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STRENGTH STUDIES ON CRIMPED STEELFIBER CONCRETE AS PARTIAL REPLACEMENT OF CEMENT WITH ZEOLITE POWDER

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ABSTRACT

In construction, aggregate is a hard, chemically inert particle material (typically sand and gravel) that bonds to structural materials by cementing them together with cement and water. Experimental research was done to determine the impact of partially replacing cement with zeolite powder on the properties of concrete. Various percentages of cement can be replaced by zeolite powder, including 0%, 5%, 15%, 20%, 25%, and 30%. Crimped steel fibres are combined with concrete in amounts of 1%, 2%, 3%, and 4%. In order to reduce CO2 production, zeolite is utilised to partially substitute cement in concrete. Powdered zeolite is a component of natural pozzolanic material. Zeolite can be used as a partial replacement for cement in concrete since it can partially replace cement's aggregate and has great compressive strength. Since it will absorb harmful gases and offer strong compressive, split tensile strengths and Ultrasonic pulse velocity for 28,56 and 90 days.

***KEYWORDS**: Zeolite powder, Crimped steel fibre, Compressive strength, Split tensile strength, UPV.*

1. INTRODUCTION:

A composite material made of fine and coarse aggregate mixed with a cement paste that is initially fluid before hardening (curing). The most often used building material worldwide, second only to water in terms of usage, is concrete. Aggregate, dry Portland cement, and water are combined to form fluid slurry that is easy to pour and shape. The reaction between the cement and water, known as concrete hydration, allows the mixture to solidify over the course of many hours to produce a durable stone-like product with a range of uses. Concrete can be prepared using a variety of tooled techniques during this time, in addition to being cast in forms. Additives (such pozzolans or superplasticizers) are routinely added to the mixture in order to improve the physical properties of the wet mix,

slow down or speed up the curing process, or change the final product in some other way.

Crimped Steel fibre is a type of metal reinforcement. The phrase "steel fibre for reinforcing concrete" refers to short, discrete lengths of steel fibres with various cross-sections and an aspect ratio (ratio of length (20) to diameter (100)) that are small enough to be incorporated haphazardly into a mixture of unhardened concrete using conventional mixing methods. By adding a specific amount of steel fibre to concrete, its physical properties can be changed qualitatively, improving the substance's tenacity, durability, and resistance to cracking, impact, fatigue, and bending, among other properties.

Zeolite is one metal oxide that possesses a significant solid acidity.Zeolite is also offered as a powder for use as a partial substitute for cement in concrete. It has considerable pozzolanic reactivity and the ability to take carbon dioxide from the air.

2. OBJECTIVES:

1. To use zeolite powder in concrete as efficiently as possible.
2. The behaviour of crimped steel fibre in concrete is examined in this experiment.

3. MATERIALS

3.1 Cement:

In concrete, which is used for building and sets and hardens to bond other materials, cement is primarily employed as a binder material. Construction uses OPC (ordinary Portland cement) of grade 53.

3.2 Fine Aggregate:

Made up of natural sand or crushed stone, fine aggregate is an essential component of concrete. The hardened properties of the concrete are significantly influenced by the fine aggregate density quality.

3.3 Coarse Aggregate:

Coarse aggregate refers to the aggregate that is retained over the IS Sieve 4.75 mm. According to IS383:1970, the typical maximum size is gradually 10–20 mm.

3.4 Water:

The potable water which was used for the manufacture of concrete**.**

3.5 Zeolite powder:

Zeolite has been used as a fluidizing agent for carriers, an antibacterial agent, to prevent concrete from cracking, to strengthen concrete, to manage humidity, and as an agent to increase concrete strength.

3.6 Crimped steel fibers:

The crimped steel fibres are produced using either carbon steel or stainless steel. Due to their ductility, metals may be pulled through ever-smaller dies to be transformed into wire. Due to its stiffness, high strength fibre reinforced concrete must possess specific mechanical properties.

4. EXPERIMENTAL RESULTS

4.1 Compressive strength

Compressive strength of concrete must be evaluated since it serves as a standard to determine the material's quality.

Table 1: Compressive strength of concrete with Zeolite powder as partial replacement of cement in concrete

S.No.	% Zeolite powder	Compressive Strength, N/mm^2		
		28 days	56 days	90days
1	0	40.06	43.32	46.55
2	5	43.68	47.26	50.72
3	10	47.15	50.97	54.76
4	15	50.67	55.12	58.93
5	20	49.11	53.19	57.03
6	25	46.21	49.97	53.67
7	30	45.02	48.78	52.29

Table 2: Compressive strength of concrete with crimped steel fibre concrete

S.No.	% Crimped steel fibre	Compressive Strength, N/mm^2		
		28 days	56 days	90days
1	0	40.06	43.32	46.55
2	1	40.48	43.76	47.04
3	2	41.08	44.46	47.75
4	3	42.73	46.21	49.74
5	4	41.26	44.66	47.95

Table 3: Combined compressive strength of concrete with 15% Zeolite powder and 3% Crimped steel fibers

S. No.	ZP +CSF	Compressive Strength, N/mm^2		
		28 days	56 days	90days
1	0%	40.06	43.32	46.55
2	15% ZP +3%CSF	51.64	55.85	60.02

4.2 Split tensile strength results

The split tensile strength conducted in compressive strength machine for the cast and cured specimens and the results are furnished in Table.

Table 4: Split tensile strength of concrete with Zeolite powder as partial replacement of cement in concrete

S.No.	% Zeolite powder	Split tensile Strength, N/mm^2		
		28 days	56 days	90days
1	0	3.95	4.27	4.59
2	5	4.28	4.62	5.37
3	10	4.66	5.04	5.41
4	15	5.05	5.46	5.86
5	20	4.85	5.25	5.63
6	25	4.61	4.98	5.35
7	30	4.26	4.61	4.95

Table 5: Split tensile Strength of concrete with crimped steel fibre concrete

S.No.	% Crimped steel fibre	Split tensile Strength, N/mm^2		
		28 days	56 days	90days
1	0	3.95	4.27	4.59
2	1	4.01	4.34	4.66
3	2	4.07	4.41	4.73
4	3	4.26	4.61	4.95
5	4	4.08	4.40	4.74

Table 6: Combined Split tensile strength of concrete with 15%Zeolite powder and 3% Crimped steel fibers

S.No.	ZP +CSF	Split tensile Strength, N/mm^2		
		28 days	56 days	90days
1	0%	3.95	4.27	4.59
2	15% ZP +3%CSF	5.22	5.64	6.06

4.3 Ultrasonic Pulse Velocity Test:

Ultrasonic pulse velocity (UPV) testing, which analyses the speed and attenuation of an ultrasonic wave as it runs through the element under test, is used to evaluate the integrity and quality of structural concrete or stone that is up to 6 feet thick.

Table 7: Ultra sonic pulse velocity of concrete with Zeolite powder as partial replacement of cement in concrete

S.No.	% Zeolite powder	Upv for 28 days	Quality of concrete
1	0	4115	Good
2	5	4385	Good
3	10	4509	Excellent
4	15	4632	Excellent
5	20	4467	Good
6	25	4281	Good
7	30	4102	Good

Table 8: Ultra sonic pulse velocity of concrete with crimped steel fiber concrete

S.No.	% Crimped steel fibre	Upv for 28 days	Quality of concrete
1	0	4115	Good
2	1	4485	Good
3	2	4512	Excellent
4	3	4785	Excellent
5	4	4636	Good

Table 9: Combined Ultra sonic pulse velocity of concrete with Zeolite powder and Crimped steel fibers

S.No.	ZP +CSF	Upv for 28 days	Quality of concrete
1	0	4115	Good
2	15%ZP+3%CSF	5043	Excellent

5. CONCLUSION:

1. The Normal Concrete Compressive strength result for 28,56 and 90 days is 40.06 N/mm^2, 43.32 N/mm^2 and 46.55N/mm^2.
2. At 15% replacement of cement by zeolite powder the achieved compressive strength of concrete is for 28, 56 and 90days 50.67 N/mm^2, 55.12N/mm^2 58.93N/mm^2.
3. At 3% crimped steel fibre concrete the achieved compressive strength of concrete is for 28, 56 and 90days 42.73 N/mm^2,46.21 N/mm^2 ,49.74 N/mm^2.
4. Combined replacement of compressive strength of concrete with 15% of zeolite powder and 3% of crimped steel fibre at 28,56 and 90 days are 51.64 N/mm^2, 55.85 N/mm^2 and 60.02 N/mm^2.

5. The Normal Concrete Split tensile strength result for 28,56 and 90 days are 3.95 N/mm^2, 4.27 N/mm^2 and 4.59N/mm^2.
6. At 15% replacement of cement by zeolite powder the achieved Split tensile strength of concrete for 28,56 and 90 days are 5.05N/mm^2, 5.46 N/mm^2 and 5.86 N/mm^2.
7. At 3% crimped steel fibre concrete the achieved compressive strength of concrete is for 28,56 and 90 days 4.26 N/mm^2, 4.61 N/mm^2 and 4.95 N/mm^2.
8. Combined replacement of compressive strength of concrete with 15% of zeolite powder and 3% of crimped steel fibre at 28,56 and 90 days are 5.22 N/mm^2, 5.64 N/mm^2 and 6.06 N/mm^2.
9. The Normal Concrete upv strength result is for 28 days is 4115m/s.
10. At 15% replacement of cement by zeolite powder the upv strength result is for 28 days is 4632m/s.
11. At 3% crimped steel fibre concrete the upv strength result is for 28 days is 4785m/s.
12. Combined replacement of 15% of zeolite powder and 3% of crimped steel fibre the upv strength result is for 28 days is 5043m/s.

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