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To Achieve Sustainability in the Climate by using Industrial by-Products Granulated Blast Furnace Slag in Place of Sand

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Abstract - *The use of granulated blast furnace slag (gbfs) is well established in many cement applications where it provides enhanced durability, including high resistance to chloride penetration, resistance to sulphate attack and protection against alkali silica reaction (ASR). The main objective of my present work is that remove the presence of Alkalies and Chlorides which causes distortion of building and also reduces the age of building due to reason of corrosion in reinforcement and formation of cracks.*

- *To establish the utilization of GBFS in concrete.*
- *To find the percentage replacement of river sand and manufacture sand by Granulated Blast Furnace Slag.*
- *To achieve sustainability in the environment by using industrial by-products.*
- *Control the effects of corrosion in reinforcement at the time of using GBFS as fine aggregate.*
- *Control the formation of cracks during curing process and gain strength as similar that concrete in which using river sand or manufacture sand.*

Key Words*: Granulated Blast Furnace Slag, Sand, Cement, Environment, By-*Products, Environment

1. INTRODUCTION

Cement, Fine aggregate (sand) and coarse aggregate are very important materials in construction industries. Fine aggregate is very important material for making cement mortar and concrete. Sand plays most important role in voids filling. Sand has very high volume utility as compare to the other construction materials. The natural sand requirement is exponentially increasing in developing of all countries. These are the shortage of good quality natural sand and the sand deposits are being exploited improvidently which is creating a serious problem to the environment as well as our society. Rapid construction of high-volume of sand from the river bed is the cause for problems like water retention, sliding, vegetation vanishing on the river banks, aquatic life chains disturbance and low agriculture production due to reduction in water table are few important examples. The rapid growth in population causes an acute deficiency of construction materials, and there is a challenge for the all Civil Engineers to accept and use the industrial by-product materials as alternatives to natural building and construction materials as per a study.

2 Literature Review

Researcher– Rao CH Srinivasa, 2019.
Sand is most important for our construction work and usage of high volume of sand creating very serious problem for our environment as well as ecosystem. For protecting natural sand generates high volume extraction of rocks bed and crushing the rock for creating the manufacture sand but it also affects our environment. So uses the granulated blast furnace slag at the place of river sand and manufacture sand.

Yuksel Isa, 2018
In this project used the Blast Furnace Slag and find their properties. The physical properties of Blast Furnace Slag are studied in this project. The properties of slag are compressive strength of GBFS concrete, permeability of GBFS concrete, react with external agents.

Grubesa Ivanka Netinger, Bnasode Samitinjay S., 2016.
In this defines the applications of slag with concrete and cement. The slag increases the strength of the structure but it less durable because the presence of alkali and other organic agents. It effects our environment as well as our forest nature because of dumping. It is mostly used in road, highways construction works.

Methodology Adopted

- **Foam Separation Method** – Foam separation involving sodium dodecyl sulphate could remove a series of alkali metal ions.
- **Alkalies Removal Test** – Use the Oxalic Acid to remove the Alkalies from slag and it converts into Fe(C2O4).
- **Chloride Removal Test** – Remove the Chloride from slag by use of HCL and NaOH liquid.
- **Compressive Strength Test** – Compressive Strength of Concrete is found after the 7 days, 14 days & 28 days curing.
- **Workability Test –** It is obtained by Slump Cone Test.
- **Water Absorption Test** – In this, find out the quantity of absorb water by weight check at dry condition and then wet condition.

Results

Time	pH value
After 1 hours	10.61
After 4 hours	10.01
After 8 hours	9.06
After 12 hours	8.99
After 16 hours	8.01
After 20 hours	7.09
After 24 hours	7.02

Table (1) Observation Table of Foaming Test

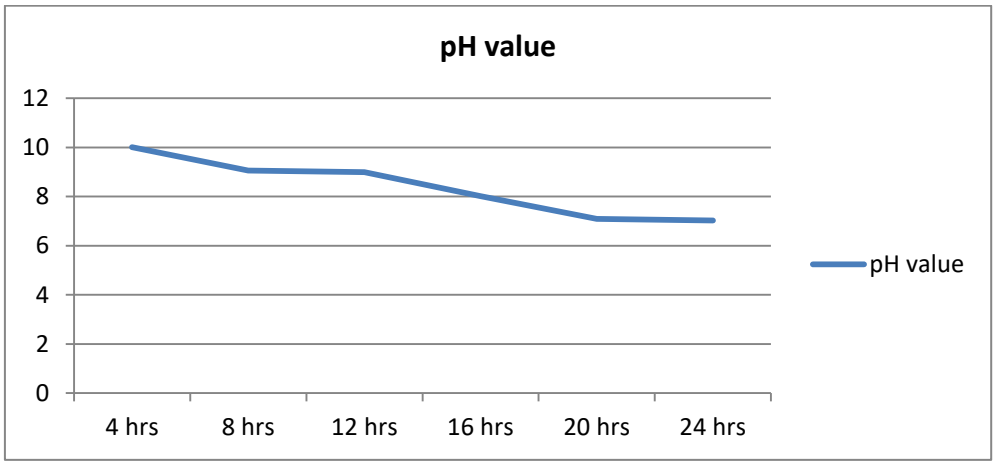

Figure (01) Line Chart on the basis of observation of Foam Separation Method

Result

The pH value of GBFS (Granulated Blast Furnace Slag) is **7.02**.

1.2 Observation Table of Alkali Removal Test

Time	pH value
30 min	10.23

45 min	10.21
1 hrs	7.02
1 hr 15 min	7.01
1 hr 30 min	7.00
1 hr 45 min	6.99
2 hr	6.98

Table (2) Observation table of pH value of Alkali Removal Test

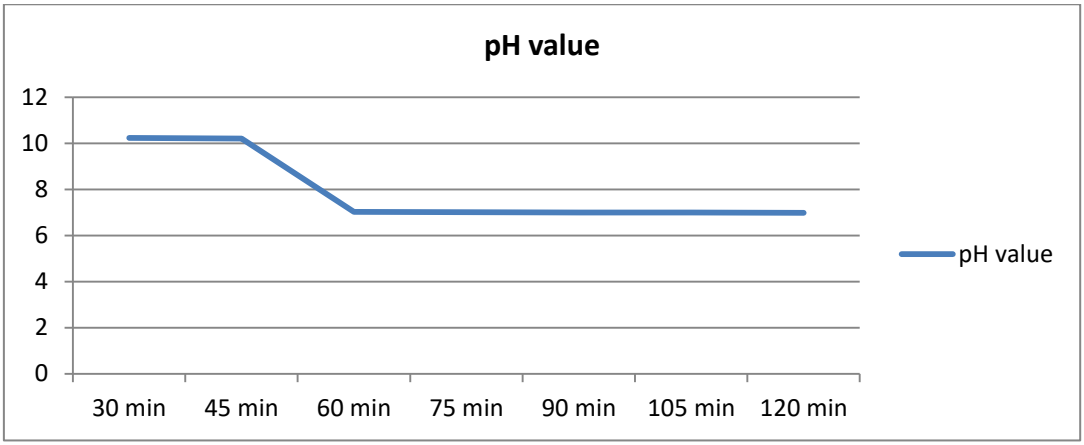

Figure (03) Line Chart on the basis of observation of Alkali Removal Test

Result

The pH value of GBFS (Granulated Blast Furnace Slag) is **6.98**.

1.3 Observation Table of Chloride Removal Test

Time	pH value
1 hr	10.56
2 hr	10.22
3 hr	9.65
4 hr	8.23
5 hr	7.68
6 hr	7.08
7 hr	7.08

Table (3) Observation table of pH value of GBFS in Chloride Removal Test

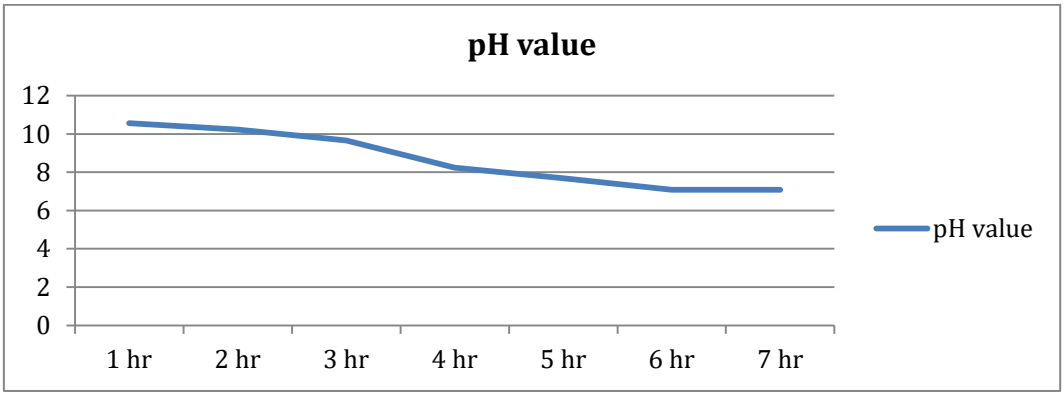

Figure (04) Line Chart on the basis of observation of Chloride Removal Test

Result

The pH value of GBFS(Granulated Blast Furnace Slag) is **7.08**.

1.4 Observation Table of Compressive Strength of GBFS Concrete

Sr. No. & Grade		Age of Cube	Compressive Strength (N/mm2)	Avg. Compressive Strength (MPa)
1.	M10	3 days	4.1	4.1
2.	M15		6.2	6.2
3.	M20		8.4	8.4
4.	M10	7 days	7.6	7.6
5.	M15		10.3	10.3
6.	M20		15.5	15.5
7.	M10	28 days	13.4	13.4
8.	M15		19.7	19.7
9.	M20		24.7	24.7

Table (4) Observation table of Compressive Strength Test of GBFS Concrete

Result

The three days observation reports are M10 concrete mix of 30.5% , M15 concrete mix of 31% and M20 concrete mix of 34%. The seven days observation reports are M10 concrete mix of 56.7%, M15 concrete mix of 52.2% and M20 concrete mix of 62.7%. The 28 days observation reports are M10 concrete mix of **13.4 MPa** (99%), M15 concrete mix of **19.7 MPa** (99%) and M20 concrete mix of **24.7 MPa** (99%).

1.5 Observation Table of Workability Test of GBFS Concrete

Workability	Slump (mm)
M10	180
M15	175
M20	165

Table (5) Observation Table of Workability Test of GBFS Concrete

Result

Workability of concrete are **very high workability** (which above 150mm-200mm as per IS 9103:1999).

4.6 Observation Table of Water Absorption Test

Mix	Dry Weight (kg) w1	Weight after immersion in water (kg) w2	% water absorption	Quality
M10	2.89	2.96	2.42	Good
M15	2.92	3.05	4.45	Average
M20	2.91	3.02	3.78	Average

Table (6) Observation Table of Water Absorption Test

Result

The water absorption value of M10 mix **2.42%** (Good), M15 mix **4.45%** (Average) and M20 mix **3.78%** (Average). (According to code BS 6349 that water absorption value 2-3% is good, 3-5% is average and above 5% is not preferred for high humidity areas.)

5. Conclusions

- The pH value of GBFS (Granulated Blast Furnace Slag) is **7.02** after 24 hrs. By using foam separation test removing 99% of alkalies from GBFS.
- The excess using of river sand and manufactured sand are saved by using GBFS.
- The pH value of GBFS is balanced as equal to the river sand which is 7.00.
- The external effect of rain water and chemical attacks are protected by removing the alkalies from GBFS.
- The pH value of GBFS (Granulated Blast Furnace Slag) is **6.98** after 2 hrs. By using alkalies removal method for removing the alkalies from GBFS and it is work at the place of RS & MS.
- The pH values of GBFS (Granulated Blast Furnace Slag) is **7.08** after 6 to 7 hrs by using of chloride removal method and remove the chloride from GBFS and prohibits the ASR in GBFS concrete.
- The 28 days observation report of compressive strength of GBFS concrete has 99%. M10 concrete mix of **13.4 MPa** (99%), M15 concrete mix of **19.7 MPa** (99%) and M20 concrete mix of **24.7 MPa** (99%).
- The strength of GBFS concrete is very high and also be durable.

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BIOGRAPHIES

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