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Strength and Durability of Concrete Made with Wollastonite Mineral

Aman Sharma [1] ***Dr A.K. Saxena*** [2]

[1](Post Graduate Student, Department of Civil Engineering, LNCT Bhopal, M.P. INDIA)
[2](Professor, Department of Civil Engineering, LNCT Bhopal, M.P. INDIA)

ABSTRACT

In the present experimental study the various strength properties like strength of concrete and also durability properties like Acid attack and porosity test on both ordinary concrete and wollastonite Concrete, best wollastonite concrete mix is carried out and compared with ordinary concrete mix. In this study different percentage of wollastonite as partially replacement with cement is used. It was found that with increase of amount of wollastonite in concrete with increase acid attack effect. Finally the strength of concrete maximum obtained use of 15% wollastonite in concrete after that increase percentage of WP with decrease strength of concrete. The durability of concrete decrease with increase percentage of wollastonite in concrete compare with normal mix.

Keywords: - Opc, Wollastonite Mineral, Acid Resistance Test, Porosity Test.

1 . INTRODUCTION

It is widely known that producing high-quality concrete is a prerequisite for building concrete buildings. Concrete of good quality is made by carefully mixing cement, water, fine and coarse aggregate, and admixtures as needed to achieve the best result in terms of quality and economy for any application. Because of the increasing economy, investment in infrastructure construction has expanded dramatically. Concrete is used extensively in the construction of infrastructure like as dams, bridges, underwater structures, highways, and buildings. Wollastonite is a calcium meta-silicate (CaSiO3) mineral that forms spontaneously when limestone interacts with silica in heated magmas. Wollastonite is made up largely of Calcium Oxide (CaO) and Silica Oxide (SiO2), and has a specific gravity of 2.87 to 3.09. To make cost-effective concrete, effective utilisation of natural minerals and industrial byproducts will be used.

2. Reviews of the literature

Lopes and Chikkanagoudar (2020) Research on construction binding materials that are both durable and efficient. India is the world's second-largest cement production. For every tonne of cement produced, approximately 1.5 tonnes of raw material are required. Supplementary cementitious materials are used in concrete production to reduce cement use. Wollastonite is a naturally occurring mineral that forms when limestone and silica collide in heated magmas. Wollastonite is used to partially replace cement in concrete at 0 percent, 110 percent, 12 percent, 14 percent, 16 percent, and 18 percent in this study. The influence of Wollastonite on concrete strength qualities for M30 grade mix is investigated. The Mix Design is carried out in accordance with IS 10262 (2019). To estimate workability, the slump and compaction factor are calculated. Compression and flexural strengths of various concrete mixes are determined. The cubes are immersed in HCl and MgSO4 solution for 28 days to test their chloride and sulphate resistance. The results of different combinations of mixtures are then compared to a standard concrete mix.
Kuldasheva et al. (2020) examined the impact of employing mineral Wollastonite fibre as a partial substitute for cement in Portland cement mortar mixtures. Three different mixtures of Wollastonite fibre as a reinforcing component with replacement levels of 5 and 10% were made and tested. The introduction of Wollastonite fibre into a cement composition increased flexural straight to 132 percent and compressive straight to 140 percent, according to research and test results.

3. Materials and Methodology

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3.1 Cement

Throughout the experiment, ordinary Portland cement (OPC) from a single lot was used. . All tests were carried out in accordance with IS: 4031-1988 recommendations. Cement was properly preserved to avoid its characteristics from deteriorating due to moisture interaction.

3.2 Aggregate fines

Fine aggregate is made from locally available river sand that has been sieved through a 4.75mm IS sieve. Sand has a specific gravity of 2.61.

3.3 Aggregate of Courses

As coarse aggregate, angular aggregates from a local source with a maximum size of 12.5mm and a specific gravity of 2.65 were employed.

3.4 **Wollastonite Minerals-**

Before mixing in concrete, it was sieved with an IS-90 micron sieve.

3.5 Admixture Water-

Reducing and set-retarding admixtures are allowed to improve the concrete's workability. For workability, the super plasticizer Gelenium hky 8765 was utilised.

4. RESULT AND DISCUSSION ON EXPERIMENTAL TESTS

4.1 Acid Resistance test

For acid resistance, 1% dilute sulphuric acid (H_2SO_4) by volume of the water with pH value of 2 was maintained. Cubes were immersed in acid for a period of 28 days. The action of acids on hardened concrete is the conversion of ferrous compounds into the ferrous salts of the attacking acid. As a result of these reactions, the structure of concrete gets destroyed**.**

Table 4.1 Loss of compressive strength after acid attack

Description	% difference in compressive strength
100%OPC	3.18
95%OPC+5%WP	5.55
90%OPC+10%WP	6.94
85%OPC+15%WP	2.99
80%OPC+20%WP	5.32

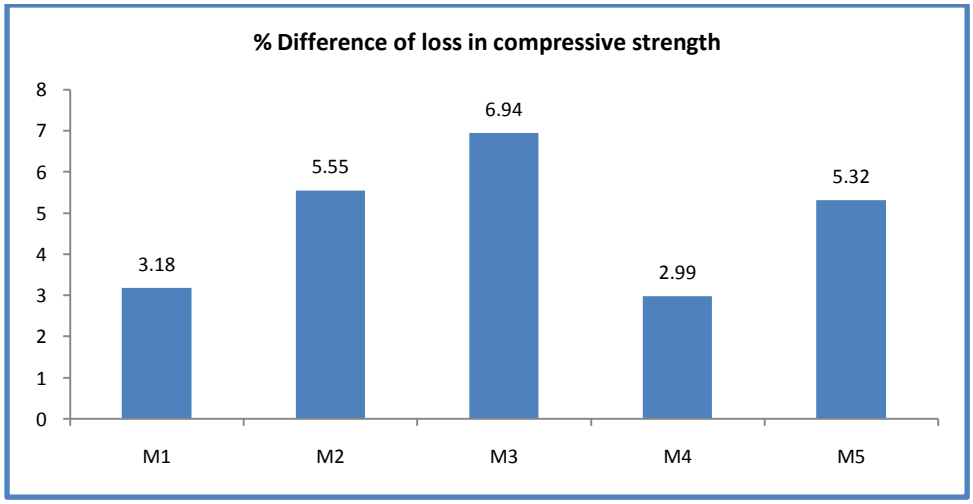

Fig. 4.1 Variation loss of strength of concrete with age

4.2 Porosity test

The results of the porosity of different concrete specimens cured at different ages are presented and discussed in this section.

Table 4.2 Porosity results of all mixes at different curing ages

Mix number	Description	7 days	14 days	28 days
M1.	100% OPC	8.92	8.53	8.63
M2.	95% OPC + 5% WP	7.85	6.60	5.99
M3.	90% OPC + 10% WP	9.30	10.11	9.86
M4.	85% OPC + 15% WP	6.92	7.62	7.45
M5.	80% OPC + 20%WP	8.56	9.45	9.97

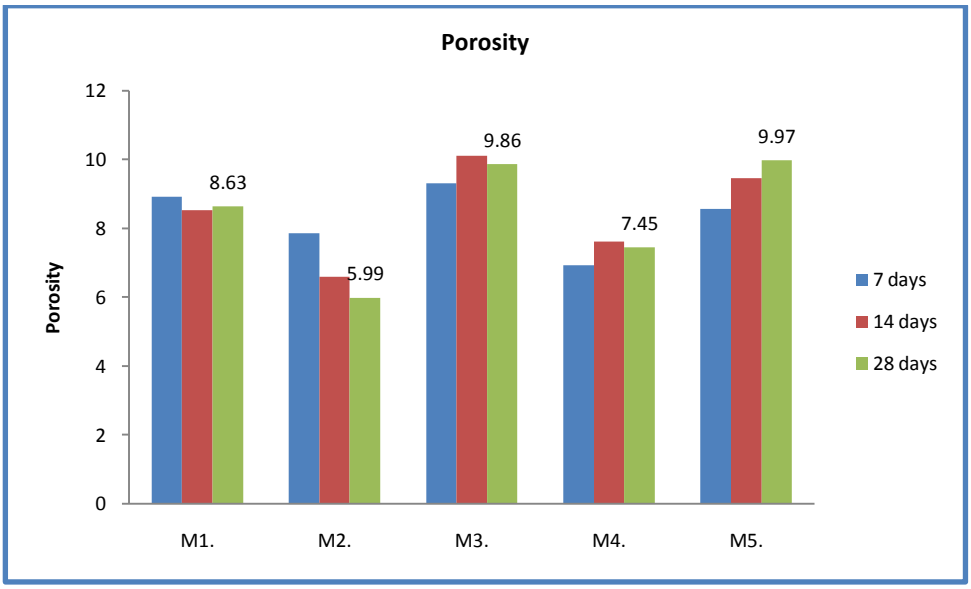

Fig. 4.2 Variation of porosity of concrete with age

5. CONCLUSIONS

In the current investigation, wollastonite powder (WP) was used to examine the strength and durability characteristics using test. The experimental data obtained has been analysed and discussed in Chapter-4, to fulfil to the best of ability, the objectives set forth for the present investigation.

a. Reduction in bleeding is observed by addition of wollastonite powder in the m wollastonite powder concrete mixes.
b. It was observed that use of wollastonite in concrete 15% with minimum loss of strength due to acid attack compare with control mix.
c. It was investigated that porosity of wollastonite mineral concrete is less compare with normal mix also minimum porosity obtained from mix 85% OPC + 15% WP.
d. Further studies can be carried out as this study only concludes that there is an increase in strength upto 15% replacement of cement by the wollastonite powder. Further scope is to find out the optimal %age of wollastonite powder to replace.

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