International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 6 Issue 4, May-June 2022 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Study on Strength of Concrete by Partial Replacement of Cement to Wollestonite and Make Concrete Economical- A Review

Vikas Kumar[1], Devander Kumar[2]

[1]Research Scholar, [2]Assistant Professor,
[1,2]Department of Civil Engineering, Om Institute of Technology & Management, Hisar, Haryana, India

ABSTRACT

In this study we will use Wollastonite material as partial replacement of cement. We will replace the cement with wollastonite with percentage change of 6%, 12%, 18%, 24% respectively by weight. After replacing these materials with cement check the effect on compressive strength, split tensile strength, flexural strength (at 7 days, 14 days, 28 days) and slump cone test for workability. For this study we will use ordinary Portland cement of grade 53 and design mix of grade M35.

How to cite this paper: Vikas Kumar | Devander Kumar "Study on Strength of Concrete by Partial Replacement of Cement to Wollestonite and Make Concrete Economical- A Review" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-4, June 2022, pp.1756-1759, URL: www.ijtsrd.com/papers/ijtsrd50381.pdf

IJTSRD50381

INTRODUCTION

In developing country like India there is a huge scope in construction. Construction of many mega projects like different bridges, tunnels and different kind of structures including Cement concrete roads are in progress and planning for construct many such projects in future. Due to the structural strength and stability, concrete is widely used as construction material. Ordinary Portland cement is the most used binding material in the concrete. Here we discus about the wollestonite use as partial replacement of cement which increase the strength as well as reduce the dependency on cement.

Wollestonite

Wollastonite is a mineral which contains silica and clay are predominant, almost in half ratio, 48.3% CaO and 51.7% SiO_2. It also contain small amount of manganese (mn), iron (Fe) and magnesium (mg). Chemical formula for Wollastonite is "$CaSiO_3$". It forms due to the weathering action or can say from the metamorphism reaction on limestone. So wollastonite is a metamorphic rock. It is found in different colours like white, grey, pale green, pinkish, red, brown, yellow with high brightness. Wollastonite has its different crystal shapes. It is not found in circular shape although it is found in needle like crystal structure. The length of wollastonite micro fiber is 0.4 – 0.6 mm and dia 25 – 150 µm. And less than 25 µm will be consider as powder and more than 150 µm will be consider as fibers. Because of its shape it can also be used as filler and can be replaced by sand also. From different researches it was proved that use of wollastonite as a replacement of cement or as filler in place of fine aggregates and sand improves the flexural strength, its compressive strength and ductility of the concrete. India is the second major producer of wollastonite following China. It is profusely found in Pali (Rajasthan) Sirohi Distt. Udaipur and also found in Uttarakhand, Andhra Pardesh and Tamil Nadu. It has similar properties as cement. Also it has its binding properties. So it can be used as a replacement or partially replacement of

cement with some ratio. It helps to reduce cracking and glaze effect. It can be used as an additive in paints and helps in improvement in the durability of the paint. It also use in plastic to increase its flexural strength. Wollastonite is used in friction products like breaks and clutches. One another use of wollastonite is, it use in the tile manufacturing industries.

Literature Review

Srushti zade (2019) In the present year of grace, the most extensively used material in the construction industry is for sure the concrete. One of the main constituent of concrete is cement. And this fact should be one of the main concerns that cement production causes emission of large amount of carbon dioxide gas into the atmosphere and so this exhale of gases further leads to the contribution in the greenhouse effect. So taking this unwell consequence into consideration we have come up with a choice. A choice to cement which is wollastonite. Wollastonite is naturally occurring mineral and is cheaper when compared to cement. So in this project particular we are studying the strength properties of concrete by adding wollastonite in it to some desirable percentage with simultaneously replacing the cement percentage by maintaining W/C ratio. This would further help in reducing cement production and thus the greenhouse effect at some extent.

Rakibul I. Khan (2019) Wollastonite is a naturally taking place calcium silicate mineral that can be used to improve the chemo mechanical performance of cementations materials. This item presents the influences of ground wollastonite on Portland cement hydration kinetics, segment formation and compressive strength. Ground wollastonite with 3.5 lm and 9.0 lm mean particle sizes were use in this study to change 10%–50% by weight of cement in the paste and mortar mixture. The result of ground wollastonite was compare with that of earth limestone. The piece of cementations mixture contains wollastonite and limestone is monitored using isothermal calorimeter, thermo gravimetric analysis (TGA), X-ray diffraction (XRD) and scan electron microscope (SEM). earth wollastonite was observed to hasten the cement hydration due to the space filler effect. The hydration increase of rate result of wollastonite was like to that of limestone. Earth wollastonite accelerate both C3S hydration and the response of aluminates phase. Wollastonite with the stand for particle size of 9.0 lm remains chemically inert up to 28 days of remedial as experiential from XRD and TGA results. While wollastonite with the mean particle size of 3.5 lm obsessive some Ca(OH)2 due to a measured pozzolanic effect. Combine all of these effects; using wollastonite-3.5 lm to replace 30% (by weight) of cement in a mortar mix reduced the compressive strengths after 7 days and 28 days curing just by 3% and 10%, in that order.

Shubham Dahiphale (2018) Wollastonite is a of course up mineral well-known as calcium metasilicate (CaSio3). It contains silica which react with water to figure calcium-silicate-hydrate (CSH). CSH is also dependable for impart strength to cemented matter when Portland cement hydrates. In this study wollastonite was use to change cement in concrete mix awake to 30 %. There were 9 concrete mixes ready with dissimilar wollastonite percentages which are 0%, 5%, 10%, 12.5%, 15%, 17.5%, 20%, 25%, 30% by mass of cement. Water cement ratio used was 0.44. It was observed that there was a rise in compressive strength at 10%, 12.5%, 15% wollastonite alternative as compared to control mix. Highest increase was pragmatic at 15% wollastonite substitute.

Shashi Kant Sharma (2018) Self compacting concrete (SCC) has good flow ability, pass ability and separation confrontation because of huge cementitious material & elevated coarse aggregate to fine aggregate ratio, and elevated free water accessibility. But these factors make it very liable to shrinkage. Fibers are known to decrease shrinkage in concrete mix. awaiting now for conserve cement, only pozzolanic materials are admixed in concrete to give in a SCC. Hence, this study compares the exercise of wollastonite micro fiber (WMF), a low-cost pozzolanic easily process raw mineral fiber, and fly ash in compliant economical SCC for rigid pavement. Micro silica was used as a admiring substance with both admixtures. Since WMF has large surface area (827 m 2 /kg), is acicular in natural world; therefore its use in acquiescent SCC was doubtful. Binary and ternary mixes were constituting for WMF and flyash, in that order. Paste mixes were experienced for compatibility with super plasticizer and trial was perform on a usual concrete mix of flexural strength 4.5 MPa to acquiesce SCC. Flexural strength test and reserved shrinkage test were performing on those mix, which capable self-compacting criterion. Results shown that WMF admixed pastes have elevated water demand and equivalent setting times to fly ash mixes. Workability tests showed that 20% WMF with microsilica (5-7.5%) is well-organized enough in achieve SCC and superior flexural strength than usual concrete at 90 days. Also, stress rate owed to shrinkage was smaller and time period for final strain was senior in WMF admixed SCC which encourage its use in compliant a SCC than pozzolanic materials.

Mona Abdel Wahab (2017) The consequence of using mineral Wollastonite residue as a partial alternative of cement or sand in Portland cement mortar mixes was considered. Seven dissimilar mixes of mortar incorporate Wollastonite as a inequitable substitute of cement or sand with alternative levels of 10%, 20%, and 30% were ready and tested. Initial setting time was considered and a hold-up up to 60% was observed for mortar mixes with 30% sand alternative while mortar mixes by cement substitute showed a minor increase up to 5%. Compression test result show a 45% raise in compressive strength due to 20% sand alternative. Flexural strength was improved by 28% by the similar batch. The consequence of Wollastonite in resist drying shrinkage was investigate and test results showed a decrease in length alteration for mutually mortar mixes with 30% cement substitute and 30% sand substitute up to 47% and 44% in that order.

Research Methodology

1. Study all the literatures about this research for getting different ideas for this research.
2. All the required material are collected and brought to laboratory for testing purpose. These materials include wollestonite, cement (grade 53), aggregates.
3. **Cement:** Cement is a binding material which used widely for construction purpose. Generally, it is grey in colour and it should be found cool when insert hand in cement bag. It should be felt smooth and there is no lumps when rubbed in between fingers.
4. **Aggregates**: Coarse aggregates which used for this study should be clean and dust free with good abrasion value and minimum water absorption. Coarse aggregates must be retained in 4.75mm sieve. Fine aggregates used must be passed from 4.75mm sieve.
5. **Wollestonite:** Wollestonite has its name in the honour of mineralogist W.H. Wollestone. The cemical name of wollestonite is Calcium metasilicate as it includes calcium oxygen and silicon. Chemical formula of wollestonite is $CaSiO_3$. It forms when mixed limestone is subjected to high pressure and temperature at times in the occurrence of silica-bearing fluid as contact in metamorphic rock.
6. Different testing samples will be prepared for various perportions of mixing wollestonite in place of cement. Like 6%, 12%, 18%, 24%.
7. Various kind of tests will be performed on cement, aggregates and on concrete.
8. Tests:

A. Aggregate test

1. Elongation Index Test
2. Flakiness Index Test
3. Los Angeles Abrasion Test
4. Aggregates Impact value Test

B. Cement test

1. Standard Consistency and Setting time
2. Soundness test
3. Specific Gravity of cement

C. Concrete test

1. Compressibility test
2. Split tensile strength test
3. Flexural strength test
4. Workability

Objective of Study

1. To investigate the mechanical properties of concrete with partial replacement of cement by wollastonite.
2. To find the optimal amount of wollastonite required to achieve maximum compressive, flexural strngth and tensile strength of concrete.
3. To compare the workability of wollestonite concrete to the ordinary designed concrete.
4. To compare the mechanical strength parameters of concrete with partial replacement of cement by wollastonite.

References

[1] Srushti zade, Meeyosh borkar, Payal makode, Rugved motghare, Pragati sakharkar, Bharti dongre, Pratik bandhekar (February 2019), "TO STUDY THE STRENGTH OF CONCRETE BY ADDING WOLLASTONITE IN IT" IJARIIE-ISSN(O)-2395-4396 (Vol. 5)

[2] Rakibul I. Khan, Warda Ashraf (May 2019), "Effects of ground wollastonite on cement hydration kinetics and strength development" Published by Elsevier Ltd

[3] Shubham Dahiphale, Kabir Khan, Kshitij Tikhe (2018), "Properties of Concrete Containing Wollastonite" International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE) ISSN (Online) 2456-1290

[4] Shashi Kant Sharma, G.D. Ransinchung and Praveen Kumar (2018), "Investigating the use of wollastonite micro fiber in yielding SCC" Advances in Concrete Construction, Vol. 6

[5] Mona Abdel Wahab, Ibrahim Abdel Latif, Mohamed Kohail, Amira Almasry (July 2017), "The use of Wollastonite to enhance the mechanical properties of mortar mixes" Published by Elsevier Ltd.

[6] Vikram Singh Meeena, Deven Singh (2017), "Wollastonite : An Energy Efficient Building Material ", International Journal of Trend in Scientific Research and Development(IJTSRD)

[7] KANDULA MOHANKRISHNA REDDY & K. V. S. GOPALA KRISHNA SASTRY (September 2016), "STRENGTH PROPERTIES OF CONCRETE USING WOLLASTONITE-FLYASH AND WOLLASTONITE-SILICA FUME" International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD) ISSN(P): 2249-6866; ISSN(E): 2249-7978 Vol. 6, Issue 5

[8] Rakesh Kumar (2016), "Wollastonite Mineral Fibre in Manufacturing of an Economical Pavement Concrete" Fourth International Conference on Sustainable Construction Materials and Technologies.

[9] N. I. Demidenko, L. I. Podzorova, V. A. Skorokhodov, V. Ya. Shevchenko (2016), "Wollastonite as a new kind of Natural Material", Science for Ceramic Production

[10] Kandula Mohan Krishna Reddy, K.V.S. Gopala Krishna Sastry (2016), "Strength Properties of concrete using wollastonite, Fly Ash and wollastonitesilics fume ", International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD) ISSN(P): 2249-6866; ISSN(E): 2249-7978 Vol. 6, Issue 5, Oct 2016, 1-12

[11] Dey V, Kachala R, Bonakdar A and Mobasher B (2015), "Mechanical properties of micro and sub-micron wollastonitefibers in cementitious composites", Construction and Building Materials, Vol. 82,pp. 351 - 359.