JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

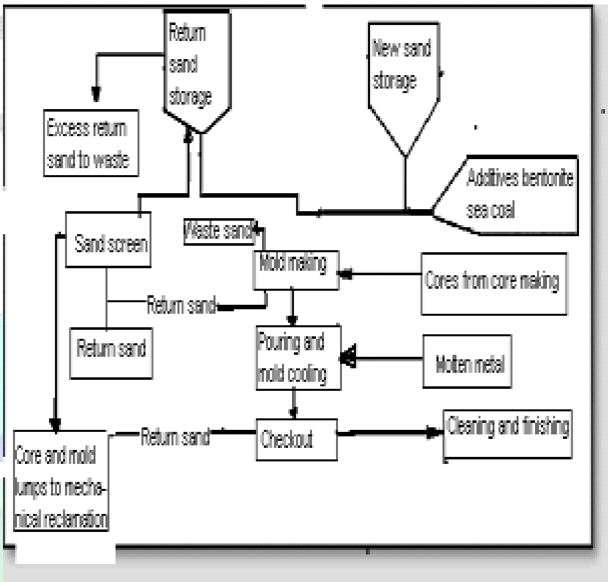
"To Study Waste Foundry Sand as Concrete Ingredient"

Asst Prof. Pratiksha Pawar , Mr. Ketan Raval , Mr.Vinayak Jankar, Mr. Rutwik Deshmukh, Mr.Sagar khabale, Mr. Soheab Mursal.

Abstract: Waste foundry sand (WFS) is a by-product of the foundry sector. While ensuring enduring construction, the usage of WFS in building materials will protect the environment and its resources. The use of industrial waste in concrete compensates for a lack of environmental resources, resolves the problem of trash dumping, and offers another form of environmental protection. In the last several decades, a number of researchers have looked at whether WFS may be used to produce concrete instead of natural river sand in an effort to solve the problem of WFS in the foundry region and achieve its recycling. However, it is noted that there is a dearth of understanding regarding the development of WFS in the manufacturing of concrete, necessitating a compressive study. The current study investigates a number of characteristics, including the physical and chemical makeup of WFS, its new features, and the mechanical and durability performance of concrete using WFS as a partial replacement. The results of several research indicate that replacing WFS up to 30% boosted the concrete's durability and mechanical strength to some amount, but that as the replacement level of WFS grew, the workability of fresh concrete decreased. Future study should combine WFS with pozzolanic material or fibre reinforcement, according to this review.

Keywords: waste foundry sand; flowability; mechanical strength; durability performance

I. **INTRODUCTION**: High-quality, homogenous silica sand known as "foundry sand" is used to create cores and moulds for ferrous and nonferrous metal castings. 100 million tones of foundry sand are reportedly used yearly in the metal casting industry. Foundry sands physically deteriorate over time until they are unusable as mold-making materials. As a result, 9 to 10 million tones of sand are thrown away annually. The abandoned foundry sands, on the other hand, are often regarded as a higher grade material than common bank run or natural sands used in construction due to their compositional consistency and remarkable consistency. At the moment, landfills are utilized to dispose of the remaining 28% of waste sand, which is employed mostly in construction-related applications. Foundry sand recycling can conserve energy and lessen the demand for mining. The technical and construction characteristics of foundry sand for use in concrete are thoroughly discussed in this work. We discuss recent research that address the environmental issues associated with employing discarded foundry sand, an industrial by-product, as a building material. To show how leftover foundry sand may be successfully applied, certain case examples are offered. Resources and technologies, including web-based training and a foundry locating map module, are mentioned in order to advance the use of leftover foundry sand in building applications.



Necessity: Sand mining is surprisingly an intensely politicized phenomenon that has gone unchecked for many decades in India. This article attempts to tease out thebigger picture about the dangers of dredging indiscriminately in the quest formodernization and how these threats are compounded by corruption in the sector and a lack of integrity.
A group of reporters are visiting a picturesque creek of a river on the western coast of India and are taking some photos.

ALTERNATIVE TO SAND

In the most of the advanced parts of the world, people are using graded crust stone sand manufactured from the stone, as an alternative to sea and river sand.The Indian industry is yet to adapt to this slowly if government allows, this can be a permanent alternative to river sand.

The government is yet to clear their position whether they allows to clearing the hills to crust the stones & whether that will be acceptable to environmentalists. Till the time a fair decision is taken, the construction industry will continue to face a crisis on account of non-availability / less availability of sand.
The present rate of one truck of sand is more than Rs15,000. It was Rs 3000 a year ago.

Where does it come from?
Foundries purchase high quality size-specific silica sands for use in their molding and casting operations. The raw sand is normally of a higher quality than the typical bank run or natural sands used in fill construction sites.
The sands form the outer shape of the mold cavity. These sands normally rely upona small amount of bentonite clay to act as the binder material.
Chemical binders are also used to create sand "cores". Depending upon the geometry of the casting, sand cores are inserted into the mold cavity to form internal passages for the molten metal (Figure 1.1). Once the metal has solidified, the casting is separated from the molding and core sands in the shakeout process.
In the casting process, molding sands are recycled and reusedmultiple times.
Eventually, however, the recycled sand degrades to the point that it can no longer be reused in the casting process. At that point, the old sand is displaced from the cycle as byproduct, new sand is introduced, and the cycle begins again. A schematic of the flow of sands through a typical foundry

How is it Produced?
Waste Foundry sand is produced by five different foundry classes. The ferrous foundries (gray iron, ductile iron and steel) produce the most sand. Aluminum, copper, brass and bronze produce the rest. The sand is typically used multiple times within the foundry. The sands from the brass, bronze and copper foundries are generally not reused.

FOUNDRY WHERE IN RECYCLING OF SAND DOESN'T TAKES PLACE

NAME OF THE FOUNDRY	Mahabal Industry
FINAL PRODUCT OF THE FOUNDRY	STEEL
TYPE OF SAND USED IN THE FOUNDRY	60-80 SAND
AMOUNT OF SAND USED PER DAY	5 TONNES
SOURCE OF THE SAND	PHONDA IN KONKAN ARE A
AMOUNT OF FOUNDRY SAND GENERATED PER DAY	ALLMOST ALL
WHETHER IT IS REUSED OR DISPOSED	DISPOSED
IF DISPOSED THEN THE CURRENT METHOD OF DISPOSAL	FOR LOCAL PURPOSESAND LAND FILLING.

Table 5.1.1

MATERIALS USED: Plain Cement Concrete, herein referred to as "Concrete" consists of a mixture of approximately 30% sand, 50% gravel, 15% cement, and 55% water. Concrete can be either cast-in-place, or pre-cast into concrete products such as bricks, pipes, blocks, etc.The fine aggregate portion used in the production of concrete is of particular interest when foundry sands are beneficially reused in concrete production.

CRUSHING AND SCREENING

It may be necessary to crush the spent foundry sand to reduce the size of oversizecore butts or unclasped molds. The spent foundry sand can also be screened and over size material(from mold sand cores that have not completely collapsed) removed.

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

The sand used in this investigation is ordinary riversand.
The sand confirms to grading zone- III

Physical properties of the fine aggregate are as follows:
Specific gravity: 2.58
Fineness modulus: 2.87%
Bulk density 1692kg/m^3
Water absorption 2.1%

The coarse aggregate used in the investigation is 20mm
Physical properties of the coarse aggregate are as follows: Specific gravity: 2.6
Fineness modulus: 7% Bulk densit1652kg/m3
Water absorption 1.12%

Foundry sand: foundry sand was procured from Krishna Factory Karad.
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

CASE STUDY

A study investigating the beneficial reuse of foundry sand in cast-in-place concrete and concrete blocks. Several concrete mixes using foundry sand as a partial replacement for fine aggregate were developed and tested.
Concrete blocks from several mixes were prepared for testing compressive strength. And the concrete cylinders from several mixes were prepared for testing of the splitting tensile strength. The concrete mixes were designed using weigh analysis. Replacement of fine aggregates with foundry sand ranged 10 to 60%. All mix designs used a water-cement ratio 0.45
Concrete blocks were cast manually in the laboratory. Design mixes for the blocks were developed based on sieve analysis data. Four mixes were developed using 10, 20, 40 and 60% replacement of fine aggregate with foundry sand. The 7-days and 28-days compressive strengths of the blocks were then determined. Thecompressive strength of the blocks decreased as the amount of foundry sand in the mix increased. However, the mixes containing replacement 10, 20 and 40% produced blocks with strengths higher than the minimum strength of concrete blocks cast without using foundry sand. All mixes containing 60% replacement of fine aggregate with foundry sand also produced more strength than the minimum.
Also the concrete cylinders were cast manually in the laboratory with the same procedure as of the concrete blocks. The 7-days and 28-days splitting tensile strengths of the concrete cylinders were then determined. The splitting tensile strength of the cylinders varied widely as the replacement of the natural sand with the foundry sand increased the concrete cylinders.

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 10%, 20%, 40%, 60% 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 10%, 20%, 40%, 60% of FWS

V EXPERIMENTAL RESULT AND DISCUSSION

work done and the schedule regarding casting of concrete blocks and cylinders

A. Compressive strength test:

Fig 2: Testing cubes under UTM machine

Table 1: Compressive strength test results

Sr no	% of variation	W/C ratio	Avg. compressivestrength at 7days (N/mm2)
1	0	0.45	20.37
2	10	0.45	24.70
3	20	0.45	25.50
4	40	0.45	30.37
5	60	0.45	26.4

The strength increases as the foundry sand replaces natural sand from 10% to 60% and a drop takes place in the same after that, as we go on replacing foundry sand by natural sand in more quantity by percentage till 50%. But even then it gives more compressive strength than the minimum strength of concrete given by natural sand. Hence the optimum value of 50% replacement of natural sand by foundry sand givesthe maximum strength of 30.37 N/mm2.

B Spitting Tensile strength test:

Table 2: Tensile strength test results

Sl.no	% of variation	W/C ratio	Tensile strength at 7 days (N/mm2)
1	0	0.45	10.71
2	10	0.45	11.28
3	20	0.45	11.45
4	40	0.45	14.61
5	60	0.45	12

Initially the strength increases as the foundry sand replaces natural sand by 10 to 60 % and a drop takes place in the same after that, as we go on replacing foundry sand by natural sand in more quantity by percentage from 40 to 60%. And increase takes place as we go from 20 to 40% replacement and slight decrease occurs at 60% replacement. But even then it gives more splitting tensile strength than the minimum strength of concrete given by natural sand.

C. Slump Cone test:

Table3: Results of Slump values of concrete with six mixes

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Sr no.	Mix combination	Slump value (mm)
1	Mix1	70
2	Mix2	64
3	Mix3	68
4	Mix4	60
5	Mix5	55

DURABILITY TEST

A. *Water absorption:*

Table 4: result of water absorption test

Sr .no	Mix combination	Average % of water absorption
1	Mix 1	1.456
2	Mix 2	2.44
3	Mix 3	1.88
4	Mix 4	1.97
5	Mix 5	1.78

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

Sr .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

C. Alternate wetting and drying test:

The specimens were cast and cured for 3, 7 and 28days, 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

Sr .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

CONCLUSIONS

1. Initially the strength increases as the foundry sand replaces natural sand by 10 to 60 % and a drop takes place in the same after that, as we go on replacing foundry sand by natural sand in more quantity by percentage from 40 to 60%. And increase takes place as we go from 20 to 40% replacement and slight decrease occurs at 60% replacement. But even then it gives more splitting tensile strength than the minimum strength of concrete given by natural sand..
2. 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.
3. 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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