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EFFECT OF RHA/MACUBA ON COMPRESSIVE STRENGTH OF CONCRETE

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ABSTRACT

Rice husk ash and Macuba mixture was used to replaced cement in concrete mixture. Different proportions of RHA and Macuba were intimately mixed together in an equal proportion to form a homogeneous mixture. The mixture then used in replacing cement with 0%, 5%, 10%, 15%, 20% and 25% proportion, then used to produce concrete. Concrete mixes of 1 part cement/rice husk ash/macuba mixture to 2 parts fine aggregate to 4 part coarse aggregate (1:2:4) were produced a total of 36 cubes of concrete size 150x150mm were prepared, cured for seven and twenty eight days and tested for slump and compressive strength. From the results of analysis of this study, it is observed that rice husk ash and macuba mixture as partial replacement of cement content in concrete reduces compressive strength but improves workability at 5% to 10% partial replacement and considerably reduces at 15% to 25% partial replacement of cement.

INTRODUCTION

Concrete is a universal material that is used in almost every area of construction (Blackedge, 1987). It is a mixture of well proportioned constituent material, namely, cement, aggregates and water. Cement provides the binding medium, and in the presence of water it hydrates to form cementitious substances that exhibit, high rigidity. The aggregates further enhance the rigidity and dimensional stability to the concrete (Neville, 1988).

Considerable efforts has been taken worldwide to utilize local natural waste and by-products materials as supplementary cementing materials to improve the properties of cement concrete as well as the use of these materials leads to the proper disposal of natural waste results in the less impact on environment in order to reduce the loss due to improper disposal of the waste (Pravin et.al, 2011).

A pozzalana may be added to the constituent's material of concrete to partially replace the cement content (Malgotra and Mehta (1996)). Pozzalana is a material other than cement, sand, gravel and water that is used as an ingredient of concrete and is added to the mix immediately before or during mixing. Pozzalana may often be cheaper than Portland cement it replaces, but its chief advantages lies in slow hydration and therefore low rate of heat development. Hence, Portland pozzalana cements or partial replacement of Portland cement by the pozzalana is used in massive concrete construction (Day,1990).

This paper present the preliminary investigation of concrete compressive strength partially replaced with the mixture of rice husk ash (RHA) and macuba. Rice husk is a by- product of the rice milling process, is available in abundance and is low in cost. Macuba is made from the pod of the locust bean tree, Genus parkia (Dorawa in Hausa), which is commonly grown in all parts of northern Nigeria. The seed and the fruits of the tree are made for food where as the pod (shell of the fruit) is ground to form Macuba. Previous researches show Rice husk ash as a good pozzolana (Day (1990) and Siddique (2008)), while Macuba was found to be a weak pozzolana (Rakiya (1992) and Muhammad (1995)). Therefore, it is the aim of this research to investigate the effect of combining rice husk ash (a good pozzolana) and Macuba (a weak pozzolana) on the compressive strength of concrete.

MATERIALS AND METHODS

Cement

The cement used for this research work is the ordinary Portland cement manufactured by Ashaka Cement plc. .

Fine Aggregate

The fine aggregate was naturally occurring, clean sharp sand sourced locally.

Coarse Aggregate

The coarse aggregate use in this project research was made of crushed granite obtained from the PW quarry in Kano. It was passed through 20mm sieve, and particles between 5mm to 20mm were used for the experiment. Therefore, the maximum size of aggregate used for this experiment is 20mm.

Rice Husk Ash

This was obtained from Tudun wada Madobi in Madobi local government, Kano State. The ash were obtained by burning the husk at open temperature.

Macuba

This was obtained from Kasuwar Rimi in Kano city. And it was sieved to obtained its finer particles passing through No.200 sieve.

Water

Clean tap water was used for this experiment, which was assumed to be fit for drinking.

Mixture Composition and Preparation

The rice husk ash and the Macuba were intimately mixed together in an equal proportion to form a homogenous mixture. This mixture was then used to partially replace a cement to be used for the concrete. The partial replacement was done in the following proportions, 0%, 5%, 10%, 15%, 20% and 25%. The 0% mix represents the control mixture, whereby only cement is present.

While serial number 2 in table 1 represent 95% cement and 5% mixture of Rice husk ash/Macuba. The remaining percentages (10%, 15%, 20% and 25%) followed similar pattern. These mixtures were also thoroughly mixed to form a homogeneous mixture before being used as binders for the concrete.

The binders were then mixed to form a concrete in a proportion of one part binder to two part fine aggregate to four part coarse aggregate (1:2:4) using water/binder ratio of 0.55.

The mixes are as shown in Table 1.

Table 1: Summary of Concrete Mixes

S. No.	(RHA/Macuba) Percentage replacements (%)	Concrete Mix Ratio (C+(RHA/macuba)):A1:A2
1	0	(1.0 +0.0):2:4
2	5	(0.95 + 0.05):2;4
3	10	(0.90 +0.10):2:4
4	15	(0.85 +0.15):2:4
5	20	(0.80 +0.2):2:4
6	25	(0.75 +0.25):2:4

Notes

C+(RHA/macuba): indicates: Cement + Rice husk ash + Macuba

A1: indicates Fin(e aggregate

A2: indicates coarse aggregate

Testing Methods

Using the mixes in Table 1, a total of 36 cubes were casted, using mould, 150 x150x 150mm. For each mix, a slump test was conducted on each sample in accordance with BS 1881-102: 1993. The cubes were then cured for 7 and 28 days, after which they are tested for

compressive strength in accordance with BS 1881-Part 116:1983.

RESULTS AND DISCUSSION

Slump Test

Slump test result is shown in Table 2.

Table 2. Results Of Slump Test On Concrete With Varying Percentage Of Rice Husk Ash And Macuba mixtures.

S. No.	(RHA/Macuba) Percentage replacements (%)	SLUMP (mm)
1	0	13
2	5	15
3	10	16
4	15	11
5	20	10
6	25	9

The result in Table 2 is presented in graphical form in Figure 1.

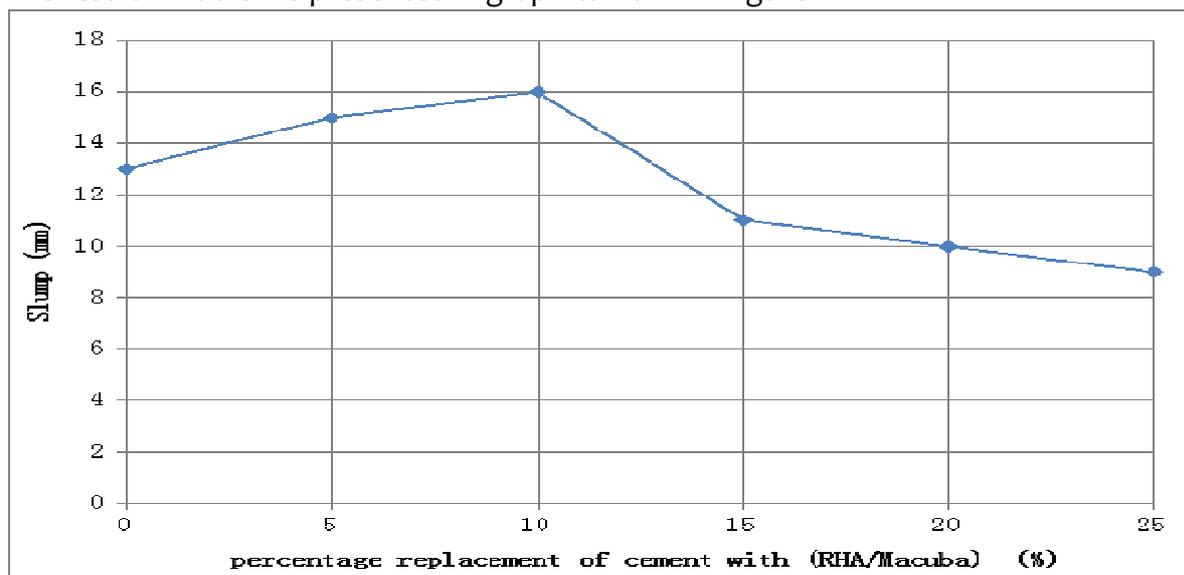


Figure 1: Slump against percentage replacement of cement with RHA/Macuba

It can be seen from Figure 1 that, there is an increase in slump from 0% replacements to 10% replacement. After 10% replacement the slump then decreases up to 25% replacement. It can be seen that the slump has a maximum value at 10% replacements. Whereas, at 15% 20% and 25% partial replacement, the water demand is higher causing the slump to reduced considerably.

It can be deduced that mixture of rice husk ash and macuba absorbs more water

than the cement, therefore concrete having higher mixture of rice husk ash and macuba will required more water for workability.

COMPRESSIVE STRENGTH TEST

Table 3 Shows the result of compressive strength test at seven days and twenty eight days of curing of concrete replaced with varying percentages of rice husk ash and macuba mixtures.

Table 3. Results Of Compressive Strength test On Concrete With Varying Percentage Of Rice Husk Ash And Macuba mixtures.

S. No.	(RHA/Macuba) Percentage replacements (%)	7 days Compressive strength (N/mm ²)	28days Compressive strength (N/mm ²)
1	0	31	36.7
2	5	27.2	30
3	10	5.8	23.4
4	15	3.6	12
5	20	2.64	3.73
6	25	0.81	2.0

The result in Table 3 is shown in graphical form in Figure 2.

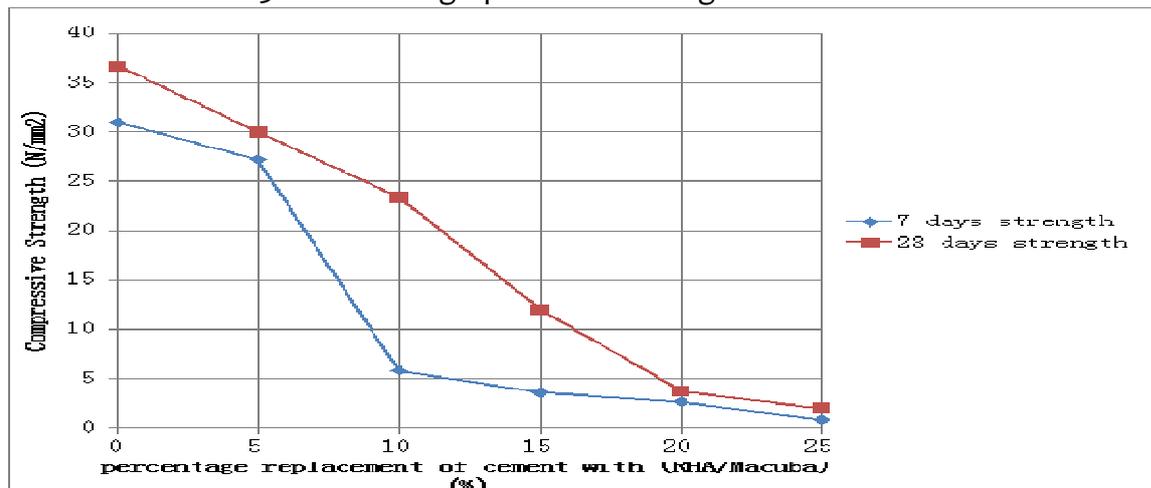


Figure 2: Compressive strength against percentage replacement of cement with RHA/Macuba

From Figure 2, the compressive strength decrease with increase in partial replacement of cement by combination of rice husk ash and macuba content. The figure 2 also shows that there is an increase in compressive strength from seven days to twenty eight days of curing in all the mixtures. Even though, 20% and 25% shows only a little increase.

From the 28 days result, 0%, 5% and 10% replacement have a compressive strength value above 20N/mm². This indicates that they can be used for normal construction. While, the remaining percentages replacement (15%, 20% and 25%), are not suitable for normal construction use.

CONCLUSION

The following conclusions were drawn from this study:

1. The research has given an insight into the behavior of concrete at

different percentages of rice husk ash and macuba mixtures as partial replacement of cement in concrete.

2. There is an increase in slump from 0% replacements to 10% replacement. After 10% replacement the slump then decreases up to 25% replacement. The slump has a maximum value at 10% replacements
3. The compressive strength decrease with increase in partial replacement of cement by rice husk ash and macuba mixture and increases with curing age.
4. Partial replacement of cement by rice husk ash and macuba mixture can be done up to 10% replacement. Above this optimum range the replacement is not advisable.

REFERENCES

- Blackledge, G.F. (1987) "Concrete practice" designed and published by the cement and concrete association, Wexham Springs, Slough S.L 3-6pl
- Day L. Robert, "Pozzolans For Use In Low-Cost Housing", A State of the Art Report prepared for The International Development Research Centre Ottawa, Canada, 1990
- Malgotra and Mehta (1996) "Pozzolan and cementitious" material published by Gordon and Breach.
- Muhammad H. G.(1995) "Effect of partial replacement of cement by Macuba on the strength properties of concrete" Unpublished thesis for the award of degree of B.Engr. Civil in Civil Engineering submitted to the department of Civil Engineering Bayero University, Kano.
- Neville A.M (1988) "Properties of concrete. Third edition, Published by Longman scientific and technical U.K. Ltd
- Pravin V. D., Sandesh D. D., Satish D, R.S.Deotale (2011). "Study of Various Characteristics of Concrete with Rice Husk Ash As A Partial Replacement Of Cement With Natural Fibers (Coir)" International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 1, Issue 3, pp.554-562
- Rakiya J. A.(1992) "Use of macuba as a local rendering admixture" Unpublished thesis for the award of degree B.Engr. Civil, submitted to the department of Civil Engineering Bayero University, Kano.
- Siddique R. (2008). "Waste Materials and By-Products in Concrete", Springer-Verlag Berlin Heidelberg