander foundry sand demonstrated increment in the compressive quality of plain cement of review M40 up to 40% and afterward there was an impressive diminishing in the quality. Greatest quality was accomplished at 40%.
- For Plain Concrete blend at 60% substitution of fine total quality of 46.43 MPa was accomplished at 28 days which is not as much as the objective quality.
- Flexural quality of cement diminished with the incorporation and increment in the level of waste foundry sand for plain concrete.
- 10% supplanting of bond with Metakaolin was observed to be ideal for M40 review of cement.
- Twofold Blended Concrete blend with Metakaolin as folio substitution containing 60% waste foundry sand was as yet functional.
- For Binary Blended Concrete blend at 60% substitution of fine total, quality of 52.0 MPa was accomplished at 28 days which is more than the objective quality.
- Twofold Blended Concrete fusing Metakaolin demonstrated better execution when contrasted with plain concrete.
- 12 % augment in the compressive quality was found at 28 days utilizing Metakaolin 5% expansion in the flexural quality was seen in Binary Blended Concrete blends when contrasted with Plain Concrete blends.
- Metakaolin which is taken from amarphus synthetic concoctions pvt ltd can be settled on substitution of concrete for a significant rate (10 %) as it were.

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org