ANALYSIS ON MECHANICAL AND PHYSICAL PROPERTIES OF DIFFERENT KENAF CORE SIZES IN CEMENTITOUS

S. Hasfawandi[1], M.M.H. Megat Ahmad[1*] and M.Y. Yuhazri[2]

[1]Faculty of Engineering,
Universiti Pertahanan Nasional Malaysia,
Kem Perdana Sungai Besi, 57000 Kuala Lumpur, Malaysia.

[2*]Fakulti Teknologi dan Kejuruteraan Industri dan Pembuatan,
Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.

*Corresponding Author's Email: megat@upnm.edu.my

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ABSTRACT: The study investigates the mechanical and physical properties of cementitious composite reinforced with different kenaf core sizes (40 mesh, 20 mesh, 3mm, <10mm, <20mm). The composite is tested using flexural, compression, and swelling tests, with variations in cured and uncured samples. For compressive strength the maximum value is 0.66 MPa and 2.10Mpa for CX3 and CR1 respectively, meanwhile the minimum value was 0.16 and 0.15 MPa for CX5 and CR5 respectively. Besides, for flexural test maximum values were 0.14MPa and 0.72MPa for CX1 and CRI respectively. The minimum value is 0.03 MPa for both CX5 and CR5. Lastly, for swelling test maximum water absorption percentage were 0.12% and 0.17% for CR4 and CX4 respectively. The minimum percentage were 0.10 and 0.11 for CR1 and CX1 respectively. Both maximum and minimum values taken at time 24 hours.

KEYWORDS: *Kenaf Core; Cement; Mechanical Properties; Different Size; Water Absorption.*

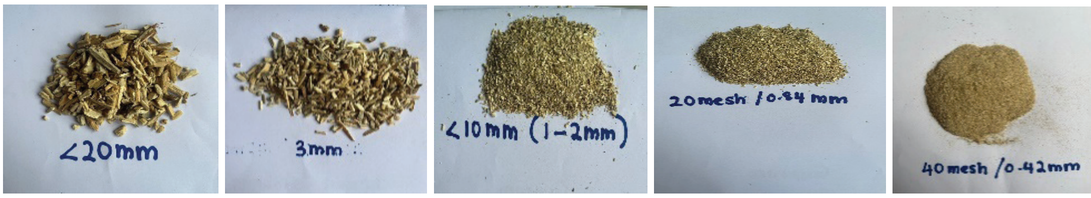
1.0 INTRODUCTION

Over the past few years, there has been a rising inclination towards utilizing natural fibres as reinforcements in the domain of composite materials Several benefits distinguish these composites from synthetic fibres, including reduced tool wear [1], low density, lower cost, greater availability, and biodegradability [2] or applications, bast fibres from plants including sisal, kenaf, flax, hemp, and jute are most often utilized [3]. The fact that kenaf has a particular modulus that is similar to glass fibre and has better mechanical qualities than other natural fibres, has been taken into consideration [4]. These are the known causes of styrene, plus a number of other very unwanted air pollutants originating from Note that some non-fiber glass fabrication processes release styrene as well. As for kenaf, it is one of the most popular natural fibers because of its high tensile properties, less mass density and renewable source. Kenaf, however, with its good moisture uptake and improved fire resistance ability is also applicable in a wide range of industries through providing cost-effective solutions to the use of natural fibers as reinforcement in composite materials. Several previous works have been done on the use of kenaf core for different applications, predominantly in ceramics composites. But still, there is limited study on it when used with gypsum material. As such those experiments were carried out according to test as follows: tensile, compressive, flexural and water absorption tests on kenaf core sizes in several different dimensions of the matrix material gypsum prior to analyzing how the mechanical properties as well physical property that involved with the size of kenaf core itself.

In reality, there have been numerous research studies conducted using kenaf fibres. Nevertheless, the core of kenaf, which is essential for comprehensive analysis, has received limited attention and is rarely investigated by researchers. Thus, the optimal characteristics of the two primary components—bast and core fibre—remain to be determined [5]. The purpose of the present work is to study the mechanical and impact properties of Kenaf core fibre reinforced cementitious composites as an alternative for effective disposal. The results, which will serve as a benchmark and provide valuable information to allow material scientists and engineers in producing more kenaf core composite goods.

2.0 METHODOLOGY

The kenaf core used in this research, which was acquired from Lembaga Kenaf dan Tembakau Negara (LKTN), has a variety of mesh sizes, including 40 mesh, 20 mesh, <10mm, 3mm and <20mm. Figure 1 shows variation of kenaf core size. The sample code for this research are C6 is no kenaf core, C1 (<20 mm), C2 (3 mm), C3 (<2 mm), C4 0.84 mm/ 20 mesh), C5 (0.42 mm/ 40 mesh).



(a) (b) (c) (d) (e)

Figure 1: Kenaf core size in mm (a) <20; (b) 3; (c) <2; (d) 0.84; (e) 0.42

In this research, the cement blend is meticulously made by hand by combining gypsum and water in a precise proportion to guarantee maximum appropriateness with same thickness for all sample at 25 mm. The mixing ratio is 1:1 based on weight fraction. The samples were cured in two conditions, which were cured for 28 days in soaked water (CR is sample code) and uncured (CX is sample code), where they were kept dry under the sun. All sample prepared and testing according to ASTM standard such as ASTM C1609 for flexural, ASTM D695, and ASTM C948.

3.0 RESULTS AND ANALYSIS

3.1 Flexural Performance

The kenaf core specimen was mounted for 3-point bend fixture in the shimadzu universal testing machine with the standard test speed 2mm/s. The force and compressive strength shown with the different types of specimens obtained from the flexural test. Same as the test mentioned before flexural test also has two vary conditions with the 6 types of variation samples. The average parameters for the flexural test sample were 28 mm in thickness, 75 mm width and length. The test indicates the material's ability to resist force from bending load.

Figure 1 shows C1 samples is considerable improvement with flexural strength 0.14 MPa (not cured, CX1) and 0.72 Mpa (cured, CR1). Besides, the minimum value is 0.03 MPa for both CX5 and CR5. From the result experimental show that C1 sample demonstrate the highest flexural strength and the C5 sample demonstrate the lowest flexural strength. In theoretically, the result same as the experiment for both samples sized. This indicated that cured of composite structure for minimum 28 days will improve flexural performance up to 112.57 %. This experimental result also show that large structure size of kenaf core will increase flexural performance as well due to nature of large shape will support more external loads [6].

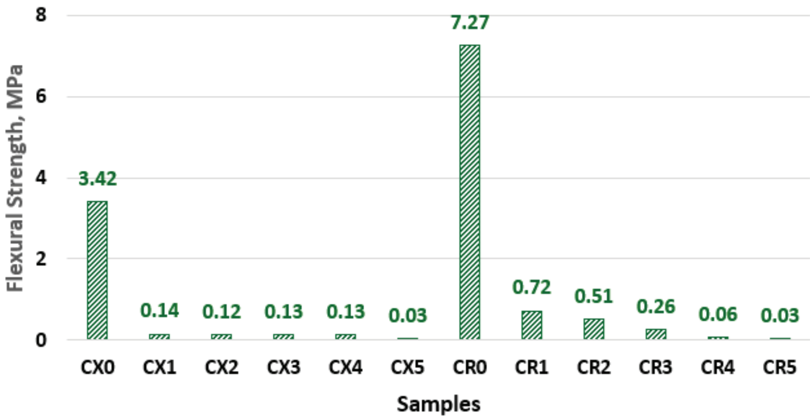


Figure 1: Flexrural strength versus sample type

More comparisons can be done with Khalil et al. [7] have been studied that natural reinforcement like kenaf influence the mechanical properties when accommodated properly in the matrix. They also, however, warn about possibilities of improper fiber distribution that can produce weak points and degrade the composite general structural integrity which agrees with the results observed in case of samples containing larger particles of kenaf showing the lower values of flexural strength and MOR.

3.2 Compression Performance

The force and compressive strength of the type of specimens provided includes compressive strength values for different specimens of kenaf core with various sized or mesh. The specimens tested in two conditions which were cured samples which soaked in water for 28 days and uncured samples which only dried under the sun for few days only. The average parameter of the specimens was 25 mm for the thickness, 75 mm for the width and length.

From the graph in Figure 3 show, for the uncured condition the C1 samples show considerable improvement with compressive strength 0.66 MPa (not cured, CX3) and 2.10 Mpa (cured, CR1). Meanwhile, the minimum value was 0.16 and 0.15 MPa for (not cured, CX5) and (cured, CR5) respectively. From the graph also, sample C5 for both cured and uncured samples have a minor compressive strength which proves that the samples are the most fragile and easy to crack from the axial force from the upper direction. For the maximum values of compressive strength, it should be the C1 samples for both cured and uncured. But from the experimental result only the cured result proves the CR1 sample has higher compressive strength. But for the uncured sample CX3 sample has the higher compressive strength. This is because of the CX1 sample having crack at the initial step of the experiment procedure.

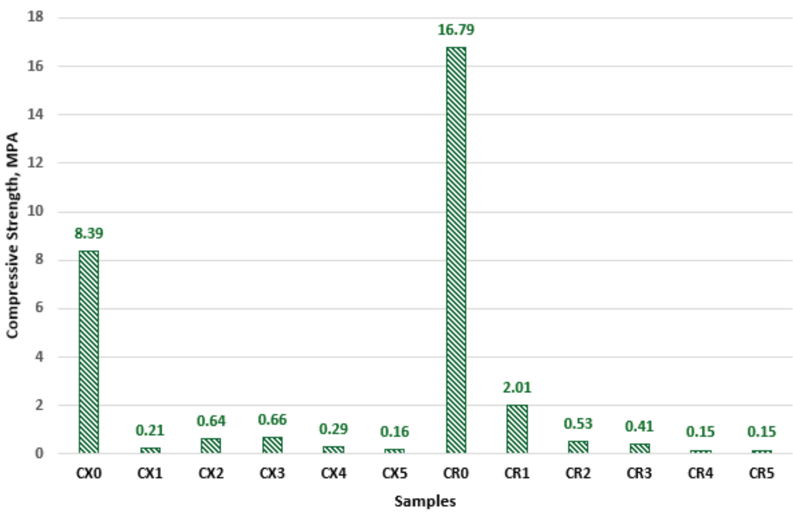


Figure 3: Compressive strength versus sample type

This indicated that cured of composite structure for minimum 28 days will improve compression performance up to 100.12 %. This experimental result also show that large structure size of kenaf core will increase compression performance as well due to nature of large shape will support more external loads [6] as same as for flexural property.

Sample C0 (pure cement) offers the highest benchmark values, but its significance is largely qualitative, heralding the benefits provided by integrating kenaf. Through modification of the size and dispersion of kenaf core particles in the cement matrix, materials like Sample C1 could be tailor-made to fulfil specific mechanical performance a wider range of applications in industries engineering fields.

3.3 Water Absorption Analysis

For the water absorption test, the test proceeds by soaking both various conditions samples (cured and uncured) in the water for 24 hours. The weight data was taken every 6 hours within a day as shown in Figure 4 and Figure 5. This demonstrates that 100% cement material was more capable of resisting water, allowing it to be used in those applications where high emphasis is placed on this property. Samples that had been mixed with the kenaf core particles showed higher water absorption. C4 for cured and not cure had the highest absorption rate of 0.17%, which was maintained after 12 hours or up to the end of the tests. This behaviour should be expected because fine particles of C1 would create a porous formation, with water absorbed into it. The product may not be useful in the interior applications but might be perfect for agriculture because of its moisture retention ability.

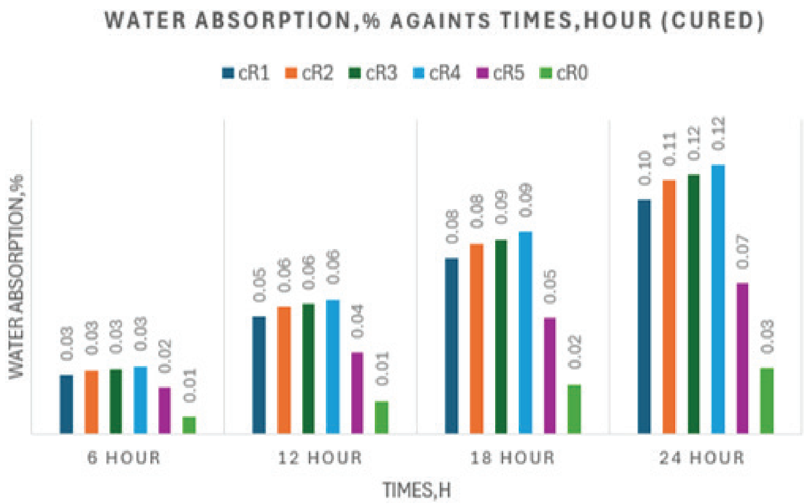


Figure 4: Percentage of water absorption on cured sample for 24 hours.

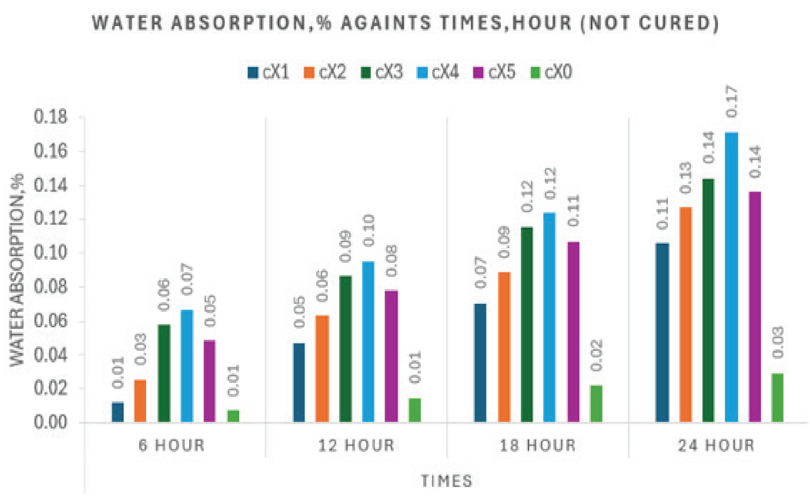


Figure 5: Percentage of water absorption on cured sample for 24 hours.

The larger particle sizes are likely to result in better structuring of the pockets of air that make capillary pathways through which water may pass. The scholars's study on snap of kenaf particles as raw materials for particleboard shows that finer particles result in far more porous snap, which can absorb notable amounts of water. Juliana et al. [8] also imply that larger snap may result in less porous snap, which cannot absorb notable amounts of water due to the limited ability for water ingress. The water absorption test results for our samples coincide with the recent study by Ahmad [9]. The scholars claim that finer fibers result in stronger capillarity and may absorb more notable amounts of water.

Ahmad [9] also reports that the larger the fibers, the slower the absorption of water by composites. The overall conclusion to be drawn from the results of our study and the study is that the size of the fibers used in the production of composites can be utilized to control how much water they absorb. The results obtained with Juliana et al. [8] further support the relationship between the size and distribution of fiber and the resulting properties of composites being of prime importance. The results show no signs of deficiencies that could be connected to experimental equipment or methods, indicating that the water uptake test produces reliable results.

6.0 CONCLUSION

The objective for this research to improve the cement and water mixture composite by add reinforment kenaf core fiber and to investigate mechanical and physical properties such as compressive strength and flexural strength and water absorption percentage of the different kenaf core sizes in the cement composite was identified. For the overall experimentaal result samples C1 more strong in both mechanical testing which was compressive test and flexural test for both cured and uncured. But for the uncured samples testing at compression test the CX3 is strong in compressive strength. But in physical testing the C4 (cured,uncured) samples prone to water absorption and C1(cured,uncured) sample have the lowest traits in water absorption percentage. As conclusion the most strong samples was sample C1 (cured,uncured) but in water absorption test C1 sample have the lowest result in water absorption test. This things could be overcome by adding coating

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