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Effect of the usage of calcite powder and diatomite powder as partial replacement with cement on the compression and split tensile strength of concrete

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Abstract — Diatomite powder continent amorphous silica and pozzolanic material. Calcite powder is natural form of calcium carbonate. This paper described the procedure and result of a laboratory investigation of mechanical properties carried out on concrete specimen containing diatomite powder and calcite powder as partial replacement of cement in concrete. Preparation of concrete specimens with diatomite powder and calcite powder with different ratio by volume as replacement with cement. Find the best compressive strength and split tensile strength from the replacement of cement with diatomite powder and calcite powder separately and together. Test result indicate that the concrete specimens containing 10% diatomite powder and 10% calcite powder replacement by volume with cement separately and together improve the compression and split tensile strength of the conventional concrete mixture.

Keywords- *calcite powder, diatomite powder, compressive strength, split-tensile strength*

I. INTRODUCTION

The most importance properties of concrete are compressive and flexural strength. The mechanical properties of concrete can be improved with alternative material used for partial replacement of Portland cement in concrete. This material is more common due to some technical, economic and environmental reasons. One of this material is diatomaceous rocks. Diatomite is sedimentary rock of biogenic origin with high natural amorphous silica content. The amorphous silica is mainly in the form of diatom frustules, and secondarily in the form of sponge spicules, silicone-flagellate skeletons and radiolarian cells. This type of SiO2 can react with Ca(OH)2 and produce calcium silicate hydrates (C-S-H), which are responsible for the development of strength. Diatomite rocks commonly contain carbonate and clay minerals, quartz, feldspars and volcanic glass.it can be used as pozzolanic material for partial replacement of cement in production of concrete. [1][5]

Calcite powder is rock forming mineral with chemical formula with CaCO3. Calcite powder is natural form of calcium carbonate with extremely high witness, purity and free flowing in nature. Calcite powder is widely used in plastic as filler, due to its high dispensability, low oil absorption, high impact resistance, smooth surface finish, easy processing and excellent dimensional stability. These materials are easily mixed, transported, and placed in the form of a slurry that will harden into a durable construction material. The properties of calcite make it one of the most widely used minerals. It is used as a construction material Calcite powder is mainly containing calcium carbonate. Mineralogical changes as functions of cement composition and amount of added calcite. Calculations of the specific volume of solids as a function of calcite addition suggest that the space-filling ability of the paste. [2][5]

II. MATERIALS

2.1 Calcite powder

In the present experimental work, Calcite powder is rock forming mineral, 25-micron size obtained from palanpur. The chemical compositions of calcite powder are showing in table 1.

2.2 Diatomite powder

Diatomite refers to the light-colored sedimentary rock that is composed of the remains of one-celled algae known as diatoms. Diatomite is highly siliceous, has a low specific gravity, and is very porous. The diatomite powder is taken size of 325 mesh size. Diatomite is sedimentary rock of biogenic origin with high natural amorphous silica content. The amorphous silica is mainly in the form of diatom frustules, and secondarily in the form of sponge spicules, silicone-flagellate skeletons and radiolarian cells. the chemical composition of diatomite powders showing in Table 2.

2.3 Aggregates

Generally, locally available coarse aggregate with combination of 20mm (70%) and 10mm (30%) are used in the present work. Also, natural available river sand of Zone II is used as a fine aggregate.

Table -1: Chemical composition of calcite power

S. NO.	Particulars	Units	Results
1	Calcium carbonate as CaO	%	53.48
2	Magnesium oxide as MgO	%	01.02
3	Aluminum oxide as Al2O3	%	00.04
4	Ferric Oxide as Fe2O3	%	00.28
5	Calcium Carbonate as CaCO3	%	95.50
6	Magnesium Carbonate as MgO3	%	02.55
7	Silicon Di-Oxide As SiO2	%	02.30
8	Loss of Ignition	%	43.52

Table -2: Chemical composition of diatomite powder

S.NO.	Particulars	Units	Results
1	SiO2	%	90 %
2	Al2O3	%	6 %
3	TiO2	%	3%
4	Fe2O3	%	1%
5	K2OMn2O	%	Traces
6	Combined Moisture	%	5%

III. METHEDOLOGY

The laboratory work has been carried out to investigate maximum compressive and split tensile strength of concrete by usage of calcite powder and diatomite powder as partial replacement with cement. Taking different ratio of 0 to 10% of calcite powder and diatomite powder as partial replacement with cement. The mix design of concrete is showing in Table3.

Table 3 Mix design

	M 25 grade of concrete for 1 m3					
NO.	Cement (kg)	Calcite powder (%)	Diatomite powder(kg)	Fine Aggregate(kg)	Coarse Aggregate(kg)	Water (kg)
M1	425	0	0	701.76	1145	192
M2	401	18.76	0	701.76	1145	192
M3	401	0	16.75	701.76	1145	192
M4	379.89	18.76	16.75	701.76	1145	192
M5	379.89	37.52	0	701.76	1145	192
M6	379.89	0	33.5	701.76	1145	192
M7	358.78	18.76	33.5	701.76	1145	192
M8	358.78	37.52	16.75	701.76	1145	192
M9	337.65	37.52	33.5	701.76	1145	192

IV. EXPERIMENTAL STUDY AND TEST RESULT

For compressive strength test, cube specimens of dimensions 150mm x 150mm x150 mm were casted, then cubes are putted in curing for 7days,14days and 28 days and after unmolding. The cubes are tested for compressive strength on compressive testing machine after 7day, 14day and 28day. For split tensile test, cylinder specimens of dimeter and height 150mm x 300 mm are casted, then cylinder are putted in curing for 7days,14days and 28 days and after unmolding. The cylinder is tested for split tensile strength after 28day.

Table 4 Test result

	Compressive strength (N/mm^2)			Split tensile strength (N/mm^2)
	7 Days	14 Days	28 Days	28 Days
M30	25.35	29.03	37.09	3.8
C5D0	25.97	31.48	38.30	4.1
C0D5	26.56	32.50	39.51	3.7
C5D5	26.32	33.94	40.28	3.9
C10D0	26.70	33.81	40.33	4.3
C0D10	28.47	35.68	44.25	4.1
C5D10	26.46	32.04	39.14	3.8
C10D5	26.88	31.16	38.70	4.0
C10D10	27.80	34.93	43.68	4.4

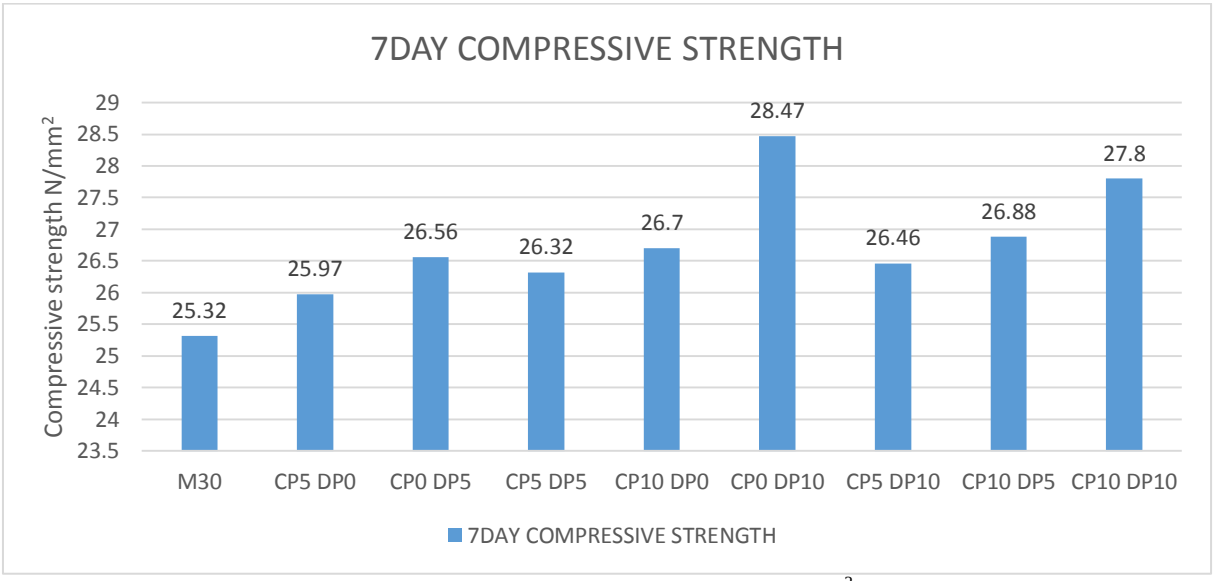

Chart -1: 7 Day compressive strength (N/mm^2)

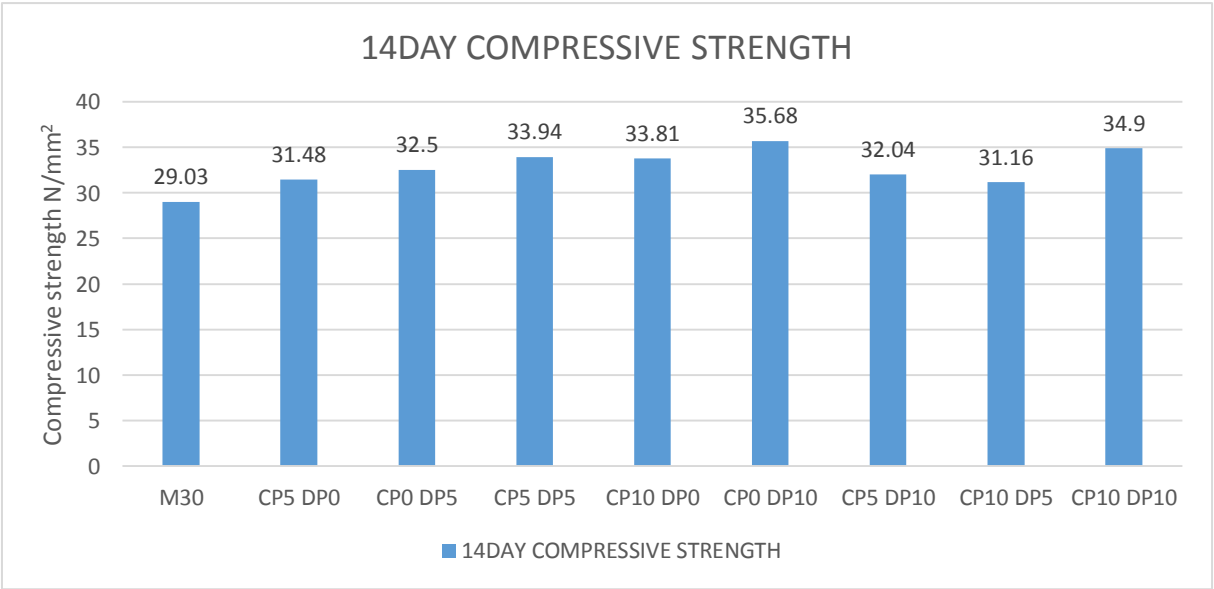

Chart -2: 14 Day compressive strength (N/mm^2)

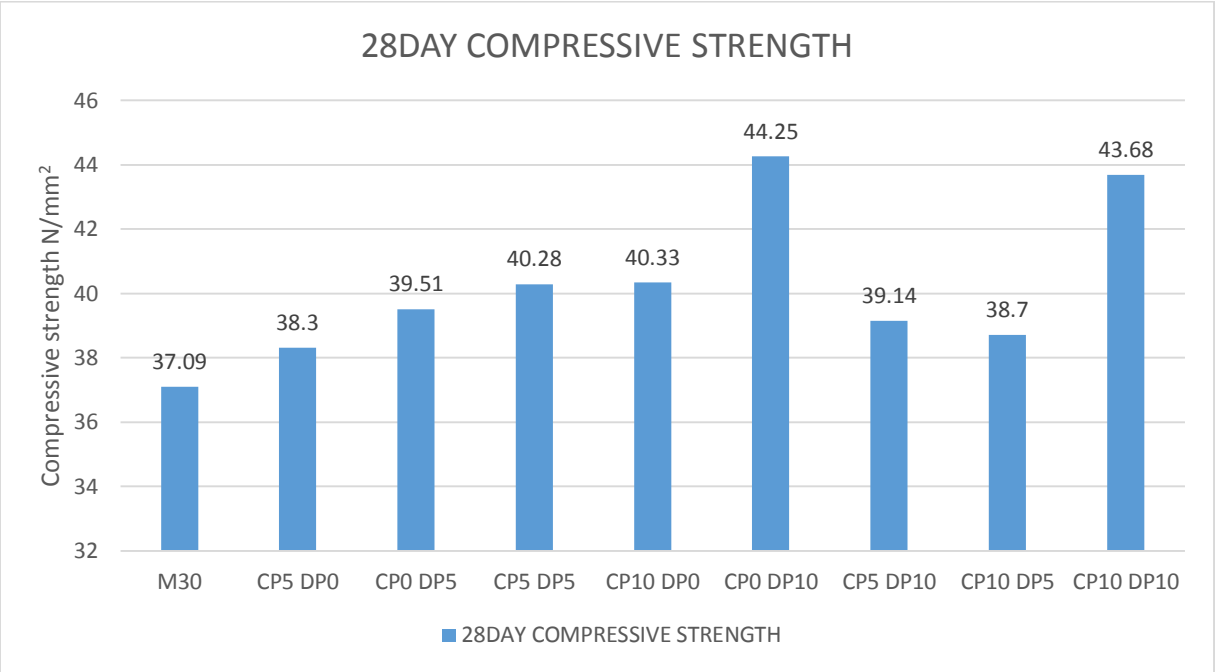

Chart -3: 28 Day compressive strength (N/mm^2)

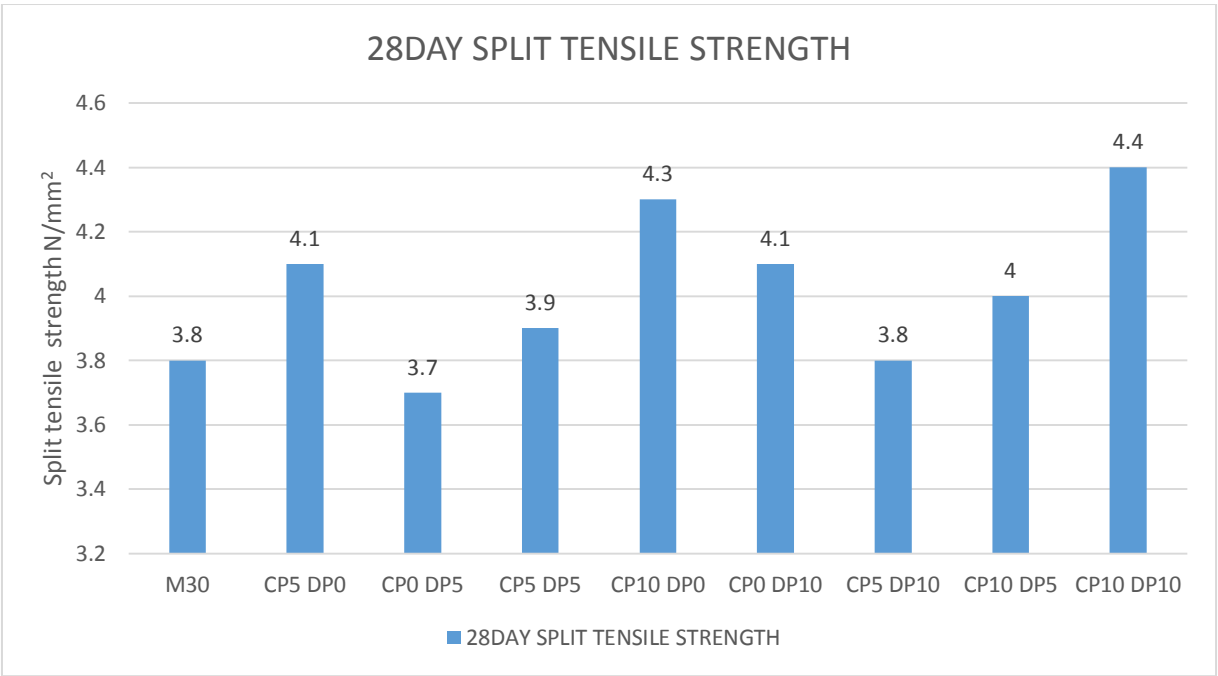

Chart -4: Split tensile strength (N/mm^2)

IV. CONCLUSION

The replacement of calcite powder and diatomite powder with cement give improvement in compression strength and split tensile strength. Here I show some results for compressive strength and split tensile strength. With 10% diatomite powder replace with cement give maximum compressive strength 44.25 N/mm^2 and 10% calcite powder and 10% diatomite powder replace with cement give maximum split tensile strength 4.4 N/mm^2. C10D10 mix proportion are given maximum result for compressive and split tensile strength.

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