e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

CONCRETE STRENGTHENING USING METAKAOLIN AS A POZZOLANIC MATERIAL

Atharva Anantalwar[*1], Pranay Mohurle[*2], Rupali Talmale[*3], Ashwini Ingle[*4], Chandrakumar Jamkar[*5], A.S Moon[*6]

[*1,2,3,4,5]Student B.E. Department Of Civil Engineering, Smt. Radhikatai Pandav College Of Engineering, Nagpur, Maharashtra, India.

[*6]Professor, HOD, Department Of Civil Engineering, Smt. Radhikatai Pandav College Of Engineering, Nagpur, Maharashtra, India.

ABSTRACT

As we all know, cement is the most often used construction material. As the construction industry and the cement business grow at a rapid pace, we need an alternative material to partially replace cement that improves the quality of concrete while also being environmentally friendly. Because of the increased demand for cement, there is a significant increase in environmental pollution as a result of CO2 gas emissions. Supplementary cementitious materials such as silica oxide fume, fly ash, slag, rice husk, and metakolin can be used on the other hand. Recently, it has been employed as an alternative pozzolonic material. with recent observed material, to boost the percentage of hsc The amorphous dehydration product metakoline al2si2o7 is a chemical substance. Which came to a conclusion based on current observation work including metakaolin extraction. During the analysis of metakolin, it was discovered that the material is highly pozzolonic and hence improves the strength of concrete. In a previous study, the qualities of blended or fine powder metakalin cement, such as setting time (initial or final), consistency, and soundness, were found to be within acceptable ranges in various categories. It is also necessary for the construction of multi-storied buildings, dams, pre-tensioned briges, fly ash, and nuclear power plants. It also demonstrates another point of view from an environmental standpoint, which is that it is an ecological and good conduct environment concern, which is why it is referred to as green pozzolanas. This paper paves the way for additional research to produce a long-lasting concrete.

Keywords: M20 Grade Of Concrete, Split Tensile Strength Compressive Strength Etc.

I. INTRODUCTION

Concrete is primarily constructed of two materials: opc (ordinary Portland cement) and ppc (pozzolonas Portland cement). Of the two, ppc is the most commonly used and favoured in the building sector. According to sources, the carbon dioxide produced during the making of concrete tonnes of cement is roughly 0.94 tonnes. It also produces sulphate dioxide and nitrogen oxide in addition to carbon dioxide. which is directly pouring the working, long-lasting oil in the green houre effect and acid rain.

Cementitious material is employed as metakaline in this paper. metakaline Is derived from kaolin, which is a stone with a high concentration of kaolinite, also known as china clay or kaolin. It was employed as a porocelin product, which is a type of ceramic. It is made of the material kaolin clay. MK is also used as an additive in concrete to increase its strength. During the MK manufacture process. Carban dioxide is based on MK, which reacts with Ca(OH)2 to create CSH at high temperatures, such as those seen in cement. It also has alumina, which interacts with CH to produce c4ah13.c2 ash8c and c3AH6. MK is found in India, for example, in Gujrat and Maharatra. Retailers indicate a variety of physical properties in the process.

II. LITERATURE REVIEW

Badogiannis.E et al (2004) Metakaolin's effect on concrete was studied. Metakaolin was employed to modify both cement and sand by 10% or 20% by weight of the original cement content in eight blend proportions to generate excessive-overall performance concrete. The performance element was used to analyse the strength development of Metakaolin concrete (ok fee). When it came to increasing strength, both bad Greek Metakaolin and commercially purchased Metakaolin produced the same results. The use of cement instead of sand produced greater results.

Justice J.M et al. (2005) conducted a comparison study by replacing 8% of the cement weight with Metakaolin and Silica fume. The addition of metakaolin proved to be beneficial, resulting in concrete with significantly higher strengths and sturdiness than standard mixtures. The use of finer Metakaolin proved more beneficial than coarser Metakaolin in improving concrete dwellings. Metakaolin was added to speed up the use of amazing plasticizers. The addition of Metakaolin improved shrinkage, durability, and several power properties.

Jian-Tong Ding et al. (2002): from this, experimentally discovered the effects of Metakaolin and Silica Fume on the concrete dwellings. At a water cement ratio of 0.35 and a sand-to-aggregate ratio of 40%, an experimental research was completed with seven concrete combinations of zero, five, ten, and fifteen percent using a mass alternative of cement with excessive-reactivity Metakaolin or Silica fume. The impact of Metakaolin or Silica fume on concrete workability, power, shrinkage, and chloride penetration resistance was studied.

Kannan V and Ganesan K. (2014) : proposed research on the durability qualities of self-compacting concrete (SCC) containing rice husk ash (RHA), metakaolin (MK), and a 1:1 mixture of MK and RHA. The various mixes' durability qualities were investigated. The results showed that SCC blended with RHA and a combination of RHA and MK had significantly better durability than SCC that had not been blended (100 percent OPC).

III. MATERIALS USED

Cement :

It's a substance that holds things together. The OPC cement is utilised. It improves the consistency of the bricks while also increasing their strength. Other cements, such as pozzolona, are favoured over Portland cement. High-grade (early strength) cement is recommended for early stripping and excellent mechanical qualities. Excess heat develops within thick walls and while employing battery-moulds, so a lower quality of cement may be requested. Cement is a binder, a substance used in construction to bind materials together by setting, hardening, and adhering to them. Cement is typically used to bind sand and gravel (aggregate) together rather than on its own.

Aggregates :

Construction aggregate, or simply "aggregate," is a broad category of coarse particle fabric that includes sand, gravel, crushed stone, slag, recycled concrete, and geo-artificial materials, among others. Aggregates are the most commonly mined materials on the planet.

Construction aggregate, also known as sand, gravel, crushed stone, slag, recycled concrete, and geosynthetic aggregates, is a broad category of coarse- to medium-grained particulate material used in construction. Aggregates are the world's most mined materials. Aggregates are a component of composite materials like concrete and asphalt, and they act as reinforcement to give the whole composite material more strength.

Fine Aggregates :

Fine aggregates in concrete include sand, surki, stone screenings, burnt clays, cinders, fly ash, and other materials. Natural sand (river banks), crushed stone sand (hard stone), and crushed gravel sand are the three Sorts (Gravel).

Metakaolin :

Metakaolin is a dehydroxylated form of the clay mineral kaolinite. Stone that are wealthy in kaolinite are known as china clay or kaolin, historically used inside the manufacture of porcelain. The particle size of metakaolin is smaller than cement particles, however not as best as silica fume.

1. Metakaolin is a supplementary cementitious material (SCM) which can be used to replace cement to a certain extent.

2. MK is a Pozzolan derived from heat treatment of natural deposits of kaolin. MK shows high pozzolana reactivity due to their amorphous structure and high surface area

3. It is a product that is manufactured for use rather than a by-product and is formed when china clay, the mineral kaolin, is heated to a temperature between 600 and 800ºC.

4. First used in the 1960s for the construction of a number of large dams in Brazil, metakaolin was successfully incorporated into the concrete with the original intention of suppressing any damage due to alkali-silica reaction.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

Benefits of Metakolin

1. Compressive and flexural strength of anticatalyst materials
2. Reduce the permeability of the environment (Which added chloride)
3. When permeability development occurs, it reduces the ability to develop. Calcium is transported to the surface of the water, where it combines with CO2 to form a white residue.
4. Support chemical aversion.
5. Promote long-term success
6. Improves concrete finishability and workability.

Uses of Metakolin

1. Top performance, immoderate, feathery concerte
2. Pre mould concrete , precast
3. Fibro cement and ferro cement product
4. Mortor and stucco

It is a ready-to-use product that is created when china clay and inorganic kaolin are heated at temperatures ranging from 600 to 800 degrees Celsius.

Metakolin was first employed in the 1960s to build Brazil's greatest dam, and it has since been effectively used in concrete to replace any damage caused by alkali silica reaction.

IV. METHODOLOGY

In this procedure, we replace metakaolin with weight to cast the cube. Using the batching method, we first take a sand sample of locally accessible sparking sand from a natural count number. Is sieve assessment confirms it to be in zone - 2. The sand is sieved with a 20 Is sieve so that fine sand can be used in concrete mixes. Following the use of sand, we use a coarse aggregate, which is a building aggregate that comprises coarse special fabir. Sand, gravel, betan stone, and other materials are utilised in the manufacturing process. The sedimentnous features of coarsed aggregate are similar to those seen in mining. Our next element is cement, which is crucial in this procedure. Cement is a finely powdered material that can act as a binding material that hardens and easily binds course and fine aggregate. For the casting of the cube, we used 43 grade cement in the propertion of M 20 cement can act as a binding material that hardens and easily binds course and fine aggregate. The most important types of cement are utilised as a factor in the creation of mortar in masonary manufacturing, and our final material is metakaoline concrete, which is the most widely used construction material on the planet. Metakaolin emits relatively little carbon dioxide; it is a silica-based substance that reacts with co(OH)2 to form CSH at room temperature, similar to cement. Metakaolin also contains alumina, which combines with CH to make more alumina and has the chemical formula CH4 AH 13 C2 ASH8 & and C3 AH6. I return to the method. Using the weight-based batching approach. We will require 36.74 kg cement, 1.35 cu feet of fined aggregate, and 2.70 cu feet of coarsed aggregate to cast 27 tubes. After weighing the material, we added 5% MK for 3 cubes for 7 days, 10% MK for 3 cubes for 14 days, and 15% MK for 3 cubes for 15 days. For a period of 28 days.After casting a cube in a mould for 24 hours of concrete curing. Then we set up for the curing process. After it has been completed. We have to test the cube on compression for 7 days. We must check 14 day cubes and 28 day cubes using the testing machine.

Fig 1: Casting of cube

Fig 2: Testing of cube

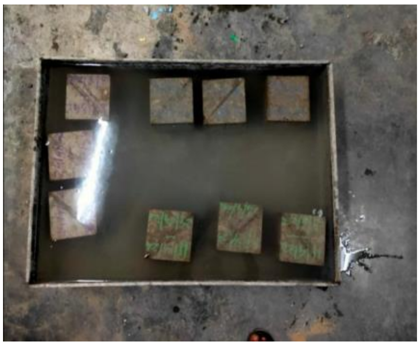


Fig 3: Curing Process

Fig 4: Moulded cube

V. STRENGHT OF CALCULATIONS

Strength Of Concrete :

5% of metakaolin increased the compressive strength of concrete by 14%.

10% of metakaolin increased the compressive strength of concrete by 21.3%.

15% of metakaolin increased the compressive strength of concrete by 5.5%.

Compressive and flexural strengths were improved both at 7 days of age and at long term.

Mould Cube Size = 15cm x 15cm x 15cm

= 3375cucm

= 3.375×10^{-3} m^3

Step : Calculation for Quantity of material :

1) Wet Volume of concrete = 3.375×10^{-3}

2) Dry Volume of concrete = $1.54 \times 3.375 \times 10^{-3}$

= 5.197×10^{-3} m^3

Step : Calculation for Quantity of each material

1) Quantity of cement = 5.197×10^{-3} x 1 = 9.449×10^{-4} m^3

1+1.5+3

= $9.449 \times 10^{-4} \times 1440$

= 1.36 Kg

2) Quantity of fine Aggregate = 5.197×10^{-3} x 1.5 =1.417×10^{-3} m^3

1+1.5+3

= $1.417 \times 10^{-3} \times 35.315$

= 0.05 cu ft.

3) Quantity of Course Aggregate = 5.197×10^{-3} x 3 =2.834×10^{-3} m^3

1+1.5+3

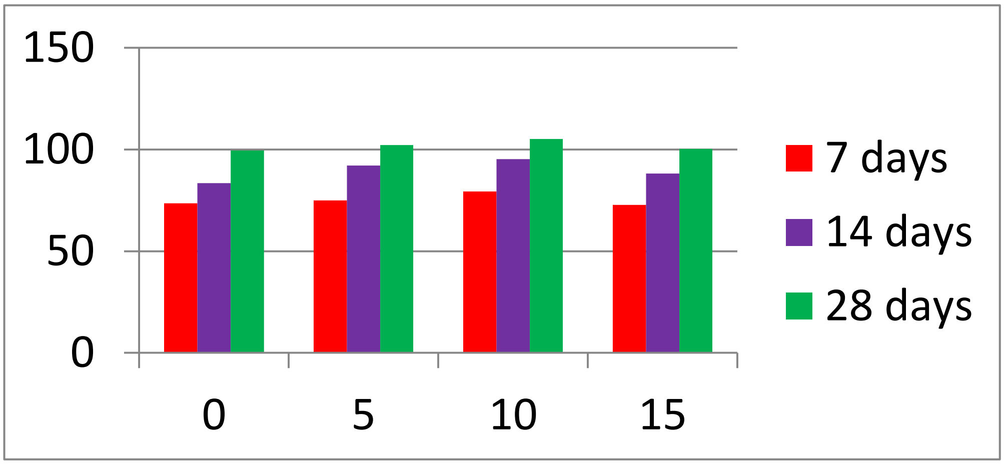
= $2.834 \times 10^{-3} \times 35.315$

= 0.100cu ft.

VI. RESULT

Sr. No.	% Of Replacement Of Metakaolin	Compressive Strength Of Concrete		
		7 days	14 days	28 days
1	0	73.49	83.42	99.55
2	5	75.01	92.1	102.22
3	10	79.34	95.3	105.25
4	15	72.72	88.2	100.23

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com



VII. CONCLUSION

The review paper contained a rigorous investigation of the performance characteristics of concrete containing MK as a partial cement substitute. Concrete attributes that were used in this study included fresh state, mechanical, and durability properties.

As the Mk replacement level rises, workability drops and setting time decreases. As the MK content rose, the mechanical characteristics (compressive and flexural strength) improved. The optimum MK replacement content was found to be between 5 and 15%, with a noticeable drop in concrete strength qualities beyond this level of replacement. After this amount of MK replacement, durability performance increased.

VIII. REFERENCE

[1] K.A. Gruber, Terry Ramlochan, Andrea Boddy, R.D. Hooton, and M.D.A. Thomas, Increasing concrete durability using high reactivity metakaolin, Cement & Concrete Composites, 23, 2001, 479-484. M.B. Kumthekar, G.S. Vyas, M.B. Kumthekar, M.B. Kumthekar, M.B

[2] N.T. Suryawanshi and M.B. More, Techno-Economic Benefits of Metakaolin Over Microsilica in the Development of High-Performance Concrete, CE&CR, 2007, 42–50.

[3] Durability of metakaolin concrete to sulphate attack, Nabil M Al - Akhras, Cement and Concrete Research, 36, 2010, 1727-1734.

[4] High Performance concrete utilising high reactivity metakaolin, Shreeti S Mavinkurve, Prabir C Basu, and Vijay R Kulkarni, The Indian Concrete Journal, 1077-1085, 2003.

[5] Yunsheng Zhang and Zongjin Li, Handbook of Structural Engineering, CRC Press, 2005, pp. 1–58.