TO STUDY THE STRENGTH OF CONCRETE BY ADDING WOLLASTONITE IN IT

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ABSTRACT

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.

Keyword : - *wollastonite powder, concrete, cubes and beams, compressive strength, flexural strength.*

1. INTRODUCTION

Concrete is a widely used construction material for various types of structure due to its structural stability and strength. The usage, behavior as well as the durability of concrete structure, built during the last first half of the century with ordinary Portland cement and plane round bar of mild steel, the ease of procuring the constituents material(whatever may be their qualities) of concrete and the knowledge that almost any combination of the constituents leads to a mass of concrete have bred contempt. Strength was stressed without a thought on durability of structure. As a consequence of the Liberty station, the durability of concrete and concrete structures is on southward journey; a journey that seems to have gained momentum on its path to self destruction. The ordinary Portland cement is one of the main ingredients used for the production of concrete and has no alternative in the civil construction industry. Unfortunately production of cement involves emission of large amount of carbon dioxide gas into the atmosphere a major contributor for greenhouse effect and the global warming, hence it is inevitable either to search for another material or partly replace it by some other material. The search for any such material which can be used as an alternative or as a supplementary for cement should lead to global sustainable development and lowest possible environmental impact. Sustainable energy and cost saving can result when industrial by-products are used as a partial replacement of cement. Fly ash, ground granulated blast furnace slag, rice husk Ash, silica fume are some of the pozzolanic material which can be used in concrete as partial replacement of cement. A number of

studies are going on in India as well as abroad to study the impact of use of these pozzolanic materials as cement replacement and the results are encouraging**.**

1.1 INTODUCTION TO WOLLASTONITE

Wollastonite is a calcium Ion silicatemineral ($CaSiO_3$) that may contain small amounts of iron, magnesium, and manganese substituting for calcium. It is usually white. It forms when impure limestone or dolostone is subjected to high temperature and pressure sometimes in the presence of silica-bearing fluids as in skarns or contact metamorphic rocks. Associated minerals include garnets, vesuvianite, diopside, tremolite, epidote, plagioclase feldspar, pyroxene and calcite. It is named after the English chemist and mineralogist William Hyde Wollaston (1766–1828).

2. OBJECTIVES

- To study physical and chemical properties of wollastonite.
- To decide the concrete mix proportions by various percentage of partial replacement of cement by wollastonite.
- To cast and determine compressive strength of conventional M20 concrete cubes.
- To cast the cubes with variable percentage of wollastonite as a replacement of cement with different percentage of wollastonite weight.
- To test compressive strength of concrete cubes with wollastonite as partial replacement material for cement.
- To compare the strength parameters of concrete cubes means cement is partially replaced by wollastonite with different amount and the conventional cubes.
- To cast and determine flexural strength of conventional concrete beams.
- To cast the beams which variable percentage of wollastonite as a replacement of cement.
- To test flexural strength of concrete beams with wollastonite as partial replacement material for cement.
- To compare the flexural strength parameters of concrete beams when cement is partially replaced by wollastonite with different percentage.

3. TESTING OF MATERIALS

3.1 TESTS ON COARSE AGRREGATE

1) Impact value of aggregate passing through 12.5 mm sieve and retaining on 10mm sieve was found to be 7.2% hence the aggregates are exceptionally strong.
2) Crushing value test of aggregate passing through 12.5 mm sieve and 10 mm sieve should be less than 10% for exceptionally strong aggregate as per IS :283-1970.
3) Abrasion test by Los Angeles apparatus:
   Abrasion value of the aggregate is found to be 25.8%.
   which is suitable for construction.

3.2 TESTS ON FINE AGRREGATE

1) Bulking of sand :
   The bulking of sand observed to be 7.5% . Permissible limit for bulking of sand for 2% of water content is 15%.
2) Specific gravity of sand :
   The specific gravity of sand is found to be 2.6 and water absorption is found to be 2%.

3.3 TESTS ON CEMENT

1) Colour of cement found was preferable. Cement should not contain lumps. Float test gave good results. Hence the quality of cement is good and preferable.
2) Fineness test on cement:

By performing fineness test, it found the 10% residue remained on the sieve no. 9 i.e 90µ which is desirable.

3) Consistency , initial and final setting time:

- The normal consistency for tested cement is found to be 40%.
- As per IS:8112,1989 – initial setting time for OPC 43 grade cement is 30 minutes.
- Final setting time for OPC 43 grade cement is 10 hours.

4) Soundness of cement :

As per IS requirement the distance between two pointers and after heating should not differ more than 10mm for all 33, 43, and 53 cement.

5) Compressive strength of a cement mortar cubes (7.06cm*7.06cm*7.06cm)

for 43 grade of cement should be 23 N/mm sq for 3 days, 33 N/mm sq for 7 days and 43 N/mm sq for 28 days.

4. METHODOLOGY

In order to achieve the objective of the present study, an experiment program was planned to investigate the effect of the wollastonite powder on properties of cement replaced by wollastonite powder in different percentage i.e. 0%,10%, 15%, 20%respectively.The various parameters are investigated and test are performed such as compressive strength.

The experiment program includes the following.

1- Testing of properties of materials used.
2- Development of concrete of desired strength by making trials.
3- Testing slump cone to assess workability.
4- Casting and curing of the specimen.
5- Compressive strength test on specimen.
6- Replacement of cement by wollastonite powder Testing slump cone test to assess workability.
7- Casting and curing of specimen.

5. MIX DESIGN

For this study, M20 grade of concrete was used. The quantities of materials used for w/c ratio worked out.

Mix design of concrete using wollastonite as a partial replacement of OPC.

Mix proportion for Cube and Beams (M20):-

a) Grade of concrete :- M20
b) Mix proportion :- 1:1.5:3 (1+1.5+3 =5.5)

Mix Design M20 9 Cubes:

Type of Mix	W/C ratio	Cement	Wollastonite (kg)	CA	FA	Water
Mix 1 (0% Wolastonite)	0.45	12.06	0	39.24	20.016	5.427
Mix 1 (10% Wolastonite)	0.45	10.854	1.206	39.24	20.016	5.427
Mix 1 (15% Wolastonite)	0.45	10.251	1.809	39.24	20.016	5.427
Mix 1 (20% Wollastonite)	0.45	9.648	2.412	39.24	20.016	5.427

Mix design for 9 beams:

Type of Mix	W/C ratio	Cement	Wollastonite (kg)	CA	FA	Water
Mix 1 (0% Wolastonite)	0.45	17.89	0	40.19	29.80	8.05
Mix 1 (10% Wolastonite)	0.45	16.01	1.789	40.19	29.80	8.05
Mix 1 (15% Wolastonite)	0.45	15.027	2.683	40.19	29.80	8.05
Mix 1 (20% Wollastonite)	0.45	14.312	3.578	40.19	29.80	8.05

6. RESULTS

Effect of wollastonite powder on compressive and flexural strength of concrete. The result of compressive and flexural strength tests using wollastonite powder in varying percentages (i.e 0%, 10%, 15%& 20%) as partial replacement of cement at moist curing ages of 7, 14 and 28 days are represented in the table and are plotted in figures which show the variations of compressive and flexural strength of concrete with different replacement level of wollastonite powder and at various ages of moist curing.

6.1 AVERAGE TEST RESULT

6.1.1 For Cube in Mpa:

NAME OF CUBE	7 DAYS	14 DAYS	28 DAYS
CONVENTIONAL CONCRETE	26.56	28.64	32.35
15% WOLLASTONITE CONCRETE	20.75	25.44	39.74
20% WOLLASTONITE CONCRETE	19.67	24.46	35.18
10% WOLLASTONITE CONCRETE	17.25	23.34	33.44

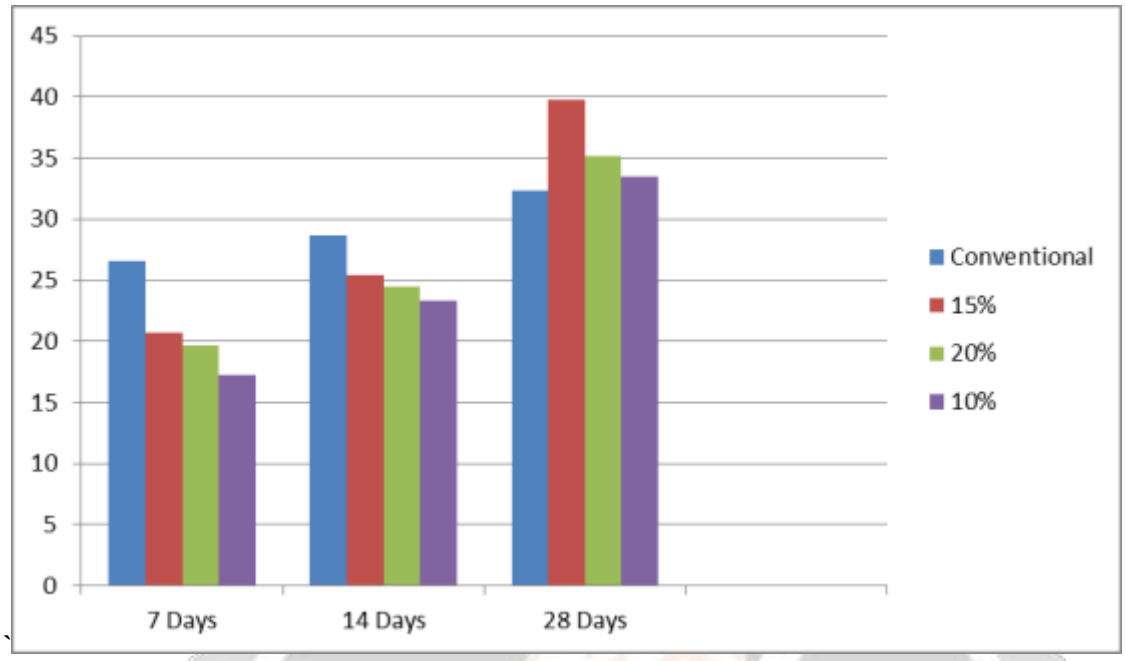

Fig 1: Average of strength of concrete Cube at various days

6.1.2 For beam in Mpa:

NAME OF BEAM	7 DAYS	14 DAYS	28 DAYS
CONVENTIONAL CONCRETE	2.25	5.09	7.89
15% WOLLASTONITE CONCRETE	2.53	5.54	10.84
20% WOLLASTONITE CONCRETE	2.6	6.35	9.71
10% WOLLASTONITE CONCRETE	2.40	5.41	8.16

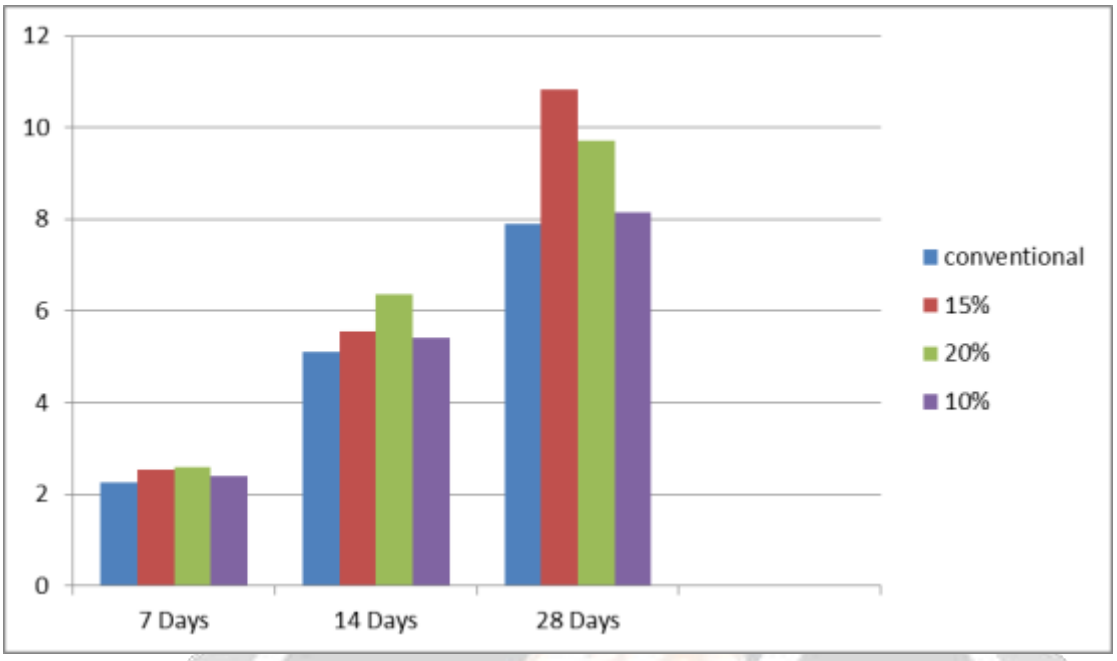

Fig 2: Average of strength of concrete Beam at various days

7. CONCLUSIONS

- Hence from above results we can conclude that by adding 15% wollastonite by replacing cement, strength of concrete is increased.
- At 15% wollastonite, strength of concrete is more than conventional concrete.
- As wollastonite is cheaper than cement we can replace 15% cement by7 wollastonite to get more strength.
- The wollastonite powder can be used in a small scale works to get economic and durable structure.
- The cost of structure an be reduced if wollastonite is used as partial replacement of cement due to its low cost than cement.

8. FUTURE SCOPE

- Other admixture can also be used with wollastonite for increasing the strength and other parameters of concrete.
- The proportion of wollastonite can be increased in concrete for getting higher strength.
- The wollastonite can also be replaced by sand.
- The wollastonite can also be replaced by both sand and cement both.
- Due to its fire resistance properties the wollastonite can used as fire resistance structure also.
- The mix design method can be developed for wollastonite concrete.

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