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PARTIAL REPLACEMENT OF CEMENT WITH CENOSPHERE AS POZZOLANIC MATERIALS IN CONCRETE

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Abstract - *In an effort to understand the potential for practical use of the Cenosphere as a fine aggregate in concrete, the moisture uptake and loss by Cenosphere and water uptake and loss in Cenosphere concrete composites have been studied. With the reference of various literature that the performance and characteristic of Cenosphere with the replacement of cement are surveyed. Initially tests were carried out on the mix with Cenosphere as replacement at various percentages such as (0%, 5%, 10%, and 15%) by mass of cement. Various tests are conducted to find the property of the Cenosphere concrete materials. The main test such as Compressive Strength for Concrete Split Tensile Strength for Concrete and Flextural Strength of concrete have been conducted. On comparing the results of Cenosphere Concrete with that of conventional concrete, 5% additionally adding of Cenosphere showed maximum compressive Strength value at 28 days 16.5%, and the Split Tensile Strength value at 28 days 5.07%.*

Key Words: **Cenosphere, Replacement of Cenosphere, Compressive Strength, Split Tensile Strength, Flextural Strength.**

1. INTRODUCTION

Nowadays, concrete made with Portland cement is probably the most widely used man made material in the world. Large quantities of waste materials and by products are generated from manufacturing process, service industries, thermal power plants and municipal solid wastes etc. Large quantities of waste materials and by-products are generated from manufacturing processes, service industries and municipal solid wastes, etc. As a result, solid waste management has become one of the major environmental concerns in the world. With the increasing awareness about the environmental, scarcity of land-fill space and due to its ever increasing cost, waste materials and by-products utilization has become an attractive alternative to disposal. High consumption of natural sources, high amount production of industrial wastes and environmental pollution require obtaining new solutions for a sustainable development. During recent years there has been a growing emphasis on the utilization of waste materials and by-products in construction materials.

2. MATERIAL USED

2.1 Cement

The cement used for this study is Ordinary Portland Cement 53 grade as per IS 12269 – 1987.

2.2 Sand

The fine aggregate was used clean dry river sand conforming to IS 383:1970. The sand was sieved to remove pebbles. The total fines content of the mix is the function of both the binder and filler content and the fine aggregate content with the grading of fine aggregate being particularly important. The grading of fine aggregate in the mortar should be important such that both workability and stability are simultaneously maintained.

2.3 Coarse Aggregate

The aggregate which are retained on the 4.75mm IS Sieve, it's known as the Coarse aggregate. The properties of coarse aggregate decide the strength of the concrete. Therefore, the aggregate should be free from the minerals and chemical impurities. Crushed granite aggregate with specific gravity of 2.80 and passing the selection of coarse aggregate contains many properties are to be considered.

2.4 Fly ash Cenosphere

Depending on the composition of coal the composition of fly ash varies. Therefore, to be used in specific applications material specifications have been developed for this waste material. The particular shows that these waste particles are made for the most part of silicon dioxide, aluminum oxide and iron oxide. Different types of structures are observed in the particles in fly ash. A few particles in fly ash are strong.

2.5 Water (W)

According to IS 3025, water to be used for mixing and curing should be free from injurious or deleterious materials. Potable water is generally considered satisfactory. In the present investigation, available water

within the campus is used for both mixing and curing purposes.

3. PROPERTIES OF MATERIAL

Table -1: Properties of Cement

S.No.	Property	Result
1.	Standard Consistency Test	32%
2.	Specific Gravity	3.11
3.	Initial setting time	43 min
4.	Final setting time	390 min

Table -2: Properties of fine aggregate

S.No.	Property	Result
1.	Fineness Modulus	2.56
2.	Specific gravity	2.65
3.	Bulk density (kg/m^3)	1716.52
4.	Sieve Analysis	Conforming to zone III

Table -3: Properties of Coarse aggregate

S.NO.	Property	Value
1.	Specific gravity	2.80
2.	Water absorption	1.5%
3.	Fineness modulus	7.08

Table -4: Properties of Cenosphere

S.NO.	Property	Result
1.	Specific gravity	2.83
2.	Initial setting time	45 minutes
3.	Final setting time	10 hours
4.	Fineness modulus	8%

4. RESULTS AND DISCUSSIONS

4.1 Compressive Strength test of cube

To determine compressive strength of concrete at the age of 7 days 14 days and 28 days. Cubes of size 150mm x 150mm x 150mm were casted. The specimens were casted for different proportions (5, 10, and 15%) of Cenosphere by replacing cement by weight in mortar cube.

Table-5: Compressive Strength of concrete specimens

Cenosphere replacement in %	Compressive Strength @ 7 days in N/mm^2	Compressive Strength @ 14 days in N/mm^2	Compressive Strength @ 28days in N/mm^2
0%	9.001	15.61	19.68
5%	8.951	14.32	19.90
10%	8.742	13.23	18.12
15%	7.406	12.82	17.08

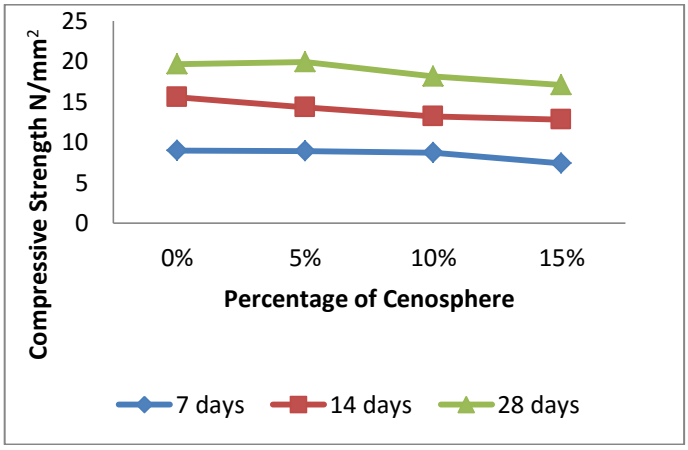

Chart -1: Compressive Strength

On comparing the results obtained from compression test, it is shown that maximum results are obtained from 5% replacement of Cenosphere in cement.

5% replacement of Cenosphere shows 1.12%, 9.82% and 16.5% higher compressive strength than 0% (conventional concrete), 10% and 15% replacement of Cenosphere for 28 days curing.

When compared to conventional concrete, 10% and 15% replacement of Cenosphere shows 8.61% and 15.22 % lesser compressive strength for 28 days curing.

4.2 Split Tensile Strength test

However, tensile strength of concrete is very low compared to its Compressive strength. The Split tensile strength test is used to determine the tensile strength of specimen For the determination of split tensile strength of the Cenosphere mass concrete specimens, cylinder specimens of diameter to length ratio1:2 was selected, with diameter as 150 mm and the length as 300 mm.

Table -5: Split Tensile Strength of concrete specimens

Cenosphere Percentage	Split Tensile Strength of Concrete (fck) N/mm²		
	7th day	14th day	28th day
0%	1.78	2.15	2.39
5%	1.83	2.17	2.45
10%	2.74	2.98	3.11
15%	2.23	2.56	2.96

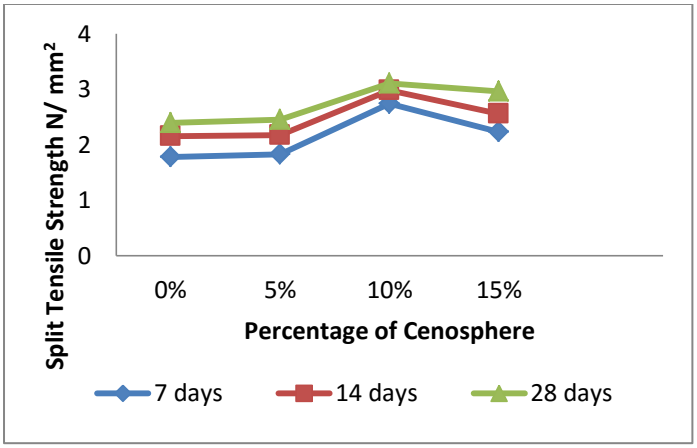

Chart -2: Split Tensile Strength

In split tensile strength test, maximum results were obtained on 10% replacement of Cenosphere. It is 30.12% higher than the conventional concrete; 26.94% and 5.07% higher than that of 5% and 15% replacement for 28 days curing.

4.3Flextural Strength test

The beam specimen size of 100x100x500 were casted to determine the Flextural strength of concrete with various percentages of Cenosphere. Specimens were dried in open air after 28 days at curing and it is subjected to Flextural strength test. Apply the load at a rate that constantly increases the maximum stress until rupture occurs. Finally the Flextural strength is calculated by using simple bending equation the bending stress.

Table-5: Split Tensile Strength of concrete specimens

Cenosphere Percentage	Flextural Strength of Concrete N/mm²		
	7 days	14 days	28 days
0%	2.9	4.1	5.5
5%	3.4	4.5	5.7
10%	3.5	4.8	6.2
15%	3.8	5.2	6.9

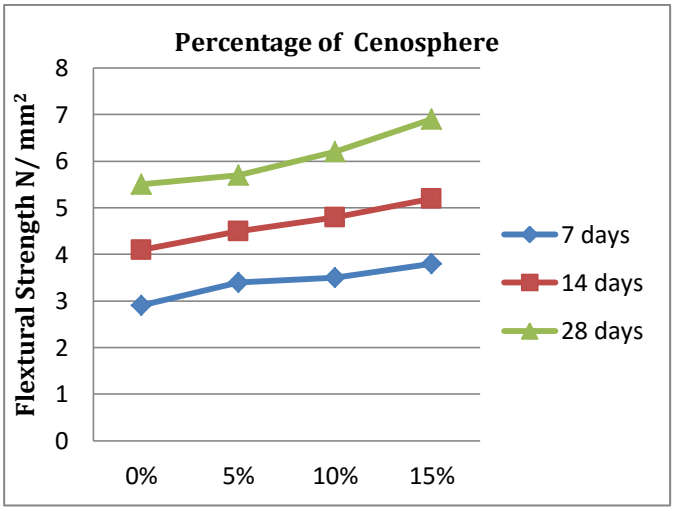

Chart -3: Flextural Strength

In Flextural strength test, maximum results were obtained on 10% replacement of Cenosphere. It is 12.72% higher than the conventional concrete; 3.67% and 25.45% higher than that of 5% and 15% replacement for 28 days curing.

5. CONCLUSIONS

Included the introduction of Cenosphere properties are discussed. Literature reviews are collected based on research for Cenosphere effect on concrete. Methodologies of the project were discussed and also material properties are derived.

Various tests are conducted to find the property of the concrete materials. The main tests such as compression strength for cube, split tensile strength for cylinder and Flextural strength test have been conducted.

On comparing the results obtained from compression test, it is shown that maximum results are obtained from 5% replacement of Cenosphere in cement.

5% replacement of Cenosphere shows 1.12%, 9.82% and 16.5% higher compressive strength than 0% (conventional concrete), 10% and 15% replacement of Cenosphere for 28 days curing.

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