Performance of Concrete Using Waste Sand from Kaolin Plant and Gfrp Powder

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I. ABSTRACT

This study makes an effort towards solving part of depletion of natural fine aggregate by reusing waste sand generated from kaolin plant and to minimize cement content by using GFRP waste powder in concrete production. Concrete made from waste sand as replacement of fine aggregate for 0% , 10% …100% with constant w/c ratio of 0.50 was studied for workability, compressive strength, split tensile strength and durability for finding optimum usage level of waste sand in concrete production. After finding optimum usage level of waste sand, GFRP waste powder is introduced as cement replacement in different proportion as 0% ,5% ,10% .15% and 20% to find optimum combination of waste sand and GFRP waste powder in concrete production.

II. INTRODUCTION

Concrete is most widely used construction material in the construction industry and it offers numbers of advantages including it's good mechanical & durability properties, low cost, and high rigidity. Concrete is the second largest used material after water. Over the past few years demand of concrete is increasing rapidly due to rapid growth in infrastructure development. For this development sand and cement is the major material. Globally 47 to 59 billion tones of materials is mined every year from which aggregates are the largest sharing about 68 to 85 % and it is fastest extraction increase. Although more sand and gravel mined there is no reliable data available except certain developed countries. So the absence of global data on aggregate mining makes environmental assessment difficult. But there is a way to estimate the global use of aggregate indirectly is through the production of cement.

River sand is only the main good ingredients in concrete production which is used as a fine aggregate. Heavy demand for the concrete leads to over exploitation of river sand in river bed which causes harmful consequences including increased in river bed depth, water table lowering and movement of saline water into fresh water aquifers. So now-a-days it is quit necessary to find an alternative material especially waste material to overcome this situation. From past few years there are numbers of research has been carried out on the use of industrial waste as a substitute or replacement material for fine aggregate. Research fining revealed that the substitution of an alternative material in concrete could improve both mechanical and durability properties of concrete which led to the sustainable development of concrete.

On other hand cement industries are the one of the most carbon dioxide emitting sources. Contribution of global cement industries to worldwide man-made CO2 production is about 6 % .The global warming is caused by the emission of green house gases like CO2 . In year 2014 global cement production is about 3900 million metric tonne and it is increasing day by day. It is estimated that 1 tonne of cement production emits 0.9 tonne of carbon dioxide. So in order to address environmental needs develop an alternative binders is quite necessary. There are so many researches consequently are on going to replace binder for the production of concrete.

So from above it is quite necessary to find an alternate of aggregate and binder material for the production of cement to overcome the future depletion of resources. In order to resolve this issues, experimental investigations is carried out on re-utilization of WS obtained from kaolin plant Bhuj in Gujarat, India as a replacement for fine aggregate in concrete production at different substitution rates. Based on test results the optimum proportion of WS in concrete production is established. After

obtaining optimum level of WS; cement is replaced with GFRP waste powder to decrease cement content in concrete production by using waste material for sustainable development.

III. MATERIALS

CEMENT

The OPC 53 grade of cement was used for all concrete mixes. Cement is a fine, greenish grey powder.

NATURAL FINE AGGREGATE

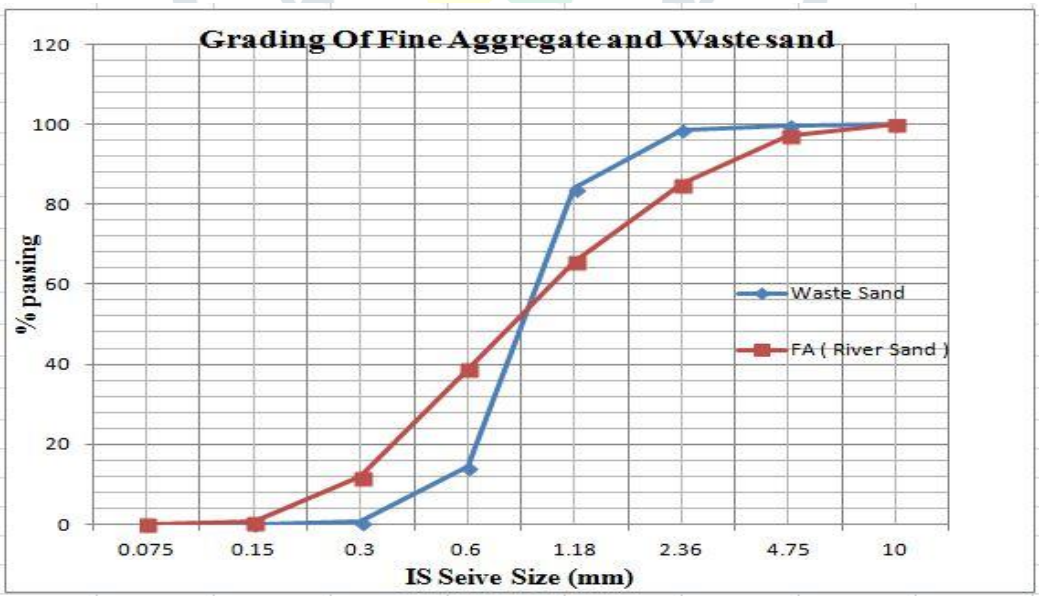
Natural Fine Aggregate used for study as conforming to zone II of IS: 383, 1987. Natural fine aggregate size less than 4.75mm.

Specific gravity	2.57
Water absorption	2.5%
Fineness Modulus	3.01

WASTE SAND

Waste sand from kaolin plant is the waste product which is obtained during making of kaolin.. During the washing of raw material waste sand produced and it is deposited near area which also produce environmental pollution. This sand is used in concrete as replacement of fine aggregate. Waste sand is obtained from kaolin plant situated near Dhaneti village near Bhuj.

Specific gravity	2.59
Water absorption	0.00%
Fineness Modulus	3.02



Waste sand Chemical Analysis of

Sr.No.	Test Description	Obtained value
1	Loss on ignition as LOI	0.09
2	Silicon dioxide as SiO_2	99.47
3	Aluminum Oxide as Al_2O_3	0.13
4	Iron Oxide as Fe_2O_3	0.07
5	Calcium oxide as CaO	0.05
6	Magnesium oxide as MgO	0.03

NATURAL COARSE AGGREGATE

Locally available 10mm and 20mm course aggregates were used for this experimental study. The physical properties of coarse aggregate are describe as below.

Specific gravity	2.89
Water absorption	0.89%
Fineness Modulus	7.24

GFRP WASTE POWDER

Here in this study,for the experimental purpose GFRP powder was obtained from a pultrusion company named Fiber Tech Composites near Piplana, Rajkot (A unit of Hi-Bond Cement) .

MIX PROPORTION

A mix 20 grade was designed as per Indian standard method and the same was used to prepare the test specimens. The design mix proportion is done in following proportion according to IS 10262:2009.

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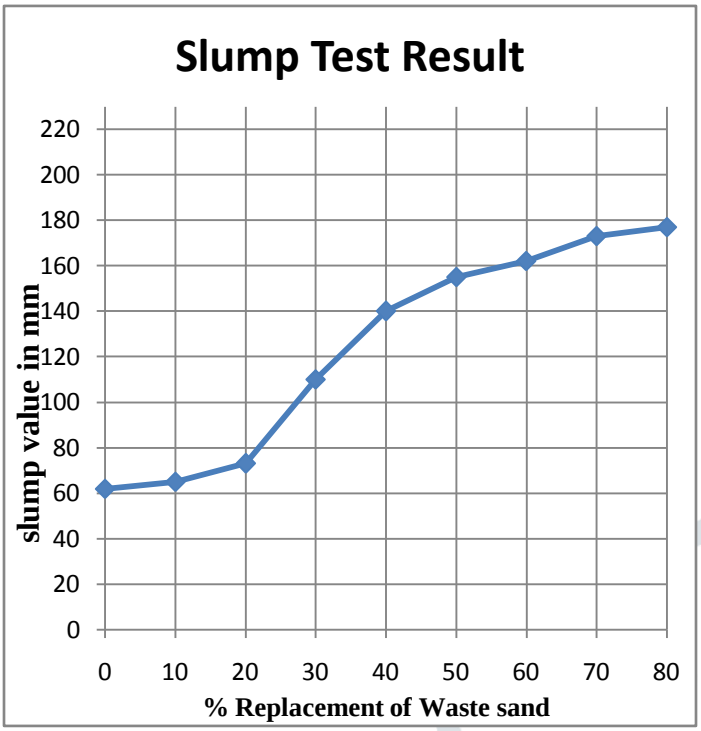
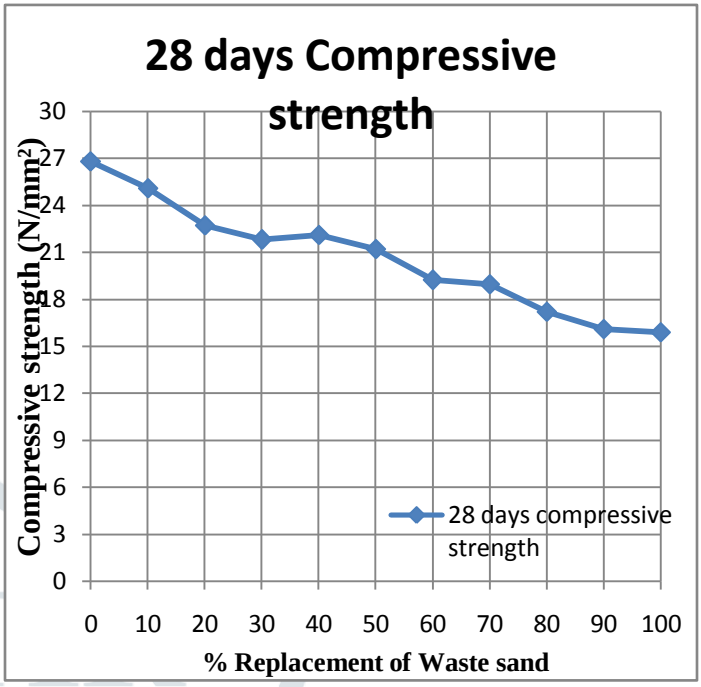
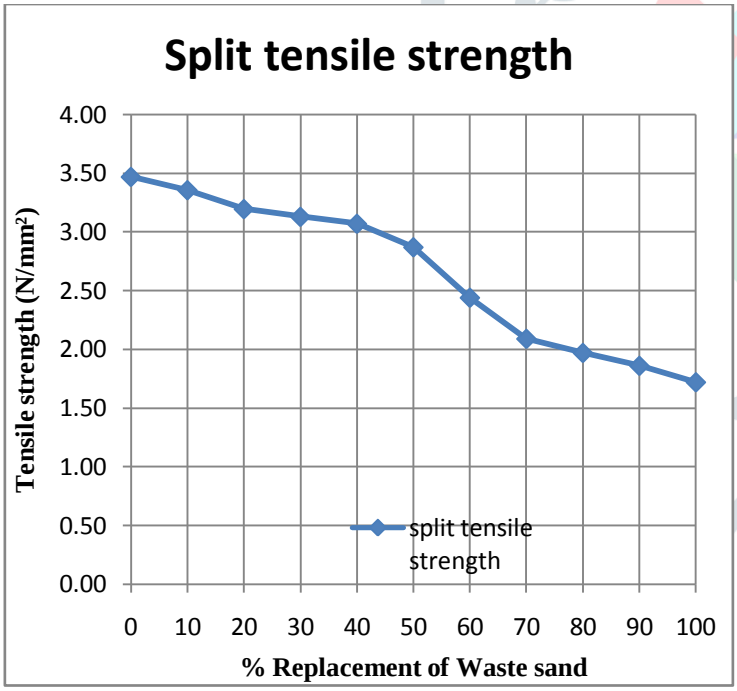
w/c ratio	Cement (kg)	Water (lit)	NFA (kg)	NCA (kg)
0.50	394	197	662	1214

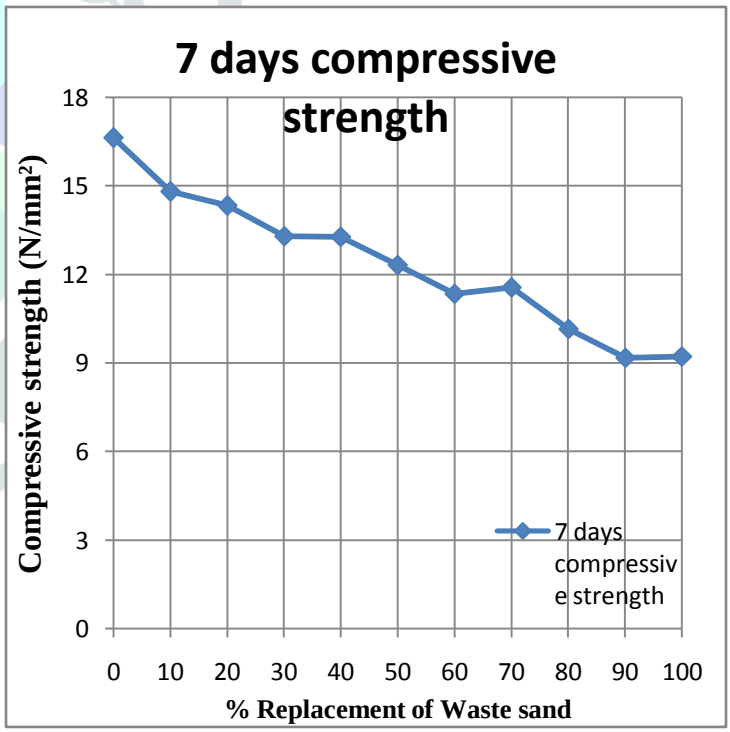
IV. RESULTS

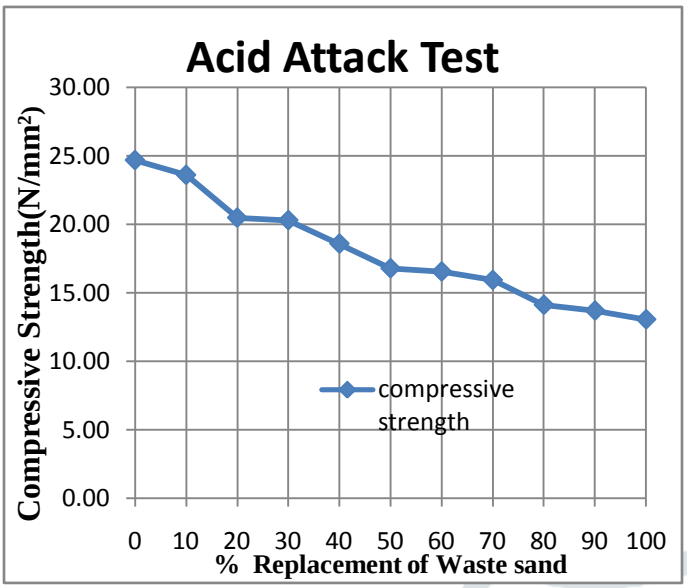
In present study various properties of concrete i.e. fresh , harden and durability was studied and result of these properties are as follows

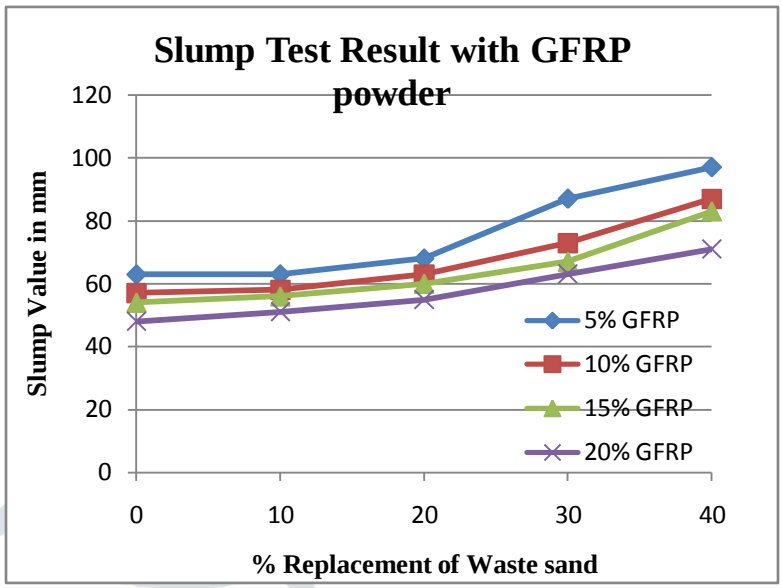

Slump Test Result
slump value in mm
220
200
180
160
140
120
100
80
60
40
20
0
0 10 20 30 40 50 60 70 80
% Replacement of Waste sand

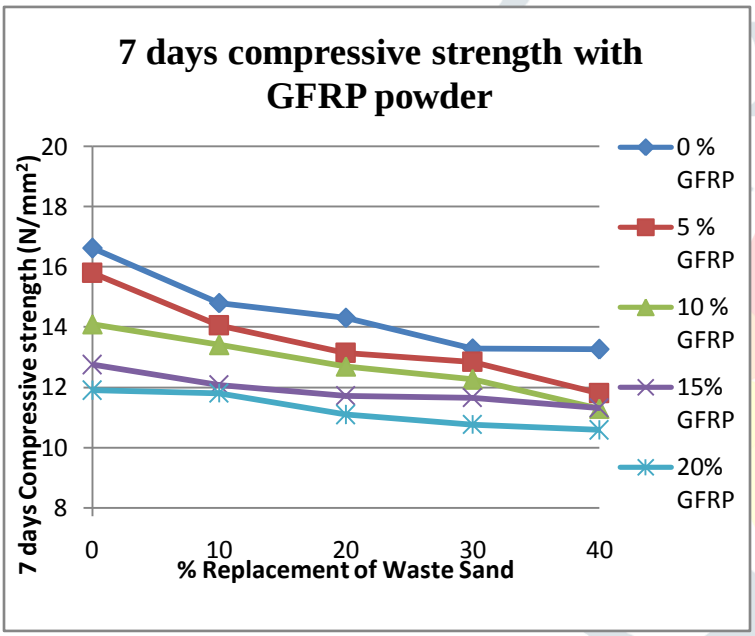

28 days Compressive strength
Compressive strength (N/mm²)
30
27
24
21
18
15
12
9
6
3
0
0 10 20 30 40 50 60 70 80 90 100
% Replacement of Waste sand
28 days compressive strength

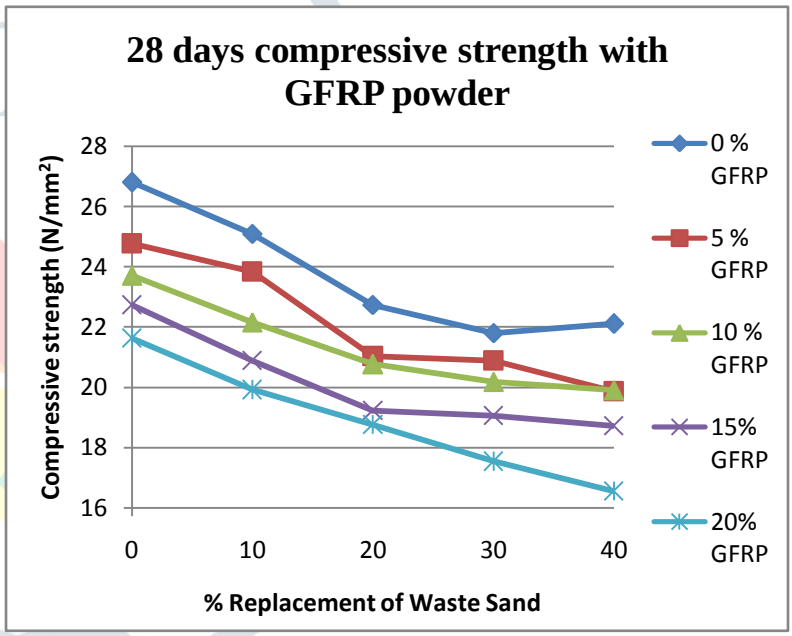

Split tensile strength
Tensile strength (N/mm²)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0 10 20 30 40 50 60 70 80 90 100
% Replacement of Waste sand
split tensile strength

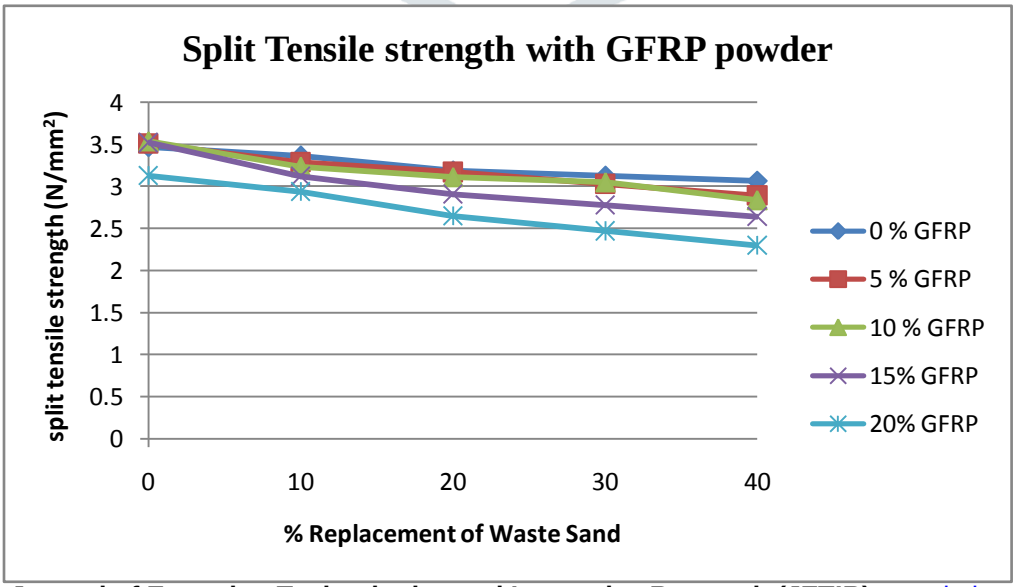

7 days compressive strength
Compressive strength (N/mm²)
18
15
12
9
6
3
0
0 10 20 30 40 50 60 70 80 90 100
% Replacement of Waste sand
7 days compressive strength


Acid Attack Test
Compressive Strength(N/mm²)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
compressive strength
0 10 20 30 40 50 60 70 80 90 100
% Replacement of Waste sand


Slump Test Result with GFRP powder
Slump Value in mm
120
100
80
60
40
20
0
5% GFRP
10% GFRP
15% GFRP
20% GFRP
0 10 20 30 40
% Replacement of Waste sand


7 days compressive strength with GFRP powder
7 days Compressive strength (N/mm²)
20
18
16
14
12
10
8
0 % GFRP
5 % GFRP
10 % GFRP
15% GFRP
20% GFRP
0 10 20 30 40
% Replacement of Waste Sand


28 days compressive strength with GFRP powder
Compressive strength (N/mm²)
28
26
24
22
20
18
16
0 % GFRP
5 % GFRP
10 % GFRP
15% GFRP
20% GFRP
0 10 20 30 40
% Replacement of Waste Sand


Split Tensile strength with GFRP powder
split tensile strength (N/mm²)
4
3.5
3
2.5
2
1.5
1
0.5
0
0 % GFRP
5 % GFRP
10 % GFRP
15% GFRP
20% GFRP
0 10 20 30 40
% Replacement of Waste Sand

V. CONCLUSION

Based on experimental investigation, following observations are made on the fresh and hardened properties of Concrete with waste sand.

I. As the increase in the content of waste sand in concrete as replacement of fine aggregate the slump also increase. After 80% of replacement segregation takes place very critically

II. The results shows that with increase content of waste sand in concrete production decreases the harden properties of concrete i.e. compressive strength , split tensile strength as well as durability of concrete.

III. The optimum usage level of waste sand is 40 % as replacement of river sand. Based on various tests concrete containing 40% waste sand as river sand replacement and 10% GFRP as cement replacement can be adopted as an optimal combination.

VI. REFERENCES

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