ISSN:2348-2079

Volume-6 Issue-2

International Journal of Intellectual Advancements and Research in Engineering Computations

An experimental study on concrete with partial replacement of fine aggregate by vermiculite and silica fume as a mineral admixture

L.Arun[*], K.Kowsalya[*], S.Madhumathi*, K.Preethi*, R.Pradheepa[#]

[*]UG Students, [#]Assistant Professor, Department of Civil Engineering, Nandha Engineering College, Erode

***Abstract*— Concrete is the single most widely used construction material in the world. Concrete is used in such large amounts because it is simply, a remarkably good building material. Aggregates generally occupy 60 to 80 percent of the volume of concrete and greatly influence its properties, mix proportions and economy. Use of vermiculite in concrete, enhances the shrinkage and crack resistance, fire resistance and reduces environmental impact and also reduces the cost. Important characteristics of a good quality aggregate include resistance to abrasion, resistance to freeze/thaw action, resistance to sulfates, correct shape and surface texture, proper gradation, density, and compressive and flexural strength. The main purpose of the research is to study the strength parameters such as compressive strength, split tensile & flexural strength of concrete using vermiculite as partial replacement with 10%, 20% and 30% by weight and silica fume (SF) as adding of 5%, 7.5% and 10% by weight of cement. The main aim of this study is to make economical and eco-friendly concrete.**

Index Terms—Vermiculite, Silica Fume, Cement, Fine Aggregate.

1.INTRODUCTION

Vermicular is an Italian word for worm from which it has consequent its name as vermiculite. Some establishment quotes the Latin word vermicular from which the name vermiculite might be implemented. Vermiculite is a hydrous phyllosilicate mineral group and is micaceous in environment. Exfoliated vermiculite is obtainable in five different grades, which are based upon weight rather than particle size. As concrete is the good building material it is used worldwide in various structural members such as slabs, beams, columns, foundation, etc., Due to its low thermal conductivity property, fine aggregates are replaced with vermiculite and its compressive strength, tensile strength and flexural strength are tested. Generally vermiculite can resist the temperature up to 1200°C and it has high thermal insulation co-efficient of λ>0.046 W/m° C. Because of this property vermiculites are added in concrete by replacing fine aggregates by 10%, 20% and 30% by weight and their strength parameters are found.

II. MATERIALS USED

A. Vermiculite

Vermiculite is a hydrous phyllosilicate mineral. Vermiculite is formed by weathering or hydrothermal alteration of biotite or phlogopite. It undergoes significant expansion when heated. Vermiculite is chosen to replace fine aggregates in concrete because of its specific properties such as it is lighter in weight, improved workability, improved fire resistance, improved resistance to cracking and shrinkage and mainly inert chemical nature. Vermiculites taken for concrete preparation which pass through 2.36mm sieve size.

B. Cement

Cement used to prepare the specimen was 53 grade Ordinary Portland cement, conforming to IS 12269:2013 with a fineness of 1%, standard consistency of 34% and Initial setting time 80 min.

C. Coarse aggregates

Coarse aggregates of 4.75mm to 12.5mm size aggregates were used.

D. Fine aggregate

Fine aggregate are taken for concrete preparation which pass through 2.36mm sieve size.

E. Water

Portable water was used for mixing and curing of concrete specimens.

F. silica fume

Silica fume is a by product of producing silicon metal or ferrosilicon alloys. One of the most favorable uses for silica fume is in concrete. The specific gravity of silica fume is 2.63.

III. MIX DESIGN

As per IS 10262:2009 design mix for M_{25} grade of concrete was prepared by replacing fine aggregates by 5%,10% and 15% by weight.

IV. MATERIALS TEST RESULT

TABLE-1: Physical properties of cement

Fineness Modulus	Fineness consistency	Initial Setting time	Final Setting time
1.0	34%	80min	280min

TABLE-2: Physical properties of fine aggregates

Fineness Modulus	Specific gravity	Water absorption
2.76	2.86	1.92

TABLE-3: Physical properties of Vermiculites

Fineness Modulus	Specific gravity	Water absorption
2.46	2.54	2.65

TABLE-4: Physical properties of Coarse aggregates

Fineness Modulus	Specific gravity	Water absorption
6.87	2.7	1.5

IV .TEST RESULTS

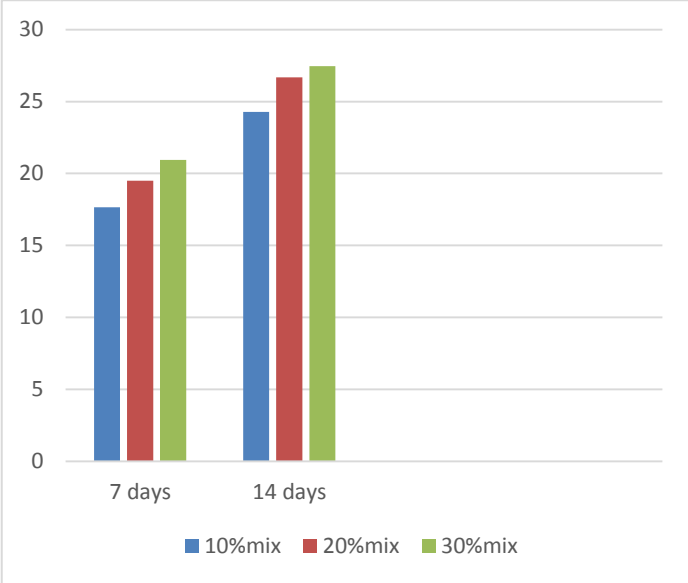
A. Compressive Strength

Compressive strength was tested in compressive testing machine. Cube specimens of size 150mm x 150mm x 150mm were adopted for the test. Compressive strength was tested after 7,21 and 28 days of curing. The results of the tests are tabulated below

TABLE-5 Compressive strength of vermiculite concrete

Percentage Replacement of Vermiculite (%)	%of Silica Fume	Age of curing	Strength of concrete (N/mm^2)
10% of vermiculite	5%	7	17.65
		14	24.28
		28	-
20% of vermiculite	7.5%	7	19.49
		14	26.67
		28	-
30% of vermiculite	10%	7	20.94
		14	27.45
		28	-

GRAPH 1: COMPRESSIVE STRENGTH TEST



B. SPLIT TENSILE STRENGTH

The test was conducted in compression testing machine. Cylindrical specimens were 150 mm diameter and 300 mm height. The results of the tests conducted are tabulated below.

TABLE-6 Split tensile strength of vermiculite concrete

Percentage Replacement of Vermiculite (%)	% of Silica Fume	Age of curing	Strength of concrete (N/mm^2)
10% of vermiculite	5%	7	2.34
		14	2.79
		28	-
20% of vermiculite	7.5%	7	2.98
		14	3.96
		28	-
30% of vermiculite	10%	7	3.68
		14	4.23
		28	-

GRAPH 2: SPLIT TENSILE STRENGTH TEST

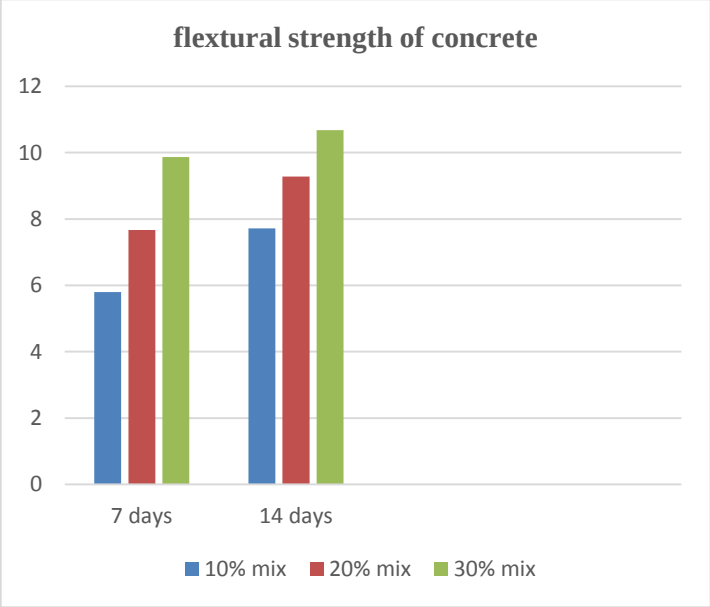
C.FLEXURAL STRENGTH

Flexural strength was tested in compression testing machine. The test was carried out on beams of size 100x100x50mm.The results of tests are tabulated below.

TABLE-7 Flexural strength of vermiculite concrete

Percentage Replacement of Vermiculite (%)	% of Silica Fume	Age of curing	Strength of concrete (N/mm^2)
10% of vermiculite	5%	7	5.8
		14	7.72
		28	-
20% of vermiculite	7.5%	7	7.67
		14	9.28
		28	-
30% of vermiculite	10%	7	9.87
		14	10.68
		28	-

GRAPH 3: FLEXTURAL STRENGTH TEST



V. CONCLUSIONS

- The strength parameters such as compressive strength, split tensile strength test and flexural strength of vermiculite concretes of various percentages are found
- Addition of vermiculites in concrete makes it heat resisting & resists shrinkage and cracks in concrete
- Because of inert chemical nature of vermiculite when it is used in concrete it will not undergo any chemical reaction and also it is an eco-friendly material.
- Silica fume when compared with the nominal mix and it is considered as the optimum mix.

VI. REFERENCES

1. M.R.Divya,Prof.M.Rajalingam, Dr.Sunilaa George (2016) "Study on Concrete with Replacement of Fine Aggregates by Vermiculite" The main purpose of the research is to study the strength parameters such as compressive strength, split tensile & flexural strength.
2. S Syed Abdul Rahman, Gijo K Babu (2016)"An Experimental Investigation on Light Weight Cement Concrete using Vermiculite Minerals" In this study, structural light weight aggregate concrete was designed with the use of natural vermiculite aggregate that will provide an advantage of reducing dead weight of structure and to obtain a more economical structural light weight concrete by the use of vermiculite power as a partial replacement of sand.
3. Mr. M. Gunasekaran et al., (2016) "Study on Vermiculite Incorporate in Mortar" Study on Vermiculite replacing natural sand is investigated. Design mix having the mix proportion 1:3 with the water cement ratio 0.5.
4. A. V. V. Sairam, K. Sailaja "an experimental study on strength properties of vermiculite concrete using flyash as partially replacement of cement and silica fume as mineral admixture"
5. S.Sharmila and L.Vijayan (2016) "an Experimental investigation on thermo proof construction using vermiplast.
6. Praveen Kumar and siddeshpai (2015) "Experimental study of vermiculite insulated samples with conventional samples in construction industry"
7. Aliakbar sayadi and Thomas R.Neizert (2016) "Assessment of vermiculite concrete containing Bio-polymer aggregate"
8. Yuvraj Chavdaa , Shilpad reinforced (2015) concrete code of practice Kewateb "Use of vermiculite for light weight floating concrete"
9. IS 456- 2000 "Plain and reinforced concrete code of practice".
10. IS 10262 - 2009 "Recommended guidelines for concrete mi design.
11. Indian standard recommended guidelines for concrete mix design IS 10262-1982."