EXPERIMENTAL INVESTIGATION ON CONCRETE AS PARTIAL REPLACEMENT OF FINE AGGREGATE BY USING SINICON PP AND STEEL SLAG

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Abstract

Concrete is the most widely used construction material today. It is the material of choice where strength, performance, durability, impermeability, fire resistance and abrasion resistance are required. It is so closely associated now within every human activity. The compressive strength of concrete is one of the most important and useful properties of concrete. For better workability, fine as well as coarse aggregate should be properly graded.. In my project deal with the study on concrete as partially replace 10%, 30% and 50% as sinicon pp (pratliperl) and 10%, 30% and 50% as Steel slag instead of sand. Then finally combine the two material as sinicon pp and Steel slag that means fully replaced fine aggregate. In this concrete act as a green concrete hence its observe the green house gases release by building

Keywords: **Sinicon pp, Steel slag, Fine Aggregate, Compression strength, Emission of green house gas**.

1.Introduction

Aggregates are the most important constituent of concrete. They give body to the concrete, reduce shrinkage and effect economy. Earlier, aggregates were considered as chemically inert materials but now it has been recognized that some of the aggregates are chemically active and also that certain aggregates exhibit chemical bond at the interface of aggregate and paste. The mere fact that the aggregates occupy 70-80% of the volume of concrete, their impact on various characteristics and properties of cement is undoubtedly considerable.

Sinicon PP (PARTLIPERL)

Sinicon PP is a unique volcanic glass. A large deposit of which is found at only one location on the earth which is South Africa. It is made out of feed from this mines using patented manufacturing process to convert this volcanic glass into well-sealed tough glass granules which is ideally suited for use with cementitious and other binders. Sinicon provides products that are meant to be solutions for life. Pratley is a technology company owned by Scientists.Pratley has their products on the Moon. Pratley is holding over 300 patents worldwide. Pratley is manufacturing over 800 products in Adhesives, Cable Glands, Explosion Proof Materials, Minerals, and Diamonds etc. Presently operating out from South Africa, USA and UK.

Steel Slag

The slag produced at blast furnace during pig iron manufacturing is called blast furnace slag. The slag produced at steel melting shop is known as steel slag. Slag output obtained during pig iron and steel production is variable and depends mainly on composition of raw materials and type of furnace. Typically, for ore feed containing 60 to 65% iron, blast furnace (BF) slag production ranges from about 300 to 540 kg per tones of pig or crude iron produced. As a construction material, concrete is the largest production of all other materials. The present consumption is nearly 500 to 600 million tons per year and the demand is expected to reach one billion tons within the next decade. Aggregate is the important constituents in concrete. They give body to the

concrete; reduce shrinkage and effect economy. One most important factor for producing workable concrete is good gradation of aggregates. To study the compressive strength of concrete specimen by replacing different materials.

1.1 OBJECTIVE

- To produce concrete enhanced strength and for the economic construction .
- To compare the both strength of the concrete which is replace by siniconpp and steel slag for fine aggregate.
- To study the strength of concrete and optimum percentage of the partially replacement of steel slag and siniconpp via 10%, 20%, 40% and 50%.
- To study the concrete by fully replacement of fine aggregate by 50% of siniconpp and 50% of steel slag

1.2 SCOPE OF OUR PROJECT

- To gain more strength compare to normal concrete.
- To control the green gas by using siniconpp in the concrete.
- To increase the life period of the structure.
- To satisfy the fine aggregate demand.
- To use the naturally available material for replacement.
- For reducing the environmental problem.

2.METHODOLOGY

2.1. Materials used

2.1.1 Cement

Table No 2.1 Physical properties cement:

Ingredient	Content
CaO (Lime)	60-67
SiO2 (Silica)	17-25
Al2O3(Alumina)	3-8
Fe2O3 (Iron Oxide)	0.5-0.6
MgO(Magnesia)	0.1-0.4
Alkalies	0.4-1.3

2.1.2Fine Aggregate

Table No2.2 Physical properties fine aggregate

S.No	Properties	Values
1	Voids in sand	41.17
2	Specific gravity	2.74
3	Water absorption	1.0

2.1.3 Course Aggregate

Table. No 4.4 Physical properties coarse aggregate

S.No	Properties	Values
1	Impact test	9.03
2	Crushing test	36.52
3	Attrition test	5.4
4	Specific gravity	2.8

2.1.4 STEEL SLAG

Table No 2.3Properties of steel slag

S.NO.	Properties	Values
1	Impact test	40%
2	Crushing test	62.03
3	Specific gravity	2.5
4	Water absorption	4%

3.MIX DESIGN

The mixes were designated in accordance with IS 10262- 2009 mix design method. Based on the results, the mix proportions M50 was designed. Concrete mix with w/c ratio of 0.35 was prepared. The details of mix proportions for $1m^3$ of concrete are given in Table below

Grade	Cement	FA	CA	Water
Mix 50	422	621	1284	147.6
	1	1.47	3.042	0.35

4.TESTING OF SPECIMENS RESULT AND DISCOUSION

1. Slump test
2. compaction factor test

1.SLUMP TEST

Slump is a measure indicating the consistency or workability of cement concrete. It gives an idea of water content needed for concrete to be used for different works. A concrete is said to be workable if it can be easily mixed and placed, compacted and finished.

Type of slump: True slump
Slump value :10mm

2.COMPACTION FACTOR TEST

It gives an idea of degree of compaction and can be defined as the ratio of the density actually achieved in the test to the density of fully compacted concrete. The degree of compaction in this test is high. The degree of compaction in this test is achieved by allowing the concrete to fall from standard height to the container.

TEST SPECIMEN

Sample-1: Conventional Concrete
Sample-2: 10% of sinicon pp partially replaced by fine aggregate
Sample-3: 30% of sinicon pp partially replaced by fine aggregate
Sample-4: 50% of sinicon pp partially replaced by fine aggregate
Sample-5: 10% of steel slag partially replaced by fine aggregate
Sample-6: 30% of steel slag partially replaced by fine aggregate
Sample-7: 50% of steel slag partially replaced by fine aggregate
Sample-8: 50% of sinicon pp and 50% of steel slag fully replaced by fine aggregate

4.3COMPRESSIVE STRENGHT OF CUBE

The experimental program was designed to study the mechanical properties of concrete with partial replacement of coarse aggregate by steel slag for M20 grade of concrete. The compressive strength of the cubes after replacing the coarse aggregate by 10%, 20%, 30% and 40% with steel slag is studied after 7 days and 28days For the test specimens, 53 grade Portland pozzolana cement natural river sand and coarse aggregate, steel slag from steel plants are being utilized.

The concrete cubes (150mmX150mmX150mm). Each layer was compacted with 25 blows using 16mm dia rod.

Compressive strength = P/A

Table: 4.1.Compressive strength for 7 days

S.NO	SAMPLE	DURATION (day)	LOAD (KN)	COMPERESION STRENGTH (N/mm^2)
1	Conventional	**7**	667	**29.64**
2	(sinicon 10%)	**7**	655	**29.11**
3	(sinicon 30%)	**7**	680	**30.22**
4	(sinicon 50%)	**7**	700	**31.11**
5	(steel slug 10%)	**7**	670	**29.80**
6	(steel slug 30%)	**7**	701	**31.11**
7	(steel slag 50%)	**7**	714	**31.73**
8	**(sinicon 50% + steel slag 50%)**	**7**	**728**	**32.3**

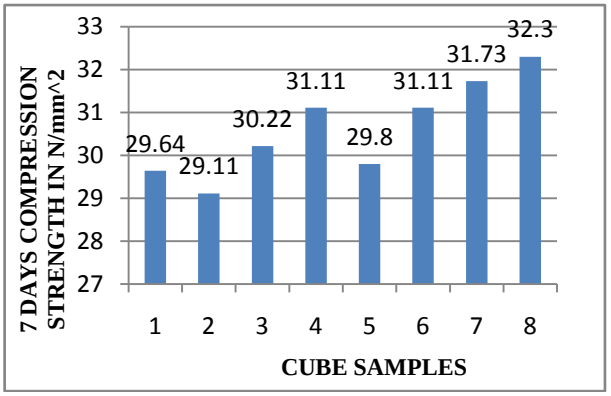

Figure No 4.1 Graph representing the 7 days compressive strength for different concrete samples

Table. 4.2 Compressive strength for 14 days

S.NO	SAMPLE	DURATION (day)	LOAD (KN)	COMPERESION STRENGTH (N/mm^2)
1	Conventional	**14**	925	41.11
2	(sinicon 10%)	**14**	887	39.42
3	(sinicon 30%)	**14**	940	41.77
4	(sinicon 50%)	**14**	970	43.11
5	(steel slag 10%)	**14**	893	39.68
6	(steel slag 30%)	**14**	952	42.31
7	(steel slag 50%)	**14**	982	43.64
8	**(sinicon 50% + steel slag 50%)**	**14**	**997.5**	**44.33**

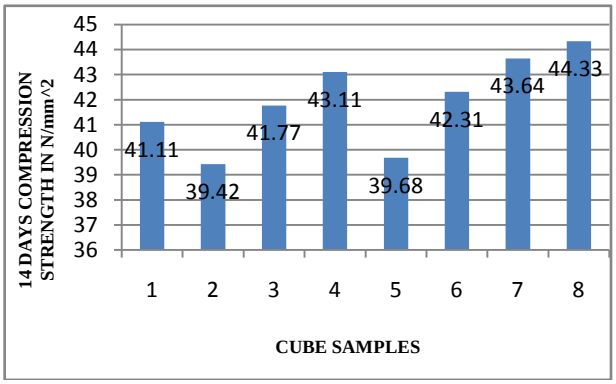

Figure No 4.2 Graph representing the 14 days compressive strength for different concrete samples

Table.4.3 Compressive strength for 28 days

S.NO	SAMPLE	DURATION (day)	LOAD (KN)	COMPERESION STRENGTH (N/mm^2)
1	Conventional	**28**	1152	51.2
2	(sinicon 10%)	**28**	1147	50.9
3	(sinicon 30%)	**28**	1197	53.2
4	(sinicon 50%)	**28**	1210	53.8
5	(steel slug 10%)	**28**	1160	51.5
6	(steel slug 30%)	**28**	1222	54.3
7	(steel slag 50%)	**28**	1250	55.6
8	**(sinicon 50% + steel slag 50%)**	**28**	**1268**	**56.35**

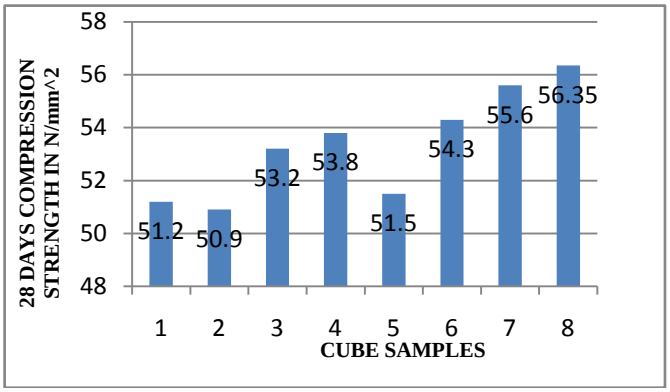

Figure No 4.3 Graph representing the 28 days compressive strength for different concrete samples

4.4SPLIT TENSILE STRENGTH ON CONCRETE

The tensile strength is one of the basic and important properties of the concrete. The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack. The cracking is a form of tension failure. The splitting tests are well known indirect tests used for determining the tensile strength of concrete sometimes referred to as split tensile strength of concrete.

The magnitude of this tensile stress σ_{sp} is given by the formula

$\sigma_{sp} = 2p/\pi dl$

Table.4.4. 7 Days split tensile strength

S.NO	SAMPLE	DURATION (day)	LOAD (KN)	SPLIT TENSILE STRENGTH (N/mm^2)
1	Conventional	**7**	225	3.18
2	(sinicon 10%)	**7**	209	2.95
3	(sinicon 30%)	**7**	215	3.04
4	(sinicon 50%)	**7**	219.5	3.10
5	(steel slug 10%)	**7**	215	3.04
6	(steel slug 30%)	**7**	220	3.16

7	(steel slag 50%)	7	228	3.22
8	**(sinicon 50% + steel slag 50%)**	**7**	**235**	**3.32**

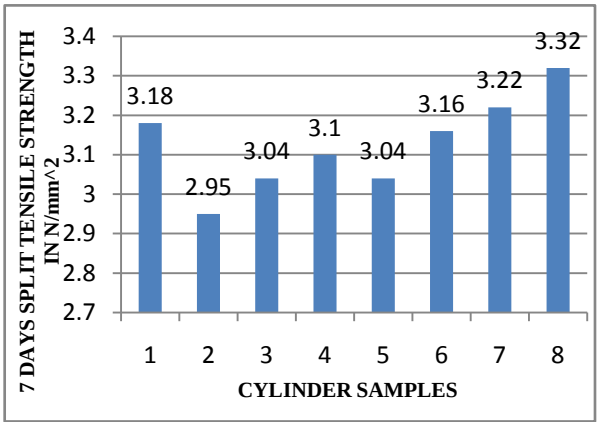

Figure No 4.4 Graph representing the 7 days Split Tensile strength for different concrete samples

Table.4.5. 14 Days Split Tensile Strength of Concrete

S.NO	SAMPLE	DURATION (day)	LOAD (KN)	SPLIT TENSILE STRENGTH (N/mm^2)
1	Conventional	**14**	301.5	4.26
2	(sinicon 10%)	**14**	260	3.67
3	(sinicon 30%)	**14**	290	4.10
4	(sinicon 50%)	**14**	298	4.2
5	(steel slug 10%)	**14**	272	3.84
6	(steel slug 30%)	**14**	300	4.24
7	(steel slag 50%)	**14**	307	4.34
8	**(sinicon 50% + steel slag 50%)**	**14**	**315**	**4.45**

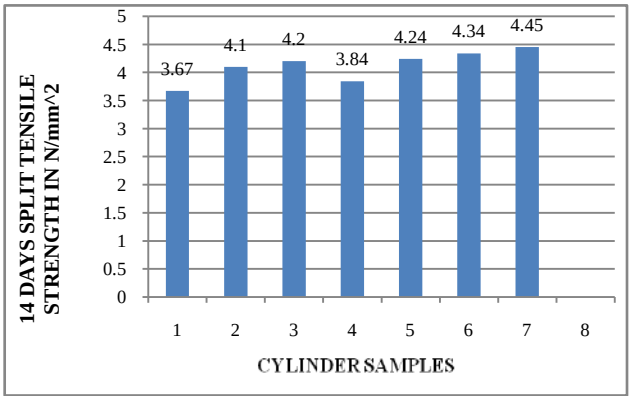

Figure No 4.5 Graph representing the 14 days Split Tensile strength for different concrete samples

Table.4.6. 28 Days Split Tensile Strength of Concrete

S.NO	SAMPLE	DURATION (day)	LOAD (KN)	SPLIT TENSILE STRENGTH (N/mm^2)
1	Conventional	**28**	388	5.5
2	(sinicon 10%)	**28**	350	4.9
3	(sinicon 30%)	**28**	386	5.4
4	(sinicon 50%)	**28**	397	5.6
5	(steel slug 10%)	**28**	367	5.19
6	(steel slug 30%)	**28**	393	5.5
7	(steel slag 50%)	**28**	403	5.7
8	**(sinicon 50% + steel slag 50%)**	**28**	**415**	**5.87**

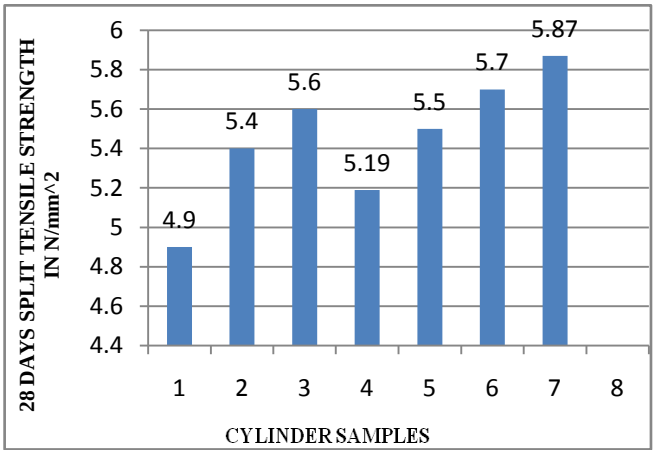

Figure No 4.6 Graph representing the 28 days Split Tensile strength for different concrete samples

CONCLUSION

The compressive strength of concrete depends upon a number of factor such as mix ratio, size, texture of coarse & fine aggregate, method of compaction, curing period. The aim of research was to investigate the manufacturing of concrete using sinicon pp (pratliperl) and steel slag. During the project we have tested various concrete cubes under the names of sample -1, sample-2, sample-3, sample-4, sample5, sample-6 and sample-8. The test results shows that the concrete using 50% sinicon pp (pratliperl) and 50% steel slag is much stronger than other sample which I casted with normal aggregates and various percentage we separately added above addition materials. The project result reinstates the strength. In this

project we can able to cast a concrete materials with some qualifications like light weight, eco-friendly, fire resisting, thermal insulating, vermin, termite proofing. Therefore, the optimum percentage of replacement suggested is 50% of both sinicon pp and steel slag in which the strength obtained is 56.35Mpa for M50 grade of concrete. The cost of construction varies depending on the cost of materials. Since steel slag is available at free of cost, the cost of concrete decreases, as the percentage of replacement increases. So, more the percentage of replacement, higher will be the reduction in cost. The weight of the steel slag is less than the fine aggregate. By replacing the fine aggregate by steel slag and sinicon pp the weight of the concrete is reduced. Thus it can be used where the light weight concrete is used.

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