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Utilization and Experimental Investigation on Metakaolin and Waste foundry Sand in Concrete as Partial Replacement of Cement and fine Aggregate

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ABTRACT: Concrete is a fundamental component of the construction industry. Concrete usage is relatively high in emerging nations due to infrastructure development. Cement usage is likewise quite high in order to satisfy the requirements. Concrete cubes, cylinders, and beams of M-40 grade were casted and tested to evaluate numerous qualities of concrete such as workability, compressive strength, flexural strength, and split tensile strength test during these trial examinations. Metakaolin was substituted with cement at a rate of 0, 5, 10, 15, and 20% by weight of concrete in cement, with testing taking place after 7, 21, and 28 days to see if the combined impact of MK (10%) and Waste Foundry Sand (0 to 50%) on concrete compressive strength.

Key Word : Waste Foundry Sand ,Cement, Metakaolin, Concrete, Mechanical properties, Durability, compressive strength, flexural ,strength and split tensile strength.

1.INTRODUCTION

With an annual use of more than 100 million cubic metres, concrete is India's most commonly used construction material. It is commonly recognised that traditional concrete rated for compressive strength does not effectively fulfil numerous functional criteria like as impermeability, frost resistance, and thermal cracking. When compared to regular concrete, high performance concrete is a concrete composition with superior durability and strength. One or more cementitious ingredients, such as fly ash, Silica fume, or powdered granulated blast furnace slag, are used in this concrete, as well as a superplasticizer.Concrete is undeniably the most frequently utilised artificial construction material in the world today, and it will continue to be so for the next several decades.

Concrete's appeal stems from its plentiful raw materials, superior strength and durability, inexpensive production and maintenance costs, adaptability in producing varied shapes, and limitless structural possibilities when combined with steel reinforcement. However, due to the critical component cement, the concrete industry confronts a significant difficulty. For every tonne of Portland cement manufactured, about one tonne of CO_2 is created.

1.1 Metakaolin

Metakaolin is a pozzolanic substance that is perhaps the most effective for usage in concrete. It's a product that's made for use rather than a by-product, and it's made when china clay, or kaolin, is heated to between 600 and 800 degrees Celsius.

Metakaolin

1.2Waste Foundry Sand (WFS): As commercial by-merchandise and waste substances continue to develop, solid waste management has become one of the world's most pressing environmental issues. Due to a scarcity of land filling space and its ever-increasing cost, the utilisation of waste material and by-products has become an enticing option for disposal. One of these businesses is waste foundry sand (WFS)..

Waste Foundry Sand

2. LITERATURE REVIEW

Many studies have been conducted to determine the advantages of employing waste materials such as Metakaolin, granite dust, marble dust, stone dust, and glass powder in the production and enhancement of concrete qualities. This chapter also includes a brief assessment of the literature pertaining to Metakaolin concrete's strength and durability.

Terrence Ramlochana and his colleagues

Metakaolin is particularly effective in suppressing the alkali silica reaction, expansion, as evidenced by his laboratory work. Approximately 10 to 15% metakaolin was necessary to keep the growth to 0.04 percent at the end of two years, with the limit being highly depending on the kind of aggregates used.

G. Batis, et al. discovered that when metakaolin is added to mortar for the goal of improving corrosion resistant qualities, there is no significant change in 1 day strength, but 2 days and 28 day strength are considerably raised to a maximum value.

Jibing Bai and Albinas Gailius revealed the construction of a multivariate statistical model for consistency parameter prediction for concrete including FA and MK, encompassing slump, compacting factor, and vebe time. The models developed provide an effective, quantitative, and quick method for predicting consistency in concrete mixes with PC-FA-MK blends as a binder.

3. OBJECTIVE

The following are the goals of this project.

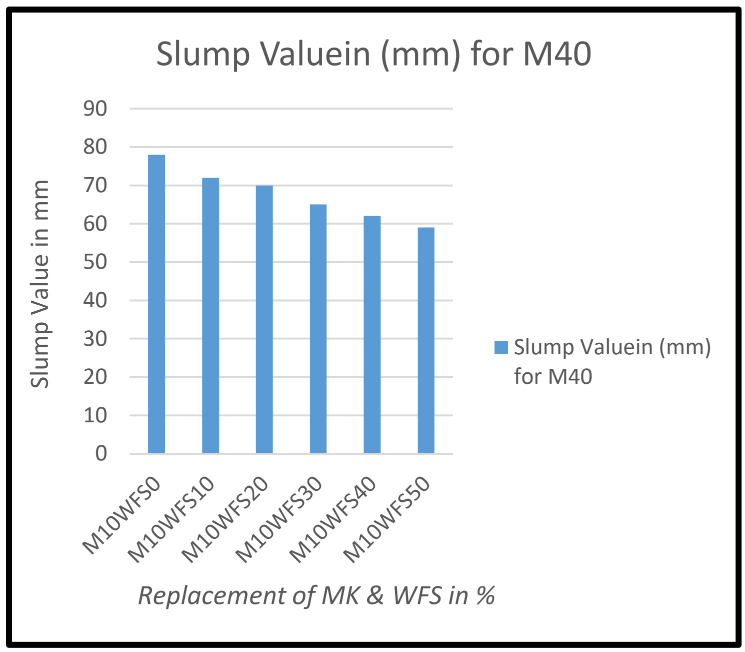
- The purpose of this study was to see how Metakaolin and Waste Foundry Sand affected the strength qualities of M40 grade concrete when used as a partial replacement for cement.
- To determine the best value for replacing cement in a concrete mix with Metakaolin.
- To investigate the Metakaolin concrete's long-term durability.
- Metakaolin was used to examine the concrete's strength qualities.

4. EXPERIMENTAL INVESTIGATIONS

- Materials Used
  The following are the materials used in the investigation.
  Cement (OPC 53 grade)
  Metakaolin
  Waste Foundry sand
  Fine Aggregates
  Coarse Aggregates
  Super plasticizer

5. RESULT

5.1 A SLUMP CONE TEST RESULTS



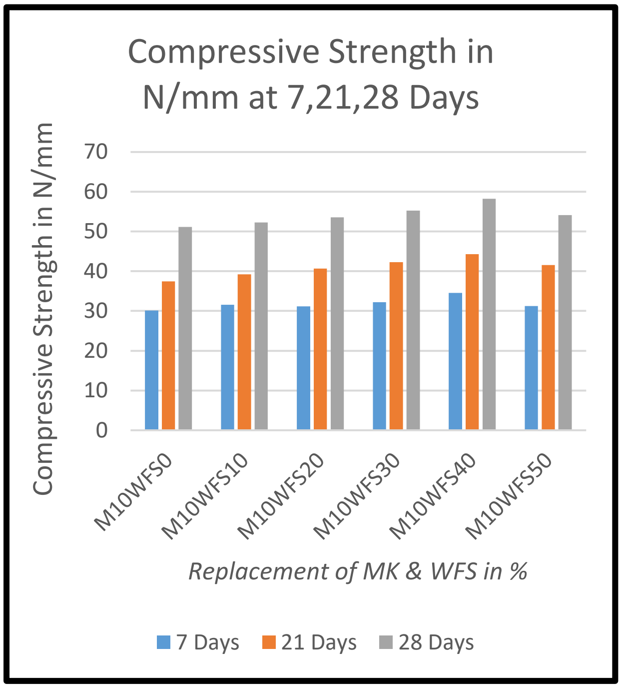
Variation of Slump Value at different percentage of Metakaolin and Waste Foundary sand

From the Experimental result it was found that Slump value decreases when increase the percentage of Metakaolin and Waste Foundary sand

5.2b HARDNESS TEST OF CONCRETE

Compressive strength test results

After a curing time of 7, 21, and 28 days, the compressive strength of specimens created during the work containing various percentages of Metakaolin powder and Waste Foundary sand was tested. Three samples of each % replacement are evaluated, with the average of the three being used.



Variation of Compressive Strength at Different percentage of MK & WFS at 7,21 and 28 days

The compressive strength of M 40 grade concrete increases at 7, 21, and 28 days when the percentage of Waste Foundry Sand increases from 0% to 50% while the percentage of MK remains constant. The strength increase at 28 days is up to 18.3 percent, with 40% sand replaced by WFS and 10% cement replaced by MK. The percentage of WFS strength falls as the percentage of WFS increases; the ideal percentage of WFS is 40%, which gives the greatest value of compressive strength. If MK is used instead of cement, the maximum compressive strength is 51.2 N/mm2. However, when waste glass powder and stone dust are combined, the compressive strength increases to 58.23 N/mm2.

6. CONCLUSIONS

- Metakaolin increases the strength and durability of concrete, requiring less cement and resulting in a concrete with greater strength attributes than standard concrete. Chemical resistance is much increased, which improves durability.
- The compressive strength of M 40 grade concrete improves at 7, 21, and 28 days when the proportion of Waste Foundry Sand increases from 0% to 50% at a constant percentage of MK. The strength increase at 28 days is up to 18.3 percent, with 40% sand replaced by WFS and 10% cement replaced by MK. The percentage of WFS strength falls as the percentage of WFS increases; the ideal percentage of WFS is 40%, which gives the greatest value of compressive strength. If MK is used instead of cement, the maximum compressive strength is 51.2 N/mm2. However, when waste glass powder and stone dust are combined, the compressive strength increases to 58.23 N/mm2.

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