An Experimental Investigation on Properties of Concrete by Partial Replacement of Cement with Dolomite and Fine Aggregate with Crushed Sea Shell Powder

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Abstract : In this study a small trail is done to modify the properties of concrete by partial replacement of cement with dolomite powder varying from 0% to 25% with interval of 5% and fine aggregate with crushed sea shell powder is varied different percentages of 50%, 60%, 70%, 80% and 90%. Tests are conducted to determine the mechanical (compressive and tensile strength tests) of concrete at 7 and 28 days. The maximum strength is obtained for 80% replacement of sea shell and 15% of dolomite powder.

IndexTerms **- Crushed sea shell, Compressive strength, Dolomite powder and Split tensile strength.**

I. INTRODUCTION

Concrete is the most durable and reliable construction material around the world and it is the important basic material in all civil engineering structures. The ingredients of concrete are cement, fine aggregate, coarse aggregate and water. The cement and water form a paste which coats the sand aggregate. Concrete is the most generally utilized substance after water and more than six billion tons of cement is created every year. Aggregate is the most important constituent material in concrete. They are providing the concrete to the body, reducing shrinkage and economic effects. In my project a partial replacement is taking to reduce the usage of cement with dolomite powder and fine aggregate with crushed sea shell to get the strength. By replacing the ingredients, the strength will be increased at 15% of dolomite and 80% of crushed sea shell.

1.1 Dolomite: Dolomite is an anhydrous carbonate mineral composed of calcium magnesium carbonate ($CaMg(co_3)_2$). The term is also used for the sedimentary carbonate rock composed mostly of the mineral dolomite. An alternative name for dolomite is dolostone as a dolomitic rock.

1.2 Crushed sea shell: A sea shell is also known simply a shell. It is usually created by an animal that lives in the sea. The shell is part of the body of the animal. Empty seashells are often found in the beach. Basically sea shells having 95% of calcium carbonate.

II. LITERATURE REVIEW

- **Preethi, Prince Arulraj, Effect of Replacement of Cement with Dolomite Powder on the Mechanical Properties of Concrete Vol:2, Issue 4, April 2015,** Dolomite is a carbonate material composed of calcium magnesium carbonate $CaMg(CO_3)_2$. Dolomite is a preferred for construction material due to its higher surface hardness and density. An attempt has been made to explore the possibility of using dolomite as a replacement material for cement. M20 grade concrete specimens were made by replacing 5, 10, 15, 20 and 25% of cement with dolomite powder. The compressive, split tensile and flexural strength of the specimens were found on the 7and 28days. Optimal replacement percentage of dolomite was determined.
- **Monita Oliviaa, Annisa Arifandita Mifshellaa, Lita Darmayantia, Mechanical properties of seashell concrete,125(2015)760-764,** Shell is a type of marine by-product that can be used to replace aggregate or cement partially in concrete. In this research, the seashell was used as a partial cement replacement. The ground seashells were prepared by burning, crushing, grinding and filtering the powder using 160-micron sieve. Based on the trial mixes using the ground seashell with proportion of 2, 4, 6 and 8% by weight of cement, The properties like compressive strength, splitting tensile strength, flexural strength and modulus of elasticity of seashell concrete are determined.

III. OBJECTIVES

The objectives of this study as follows,

a) To optimize the cement with dolomite.
b) To optimize the fine aggregate with crushed sea shell.
c) To evaluate the compressive and split tensile strength tests.

IV. MATERIALS

a. Cement: cement is mainly used as a binder material in concrete which is used for construction that sets, hardens to other materials bind together. OPC (ordinary Portland cement) of 53 grade is used in construction purpose and its properties presented in table 1.

Table 1. Physical Properties of OPC

S.No	Description of item	Values
1	Specific gravity	3.14
2	Fineness of cement	10%
3	Water absorption	3%
4	Bulk density	1440kg/m^3

b. Fine aggregate: Fine aggregate is the essential ingredient in concrete that consists of natural sand or crushed stone. The quality of **fine aggregate density** strongly influences the hardened properties of the concrete.

Table 2. Physical properties of fine aggregate

S.No	Description of item	Values
1	Specific gravity	2.65
2	Fineness of fine aggregate	6.5%
3	Water absorption	1.5%
4	Bulk density	1350kg/m^3

c. Coarse aggregate: The aggregate which is retained over IS Sieve 4.75 mm is termed as coarse aggregate. The normal maximum size is gradually 10-20 mm as per IS 383:1970.

Table 3. Physical properties of coarse aggregate

S.No	Description of item	Values
1	Specific gravity	2.6
2	Fineness of fine aggregate	6.5%
3	Water absorption	5.5%
4	Bulk density	1550kg/m^3

d. Dolomite: Dolomite is obtained from industry (M/s. Phanindra PVT limited). The physical properties of colour and specific gravity are white and 2.85 respectively.

e. Sea shell: seashells is utilizing as construction materials in concrete. The seashells were utilized as partial or total replacement of fine and coarse aggregates in concrete. This paper is a literature review of seashell aggregate concrete. The physical properties of colour and specific gravity are white and 2.27.

f. Water: Water is one of the most important elements in construction and is required for the preparation of mortar, mixing of cement concrete and for curing work etc. The quality of water used has a direct impact on the strength of the motor and cement concrete in the construction work. PH value of water is 6 to 8.

V. RESULTS AND DISCUSSIONS

a. Compressive strength test: The cube specimens of 150mm x 150mm x150mm were cast and tested in compression testing machine for 7 and 28days of curing period for different proportions of concrete mix and presented in table 2.

Table 2: Compressive strength of concrete with dolomite as partial replacement of cement in concrete

S.No.	% of Dolomite	Compressive Strength, N/mm^2	
		7 Days	28 Days
1	0	35.76	51.76
2	5	37.54	53.94
3	10	38.54	56.19
4	15	42.26	59.28
5	20	38.94	56.77
6	25	37.57	53.99

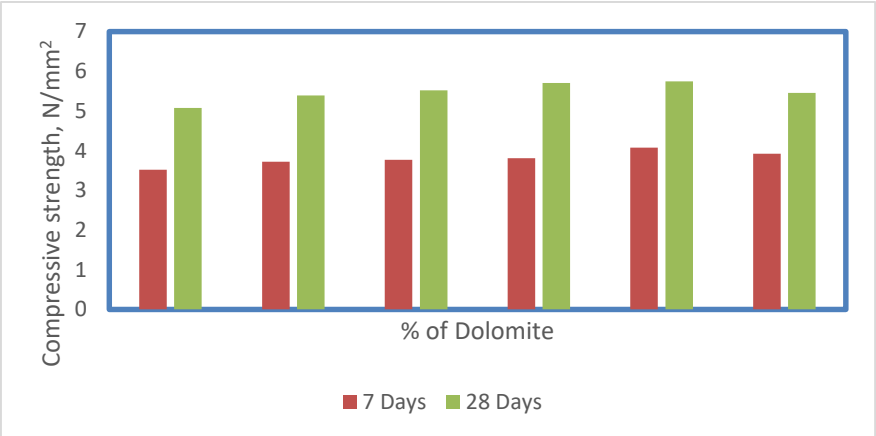

Figure 1: Compressive strength of dolomite

Table 3: Compressive strength of concrete with crushed seashell as partial replacement of fine aggregate in concrete

S.No.	% of Crushed sea shell	Compressive Strength, N/mm^2	
		7 Days	28 Days
1	0	35.76	51.76
2	50	38.69	56.24
3	60	39.63	56.94
4	70	41.16	57.74
5	80	42.07	58.03
6	90	39.56	56.85

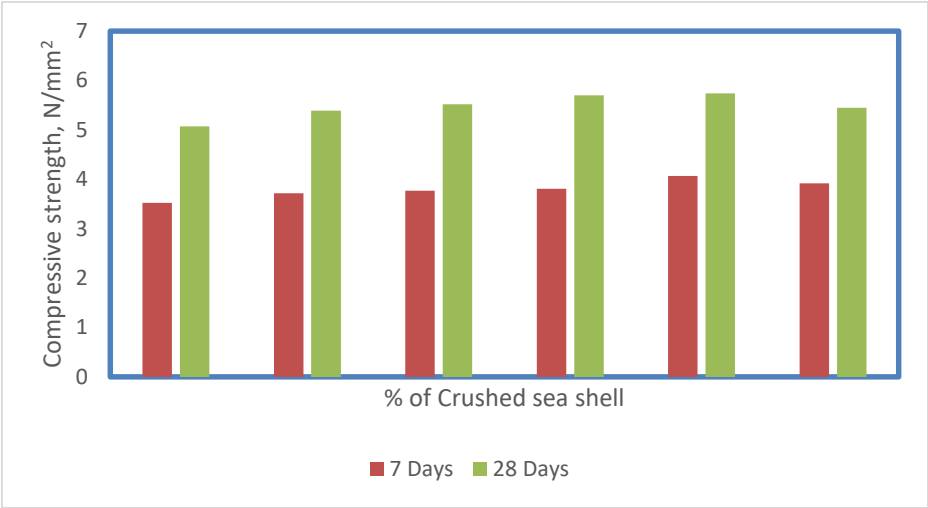

Figure 2: Compressive strength of crushed sea shell

b. Split tensile strength test: At the age of 7 and 28days, the cylindrical specimens (150mm diameter x 300mm height) were tested for evaluating the split tensile strength. The experiment is performed by putting a cylindrical sample horizontally between a compression testing machines loading surface and the load is applied until the cylinder fails along the vertical diameter.

Table 4: Split tensile strength of dolomite as partial replacement of cement in concrete

S. No	% of Dolomite	Split tensile strength, N/mm^2	
		7 Days	28 Days
1	0	3.52	5.07
2	5	3.64	5.28
3	10	3.72	5.45
4	15	3.87	5.63
5	20	3.6	5.10
6	25	3.49	4.85

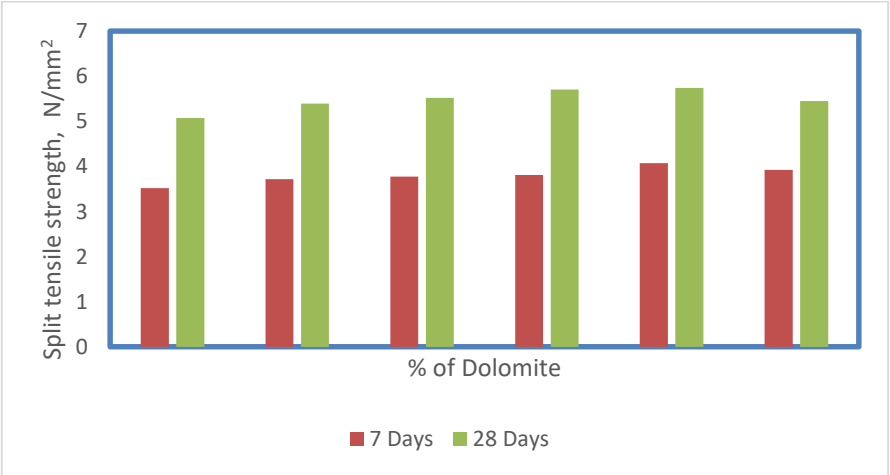

Figure 3: Split tensile strength of dolomite

Table 5: Split tensile strength of crushed sea shell as partial of fine aggregate in concrete

S. No	% of Crushed sea shell	Split tensile strength, N/mm^2	
		7 Days	28 Days
1	0	3.52	5.07
2	50	3.72	5.39
3	60	3.77	5.52
4	70	3.81	5.70
5	80	4.07	5.74
6	90	3.92	5.45

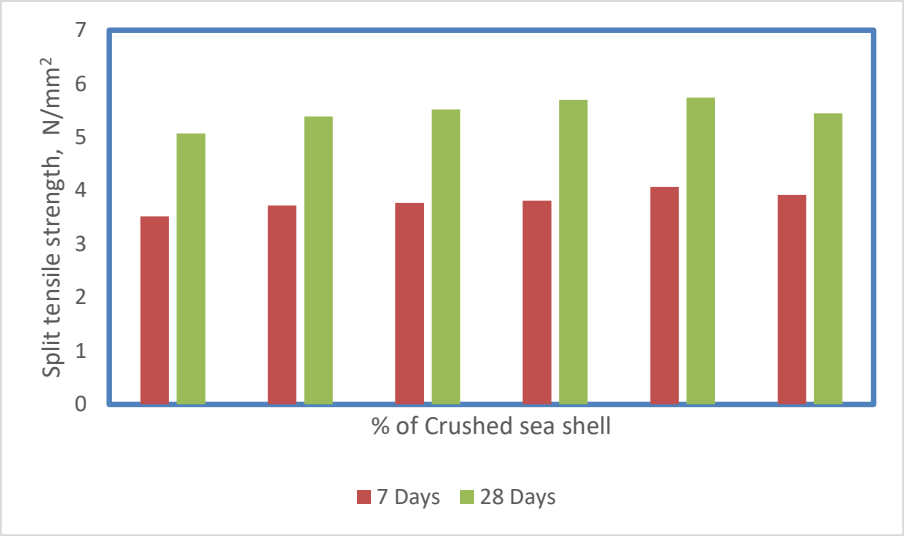

Figure 4: Split tensile strength of crushed sea shell

Table 6: Compressive strength of Concrete with crushed sea shell and dolomite

Sl.NO	Description	Compressive Strength, N/mm^2	
		7 days	28days
1	Normal concrete	35.76	51.76
2	80% Crushed sea shell+15% Dolomite	63.24	87.67

Table 7: Split tensile strength of 15% dolomite and 80% crushed sea shell as partial replacement of fine aggregate in concrete

Sl.NO	Description	Split tensile strength, N/mm^2	
		7 days	28days
1	Normal concrete	3.52	5.07
2	80% Crushed sea shell+15% Dolomite	5.91	8.50

VI. CONCLUSION

In this study, the concrete ingredients like cement and fine aggregate are partially replaced by Dolomite powder and Crushed sea shells respectively. Crushed sea shells are varied different percentages of 0, 50,60,70,80,90% and dolomite powder is varied with different percentages like 0,5, 10, 15, 20 and 25%.

1. At 15% replacement of cement by dolomite the achieved compressive strength of concrete is 42.26N/mm^2 for 7days.
2. At 15% replacement of cement by dolomite the achieved compressive strength of concrete is 59.28N/mm^2 for 28days.
3. At 80% replacement of fine aggregate by crushed sea shells the achieved compressive strength of concreteis 42.07N/mm^2 for 7days.
4. At 80% replacement of fine aggregate by crushed seashell the achieved compressive strength of concreteis 58.03N/mm^2 for 28days.
5. At 15% replacement of cement by dolomite the achieved split tensile strength of concrete is 3.87N/mm^2 for 7days.
6. At 15% replacement of cement by dolomite the achieved split tensile strength of concrete is 5.63N/mm^2 for 28days.
7. At 80% replacement of fine aggregate by crushed sea shells the achieved split tensile strength of concreteis 4.07N/mm^2 for 7days.
8. At 80% replacement of fine aggregate by crushed seashell the achieved split tensile strength of concreteis 5.74N/mm^2 for 28days.
9. The percentage increase of compressive strength of concrete with 15% of dolomite and 80% of crushed sea shell at 7 and 28 days are 76.84 and 69.37 N/mm^2.
10. The percentage increase of split tensile strength of concrete with 15% of dolomite and 80% of crushed sea shell at 7 and 28 days are 67.90 and 67.65 N/mm^2.

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