

Study of strength properties of concrete with zeolite as a partial replacement of cement

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Abstract -In this study the application of natural zeolite as a partial supplementary cementitious material has been carried out. To this aim some castings of concrete made with 0 %, 5%, 10%, 15% and 20 % replacement of cement with zeolite are studied. The mechanical properties such as compression strength, tensile strength and flexural strength of concrete were carried out. Also workability was tested using slump cone test and compaction factor test.

IndexTerms - Zeolite, Workability.

1. INTRODUCTION

It has been found that some percentage of zeolite can be replaced with cement in concrete for various construction activities. Zeolites have been widely used in various industries, leading to a high commercial value; this is mainly due to the wide diversity of naturally occurring species and the ability to synthesize new types. In the cement and concrete industry, natural zeolite is a popular natural pozzolanic material in some regions of the world owing to their economic, environmental and technical advantages, among others used pozzolanic materials. Generally the use of natural zeolite can overcome environmental and economic problems associated with the use of high quantity of cement. Zeolite is usually manufactured in factories. This kind of material has characteristics to absorb CO₂ with incredible strength. Because of this nature, zeolite can be substituted in place of cement. This type of material is easily available in market. As the material comparatively little costly even the replacement is made only up to certain extent so that this will be affordable due to its additional benefits. There is vast scope and need for study of this material for developing country like India. If it is proven that the concrete is durable, strong and economical, this will lead to the use of zeolite to replace part of the cement.

2. OBJECTIVES:

Following are the objectives of study.

1. To study the Workability properties of fresh concrete with zeolite.
2. To study the Mechanical properties of hardened concrete with zeolite.

3. EXPERIMENTATION AND TEST RESULTS :

, Properties of materials used:

The following tests were taken on M25 grade concrete having proportion of 1:1.45:2.79 and water-cement ratio of 0.44

A) Cement: Type of cement -Ultratech brand OPC- 53 grade having Specific gravity-3.15 was used.

B) Locally available basalt rock coarse aggregate were used having Specific gravity-2.87, Water absorption-0% , Free surface moisture –nil.

C) Locally available river sand was used as fine aggregate having Specific gravity-2.56, Water absorption-0%, free surface moisture-0%.

D) Zeolite were used having physical appearance off white, pH 7.3 , bulk density – 0.81Kg/lit, specific gravity - 2.6

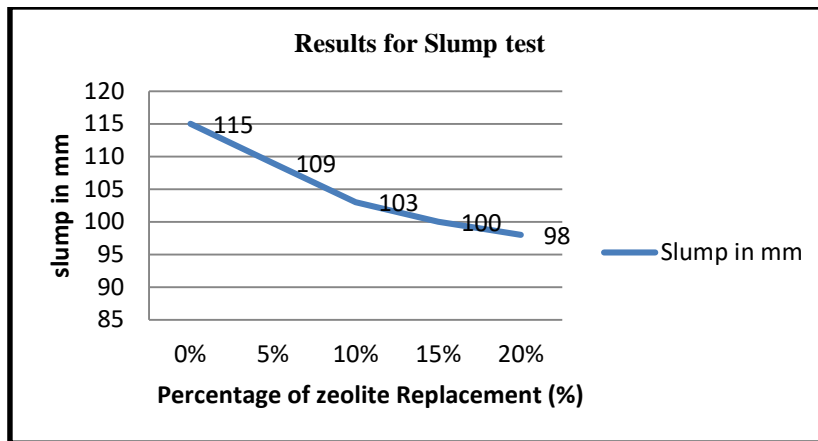
3.1 TEST RESULTS FOR WORKABILITY OF CONCRETE:

3.1 .1 Slump cone test results:

Table no. 3.1 Overall results for slump cone test:

Sr no.	Zeolite %	Slump in mm
1	0%	115
2	5%	109
3	10%	103
4	15%	100
5	20%	98

Graph no. 3.1 : Graph for results of slump cone test :

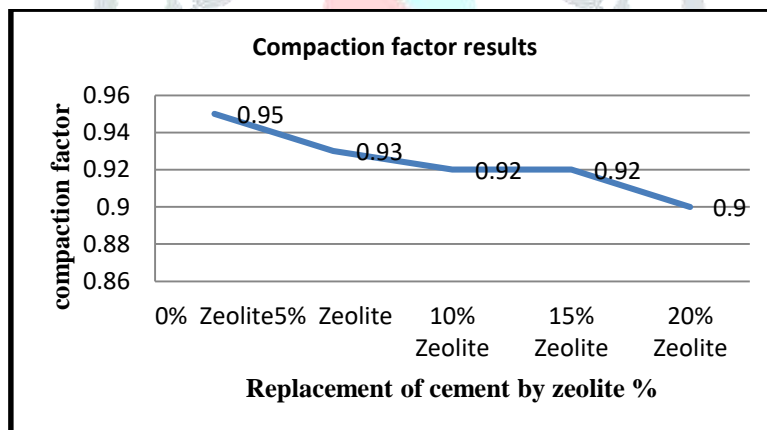


3.1.2 Compaction Factor test results :

Table no.3.2: Overall results for compaction factor considering zeolite

Sr. No	Percentage of zeolite Replacement (%)	Compaction factor
1	0% Zeolite	0.95
2	5% Zeolite	0.93
3	10% Zeolite	0.92
4	15% Zeolite	0.92
5	20% Zeolite	0.90

Graph no. 3.2 : Overall results for compaction factor test



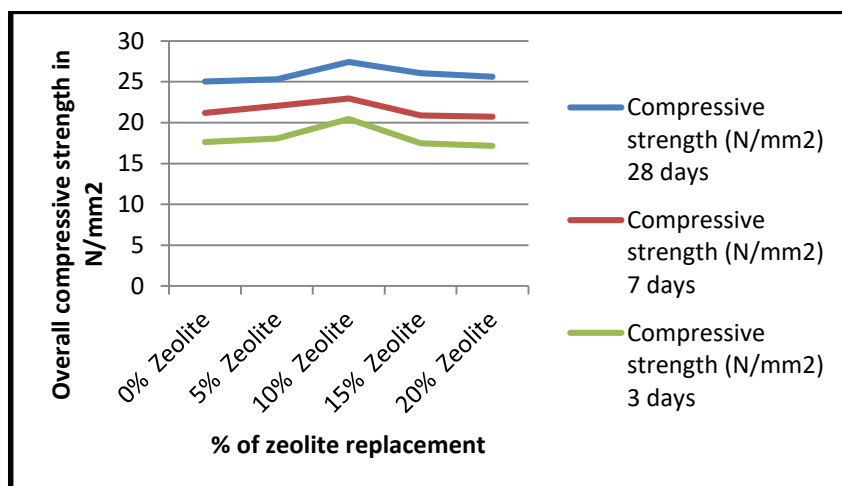
3.2 Mechanical Strength test results

3.2.1 Compressive Strength test results:

Table No.3.3:Overall Results For Compressive Strength Test

Sr. No.	Percentage of Replacement (%)	Compressive strength (N/mm ²)		
		28 days	7 days	3 days
1	0%	25.03	21.18	17.63
2	5%	25.33	22.07	18.07
3	10%	27.41	22.96	20.44
4	15%	26.07	20.89	17.48
5	20%	25.63	20.74	17.18

Graph3.3: Compressive Strength test results of Zeolite Induced Concrete

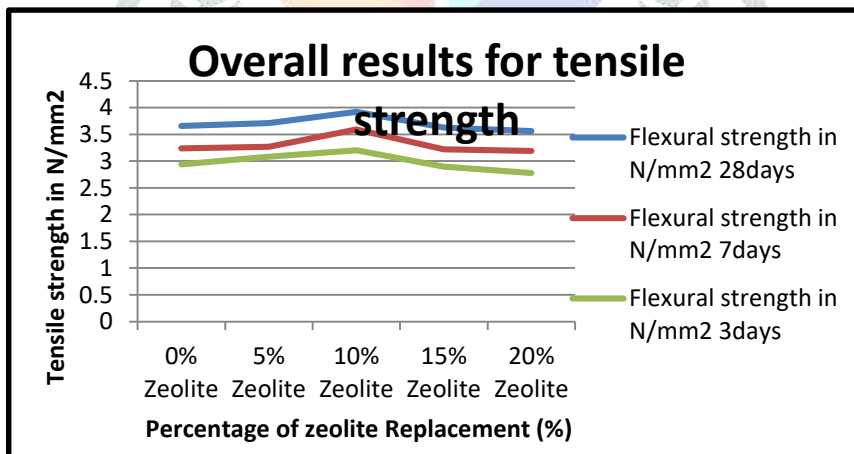


3.2.2 Tensile Strength test results

Table 3.4 -Over results for tensile strength test

Sr. No.	Percentage of Replacement (%)	Tensile strength in N/mm ²		
		28 days	7 days	3 days
1	0%	2.58	2.24	2
2	5%	2.66	2.29	2.19
3	10%	2.75	2.61	2.38
4	15%	2.57	2.33	2.05
5	20%	2.47	2.19	2

Graph 3.4: Tensile Strength test results of Zeolite Induced Concrete

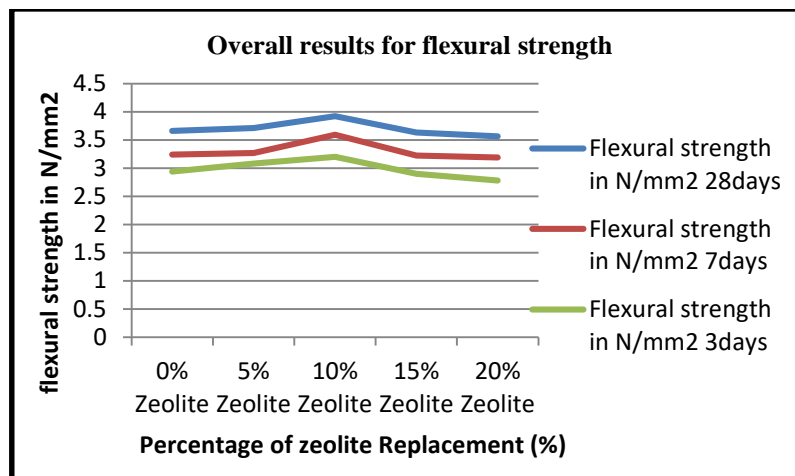


3.2.3 Flexural Strength test results:

Table no. 3.5: Overall results for flexural strength test:

Sr. No.	Percentage of Replacement (%)	Flexural strength in N/mm ²		
		28days	7days	3days
1	0%	3.66	3.24	2.94
2	5%	3.71	3.27	3.08
3	10%	3.92	3.59	3.20
4	15%	3.63	3.22	2.90
5	20%	3.56	3.19	2.78

Graph3.5: Flexural Strength of Zeolite Induced Concrete



4. RESULTS AND DISCUSSION

Based on the different Experiments conducted following conclusion can be drawn:

- 1) The Compressive Strength of Zeolite induced concrete shows increasing trend of Strength upto 10% replacement of cement by zeolite and after this the Compressive Strength goes on decreasing hence 10% replacement of cement by zeolite is an optimum percentage of replacement.
- 2) The tensile Strength of Zeolite induced concrete shows increasing trend of Strength upto 10% replacement of cement by zeolite and after this the tensile Strength goes on decreasing hence 10% replacement of cement by zeolite is an optimum percentage of replacement.
- 3) The flexural Strength of Zeolite induced concrete shows increasing trend of Strength upto 10% replacement of cement by zeolite and after this the flexural Strength goes on decreasing hence 10% replacement of cement by zeolite is an optimum percentage of replacement.
- 4) The workability of zeolite induced concrete goes on decreasing as the percentage of replacement of zeolite goes on increasing for slump cone test.
- 5) The workability of zeolite induced concrete goes on decreasing as the percentage of replacement of zeolite goes on increasing for compaction factor test.

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