IMPROVINGTHEMECHANICAL PROPERTIES OF CONSTRUCTION MATERIALS FROM HMAWZAR VILLAGE APPLYING SAWDUST (WOOD FIBRES)

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Abstract

The elementary concentrations of local clay from Hmawzar village, Pyay District, Bago Division were investigated by using EDXR Fand XRDtechniques. The mechanical properties of currently used local bricks from Hmawzar village were investigated by using compressive testing machine and bending strength testing machine. Sawdust (wood fibres) with different weight ratios were thoroughly mixed to the local natural clayin homogenously and then this mixture is made into bricks. Then the properties of newly created bricks were measured. From the results of this research, sawdust (wood fibres) is the appropriate additive to prepare bricks with higher mechanical propertiesbut not more than 1wt% fibres content. It is intended to be able to improve the quality construction materials for the benefit of the nation by using the acquired out-coming knowledge and data investigated from this research.

Keywords : EDXRF, XRD, compressive strength, bending strength modulus

Introduction

Clay bricks are the most popular construction materials. It has been used as a major construction material because it can tolerate with severe weathering action and flexible properties.Traditional bricks which are made by the clay and chaff with paddy shell and then fired in kiln.

The mechanical properties of fibres include strength, elongation, elasticity and modulus of elasticity. In this research,wood fibers such as sawdust from sawmill are used as coupling agent in brick making process. Wood is a porous and fibrous structural tissue found in the stems and roots of trees and other woody plants. Sawdust is a waste from the wood and timber industry. The mechanical properties of wood are its fitness and ability to resist applied forces (Nicoleet. al,2003).

The various weight ratio of sawdust is mixed with clay to make the clay brick and to determine the effect of different fiber content.From this research, the mechanical properties of those bricks such as the compressive strength and the flexible bending strength can be expected to improve and so to give more effect in environment benefit.

Experimental Procedure

Fine powder of clay was obtained from dried natural clay at Hmawzar Village under sunshine. Then the dried powder was made pellets S1at Universities Research Center (URC). Furthermore, the natural clay and chaff of paddy shell were thoroughly mixed and had dried them. The well dried mixture was made pellet S2 at URC. Pellet samples S1 and S2were analyzed by Energy Dispersive X-ray Fluorescence Spectroscopy(EDXRF) and X ray Diffraction (XRD) techniques at URC, Yangon.

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A ditch of clay which is ($5' \times 5' \times 1'$) from Hmawzarvillage was thoroughly mixed with a bushel of paddy shell and suitable amount of water. This mixture is kept for 24 hours. Then it is mixed with a bushel of paddy shell again.

The brick samples were made in three different molds (214mm × 97mm × 57mm) rectangular shape, (25.4 mm × 25.4 mm) dumb-bell shaped and(345.7mm×106mm ×58.4mm) rectangular shape in Figure 2. Firstly, five brick samples for one kind were made clay and chaff only had been collected. And then, the sawdust (wood fiber)content of 0.5wt%, 1wt% and 1.5wt%were homogeneously mixed with clay to prepare for the molding bricks in Figure 1.Five bricks for one kind were dried under sunlight for 3 days. The dried brick samples were baked in kiln about 5 days for measuring compressive strength and bending strength. And then, the burnt brick samples had been investigated.

The compressive strength and bending strength of the prepared brick samples were examined by universal testing machine (GUNT HAMBURG)from structural laboratory at department of mechanical engineeringin Pyay Technology University and UPM-4 testing machine fromstructural laboratory department of civil engineeringin Yangon Technology University.

Figure 1 Sawdust (Wood-fibres) with clay mixture

Figure 2 Twomouldswith required measurements

Figure 3 Bricks for measuring the compressive and bending strength

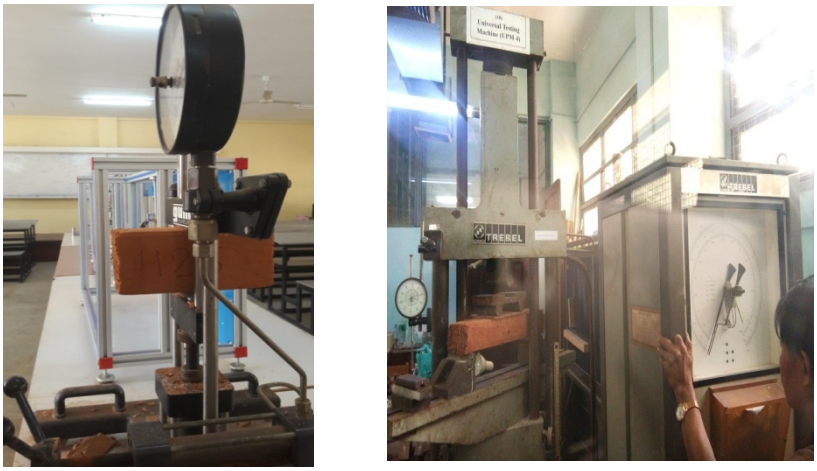

Figure 4 Compressive and bending strength testing machines

Experimental Results

EDXRF Analysis

The two pellet samples S1, S2 were investigated by EDXRF tostudy the contents of elements in these samples. Figure 5 and 6 showed the results of the EDXRF as the patterns and the concentrations of elements in sample S1 and S2 were shown in Table 1.

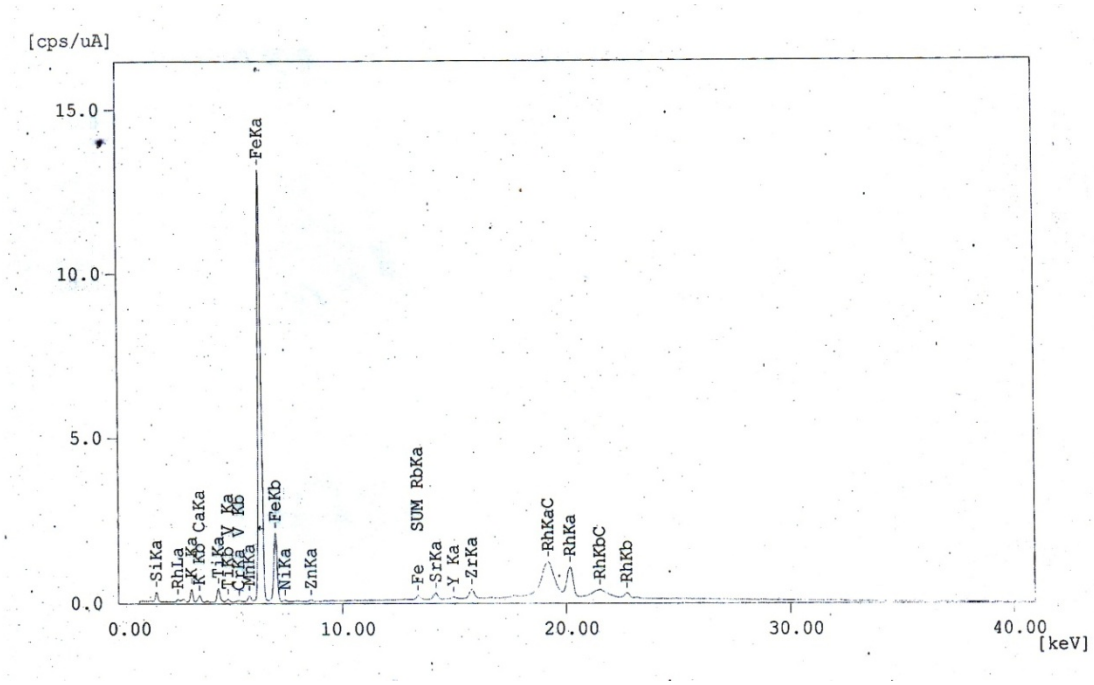

Figure 5 EDXRF pattern for sample S1

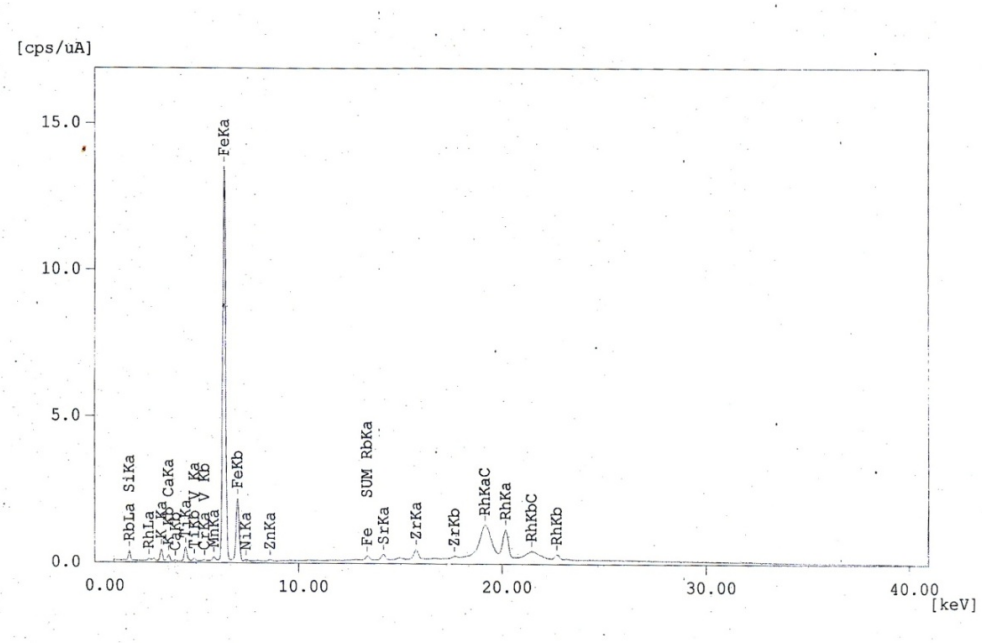

Figure 6 EDXRF pattern for sample S2

Table 1 Elementsconcentration for samples S1 and S2

Element	Sample S1(cps)	Sample S2(cps)
Si	1.7160	1.7286
Fe	107.3177	106.3175
K	2.7758	2.1158
Ti	3.1558	3.5481
Ca	1.2756	1.5121
Mn	1.3955	1.5853
Zr	3.5353	4.1870
Cr	0.2691	0.0691
Sr	1.9485	2.0211
Zn	0.4279	0.5125
Y	0.6680	0.2651
Rb	0.0318	0.0784

XRD Analysis

Pellet samples S1and S2 were analyzed by XRD technique and the results were examined with Joint Committee on Powder Diffraction Standard (JCPDS) data library file:Cat.No. 85-0795 for SiO_2 and 23-1009 for Al_2O_3, were studied for the content of silicondioxide and aluminum oxide. Theyare properties of cement. The results were shown in Figure 7,8 and their properties were shown in Table 2.

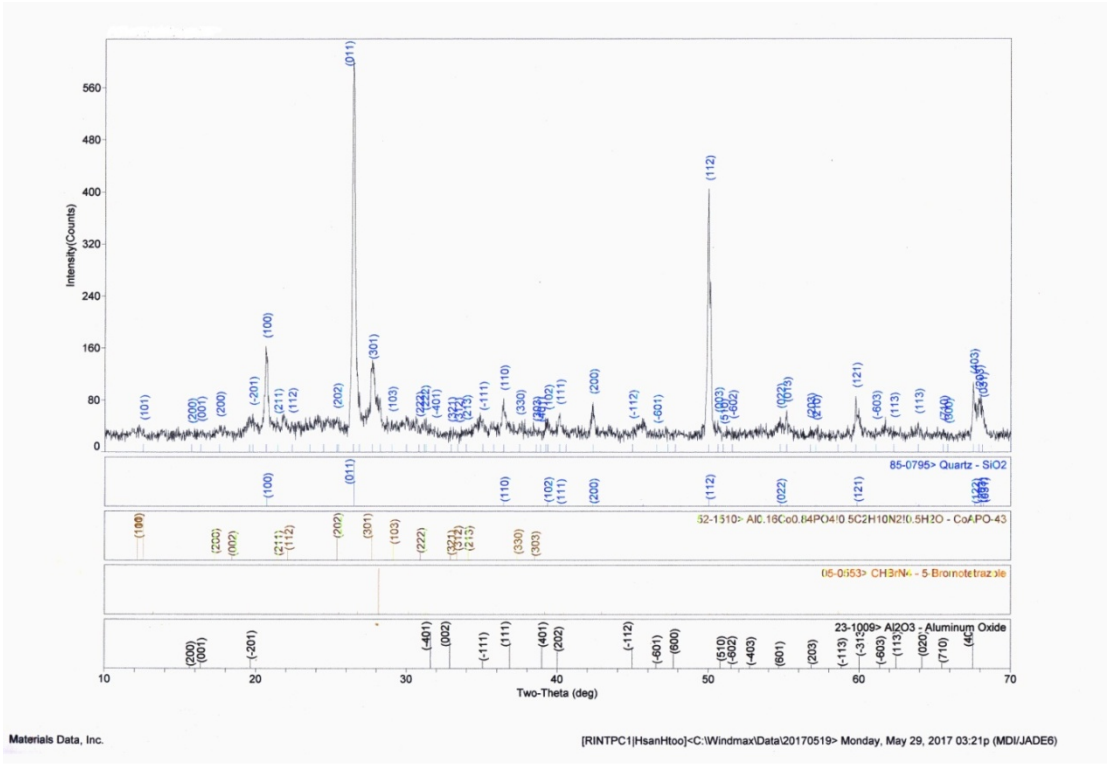

Figure 7 XRD pattern for S1

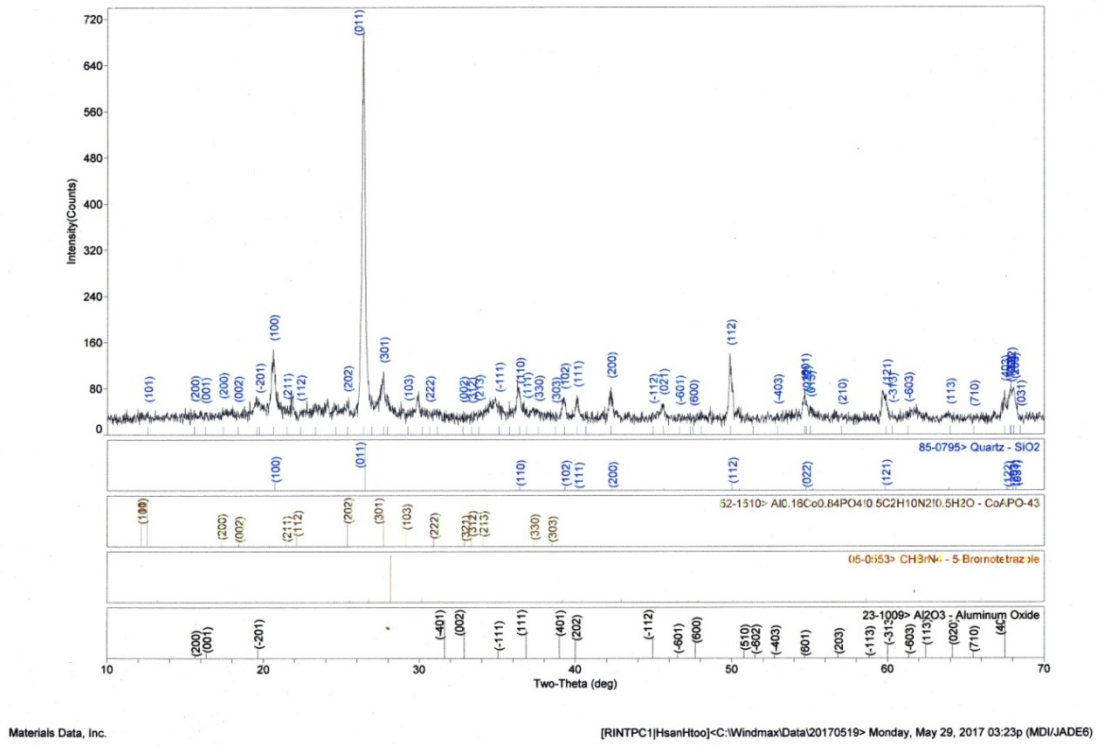

Figure 8 XRD pattern for S2

Table 2 XRD results for samples S1 and S2

	Plane	
	S1	**S2**
SiO_2	(011),(112),(100),(110),(121),(200), (111), (031), (022)	(011), (112), (100), (110),(121),(200), (111), (031), (022), (122)
Al_2O_3	(403), (710), (113), (-603), (-601), (-112), (111), (-111),(-210), (001), (200),(202), (-602)	(403), (710), (113), (-603), (-601),(-112), (111), (-111), (-210), (001), (200), (601), (-403), (600)

Compressive Strength

Table 3 Results for compressive strength

Sample	Average Compressive strength CS (MPa)
None(without fibres)	6.13
M1 (0.5 wt% of fibres)	6.79
M2 (1 wt% of fibres)	8.66
M3 (1.5 wt% of fibres)	3.76

Bending Strength Modulus

Table 4 Results for bending strength modulus

Load(N)	Average Bending strength modulusE_f (Mpa)			
	None	**M1**	**M2**	**M3**
100	83.9	106.6	117.8	100.6
150	86.6	126.7	139.8	125.1
200	89.2	125.2	161.3	149.1

Discussion

According to EDXRF results,Fe contains the highest concentration of elements in sample S1 and S2. The elements Si, K, Ti, Ca, Mn, Zr, Sr, V, Cr, Zn, Ni, Y and Rb are contained in sample S1 and S2 but different in little values (Chris, 1992).

According to XRD results, the clay and the clay with chaff from Hmawzar village have the properties of cement. The XRD results show that in sample S1, the planes (011), (112),(100), (110), (121), (200), (111), (301) and (022) identify with the planes of sample S2. But the plane(122) can be seen in the simple S2 only. All the planes can be attributed to silicate (SiO_2) plane which is matched well with the standard library file.

The planes in sample S1 and S2which (403),(710), (113), (-603), (-601), (-112), (111), (-111), (-210),(001) and (200)identify with the planes in AL_2O_3 from the library file in XRD. But the planes (202) and (-602) can be seen in sample S1 only. The plane (601), (-403) and (600) can be seen in sample S2 only(Guy, 1992).

According to the five conventional bricks, without wood fibre(None) and currently used in Hmawza of Pyay District, the average compressive strength is 6.13MPa. But The average compressive strength of0.5wt%(M1), 1wt%(M2) and 1.5wt% (M3)wood- fibres content bricks

are found to be 6.79MPa, 8.66MPa and 3.761MPa respectivelyin Table 3 and were describedwith bar graph in figure 9.

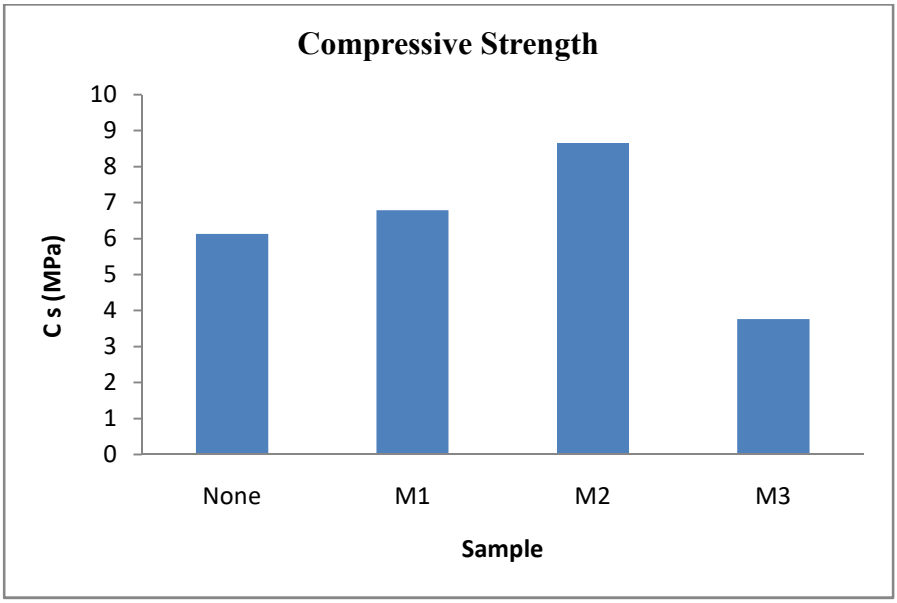

Figure 9 Compressive strength vs different fibres content

The average bending strength modulus of 5 bricks without wood-fibres (None) for each loadsuch as 100, 150 and 200N were 83.9MPa, 86.6MPa, 89.2 MPa. The modulus values of various fibres content bricks M1, M2 and M3 were increasing for every load. It was noted that the average bending strength modulus of M2 which has the highest values were 117.8MPa, 139.84MPa, 161.321MPa respectively. From the results of bending strength modulus were described with bar graph in figure 10.

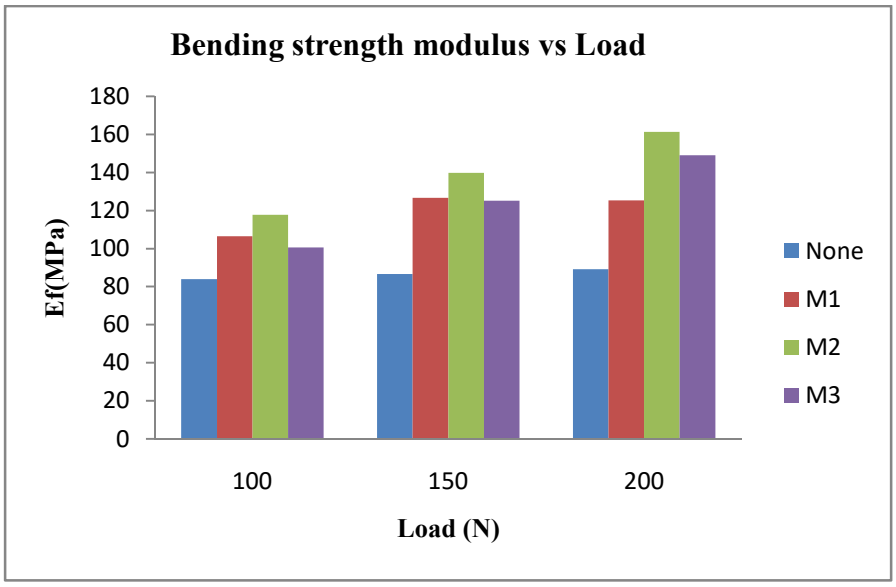

Figure 10 Bending strength modulus vs different fibre contents

Conclusion

According to the EDXRF results,iron (Fe) is the highest concentration in natural clay from Hmawzar village. When the natural clay was mixed with chaff, their consisted values are not changed. But rubidium (Rb) element contains in S2 is greater than S1. Rubidium element has the properties of tracking the trace of oxygen from the materials.

From the XRD results, silicon dioxide and aluminum oxide are found in the natural clayfrom Hmawzarvillage. They have the properties of cement. So, this natural clay has been appropriated for making bricks (Callister, 1997).

The average value of compressive strength of brick samples which were made by the mixture of natural clay and paddy shell without mixing wood fibre is 6.13 MPa. This value is to be agreed with the BIS (Bureau of Indian Standard,BIS 1077-1992) standard values of ordinary class clay brick. So that conventional bricks currently used in Hmawzarvillage is safein construction.

The average bending strength modulus of 5 bricks without wood-fibres (None) for each loadsuch as 100N, 150N and 200N were 83.9 MPa, 86.6 MPa, 89.2 MPa. The modulus values of various fibres content bricks M1, M2 and M3 were increasing for every load.

From the above mentional results, the wood-fibres are the appropriate additive to prepare bricks with higher compressive strength and bending strength modulus but not more than 1wt% fibres content.

And also it can be concluded that, the present work has primarily been focused upon the compressive strength and bending strengrh modulus will be supported for further studies concerning the environmental safety and protecting the building from damaging by the natural disasters such as earthquakes, storm, land-slide, etc.

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