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Strength and Durability Studies of Concrete Containing Waste Foundry Sand

Ranjeet Rajbhar[1], Pushpendra kumar Kushwaha[2] ,Mithun Kumar Rana[3]

[1,2,3,] Civil Engineering & RKDF College of engineering Bhopal

ABSTRACT - Recently, the availability of natural river sand has been restricted due to its high cost and scarcity. Mortar is a key component and is commonly used in the construction industry. There are numerous studies being done right now to develop substitutes for river sand, such as manufacturing sand, siliceous stone powder, crushed granite powder, etc., to relieve the demand for river sand. The main waste material created during the metal casting process is foundry sand. Recycling must be prioritised above disposal in the foundry sectors since using natural sand depletes environmental resources. In addition to discussing the cost of processing UFS and its use in M20 and M30 grade concrete, this paper compares the compressive strength of M20 and M30 grade concrete to concrete that has had UFS replaced. Therefore, using UFS rather than discarding it is a prudent decision that also reduces harm to the environment. Studies contrasting the trial mix with the control mix have been done,

.Key Word- Foundry Sand, Environmental, Split tensile strength, Natural river, stone powder

1. INTRODUCTION

1.1 INTRODUCTION OF FOUNDRY SAND

Molding sand, commonly referred to as foundry sand, tends to pack tightly and maintain its shape when moistened, squeezed, heated, or lubricated. It is employed in the sand casting procedure. Due of the simplicity of the materials used, sand casting is one of the earliest casting techniques. Due to its simplicity, it is still one of the least expensive methods for casting metals. Other casting techniques, such those that use shell moulds, provide surfaces with a higher quality finish but at a higher expense. Sand, bentonite clay, powdered coal, and water are the main ingredients in foundry sand. It is mostly used to create metal casting moulds. Sand, which can be either silica or olivine, always makes up the greatest percentage of the mixture. Sand used for casting has good pozzolanic qualities.

Fig 1 Foundry sand

1.2 SOURCES OF USED FOUNDRY SAND

UFS can be obtained directly from foundries and it is a uniformly graded material. The spent material, however, often contains metal from the casting and oversized mold and core material containing partially degraded
binder. UFS may also contain some leachable contaminants, including heavy metals and phenols that are absorbed by the sand during the molding process and casting operations.

2. LITERATURE REVIEW

To ascertain if foundry sand treated with up to 12% Cement Kiln Dust (CKD) by dry weight of soil was suitable for use as road pavement material, Moses et al. (2018) conducted laboratory tests. Samples were compressed using the British Standard Heavy (BSL), West African Standard (WAS), and Standard Proctor (BSL) energy levels (BSH).

The impact of waste foundry sand (WFS) on the slump of concrete was investigated by Guney et al. in 2020. WFS of 0, 5, 10, and 15% was used to partially replace fine aggregates. Waste foundry sand was shown to reduce the fluidity and slump value of fresh concrete. This may be caused by the leftover foundry sand's inclusion of fine clayey elements, which are effective at reducing the fluidity of fresh concrete.

The impact of using fly ash, slag, silica fume, and marble dust in place of cement on the compressive strength of cement mortar was examined by Aggarwal et al. in 2022. The outcome demonstrated that replacing different industrial wastes (up to 20%) increased mortar's compressive strength.

3. OBJECTIVE OF THE RESEARCH WORK

The objective of the studies is to determine the durability and strength of two concrete grades (20 & 30 MPa) of concrete contains UFS (0-20% at an increment of 5%)for the partial replacement of the foundry sand to the study.

4. RESULTS AND DISCUSSIONS

4.1 Slump Test

The consistency of concrete was measured by using slump test as per IS 1159-1959. This common test is used to measure the slump value of concrete with various TUFS percentages and compared with control concrete.

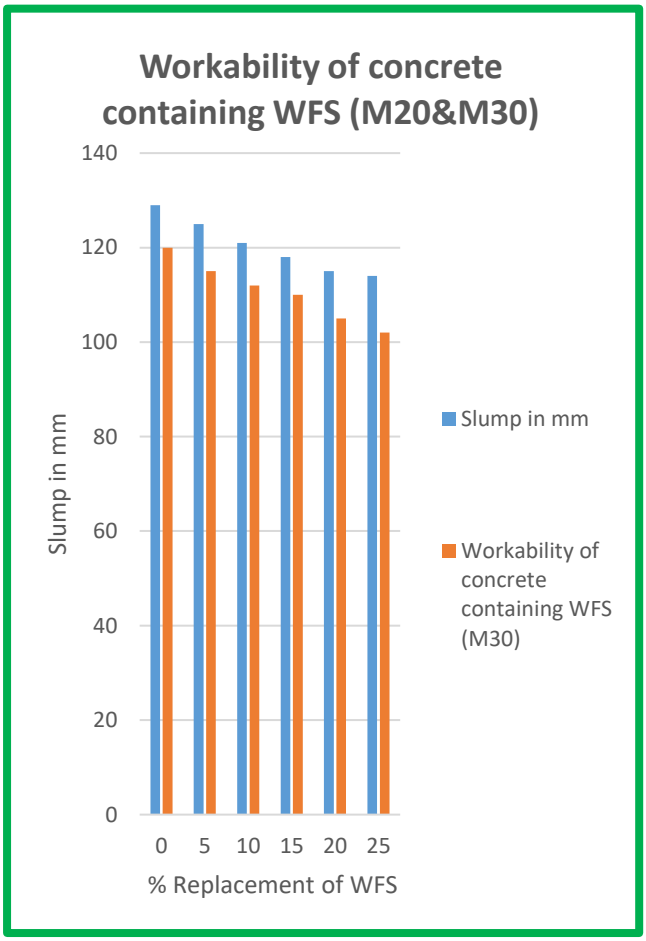

Figure 2 Slump values of various concrete mixes

4.2 Mechanical Properties of Concrete

4.2.1 Compressive strength (M20 concrete mix)

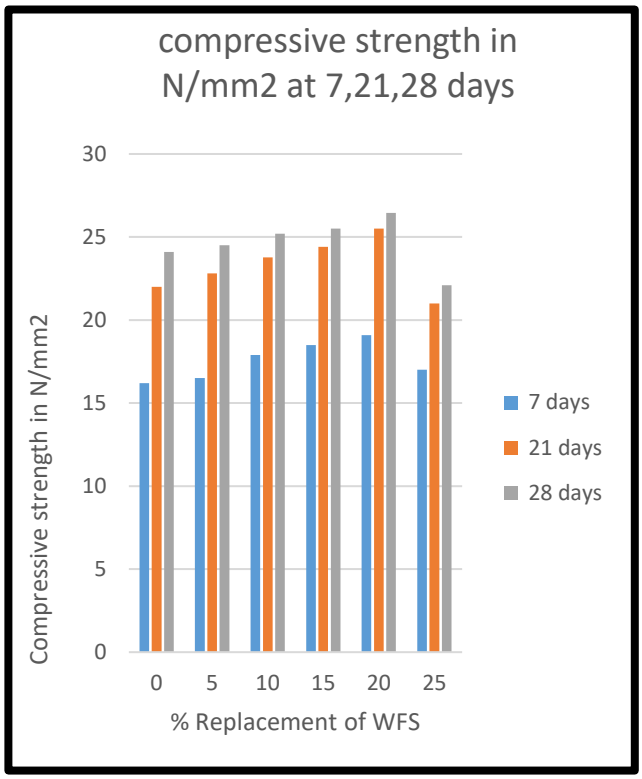

Fig 3 UFS replacement Vs compressive strength (M20)

The compressive strength results at 7, 21 and 28 day cured M20 concrete with varying percentages of replaced UFS is shown in the Table 5.3. The 28 day results of control (0wt% UFS) and trial mixture (20 wt% UFS) were 24.1 and 26.45 MPa respectively. Compressive strength of concrete mixtures made with UFS up to 20 wt% exhibit almost equal value as that of control mix

4.2.2. Compressive strength (M30 concrete mix)

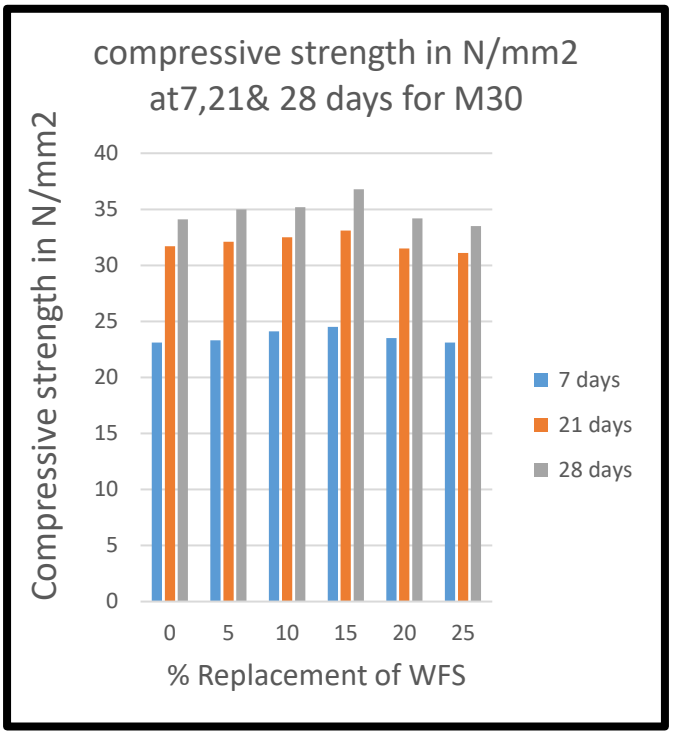

Fig 4 UFS replacement Vs compressive strength (M30)

The compressive strength results at 7, and 21 and 28 day of cured M30 concrete mix with varying percentages of UFS are given ,The test results show that the compressive strength increases with increasing UFS aggregate up to 15 wt% replacement. The strength of concrete mixtures made with UFS up to 15 wt% reveal approximately equal value as that of the control mix.

5. CONCLUION

- Compressive strength, split tensile strength, flexural strength and modulus of elasticity of both grades of concrete mixes (M20 and M30) increased due to replacement of fine aggregate with used foundry sand.
- In M20 grade concrete maximum test results was achieved with 20 % replacement of fine aggregate with UFS. Beyond 20% replacement it goes to decrease, In M30 grade concrete maximum test results was achieved with 15 % replacement of fine aggregate with UFS. Beyond 15 % replacement it goes to decrease,

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