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EXPERIMENTAL STUDY ON STRENGTH OF CONCRETE CONTAINING WASTE MATERIALS AND NANO SILICA

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Abstract - *The main purpose of this study is to analyses the impact of sawdust and brick kiln dust on Concrete. In this trial work endeavor has been made to interchange fine aggregate with sawdust and brick dust. Both brick kiln dust and sawdust are waste materials and dumping of it cause land insufficiency and increase environmental pollution. This research concerns with use of Nano silica of size 235 nm to boost the compressive strength of concrete. In this experiment, analysis has been carried out on nano silica added in place of cement in 0.30%, 0.60% and 1.0% blended with concrete. This research points toward the waste management from saw dust , Brick kiln dust and also use of nano silica in concrete. To maximize the economical benefit and sustainable environment, this paper proposes M20 and M25 grade concrete mix by incorporating waste materials (i.e. brick kiln and saw dust) which replace fine aggregate and cement replace by Nano silica in varying percentage.*

Key Words-Nano silica, Brick kiln dust, Saw dust, Compressive Strength

1. INTRODUCTION

Over past years, a quick development in the field of concrete technology has taken place. Concrete has become the most popular construction material. Even common person have started using concrete in multidimensional applications. Its popularity and ease with which it can be prepared, has led to many discovery in the field of construction technology. Earlier we have a tendency to think of M-20 grade concrete solely now a days we are producing well higher than M-60.Thus, based on natural minerals aggregate it's currently potential to provided concrete with compressive strengths up to 250 MPa. If natural mineral aggregate is substituted by high quality ceramic aggregate, compressive strengths up to 500 MPa will be achieved. Also over recent years however many relatively new concrete structures and industrial products have shown a poor performance. It is great challenge, therefore both to utilize and apply and also further develop existing technology on high performance concrete to the benefit of both the concrete industry and the society.

1.1 Problem Formulation

Concrete is made by natural resources such as sand, coarse aggregate, limestone. Due to issue related to limited natural resources like stream sand and stone, quantity of river sand decrease continuously and effect on environment. On other side, large amount of brick kiln dust, saw dust waste is being produced every day .It create major environment impact and also faces to disposal and management problem due to large quantity of waste material. On other side, along world wide consumption of cement in concrete is very high and it is observe that the manufacturing process of cement consume more quantities of fuel and due to burning of fuel huge quantities of co_2 emitted in to the environment and increase global warming problem.

1.2 Objective of the Study

This paper focused on reducing the environmental pollution, dispose and management problem of waste material which is generated from industrial and domestic sources and also trying to reduce cost of concrete construction by using waste material.

The main objectives of this study are as mentioned below:

- To know the impact of nano-silica, brick kiln and saw dust on the concrete compressive strength.
- To observe the microstructure of the hardened concrete.
- To illuminate the change in concrete properties, if any, by explaining the microstructure.
- To conclude the optimum percentages of brick klin dust, saw dust and nano silica in concrete mix.
- Evaluation of percentage saving of the cost in construction of concrete.

2. MATERIAL

2.1 Cement

In this study PPC of 43 grade is used for experiment i.e. after the curing of 28days the compressive strength should not less than 43N/mm^2.

2.2 Fine Aggregate

Sand fractions from 4.75mm to 150 mm are termed as fine aggregate. The river sand, crushed sand are used together as fine aggregate conforming to IS code.

2.3 Coarse Aggregate

The fractions from 20.0 mm to 4.75 mm are called as coarse aggregate. The Coarse Aggregates from Crushed Basalt rock, conforming to IS:383-1970 is being empolyed in the experiment.

2.4 Brick Kiln Dust

Brick-kiln dust contains Ca, Mg, Na, Cd, Zn, N, S, Mo and Si compound and great levels of P and K, and its nature is alkaline with pH ranging from 8.1 - 10.5

Fig.1: Brick kiln dust

2.5 Saw Dust

Saw dust concrete included roughly equal components by volume of Portland pozzolanic cement, sand and saw dust, with water to allow a slump of 25 to 50 millimeter. Saw dust form good bonds with ordinary concrete and could be a good insulator.

2.6 Nano Silica

The avg. size of nano silica was found to be 235 nm from Particle Size Analyser. Nano silica would be a derivative of the reduction of quartz for the production of silicon and ferrosilicon.

Fig. 2: Nano Silica

3. TEST PERFORMED

3.1 Compressive Strength

Tests were conducted on cube of size 150x150x150 mm at 7, 14 & 28 days curing.

C = P/A Its units is N/mm^2.

Fig.3: Compressive strength test

3.2 Slump Cone Test

This test is performed in field with a frustum shaped mould called slump cone whose top diameter is 10cm, bottom diameter is 20 cm and height is 30 cm.

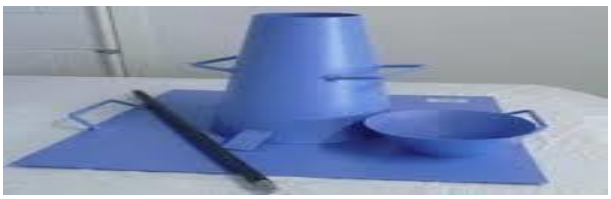


Fig.4: Slump cone

3.3 Compaction Factor Test

Apparatus consist of trowels, hand scoop (152 mm long), a rod of steel or other suitable material and a balance.

Fig.4: Compaction factor Apparatus

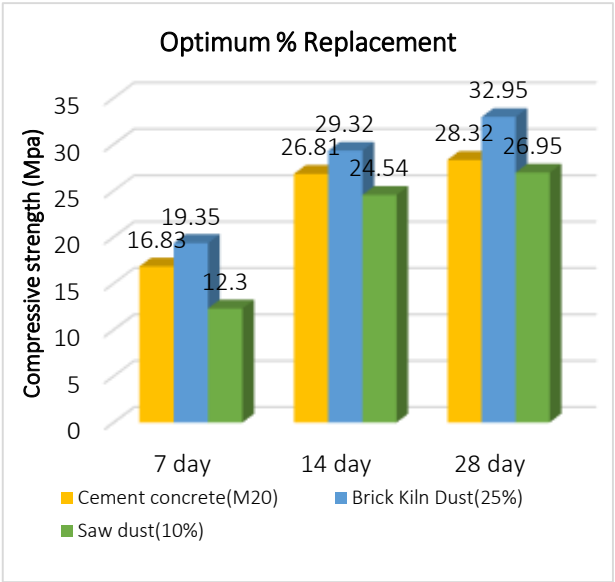
3.4 Ultrasonic Pulse Velocity Test

It is a non-destructive testing technique (NDT). The method is based on measuring the ultrasonic pulse wave through the concrete with a generator and a receiver.

4. RESULTS

4.1 Compressive strength test

a) for Brick kiln dust & Saw dust

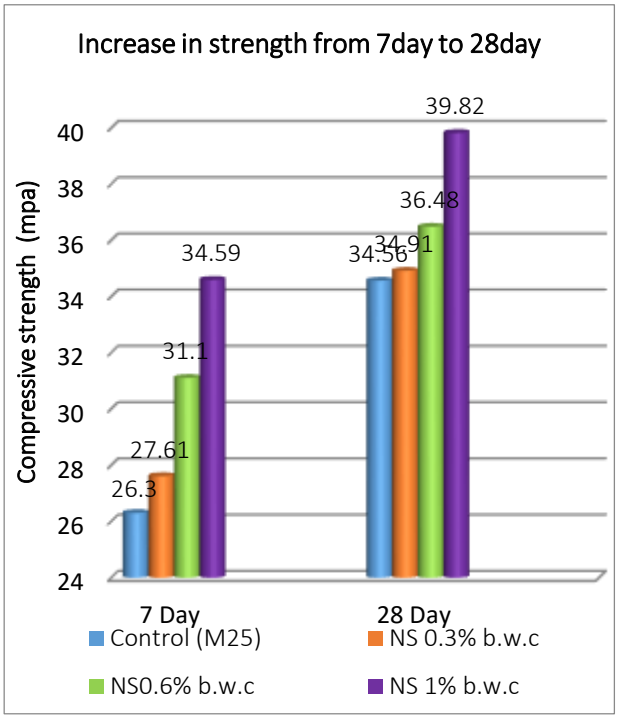


Graph 1: Compressive strength (M20) Comparison

- We substitute sand with Brick Kiln Dust by 10.0%, 25.0%, & 50.0% and check compressive strength. We conclude that at 25.0% substitution of sand with brick kiln dust compressive strength of concrete is increased than plain concrete. Value increased from 28.32 to 32.95 MPa

- We substitute sand with saw dust by 5%, 10%, & 15% and check compressive strength. We conclude that at 10% substitution of sand with saw dust compressive strength of concrete is quite satisfactory . Value increased from 28.32 to 26.95 MPa

b) for Nano silica



Graph 2: Compressive strength (M25) Comparison

- From the compressive strength test results, it will be determined that increase in concrete compressive strength is observed on addition of a small quantity of Nano Silica. Observation reflect that the increase in strength is maximum for nano silica 1% blended with concrete and minimum for nano silica 0.3% blended with concrete. Value increased from 34.56 MPa to 39.82 MPa.

4.2 Ultrasonic Pulse Velocity Test

Table 1: UPV Test for control sample (M25)

28-DAY TEST RESULT			
Sample No.	**Length (mm)**	**Velocity (m/s)**	**Time (µs)**
1	150	4808	31.2
2	150	4854	30.9
3	150	4778	31.4

Table 2: UPV Test for sample with nano silica 1% b.w.c

28-DAY TEST RESULT			
Sample No.	**Length (mm)**	**Velocity (m/s)**	**Time (µs)**
1	150	4658	32.2
2	150	4702	31.9
3	150	4808	31.2

From table no. 1 and 2 we conclude that the quality of concrete gets slightly affected on addition of Nano Silica but the overall quality of concrete is preserved

5. CONCLUSIONS

- In Experimental investigation, it is found that brick kiln dust, saw dust and nano silica would be utilized as alternative material to fine aggregate and cement.
- The optimum % of Brick Kiln Dust as substitution for sand is about 10- 25%.
- The optimum % of saw dust as substitution for sand is about 5-10%.
- The optimum % of nano silica as substitution for cement is around 1.0%
- Without the use of super plasticizers a proper compaction of the concrete was hindered.

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