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SUITABILITY OF THE USE OF RICE HUSK IN CONCRETE

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ABSTRACT

In order to verify the compressive strength of concrete cube when rice-husk ash is used as partial replacement of cement, a laboratory analysis was carried out in this paper. The rice-husk percentages used are: 10%, 20% and 25% and a mix ratio G 20 i.e. 1:2:4 was used. The results obtained shows that up to 20% of rice- husk can be used to replace cement in the mixture, because nearly 20N/ mm^2 is achieved, which is within the compressive strength limit expected from concrete mix ratio of 1:2:4. However, the percentage ratio of the rice-husk should not be increased to above 20% say 25%. This is because the results obtained when 25% rice-husk was used after curing for 7,14,21,28 days, are 12.70, 10.80, 9.10 and 7.8 N/ mm^2 respectively. All these are far less than the 20 N/ mm^2 the minimum compressive strength expected.

INTRODUCTION

Concrete is a very important material used in construction of civil engineering works. Most of Civil Engineering structures are made up of concrete. Concrete is the most widely used man made construction material in the world, and it is second only to water as the most utilized substance in common use in any construction site. It is obtained by mixing cementious material, water and aggregate (and sometimes admixtures) in required proportion. The admixture when placed in forms and allowed to cure hardens into rock-like mass known as concrete (BS1881). It is used in construction of most structures, which include foundation in walls, floors, highway, pavements, columns and beams etc (Bala et al, 2007). Concrete when properly mixed, compacts, makes workability easier and durable, especially if it is given enough curing period. This paper intends to find out or verify the compressive strength of concrete cube, when rice – husk ash is used as partial replacement for cement. The compressive strength of concrete is defined as the maximum load the concrete can carry per unit area. That means it is the force per unit area required to crack or fracture a material such as cubes, sandcrete blocks, etc. The samples of the cubes used were of 1500mm x 150mm and a mix ratio of 1:2:4, also known as G 20, which means the permissible minimum compressive strength should be 20 N/mm^2. The rice husk ash percentages used in this paper are: 0% (normal concrete mix), 10% rice husk ash, 20% and 25%. The ash is obtained by burning the husk which results in removal of the organic component from the husk as volatile components. Ashing the husk involves the dehydration process in which all water molecules both free and bonded are removed from the husk at temperature ranging between 100-170^0 C (Diyaudden, 2008).

LITERATURE REVIEW

From economical, technological, and ecological point of view, cement replacement by other binders have a great role to play in the future of construction industry. Small use of inert fillers has always being acceptable, as cement replacement (Bloen, 1959). They impact not only technical advantage to the resulting concrete but also enable larger quantities of cement replacement to be achieved. Many of these mineral admixture or additives are industrial or/and agricultural by-products considered as waste just like rice-husk ash (Hassan, 2008). Due to the increasing cost of cement, there is need to look for a cheaper way of reducing the percentage of cement in concrete mix, without decreasing the strength of the cube. That alternative is what this paper intend to look at using rice-husk ash. The strength of the binding agent is one of the factors that affect the strength of concrete. Rice-husk ash is a burnt agricultural residue and has been used in construction industries in many countries. It is also used for soil stabilization and improvement (Hassan, 2008).

Rice-husk contains 92.93% silica. The weight of the husk is around 20% of the original weight of the rice grain. Statistics has shown that one ton of rice yield 200kg of husk. Typical chemical analysis of rice-husk is shown below:

Constituent	Percentage/weight
SiO_2	92.15
$A1_2O_3$	0.41
Fe_2O_3	0.21
CaO	0.41
MgO	0.45
Na_2O	0.08
H_2O	0.31 (Hassan,2008)

METHODOLOGY

The method normally adopted in mixing concrete is hand or mechanical mixing method. However, the method of mixing used in this paper is hand mixing. The concrete was mixed according to BS 1881.

For hand mixing of concrete, the materials to be used are measured out by volume in a gauge. The proportion mix ratio of 1:2:4 of coarse aggregate, sand and rice-husk ash were thoroughly mixed in clean surface using a shovel until a homogenous or suitable consistency was reached. The ash from rice husk was obtained from rice grinding machine operator and after burning, the residue was taken to the laboratory for sieving

The cubes were cast and cured at room temperature with water for 7 days, 14 days 21 days, and 28 days respectively. The cubes were then crushed and their average compressive strength was determined in the laboratory of the department of Civil Engineering, Kaduna Polytechnic.

DISCUSSION OF RESULTS

Compressive Strength of Concrete Cube for First Cube

% rice husk ash (control) 7 days.

Density = Mass

Volume

Mass = Weight of concrete cube = 8.25kg

Volume = $\frac{150 \times 150 \times 150}{10^7}$ = $0.003375m^3$

Density = $\frac{8.25}{0.003375}$ = $2244.44kg/m^3$

Compressive strength = $\frac{Load}{Area}$

Area = 150 x 150 = $22500mm^2$

Load = 431.7KN

:. Compressive strength = $\frac{431.7 \times 10^3}{22500}$ = $19.19N/mm^2$

Test For Second Cube for 7 Days (0% rice husk ash)

Density = $\frac{Mass}{Volume}$

Mass = weight of concrete cube = 8.05kg

Volume = $\frac{150 \times 150 \times 150}{10m^9}$ = $0.003375m^3$

Density = $\frac{8.05}{0.003375}$ = $2385.18kg/ m^3$

Compressive strength = $\frac{Load}{Area}$

Load = 432KN

Area = 150 x 150 = $22500mm\ m^2$

Compressive strength = $\frac{432 \times 10^3}{22500}$ = $19.2N/mm^2$

Compressive Strength of Congrete Cube for Third Cube

Density = $\frac{Mass}{Volume}$

Mass = Weight of concrete cube = 8.25kg

Volume = $\frac{150 \times 150 \times 150}{10^7}$ = $0.003375m^3$

Density = $\frac{8.25}{0.003375}$ = $2244.44kg/m^3$

Compressive strength = $\frac{Load}{Area}$

Area = 150 x 150 = $22500mm^2$

Load = 431.7KN

:. Compressive strength = $\frac{431.7 \times 10^3}{22500}$ = $19.19N/mm^2$

The compressive strength of the remaining percentages (10%, 20% and 25%) was calculated in a similar way.

Table 1: Summary of results of compressive strength

Percentage of Rice Husk	Curing days	Compressive Strength (N/mm^2)
0%	7 days	19.19
	14 days	21.27
	21 days	24.67
	28 days	26.30
10%	7 days	15.70
	14 days	17.77
	21 days	19.20
	28 days	22.50
20%	7 days	13.50
	14 days	15.0
	21 days	17.80
	28 days	19.10
25%	7 days	12.70
	14 days	10.80
	21 days	9.10
	28 days	7.80

CONCLUSION

From the results obtained in the laboratory analysis, it is clear that the compressive strength increases with curing days and the more the rice husk ash percentage is increased to replace the cement in the concrete mix, the less the strength of the cube. Therefore it can be concluded that 20% of the cement can be replaced by the rice husk ash and the cube can still be used without any fear. This is because nearly 20 N/mm^2 strength (19.10 N/mm^2) is achieved after curing for 28 days, which is in line with what is expected from a concrete mix of ratio 1:2:4 that were used in the research (see appendix). When **the** percentage of rice husk was increased to 25%, the compressive strength results obtained is low and hence should not be used.

RECOMMENDATION

If one consider the importance of concrete in the construction industry and the use of concrete cubes, and also considering the present economic situation in country, it can be safely be recommended that instead of throwing rice husk as solid waste, it can be put into proper use by replacing up to 20% of cement in a concrete mix with it. This idea can be described as waste to wealth.

REFERENCE

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APPENDIX

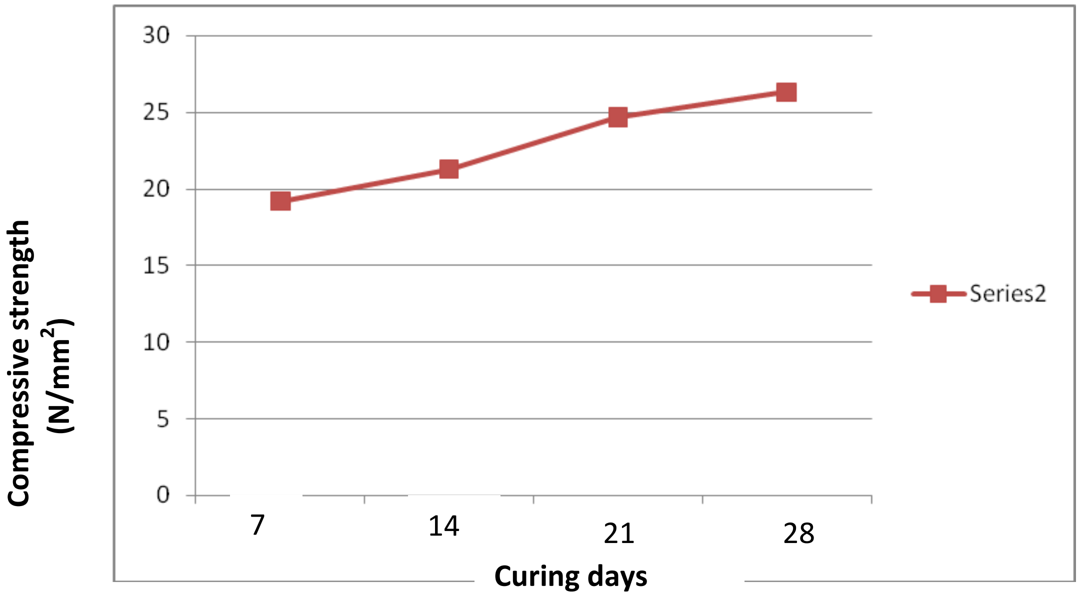

Fig. 1: Compressive strength versus curing days for 0%

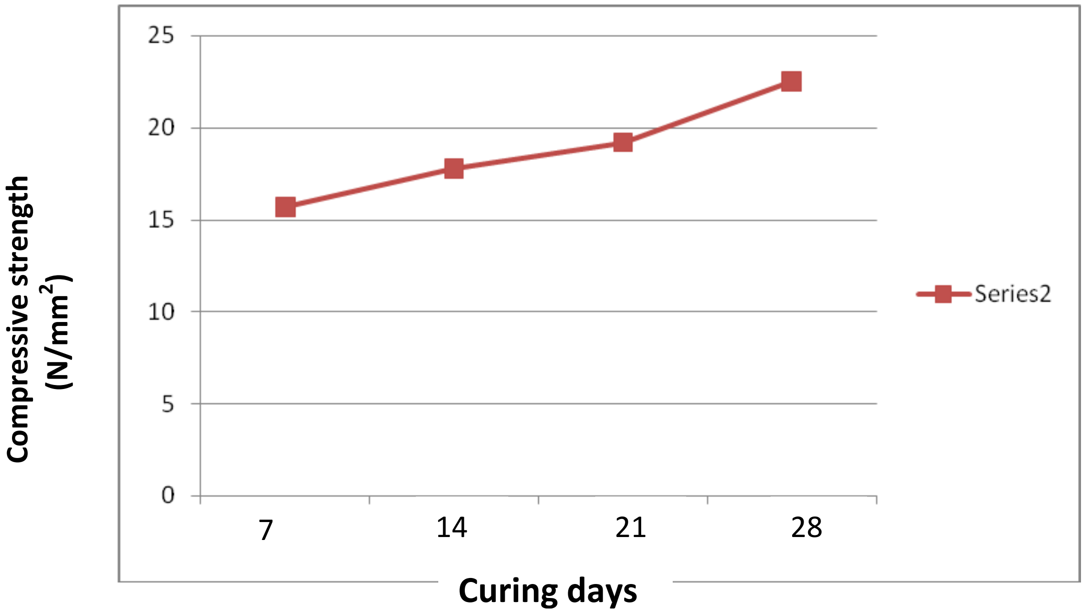

Fig. 2: Compressive strength versus curing days for 10%

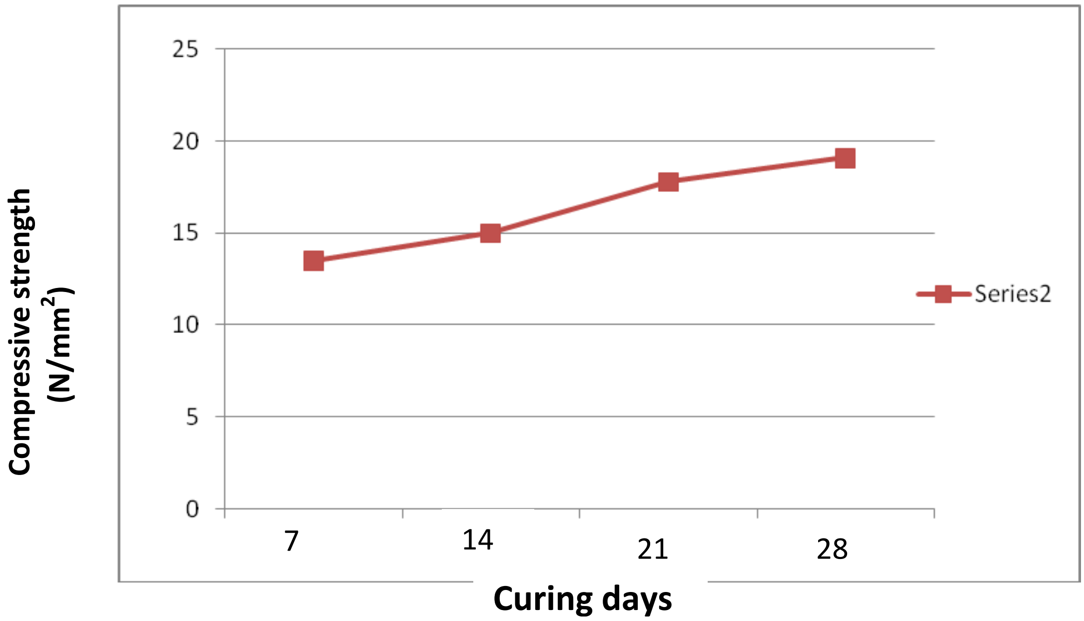

Fig. 3: Compressive strength versus curing days for 20%

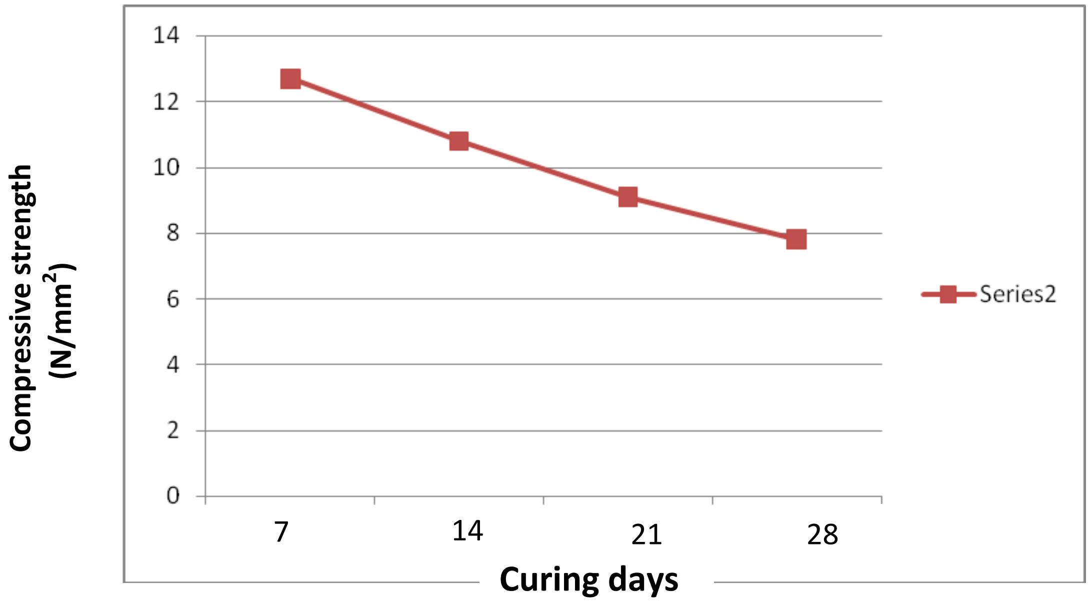

Fig. 4: Compressive strength versus curing days for 25%