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UTILIZATION OF RICE HUSK ASH ON PERVIOUS CONCRETE AS A PARTIAL REPLACEMENT OF CEMENT

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ABSTRACT

Rice Husk Ash (RHA) is an agricultural waste product which is produced in large quantities globally every year and difficulty involved in its disposal, RHA becoming an environmental hazard in rice producing countries. India alone produces around 120 million tons of rice paddy per year, giving around 6 million tons of rice husk ash per year. RHA can be used in concrete to improve its strength and other durability factors. So we can use RHA as a partial replacement of cement in pervious concrete. In this research (OPC) cement has been replaced by RHA accordingly in the range of 10%,20%and30%byweightofcementforconstant 0.40 water cement ratio. The compressive strength test and water absorption test was carried out for 7, 28 days. So the main aim of the investigation to study the behaviour of PERVIOUS CONCRETE while replaces the RHA with different proportions in concrete. The test results were obtained from the research which are compared with the control mix (CM).

KEYWORDS: Rice husk Ash (RHA), Compressive strength, Water absorption, Pervious Concrete, OPC Cement.

1. INTRODUCTION

Pervious concrete which is also known as the no-fines, porous, gap-graded, and permeable concrete and Enhance porosity concrete have been found to be a reliable storm water management tool. By definition, pervious concrete is a mixture of gravel or granite stone, cement, water, little to no sand (fine aggregate). When pervious concrete is used for paving, the open cell structures allow storm water to filter through the pavement and into the underlying soils. In other words, pervious concrete helps in protecting the surface of the pavement and its environment.

As stated above, pervious concrete has the same basic constituents as conventional concrete, 15 -30% of its volume consists of interconnected void network, which allows water to pass through the concrete. Pervious concrete can allow the passage of 11.35-18.97 liters of water per minute through its open cells for each square foot (0.0929m2) of surface area which is far greater than most rain occurrences. Apart from being used to eliminate or reduce the need for expensive retention ponds, developers and other private companies are also using it to free up valuable real estate for development, while still providing a paved park. Pervious concrete is also a unique and effective means to address important environmental issues and sustainable growth. When it rains, pervious concrete automatically acts as a drainage system, thereby putting water back whereit belongs. Pervious concrete is rough textured, and has a honeycombed surface, with moderate amount of surface travelling which occurs on heavily travelled roadways. Carefully controlled amount of water and cementitious materials are used to create a paste. The paste then forms a thick coating around aggregate particles, to prevent the flowing off of the paste during mixing and placing. Using enough paste to coat the particles maintain a system of inter connected voids which allow water and air to pass through. The lack of sand in pervious concrete results in a very harsh mix that negatively affects mixing, delivery and placement. Also, due to the high void content, pervious concrete is light in weight (about 1600 to 2000 kg/m3). Pervious concrete void structureprovides pollutant captures which also add significant structural strength as well. It also results in

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a very high permeable concrete that drains quickly. Pervious concrete can be used in a wide range of applications, although its primary use is in pavements which are in: residential roads, alleys and driveways, low volume pavements, low water crossings, sidewalks and pathways, parking areas, tennis courts, slope stabilization, sub-base for conventional concrete pavements etc.,

Fig. 1. Pervious concrete cube

Pervious concrete system has advantages over impervious concrete in that it is effective in managing run-off from paved surfaces, prevent contamination in run-off water, and recharge aquifer, repelling salt water intrusion, control pollution in water seepage to ground water recharge thus, preventing subterranean storm water sewer drains, absorbs less heat than regular concrete and asphalt, reduces the need for air conditioning. Pervious concrete allows for increased site optimization because in most cases, its use should totally limit the need for detention and retention ponds, swales and other more traditional storm water management devices that are otherwise required for compliances with the Federal storm water regulations on commercial sites of one acre or more. By using pervious concrete, the ambient air temperature will be reduced, requiring less power to cool the building. In addition, costly storm water structures such as piping, inlets and ponds will be eliminated. Construction scheduling will also be improved as the stone recharge bed will be installed at the beginning of construction, enhancing erosion control measures and preventing rain delays due to harsh site conditions. Apparently, when compared to conventional concrete, pervious concrete has a lower compressive strength, greater permeability, and a lower unit weight (approximately 70% of conventional concrete).However, pervious concrete has a greater advantage in many regards. Nevertheless, it has its own limitations which must be put in effective consideration when planning itsuse. Structurally when higher permeability and low strength are required, the effect of variation in aggregate size on strength and permeability for the same aggregate cement ratio need to be investigated.

Fig. 2. Water flowing through pervious concrete cube

No fines concrete simply it is defined as “total elimination of fine material”. The fine aggregate is removed in this concrete so that voids are left in the coarse aggregate. The coarse aggregate may be of the usual type or the light weight aggregate. The coarse aggregate should be finer than 20 mm size and not more than 10% should

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pass the 10 mm sieve. The proportion of cement to aggregate is usually 1:6 in case of light aggregate and 1:10 in case of heavy aggregate.

Pervious concrete is sometimes called "no fines" concrete. It is designed with high porosity and allows water to pass though. It is commonly used in concrete pavement so as to reduce surface runoff and allow the recharging of ground water. The high porosity is achieved by a network of interconnected void. "No fines" concrete has little or no fines and contains just enough cement paste to cover the surface of coarse aggregates while maintaining the interconnectivity of voids.

2. MATERIALS

Cement:

Cement is the main ingredient in manufacturing of concrete. The characteristics of concrete will be greatly affected by changing the Cement content.

The Cement used in this project is Ordinary Portland Cement of 53 grade confirming to IS12269-1987 shown in

Fig. 3.

Fig. 3. Cement

Rice Husk Ash:

The rice husk ash has good reactivity when used as a partial substitute for cement. These are prominent in countries where the rice production is abundant. The properly rice husk ashes are found to be active within the cement paste. So, the use and practical application of rice husk ash for concrete manufacturing are important. Burning the husk under controlled temperature below 800 °C can produce ash with silica mainly as shown in fig.4. Reported an investigation on the pozzolanic activity of RHA by using various techniques in order to verify the effect of incineration temperature and burning duration. The samples burnt at 500 or 700 °C and burned for more than 12 hours produced ashes with high reactivity with no significant amount of crystalline material. The effect of incineration conditions on the pozzolanic characteristics of the ash and a summary of the research findings from several countries on the use of RHA as a supplementary cementing pozzolanic material.

Fig. 4. Rice Husk Ash

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Table 1. Chemical properties of Rice husk ash

COMPONENTS	CHEMICAL FORMULA	PERCENTAGES
Silicon dioxide	SiO2	79.84
Aluminium dioxide	Al2O3	0.14
Ferric oxide	Fe2O3	1.16
Calcium Oxide	CaO	0.55
Magnesium Oxide	MgO	0.19
Sodium Oxide	Na2O	0.08
Potassium Oxide	K2O	2.90

Coarse Aggregate:
Aggregate of size more than 4.75mm are generally considered as Coarse aggregate. The maximum size of Coarse aggregate used in this experimental work are 20 mm and 12 mm good quality of Coarse aggregate is obtained from nearest crusher unit. The Coarse aggregate are selected as per IS-383 specifications as shown in fig. 5.

Fig. 5. Coarse Aggregate

3. METHODOLOGY

Mix Proportion
Taking after IS: 10262-2009, our mix design was gone for pervious concrete having 28 days compressive strength of 30Mpa for control mix. For control mix having a compressive strength of30Mpa, the mix proportion arranged is organized in Table 2. Other concrete mixes were prepared by replacing cement by weight with a carved measure of Rice husk ash i.e., 10, 20, 30 %. Different constituents were kept steady.

Table 2. Mix Proportions

Mix Type	Cement(Kg/m3)	R.H.A(Kg/m3)	C.A(Kg/m3)	Water (liters)
Normal mix	450	0	1084.34	191.58
10% R.H.A	405	45	1084.34	191.58

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20% R.H.A	360	90	1084.34	191.58
30% R.H.A	315	135	1084.34	191.58

Compressive Strength Test Procedure

To assess the impact on compressive strength cube specimens were made and cured. Standard sized cube specimens of 15 X 15 X 15 cm according to IS: 516-1959 were tested for compressive strength utilizing the compressive testing machine were shown in Fig. 6. The results of compressive strength were tabulated in Table 3 and Table 4.

Fig. 6. Testing of Cube

Table 3.Compressive Strength for Nominal Mix

S.NO	**Compressive Strength (MPa)**	
	7days	**28days**
1	8.50	10.27
2	8.54	10.30
3	8.56	10.29
4	Mean **8.533**	Mean **10.28**

Table 4.Compressive strength

Rice husk Ash%	**Compressive Strength (MPa)**	
	7 days	**28 days**
0%	8.533	10.28
10%	9.10	10.91
20%	7.88	9.63
30%	7.54	9.52

Water Absorption Test:

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Water absorption is measured by measuring the increase in mass as a percentage of dry mass. It can be seen that surface water absorption is higher than internal water absorption for all the specimens. This is due to the rapid loss of water at the cover concrete during curing.

Test Procedure for Water Absorption

The 150 x150 mm cubes will be immersed in water for 28 days curing as shown in fig. 7. These specimens will then oven dried for 24 hours at the temperature 110°C until the mass became constant and again weighed as shown in fig. 8. This weight was noted as the dry weight (W1) of the block. After that the specimen will be kept in hot water at 85°c for 3.5 hours. Then this weight will noted as the wet weight (W2) of the block. The percentage Water Absorption (WA) is calculated as follows.

% Water Absorption = [(W2 – W1) / W1] x 100 Where, W1 = Oven dry weight of the cube in grams W2 = after 3.5 hour wet weights of cube in grams

Fig. 7. Cube for Water Absorption

Fig. 8. Placing of Cube in Oven

4. RESULTS AND DISCUSSION

The results are showed in the table 3 and 4 by calculating Fresh and Hardened properties of concrete. The Compressive strength is the main property for determining the concrete strength. In this the strength properties

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are calculated by replacing the cement with Rice husk ash at different proportions of 10%,20%,30%. The optimum compressive strength we achieved at 10 % replacement of cement with rice husk ash after that slowly the strength was reduced. The compressive strengths variations were shown in Fig 9.

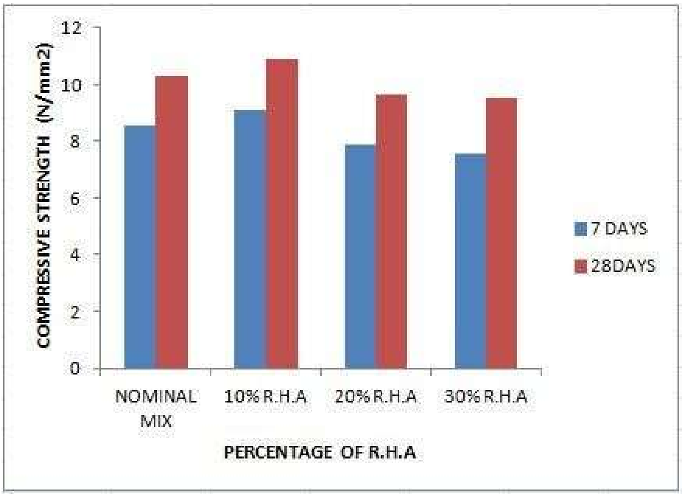

Fig. 9. Compressive strength of pervious concrete after 7and 28 days

For the control mix the water absorption was 8.64%, 10% replacement of R.H.A 7.11%, 20% replacement of R.H.A 6.8% and for 30% replacement of R.H.A 6.002% variation of percentage of water absorption as shown in fig. 10.

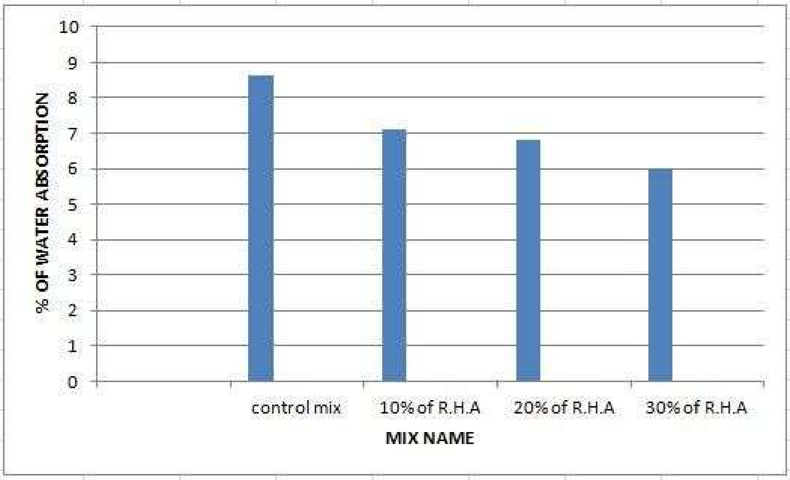

Fig. 10. Water absorption for different proportions of pervious concrete

5. CONCLUSION

The following conclusion are drawn after the finish of the experimental work

- Compressive strength of pervious concrete ranges from 7 to 9.5 MPa for seven days and 9.5 to 11 MPa for twenty eight days
- The optimum compressive strength is 10.91 MPa for 10% replacement of R.H.A.
- The compressive strength of pervious concrete is increase up to 10% replacement of cement with R.H.A beyond that it is starting to decrease.
- Water absorption of pervious concrete after 28days ranges from 6.002% to8.64%.
- The percentage of water absorption decreases with increase in percentage of R.H.A

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