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EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF DUNITE AS CEMENT

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Abstract - *Advance concrete technology can reduce the consumption of natural Concrete is widely used construction material in civil engineering structures due its high compressive strength. When concrete is exposed to elevated temperatures, its loose density, stiffness and strength. This paper tells about the dunite is used as a cement with various percentages. It is found that the concrete gains strength by adding up to 40% of dunite as a replacement in cement when compared to normal concrete. When compared to the cost of cement, the dunite powder is considered as economical by the analysis as per records of the rate of cement periodically. The replacement of dunite powder as cement will be dominant in future. It enhances durability, compressive strength and tensile strength among all other material.*

Key Words*: *Dunite, Compressive strength, Eco-friendly

1.INTRODUCTION

1.1 INFLUENCE OF DUNITE AS PARTIAL REPLACEMENT OF CEMENT IN CONCRETE

The advance of concrete technology can mnimize the consumption of natural resources and lessen the burden of pollutants on environment. Presently large amounts of dunite powder are generated in natural stone processing plants with an important impact on environment and humans. This project describes the feasibility of using the dunite powder in concrete production as partial replacement of cement. The various properties of fresh and hardened concrete have been investigated. The partial replacement of dunite (industrial bi product) results show that, it is capable of improving hardened concrete performance and Enhancing fresh concrete behaviour so it can be used in concrete mixtures containing white cement. The compressive strength and tensile strength of concrete was measured for 7, 14 and 28 days.

1.2 DUNITE vs CEMENT

Dunite is an igneous rock, of ultramafic composition, with coarse-grained or phaneritic texture, peridotite group of rocks. The dunite contains 90% olivine, remaining percentage with minor amounts of other minerals such as pyroxene, chromite, magnetite, and pyrope.

Figure 1.1 Dunite powder

2.TESTING ON PHYSICAL PROPERTIES OF MATERIALS

2.1 INITIAL SETTING TIME=48 minutes

Figure 1.2 Initial Setting Time

2.2 FINENESS MODULUS = 6%

2.3 SPECIFIC GRAVITY OF CEMENT (LE-CHATLIER FLASK)

Weight of cement used = 60 gm
Initial reading on flask = 0 ml
Final reading on flask = 23 ml
Specific gravity of cement = 2.608Properties

2.4 SPECIFIC GRAVITY OF FINE AGGREGATE

Table1.1 SPECIFIC GRAVITY OF FINE AGGREGATE

SL NO	DETERMINATION	gm	Gm
1	Pycnometer(M1)	458.10	451
2	Pycnometer+sand(half \Of bottle)(M2)	676	697
3	Pycnometer+sand+full Of water(M3)	1390	1405
4	Pycnometer+full of water(M4)	1253	1258

CALCULATIONS

Specific gravity = [(M2-M1)]/[(M2-M1) -(M3-M4)]
a). (676-458.10)/ [(676-458.10) -(1390-1253)]=2.693
b). (697-451)/ [(697-451) -(1405-1258)] = 2.49
specific gravity of fine aggregate = 2.59

2.5 SPECIFIC GRAVITY OF COARSE AGGREGATE

Table1.2 SPECIFIC GRAVITY OF COARSE AGGREGATE

SL NO	DETERMINATION	gm	Gm
1	Pycnometer(M1)	458	463
2	Pycnometer+aggregate (M2)	706	666
3	Pycnometer+aggregate +water(M3)	1405	1385
4	Pycnometer+water(M4)	1258	1253

CALCULATIONS

Specific gravity = (M2-M1)/[(M2-M1) -(M3-M4)]
(a) (706-458)/ [(706-458) -(1405-1258)] = 2.45
(b) (666-463) / [(706-458) -(1405-1258)] = 2.859
Mean of these = 2.66
Therefore, specific gravity of coarse aggregate = 2.66

2.6 SIEVE ANALYSIS FOR SAND

Quantity of Sand= 1kg
Time of sieving=15 minutes

Table1.3 SIEVE ANALYSIS FOR SAND

SL.NO	SIEVESIZE	WEIGHT RETAINED	%OF WEIGHT RETAINED	CUMULATIVE % RETAINED	CUMULATIVE % PASSING
1	40mm	0	0	0	100
2	20mm	0	0	0	100
3	10mm	0	0	0	100
4	4.75	0	0	0	100
5	2.36	98	9.8	9.8	90.2
6	1.18	60	6	15.8	84.2
7	600 micron	188	18.8	34.6	65.4
8	300 Micron	397	39.7	74.3	25.7
9	150 Micron	221	22.1	96.4	3.6
10	90 micron	21.5	2.15	98.5	1.45
11	L.P	19.5	1.95	100	0

Fineness modulus = 329.4 / 100 = 3.29%

2.7 SIEVE ANALYSIS FOR COARSE AGGREGATE
Quantity of materials=4kg
Time of sieving=15 minutes

Table1.4 SIEVE ANALYSIS FOR SAND

Sl No	SIEVES IZE	WEIGHT RETAINED (gm)	% WEIGHT RETAINER	CUMULATIVE% WEIGHT RETAINED	CUMULATIVE %WEIGHT PASSING
1	40 mm	0	0	0	100
2	20 mm	585.0	14.625	14.65	85.375
3	10 mm	3260	81.5	96.12	3.88
4	4.75mm	155	3.875	100	0
5	2.40mm	0	0	100	0
6	1.18mm	0	0	100	0
7	600micron	0	0	100	0
8	300Micron	0	0	100	0
9	150Micron	0	0	100	0

3. MIX DESIGN

3.1 DESIGN STIPULATION

Table1.5 DESIGN STIPULATIONS

SNO	DESIGN STIPULATIONS	QUANTITY
1	Charecteristic compressive strength reuired in the field at 28 days	20N/mm^2
2	Maximum size of aggregates	20mm(angular)
3	Degree of Workability	0.90(compacting factor)
4	Degree of quality of control	Good
5	Type of exposure	Mild

3.2 TEST FOR DATA MATERIAL

Table1.6 TEST FOR DATA MATERIAL

S.NO	TEST DATA FOR MATERIAL	QUANTITY
1	Cement used	OPC
2	Specific gravity of cement	2.608
3	Specific gravity of fine aggregate	2.59
4	Specific gravity of coarse aggregate	2.66
5	Water absorption of fine aggregate	Nil
6	Water absorption of coarse aggregare	Nil
7	Free moisture of fine aggregate	Nil
8	Sieve analysis of fine aggregate	Grade 3

TARGET MEAN STRENGTH FOR MIX DESIGN

fck=fck+1.65s
fck=20+1.65×4.6 = 27.59N/mm2 as per IS;10262-2002Water cement ratio = 0.5
Water content = 186 kg/m3
Sand content = 35% (from table 4)
volume= 35 – 3.5 = 31.5 %
Required water content
= 186 + 5.58 =191.6 litre /m^3.

3.3 DETERMINATION OF CEMENT CONTENT

Water cement ratio = 0.50
Water = 191.63
Cement = 191.3/0.50 = 382.6kg/m^3

This cement content is adequate for mild exposure condition, according to Appendix A of IS; 456-1978.

3.4 DETERMINATION OF COARSE AGGREGATE AND FINE AGGREGATE

The specified maximum size of 20mm, the amount of air entrapped in the wet concrete is 2%. As per equations from 3.5.1 of IS; 10262 -2002.

Therefore,
For fine aggregate: 0.98 = [191.58 + (382.6/2.608)+(1/0.315) x (fa / 2.59)] x (1/1000)

fa = 523.2

For coarse aggregate: 0.98 = [191.58 + (382.6/2.608) + (1/ (1-0.315) x (Ca / 2.83)] x (1/1000)
Ca = 1136.2kg/m3

Then the mix proportions become

CEMENT : FINE AGGREGATE : COARSE AGGREGATE

382.6kg 523.2 1136.2kg **Or 1: 1.37 : 2.96**

3.5 PREPARATION OF TEST SPECIMEN

Concrete is mixed in roller type mixing machine. Care is taken to see that the concrete is properly placed beneath and along the sides of the mould with help of trowel and vibrating table. The following specimens are cast to study the properties of conventional and replaced dunite concrete.

18 Nos of cube of size 150*150*150mm 2 Nos per each mix and each percentage of artificial aggregate (20%,40%,60%).

18 Nos of cylinder of size 150*300mm 2 Nos per each mix and each percentage of artificial aggregate (20%,40%,60%).

4.EXPERIMENTAL WORK

4.1 TEST ON WORKABIITY
4.1.1 SLUMP CONE TEST

WORKABILITY

To determine the workability of fresh concrete slump cone test is followed. The required apparatus used for doing slump test.

Table1.7 Slump Cone Test

SAMPLE NO	%OF DUNITE POWDER ADDED	SLUMP IN mm
1	0	58
2	20	52
3	40	60
4	60	46

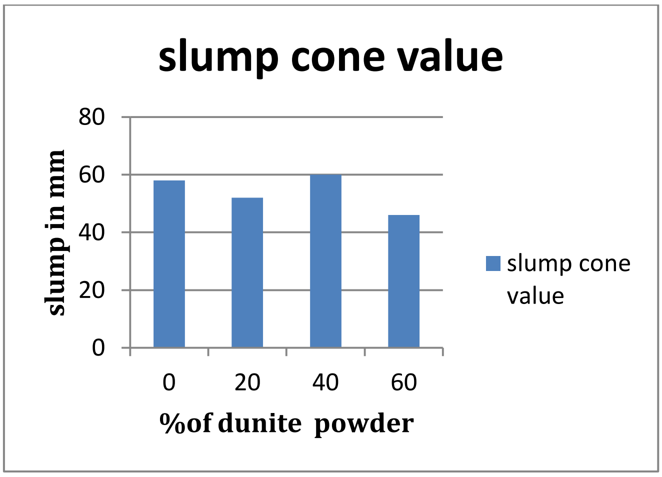

Figure 1.4 Slump Cone Test

Slump value in mm=60mm

4.1.2 COMPACTION FACTOR TEST

To determine the workability of fresh concrete compacting factor test is conducted, and required apparatus used is Compacting factor method.

Compacting factor = (Wt of partially compacted concrete)/(Wt of fully compacted concrete).

The compaction factor value = 0.80

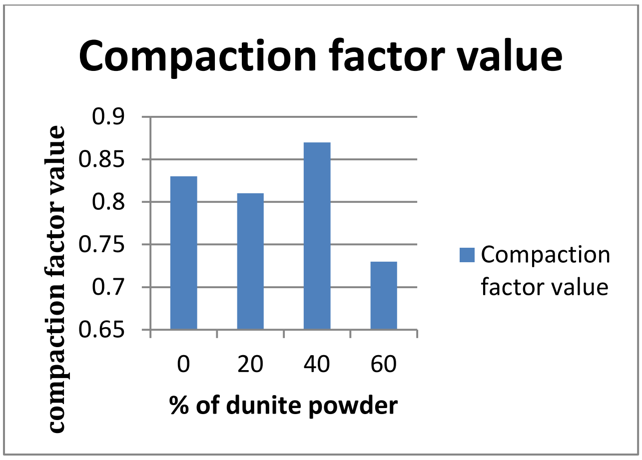

Figure 1.5 Compaction Factor Test

4.2 TESTING OF HARDENED CONCRETE

4.2.1 COMMPRESSIVE STRENGTH

For the determination of cube compression of the mortar specimens, cube of dimension of 15x15x15 cm and Specimens were dried in open air after 7,14 and 28days water curing and subjected to compression test as per standards and to that cube compressive strength (fcy) was computed from the fundamental principle. This test is shown in fig 1.5

Figure 1.6 Compression strength test for cube

4.2.1 COMMPRESSIVE STRENGTH-7DAYS

Table1.8 Compressive Strength 7Days

%	1	2	Average	Compressive Strength
0%	380	340	360	17.02
20%	355	405	380	17.88
40%	390	430	410	18.22
60%	275	325	300	16.33

4.2.2 COMPRESSIVE STRENGTH-14Days

Table1.9 Compressive Strength 14Days

%	1	2	Average	Compressive Strength(MPa)
0%	380	340	360	19.7
20%	355	405	380	20.51
40%	390	430	410	21.0
60%	275	325	300	19.0

4.2.3 COMPRESSIVE STRENGTH-28Days

Table1.10 Compressive Strength 28Days

%	1	2	Average	Compressive Strength(MPa)
0%	535	565	550	23.3
20%	580	620	600	23.9
40%	675	645	660	25.33
60%	470	435	452.5	22.11

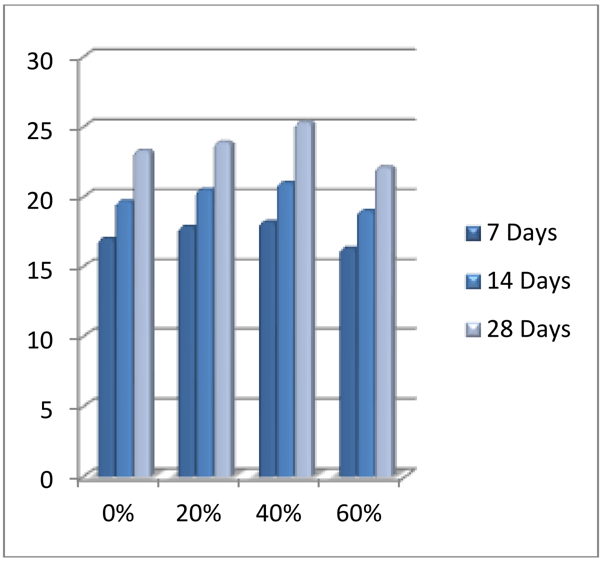

Figure 1.7 Compression Strength

4.3 TENSILE STRENGTH

4.3.1TENSILE STRENGTH-7DAYS

Table1.11 Tensile Strength 7Days

% of Dunite powder	SPECIMEN 1 TENSILE LOAD	SPECIMEN 2 TENSILE LOAD	MEAN	TENILE STRENGTH (MPa)
0%	111	129	120	1.66
20%	130	136	133	1.76
40%	125	151	138	1.87
60%	100	128	114	1.52

4.3.2 TENSILE STRENGTH-14 DAYS

Table1.12 Tensile Strength 14Days

% of Dunite powder	SPECIMEN 1 TENSILE LOAD	SPECIMEN 2 TENSILE LOAD	MEAN	TENILE STRENGTH (MPa)
0%	170	178	174	1.80
20%	182	185	183.5	1.94
40%	197	201	199	1.98
60%	165	170	167.5	1.73

4.3.3 TENSILE STRENGTH -28 DAYS

Table1.13 Tensile Strength 28Days

% of Dunite powder	SPECIMEN 1 TENSILE LOAD	SPECIMEN 2 TENSILE LOAD	MEAN	TENILE STRENGTH (MPa)
0%	111	129	120	2.03
20%	130	136	133	2.05
40%	125	151	138	2.15
60%	100	128	114	1.90

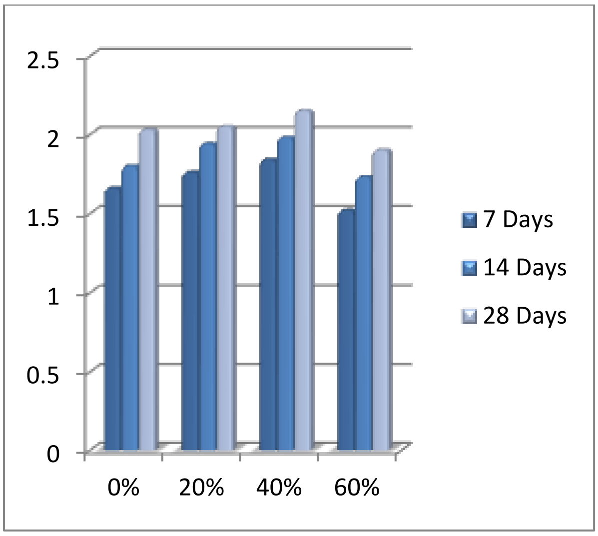

Figure 1.8 Tensile Strength

5. RESULTS

5.1 COMPRESSION

The behavior of concrete Specimens are prepared without chemical admixtures added in this tests (Grade M20). Comparing to the conventional concrete compression strength the value increases at the 40% of partial replacement of dunite powder as cement at 7, 14 and 28 days. But this status breaks at the 60% of partial replacement of dunite powder as cement.

5.2 SPLIT TENSILE

Comparing to the conventional concrete split tensile strength the value increases at the 40% of partial replacement of dunite powder as cement at 7, 14, and 28days. But this status breaks at the 60% of partial replacement of dunite powder as cement.

6. CONCLUSION

The comparative chart given in the previous chapter shows that the addition of dunite powder increases the compressive strength of concrete. It is obvious that 40% of dunite powder replacement as a cement gives good compressive and tensile strength. It is clearly identified that the crack arresting property of the concrete increases with the increment of dunite powder content. Dunite powder concrete eco-friendly, non-hazardous and easily get dispersed in the concrete mix.

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