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Synergic Effect Of Neem Seed Husk Ash On Strength Properties Of Cement-Sand Mortar

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ABSTRACT

Neem Seed Husk is a by-product obtained during industrial processing of Neem Seed to extract oil and produce fertiliser Neem seed itself is from Neem tree (Azadirachta indica). The synergic effect of Neem seed husk ash on cement-sand mortar and cement paste SEM were investigated. Flexural strength and compressive strength tests were carried out on cement-sand mortar partially replaced with 0, 5, 10, 15, 20 and 25% Neem seed husk ash. The hydration properties of cement paste partially replaced by Neem seed husk ash is investigated using SEM. The results obtained indicated that Neem seed husk ash replacements has a synergic effect on strength properties of mortar and can be used beneficially in the cement-sand mortar.

Keywords - Neem seed husk ash, Cement-sand mortar, Flexural, compressive, SEM

I. INTRODUCTION

The present society has shown increasing interest in the use of new materials in place of traditional products, which is aimed at reducing the latter's environmental impact. The use of pozzolanic materials, some of which are industrial by-products, preserves natural resources that are used in the production of cement, mortar and concrete [1]. About half of the amount of Portland cement consumed in building construction is used in masonry and plastering [2]. In those products, the maximum potential strength developed by the cement is never fully utilized. In fact, strength requirements for such applications are in the order of 4.0 MPa, while Portland cement is ideally suited for applications with strength requirements exceeding 15.0 MPa [3]. Materials with pozzolanic characteristics may thus partially replace the cement in those applications.

Neem Seed Husk is a by-product obtained during industrial processing of Neem Seed to extract oil and produce fertiliser. In producing Neem based fertilizer, extraction of neem oil is done first, and the resultant cake is used in making organic based fertilizer. Some little quantity of seed husk is crushed and ground into fertilizer formulation but large quantity usually lay waste. Neem Seed husk ash is obtained by burning the seed husk and the Neem seed itself is from Neem tree (Azadirachta indica). This paper studies the influence of Neem seed husk ash on The characteristics of cement mortars.

II. MATERIAL AND METHOD

The Neem seed husk used in this study was dried and burned in an open, after which it was calcinated in an oven at temperature of 600^{o}c to produce Neem seed husk ash (NSHA). Ordinary Portland cement which conforms to [4] was used in this study. Locally available river sand was used as fine aggregate was clean, sharp, free from clay and organic matter and well graded in accordance with [5]. Ordinary tap water, which is fit for drinking, has been used in preparing all the mixes and curing in this investigation as specified in [6].

2. Mortar Production

Mortar is a mixture of a binder material and sand. The mortar used in this study is one part binder material to three part sand (1:3) as specified in [7]. Firstly, the various percentages of NSHA/cement mixture were prepared by partially replacing cement with various percentages of NSHA. The percentages are 0 percent, 5 percent, 10 percent, 15 percent, 20 percent and 25 percent and they are by weight. The 0 percent is the control specimen. For other percentages, cement and NSHA are thoroughly mixed in dry powdered form in correct proportion. This was used as a binder and mixed in a ratio of one part binder to three part sand, using water/cement ratio of 0.50 as specified in [7].

Fifty four (54) prismatic test specimens measuring 40 millimeter × 40 millimeter cross-section and 160 millimeter length were produced and tested for flexural strength in accordance with [7] recommendations. These specimens were casted, de-molded the next day, and then cured in accordance with the standard procedure in water until tested at 7, 14 and 28 days.

3. Mortar Flexural Strength Test

The centre-point loading method was used to determine the flexural strength as specified in [7].

4. Mortar Compressive Strength Test

From the prism prepared for flexural test (40x40x160mm), a cube of 40mm x 40mm x 40mm was cut from the broken half of each of the prism after flexural test as specified in [7]. Compressive test was then conducted on each cube.

5. Scanning Electron Microscope (SEM)

The microscopic study of the NSHA paste using scanning electron microscope (SEM) was carried out using JEOL JSM840A scanning electron microscope (SEM). The paste sample used for the SEM was prepared by partially replacing cement with 0, 5, 10, 15, 20 and 25% NSHA, mixed using water-cement ratio of 0.5 and tested after 28 days curing.

III. RESULTS AND DISCUSSION

1. Mortar sand

The sand used for the study has specific gravity 2.55 and found to be suitable for concrete making as it complied with grading zone 2 of [5]. Figure 1 show its particle size distribution

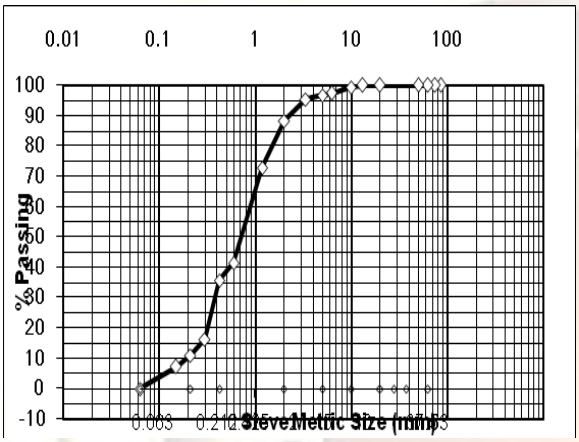

Fig 1: Particle size distribution of the Fine aggregate

2. Mortar Flexural Strength Test

Results of the mortar flexural strength test are presented in Figure 2.

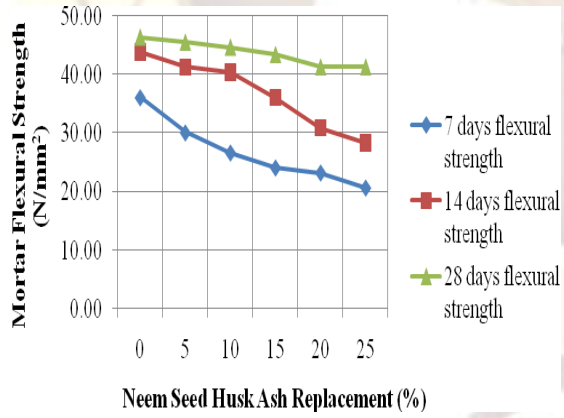

Fig. 2: Effect of NSHA replacement on Mortar flexural strength.

The mortar flexural strength increases with curing time and decreases with cement replacement by NSHA as can be seen in Fig 2. The graph shows almost a linear relationship.

Fig 3 shows a flexural strength development over a curing period of 7, 14 and 28 days. It can be seen from the graph that there is upward increase in strength with age for all replacement. Also, the strength move toward convergence at 28 days.

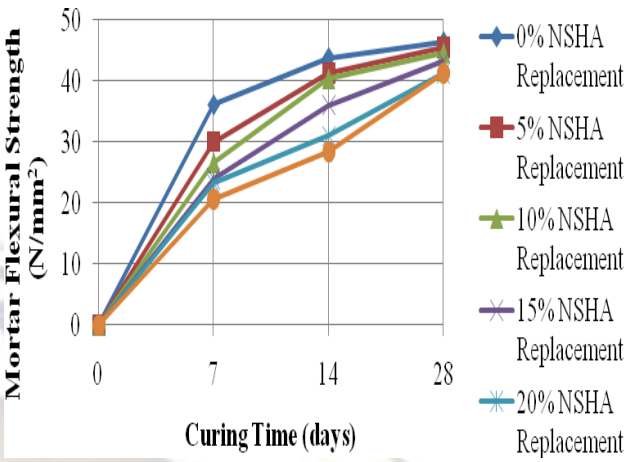

Fig. 3: Mortar flexural strength development at various replacements.

3.

4. Mortar Compressive Strength Test

Results of the mortar compressive strength test are presented in Figure 4.

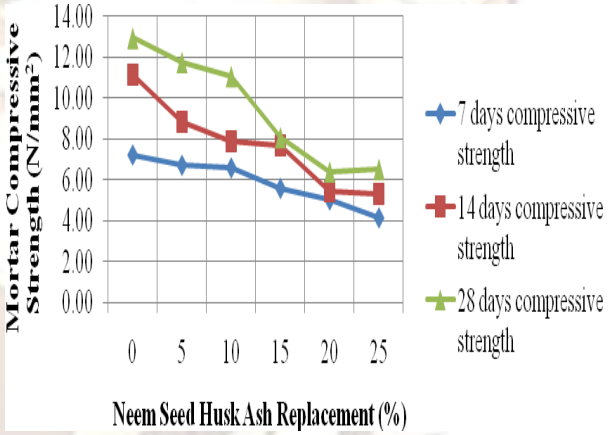

Fig. 4: Effect of NSHA replacement on Mortar compressive strength.

From Figure 4, the mortar compressive strength increases with curing time and decreases with cement replacement by NSHA as can be seen in Fig 10. Considering 28 days compressive strength result the values have satisfied the requirement of [8], where 6 N/mm^2 is stipulated as the minimum compressive strength for mortar.

Fig 5 shows a compressive strength development over a curing period of 7, 14 and 28 days. It can be seen from the graph that there is upward increase in strength with age for all replacement.

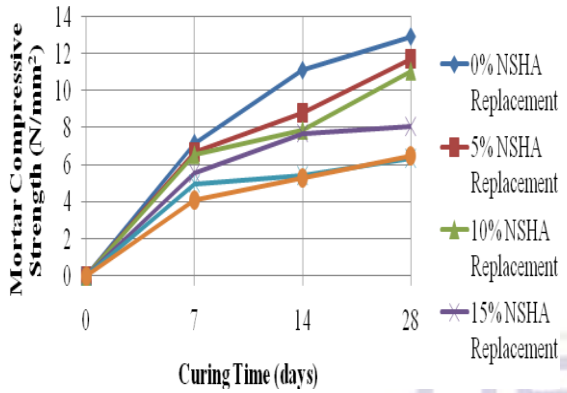

Fig. 5: Mortar compressive strength development at various replacements.

5. Scanning Electron Microscope (SEM)

Plate 1 to Plate 6 shows SEM (1000X Magnification) of cement pastes replaced with 0, 5, 10, 15, 20 and 25% NSHA which were studied after 28 days curing.

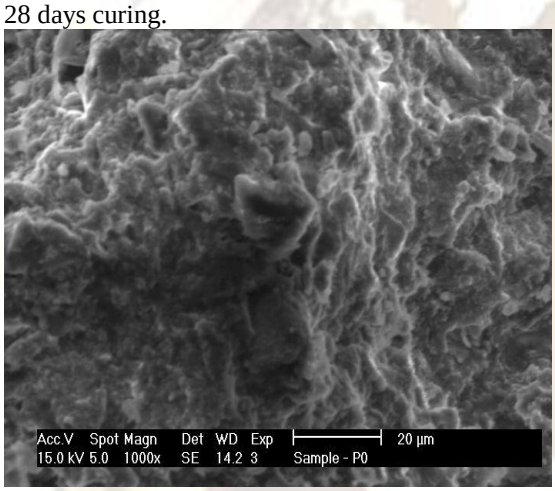

Plate 1: Paste replaced with 0% NSHA

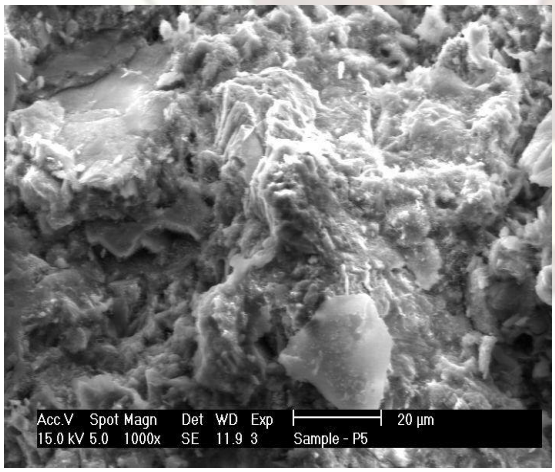

Plate 2: Paste replaced with 5% NSHA

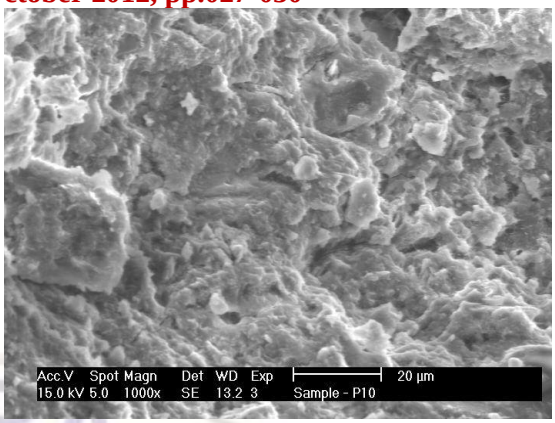

Plate 3: Paste replaced with 10% NSHA

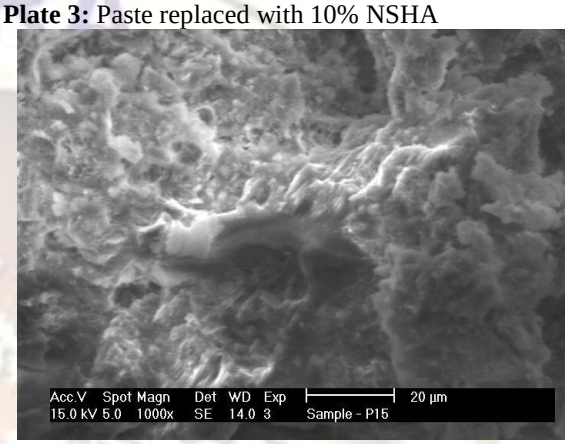

Plate 4: Paste replaced with 15% NSHA

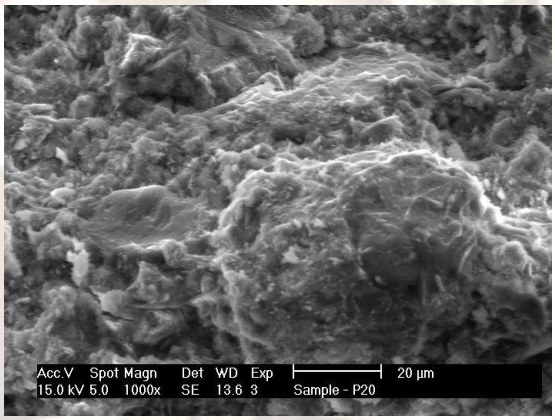

Plate 5: Paste replaced with 20% NSHA

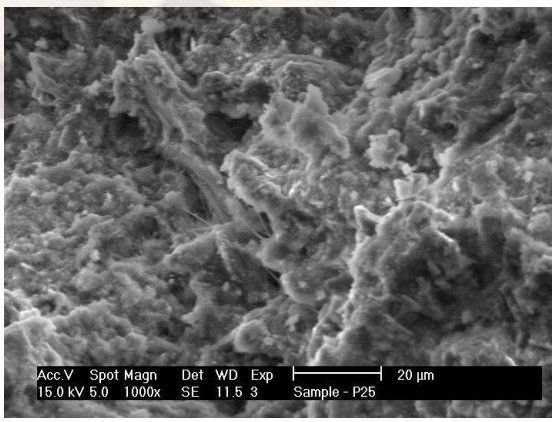

Plate 6: Paste replaced with 25% NSHA

From the Plates, it can be seen that SEM of cement paste replaced with 0% Neem seed husk ash at 28 days, has a less fibrous structure, with CSH occupying most of it. Only small CH can be seen. The other SEM of 5, 10, 15, 20 and 25% Neem seed husk ash replaced cement paste shows a more fibrous structure, having larger and more numerous CH.

The CSH can be identified by their fibrous grains forming a reticular network. While calcium hydroxide (CH) appear in many different shapes and sizes, starting from massive, platy crystals often tens of microns across with distinctive hexagonal prism morphology [9]. Also, incompletely hydrated Neem seed husk ash can be identified by their characteristic brightness.

IV. CONCLUSIONS

Neem seed husk ash was found to have synergic effect on the strength of cement-sand mortar. It was further concluded that:

1. Neem seed husk ash replacement on mortar flexural strength increases the strength with increase in curing time and decreases the strength with increase in NSHA replacement. Also, the mortar compressive strength increases with curing time and decreases with cement replacement by NSHA. Considering 28 days compressive strength result the values have satisfied the requirement of [8], and therefore Neem seed husk ash can be used to partially replace cement in a mortar.
2. Scanning electron microscope (SEM) of cement paste replaced with 0% Neem seed husk ash at 28 days, has a less fibrous structure, with CSH occupying most of it. Only small CH can be seen. While, the other SEM of 5,10,15, 20 and 25% Neem seed husk ash replaced cement paste show a more fibrous structure with larger and more numerous CH. This indicates the ash replacement has an effect on the system.

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