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Experimental Analysis of Permeable Concrete Using Cupola Slag

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Abstract -In the modern era the way of construction has changed. People are using different types of waste material in conventional concrete. Cupola slag is one of the waste product. Cupola slag is a byproduct of cast iron and nickel which is partial replacement for cement by different composition. We try to analyze and studied compressive strength, permeability. We are using this product as partial replacement of cement by composition of different percentage. We use it in different percentage like 15%, 25%, 35% and perform various tests on it. A large number of trials are required to obtain desired optimum composition of cupola slag with cement.

***Key Words*:**Permeable Concrete, Cupola Slag, Partial Replacement, desired Value.

1.INTRODUCTION

As there is an increase in use of water, ground water level is rapidly decreasing.so it causes major water issues in metropolitan cities. To satisfy need of current infrastructure development construction of conventional pavements are increased which together increasing the soil erosion, pollution, run off of water. Permeable concrete helps in reducing these kinds of problems. Permeable concrete is made up cement, coarse aggregates and water. Since it doesn't provide that much strength , it is used in parking areas, footpath, internal road. The textured surface is useful during the most difficult and dangerous driving condition such as to drive in rain and snow. In other words we can simply say that permeable concrete help to protect the surface of pavements. As demand of material increased, generation of waste is increased. Cupola slag is one of the waste product which can be used as partial replacement of cement in concrete.

Cupola slag is a byproduct of cast iron manufacturing process.This product showsproperties similar to the cement .As it showspozzolanic property it is used in the production of concrete .It will reduce the use of cement in the concrete. Replacement by weight of cement by 15%, 25%, 35%, 45% has made.

1.2Objectives

1. To determine compressive strength of permeable concrete by using cupola slag.
2. To achieve desire strength of permeable concrete.
3. To determine the of permeability of permeable concrete.
4. To obtain a cost effective concrete.

1.3Apllication

1. It can be used for residential roads as well as pathways.
2. Permeable pavement also can be used parking areas.
3. Permeable concrete can be used in minor road, sideways. It can be provided at basketball courts as well as at tennis court.
4. Noise Barrier.
5. Permeable pavement used in pavement edge drain and it can be used in slope stabilization.

2.LITERATURE REVIEW

D.A. Aderibigbe et. al. (1982)[1]has obtained the properties of cupola slag and cement similar. Study has been done on the pozzolanic property of cupola slag.

M. Harshavarthana Balaji et. al. (2010)[2], designed pervious concrete using SILICA FUME ans CUPOLA SLAG to increase its strength. Using the ACI-522R-06 they have designed permeableconcret.

D. Baricováa et. al. (2010)[3], comparison of blast furnace slag with cupola slag depending upon their mechanical properties and compositions has been represented in this paper**.** The paper present results from the research of the blast furnace and cupola furnace slag utilization in the concrete production.

A.V. Pradeepa et. al. (2014)[4], obtained experimentally that the mechanical properties were enhanced when GGBF Slag is reinforced with the Glass fiber polymer and also the specimen having 15% (largest constituent

of GGBF Slag percent among all other specimens) possesses better Tensile Strength, Compression Strength, Flexural Strength, Impact strength and Hardness

3.EXPERMETAL MATERIAL AND EQUIPMENT

3.1 Material

Cement– Ordinary Portland cement, 53 Grade conforming to IS: 269 – 1976. It will be used for casting all the specimens. The compressive strength measured in standard mortar at 28 days was 54MPa. The physical properties are conforming to IS 12269-1987. The choice of brand and type of cement affects the rate of hydration, so that the strengths at early ages can be considerably influenced by the particular cement used.

Aggregate- Locally available crushed blue granite stones conforming to graded aggregate of nominal size 14 mm- 20 mm as per IS: 383 – 1970. The specific gravity was 2.7 and retained on 13.2mm sieve and passing through 16mm.Several investigation concluded that as the aggregate size increase compressive strength of the mix decreases. Bulk density of aggregate is 1737 Kg/m^3.

Water – To mix the ingredients of concrete tap water has been used in thesis.

Cupola Slag – Cupola slag is a by- product of cast iron manufacturing is produced during the separation of the molten steel from impurities in cupola furnaces.

Cupola slag obtained from Prajapati Foundries, Pune. They are using this material for the purpose of land filling. The slag was dumped in a large lump form. It was first dusted and isolated to remove the earth impurities. It was then crushed to sizes less than 40mm with the use of UTM. Then ball mill was used to achieve the powdered granulated form of the slag. It was sieved through the 150 µm and was finally sieved through 90µm in order to get a particle size similar to the Portland cement particle size.

3.2. Equipment

Universal Testing Machine – UTM is used to test the compressive strength and tensile strength of materials. The "universal" part of the name reflects that it can perform many standard compression and tensile strength on material, component and structures.

Mould- Cubical Mould of size 150 X 150 X 150mm is used in this thesis.

Steel tamping rod – 16mm diameter of tamping rods are used for compaction.

Curing-For curing purpose water tanks are used.

4. SELECTION OF MATERIALS

Comparison between Cupola slag and OPC 53 grade

	CUPOLA SLAG	CEMENT
	It originates from melting of gauge parts of metal.	It originates from firing finely-ground clay and limestone until the limestone was calcined.
SIZE	obtained in lump sizes	It is fine powder
FEO %	1-15	0.4 – 6
CAO%	20-50	60-66
SiO2 %	25-55	19-25
Al2O3 %	5-20	3-8
BASICITY	ranges from acidic to basic slag	Very alkaline
STRENGTH PROPERTIES	depends on size of particles and composition	depends on grade of OPC cement

5. MIX DESIGN

Pervious concrete of strength 20 MPa

Design average cube strength at 28 days

Bulk Density of aggregate – 1934.3 Kg/m3

Water-cement ratio- 0.4

Dry weight of aggregate – 45.7 Kg

% void – 20%

% paste – 29%

Cement Content – 11 Kg

Water content – 4.5 liter

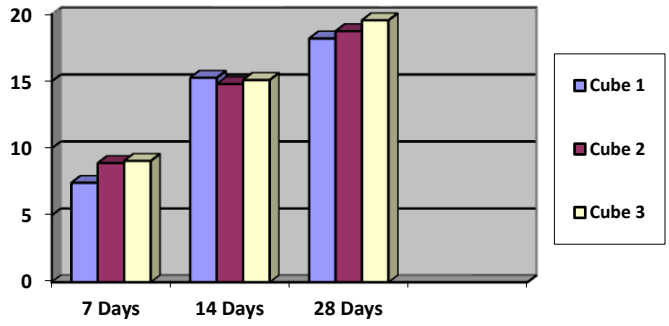
Replacement of cupola slag – 15 %, 25%, 35% by weight.

6. RESULTS

6.1 Compressive strength

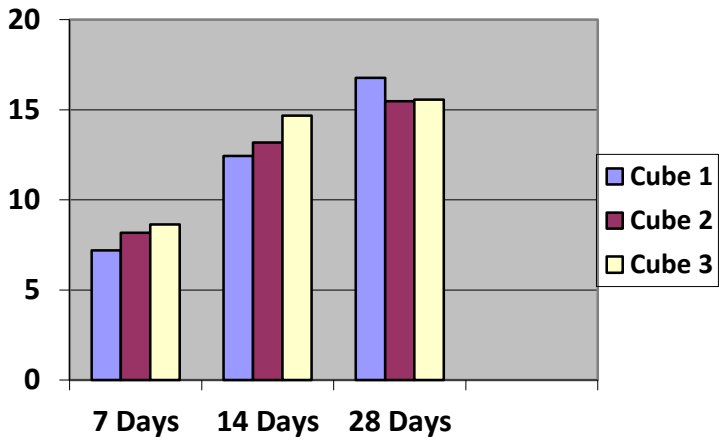
6.1.1 Cupola Slag (15% replacement)

	Strength (Mpa)	Strength (Mpa)	Strength (Mpa)
	7 Days	14 Days	28 Days
Cube 1	7.43	15.27	18.20
Cube 2	8.90	14.80	18.75
Cube 3	9.06	15.10	19.56



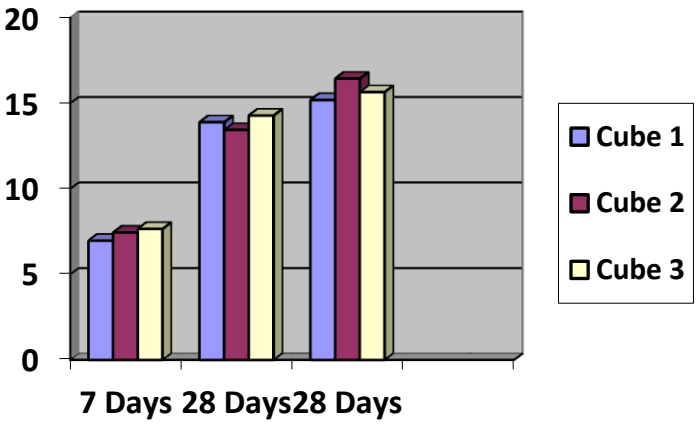
6.1.2 Cupola Slag (25% replacement)

	Strength (Mpa)	Strength (Mpa)	Strength (Mpa)
	7 Days	14 Days	28 Days
Cube 1	7.20	12.43	16.78
Cube 2	8.17	13.19	15.48
Cube 3	8.63	14.67	15.56



6.1.3 Cupola Slag (35% replacement)

	Strength (Mpa)	Strength (Mpa)	Strength (Mpa)
	7 Days	14 Days	28 Days
Cube 1	6.97	13.90	15.20
Cube 2	7.45	13.45	16.45
Cube 3	7.66	14.29	15.66



7. CONCLUSIONS

1. Replacement of cement by 15% of cupola slag helps in increase in compressive strength of concrete.

2. Increase in percentage of cupola slag above 20% will reduce the compressive strength of concrete

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