American Journal of Engineering Research (AJER)
e-ISSN : 2320-0847 p-ISSN : 2320-0936
Volume-02, Issue-12, pp-171-174
www.ajer.org

Research Paper Open Access

Influence of Neem Seed Husk Ash on The Tensile Strength of Concrete

Nuruddeen Muhammad Musa
(Civil Engineering Department, Kano University of Science and Technology, Wudil, Kano, Nigeria)

Abstract: - This paper presents the influence of Neem seed husk ash (NSHA) on the tensile strength of concrete. Neem seed husk is a by-product obtained during industrial processing of Neem seed to extract oil and produce fertiliser. Compressive strength, flexural strength and splitting tensile strength tests were carried out on concrete partially replaced with 0%, 5%, 10%, 15%, 20% and 25% NSHA. Test results shows that compressive strength decreases with NSHA replacement level, also, NSHA improves the flexural strength of the concrete. While Test results shows that 5%, 10% and 20% NSHA in the concrete improves the splitting tensile strength. An attempt also has been made to obtain a relationship between the compressive strength, flexural strength and splitting tensile strength.

Keywords: **-** *Compressive strength, flexural strength, Neem seed husk ash, splitting tensile strength.*

I. INTRODUCTION

Concrete is good in compression and poor in tension [1]. Understanding the response mechanisms of concrete under tensile conditions is a key to understanding and using concrete in structural applications, especially in determining concrete resistance to cracking. There are currently no well standardized test procedures for determining the direct tensile strength of concrete, that is, the strength under uniaxial tension. This is due to the difficulty involved in inducing pure axial tension within a specimen without introducing localized stress concentrations [2]. Therefore, several test procedures have been developed to indicate indirectly the tensile strength of concrete. These include: Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading), Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading) and Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens [2].

A Neem seed husk ash (NSHA) is obtained by burning a waste husk obtained during the extraction of oil from neem seed. The possibility of partially replacing cement with NSHA for use in low-cost construction has been shown by [3].

The present investigation has been aimed to determine the influence of Neem seed husk ash on the split and flexural tensile strengths of concrete, and the corresponding compressive strengths.

II. MATERIALS AND METHOD

(i) Materials

Dangote Ordinary Portland cement was used in this study. The cement has a specific gravity of 3.14, with initial setting time of 155minutes and final setting time of 208 minutes. Locally available sand has been used as fine aggregate. The specific gravity of the fine aggregate was determined to be 2.55. Also, locally available crushed stone aggregate of maximum size 20 mm was used. The coarse aggregate has a specific gravity of 2.75. The Neem seed husk used was obtained from Neem fertiliser processing plant, it was dried and burned in an open air, after which it was calcinated in an oven at temperature of 600^{o}C to produce an ash (NSHA).

(ii) Mix Proportion

In this study, concrete to achieve a target compressive strength of 25 N/mm^2 at 28 days was designed using the Absolute volume mix design method. Binders were prepared by partially replacing cement with various percentages of Neem seed husk ash (NSHA). The percentages are 0%, 5%, 10%, 15%, 20% and 25%

and they are by weight. The 0% is the control specimen. The binders were then mixed with the aggregates and water in accordance with the mix design proportion to form NSHA concrete.

(iii) Tests on Concrete

Compressive strength test was carried out on concrete with 0%, 5%, 10%, 15%, 20% and 25% NSHA, using iron mould of size 150 x 150 x 150 millimeter. Specimens are tested after 28 days in accordance with [5].
Flexural strength test of concrete with 0%, 5%, 10%, 15%, 20% and 25% NSHA replacement was carried out on rectangular beams measuring 150 mm x 150mm cross-section and 450 mm length. The beams were casted and cured for 28 days before tested using the three-point loading arrangement specified in [6].
Splitting tensile test of concrete with 0%, 5%, 10%, 15%, 20% and 25% NSHA replacement was carried out after 28 days in accordance with [7], on cylinder measuring 150 mm diameter and 300 mm length.
All the specimens were cured under water at room temperature until testing. Each strength value was the average of the strength of three specimens.

III. RESULT AND DISCUSSION

For all the concrete mixes, compressive, split tensile and flexural strengths were determined at the end of 28 days. Fig. 1 shows the variation of compressive strength with various NSHA replacement level. The compressive strength decreases with NSHA content. The variation is shown to have linear relationship as expressed in Eq. (1):

$$f_{cu} = -0.9837R + 27.111 \quad (R^2 = 0.9468) \qquad (1)$$

where f_{cu} and R denote the 28-day compressive strength and NSHA replacement, expressed in N/mm^2 and % respectively. From Fig.1 only 0% replacement and 5% replacement have satisfied the target designed strength of 25 N/mm^2. However, all the samples have attained the compressive strength of 20 N/mm^2 at 28 days; therefore they can be used for non-structural and mass concrete applications.

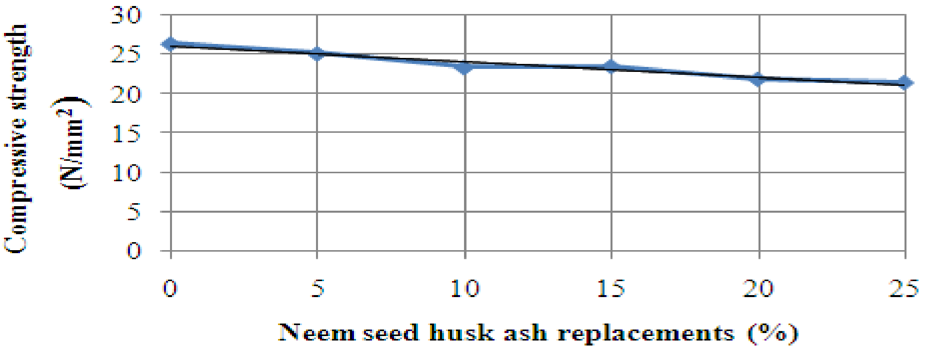

Fig. 1: compressive strength against various percentage replacement of Neem seed husk ash

(i) Flexural Strength

Fig. 2 shows the variation of flexural strength with various NSHA replacement level. It can be seen that addition of NSHA improves the flexural strength of the concrete. The increase in strength could be due to improvement of the interfacial zone between the paste and the aggregate in the presence of NSHA. The 5% replacement seems to have the highest flexural strength.

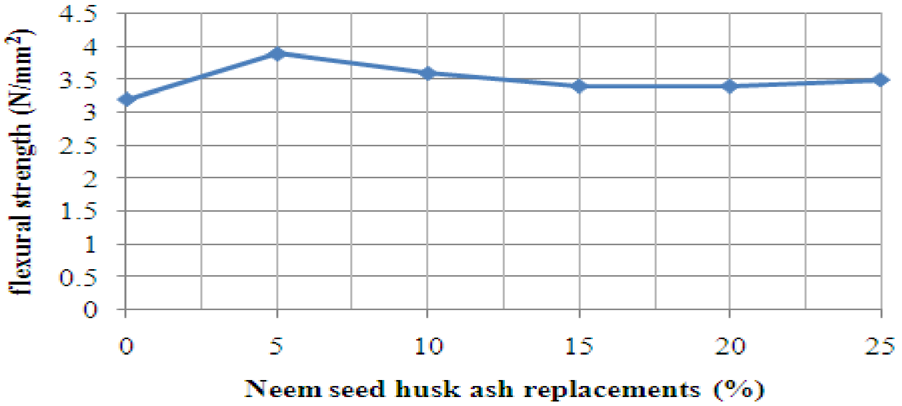

Fig. 2: flexural strength against various percentage replacement of NSHA

(ii) Relationship between Flexural and Compressive strength

Bhanja and Sengupta (2005) observed that no single equation seems to represent the flexural tensile strength with sufficient accuracy; therefore measured values should be used instead of predicated ones. In order to establish a potential relationship between flexural and compressive strength in this study, Eq. (2) was obtained from the test data:

$$f_{(fs)} = 3.9312 f_{cu}^{-0.037} \qquad (R^2 = 0.002) \qquad (2)$$

where $f_{(fs)}$ and f_{cu} denote the flexural strength and compressive strength respectively expressed in N/mm^2 . The coefficient of determination, R^2, was obtained between the test data and the regression equation. It is a measure of the portion of the total variability of the test data explained by the particular equation [8]. When R^2 is unity, all data points lies exactly or closely on the regression equation, and value of zero signifies no correlation between data points and regression equation. Therefore, statistically, there is little correlation between flexural and compressive strength of concrete containing NSHA.

(iv) Splitting tensile strength

Figure 3 shows the effect of NSHA replacement on splitting tensile strength. There is increase in splitting tensile strength from 0% replacement to 5% replacement, an increase of 11%. The strength further increases at 10% replacement, an increase of 18% higher than the control. The strength then reduces to 4% lower than the control at 15% replacement. At 20% replacement the strength is 3% higher than the control. At 25% replacement the strength is 8% lower than the control. Generally, 5%, 10% and 20% NSHA replacement increases the splitting tensile strength, with 10% replacement having the highest strength.

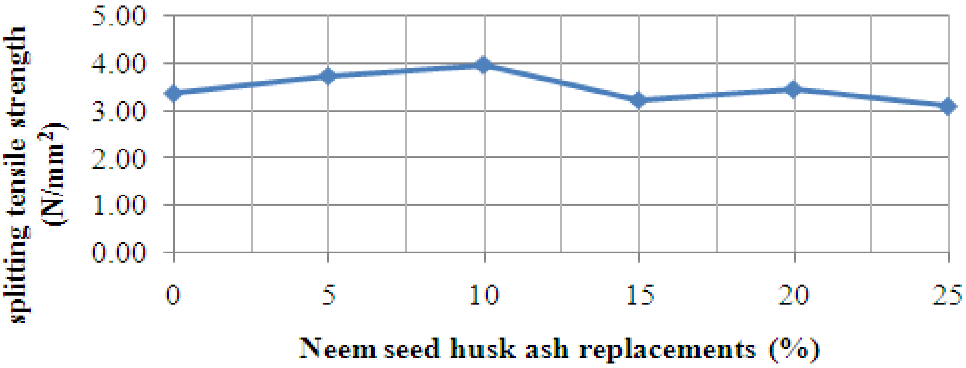

Fig. 3: splitting tensile strength against various percentage replacement of Neem seed husk ash

(v) Relationship between Splitting tensile strength and Compressive strength

Usually, the ratio of splitting tensile strength to compressive strength ranges from about 0.06 to 0.20 [9]. Based on this, the ratio of splitting tensile strength and that compressive strength are determined to be 0.13, 0.15, 0.17, 0.14, 0.16 and 0.14 for 0%, 5%, 10%, 15%, 20% and 25% respectively. These are compared with the recommended ratio of 0.06 to 0.20 and all the ratios are within the recommended limit. Furthermore, Fig 4 shows a relationship between splitting tensile strength and compressive strength using regression analysis.

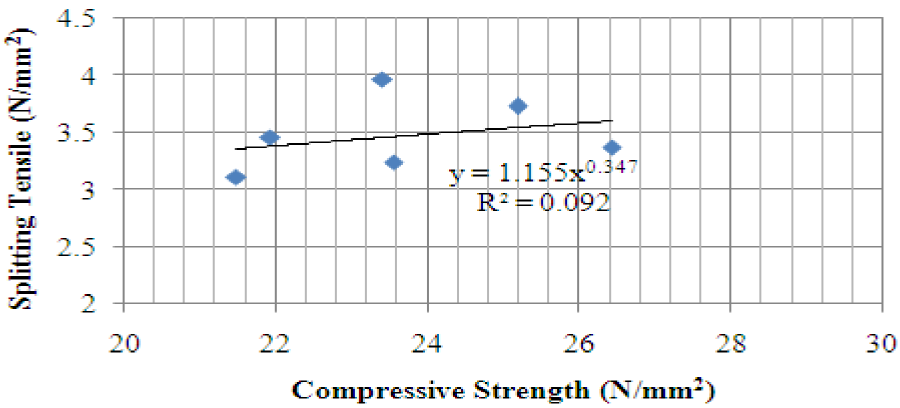

Fig. 4: Relationship between splitting tensile strength and compressive strength

(vi) Relationship between flexural strength and splitting tensile strength

Based on the test data, there is weak linear relationship between the flexural and splitting tensile strength as shown in figure 5.

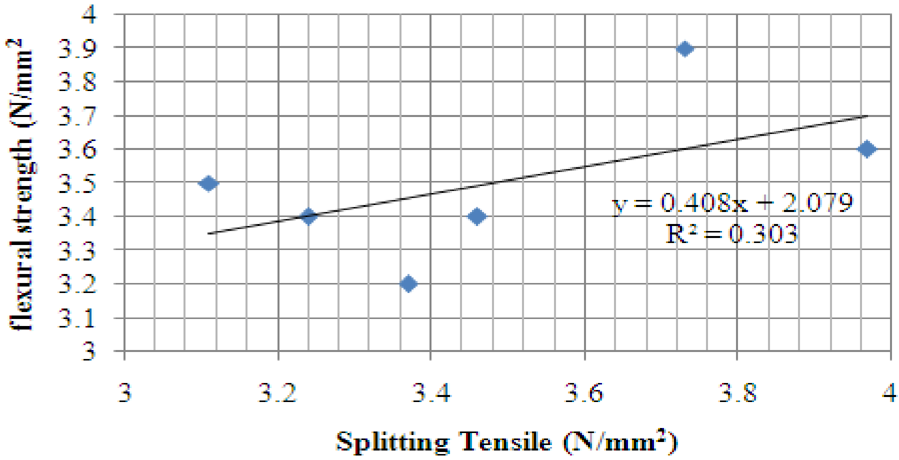

Fig. 5: Relationship between flexural and splitting tensile strength and compressive strength

IV. CONCLUSION

Based on the experimental results and discussions, the following conclusion can be drawn:

1. The compressive strength decreases with Neem seed husk ash (NSHA) content with 5% replacement level being the optimum level at 28 days.
2. NSHA improves the flexural strength of the concrete. The increase in strength could be due to improvement of the interfacial zone between the paste and the aggregate in the presence of NSHA. Statistically, there is weak relationship between flexural and compressive strength of concrete containing NSHA.
3. Test results shows that 5%, 10% and 20% NSHA in the concrete increases the splitting tensile strength
4. No strong correlation is obtained between the flexural and splitting tensile strength test data in this study.

REFERENCES

[1] Selim, P. (2008), "Experimental investigation of tensile behavior of high strength concrete", Indian Journal of Engineering & Material Sciences, Vol. 15, December 2008, pp 467- 472.

[2] Ozyildirim, C. and Carino, N. J (2006) : Concrete strength testing, chapter 13 of Significance of Tests and Properties of Concrete and Concrete-Making Materials STP 169D Edited by Joseph F. Lamond and James H. Pielert, ASTM Stock No.: STP169D ASTM International,100 Barr Harbor Drive, PO Box C-700, West Conshohocken, PA 19428-2959

[3] Nuruddeen M.M and Ejeh S.P., "Synergic Effect of Neem Seed Husk Ash on Strength Properties of Cement-Sand Mortar" International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 2, Issue 5, 2012, pp.027-030

[4] BS 1881-116:1983, "Testing Concrete: Part 116. Method for determination of compressive strength of concrete cubes", British Standards Institute, 389 Chiswick High Road, London, W4 4AL, http://www.bsi-global.com/.

[5] BS 1881-118:1983, "Testing Concrete: Part 118. Method for determination of flexural strength", British Standards Institute, 389 Chiswick High Road, London, W4 4AL, http://www.bsi-global.com/.

[6] BS 1881-117:1983, "Testing Concrete: Part 117. Method for determination of tensile splitting strength", British Standards Institute, 389 Chiswick High Road, London, W4 4AL, http://www.bsi-global.com/.

[7] S. Bhanja, B. Sengupta (2005)," Influence of silica fume on the tensile strength of concrete" Cement and Concrete Research 35 (2005) 743–747

[8] Choi, Y. and Kang, M. (2003), "The relationship between splitting tensile strength and compressive strength of fiber reinforced concretes", Journal of the Korea concrete institute, Vol. 15, No.1, February 2003, pp 155- 161.

[9] Avram, C., I. Facaoaru, O. Mirsu, I. Filimon, and I. Tertea, (1981). "Concrete Strength and Strains", Elsevier Scientific Publishing Company, pp.105-133, 249-251