EXPERIMENTAL INVESTIGATION ON THE IMPROVEMENT OF MECHANICAL PROPERTIES OF CLAY BRICK USING CORYPHA FIBRES

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Abstract

The currently used local bricks from Hmawzar Acient City, Pyay distinct, Bago division, were determined their compressive strengths. EDXRF,XRD techniques were used for the quality of earthling. In order to obtain the desired bricks, layers of coryphe fibres were inserted inside the bricks with distinct positions. Then the newly created bricks were used to investigate their mechanical properties such as compressive strength and density by using universal testing machine. This research work is intended to be able to use the qualitative bricks for the benefit of construction sites.

Keywords: EDXRF, XRD, compressive strength, density

Introduction

In Myanmar, clay bricks have been used as major construction materials. In Hmawzar village, Pyay district, the local currently used bricks are made by the mixture of clay and paddy shell and then baked for the construction of buildings. Bricks from that region are widely used due to their fair compressive strength. In this work, clay was used as raw material to make brick samples and they were examined by EDXRF method at Universities Research Centre (URC), Yangon.

In the present research work, layers of coryphe fibres were introduced by inserting them in bricks. And then the mechanical properties of those bricks such as the compressive strength and density were determined by universal testing machine from the structural laboratory at department of civil engineering in Yangon Technology University. Bricks with these properties can be expected to develop and to give more compressing resiliency from the effects caused by weather as well as the earthquake.

Corypha Palm

Corypha umbraculifera, the talipot palm, is a species of palm native to eastern and southern India and Sri Lanka. It is also cultivated in Southeast Asian countries of Myanmar, Thailand and the Andaman Islands. It is also grown sparsely in China. This palm tree is known as Paypin in Myanmar. It is a flowering plant with the largest inflorescence in the world. It is one of the largest palms with individual specimens having reached heights of up to 25 m (82 ft) with stems up to 1.3 m (4.3 ft) in diameter. It is a fan palm, with large, palmate leaves up to 5 m (16 ft) in diameter, with a petiole up to 4 m (13 ft), and up to 130 leaflets. The corypha palm is monocarpic, flowering only once, when it is 30 to 80 years old. It takes about a year for the fruit to mature, producing thousands of round, yellow-green fruit 3–4 cm (1–1.5 in) in diameter, each containing a single seed. The plant dies after fruiting. Historically, the leaves were written upon in various Southeast Asian cultures using an ironto create palm leaf manuscripts. In Philippines,

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it is locally known as *buri* or *buli*. The leaves are also used for thatching, and the sap is tapped to make palm wine. In South India, the palm leaves are used to make umbrellas for agricultural workers. [https:// en.m.wikipedia.org]

Experimental Procedure

A ditch of clay having volume with dimensions is $5' \times 5' \times 1'$ from Hmawzar village, Pyay district was thoroughly mixed with a bushel of paddy shell and suitable amount of water. That mixture was kept for 24 hours. Then it was mixed again with a bushel of paddy shell to prepare the soil for moulding as in Figure1(a). That soil was tested by EDXRF and XRD.

The stem of corypha palm was cut into strips and dried to make coryphe fibres. Thickness of coryphe fibres applied for the research was about$0.0394''$as shown in Figure 1(b) and (c).To obtain the proper bricks for measuring the compressive strength and density, mould with dimensions of$9.14'' \times 4.4'' \times 2.57''$ in Figure 2(a)was used.

For the second stage, to investigate the compressive strength, the soil was transformed into$9.14'' \times 4.4'' \times 2.57''$bricks.Five bricks were taken as a non-layer sample bricks. Next, corypha-fibres which want to be used to make layered bricks were sandwiched between soil in the mould so as to from alternate layers of coryphe fibres and soil. In this way, bricks containing one layer of coryphe fibres, two layers of coryphe fibres and three layers of coryphe fibres each for five bricks were made as shown in Figure 2(b)and (c). [Chee Ming, 2011]

To measure the density, five bricks with none -layer, five bricks with one layer and five bricks with two layers and five bricks with three layers were made as well. And then the modified sample bricks, both the non-layered bricks and layered bricks were heated under the sunlight for 15 days, and baked in the wood fire for 3 to 5 days. Then the sample bricks as shown in Figure 2(d)were then ready to be tested. [https://civilseek.com, 2019]

(a) (b) (c)

Figure 1 (a)Mixture of soil and paddy shell(b) Strips of Corypha palm's stem (c)Dried coryphe fibres

(a)

(b)

Figure 2 (a) Mould for sample preparation (b) Making bricks

(c)

(d)

Figure 2 (c) Brick before baking (d) Bricks for testing

Experimental Results

In this work, clay and paddy shell were used as raw materials to make brick samples and they were examined by EDXRF and XRD methods at Universities Research Centre (URC), Yangon.

Fine Powder of clay was obtained from dried nature clay under the sunshine. Then the dried powder was made pellet at URC and named M1 for Hmawza clay. Furthermore, the natural clay and paddy shell was mixed thoroughly and then has dried the mixture. The well dried mixture was made pellet at URC and also named M2.

EDXRF Result

The two pellet samples M1, M2 were investigated by Energy Dispersive X-Ray Fluorescence Spectroscopy (EDXRF) in Figure 3(a) and (b) to study the contents in the samples. According to the results in table 1, iron (Fe) is mainly contained in Hmawza clay.

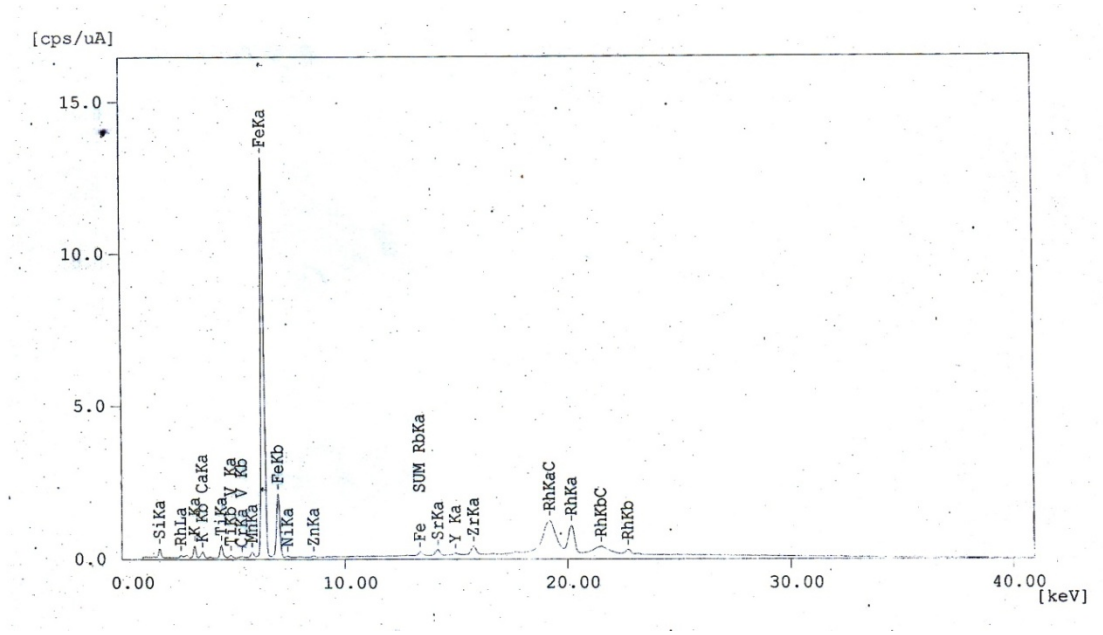

Figure 3(a) EDXRF pattern for sample M1

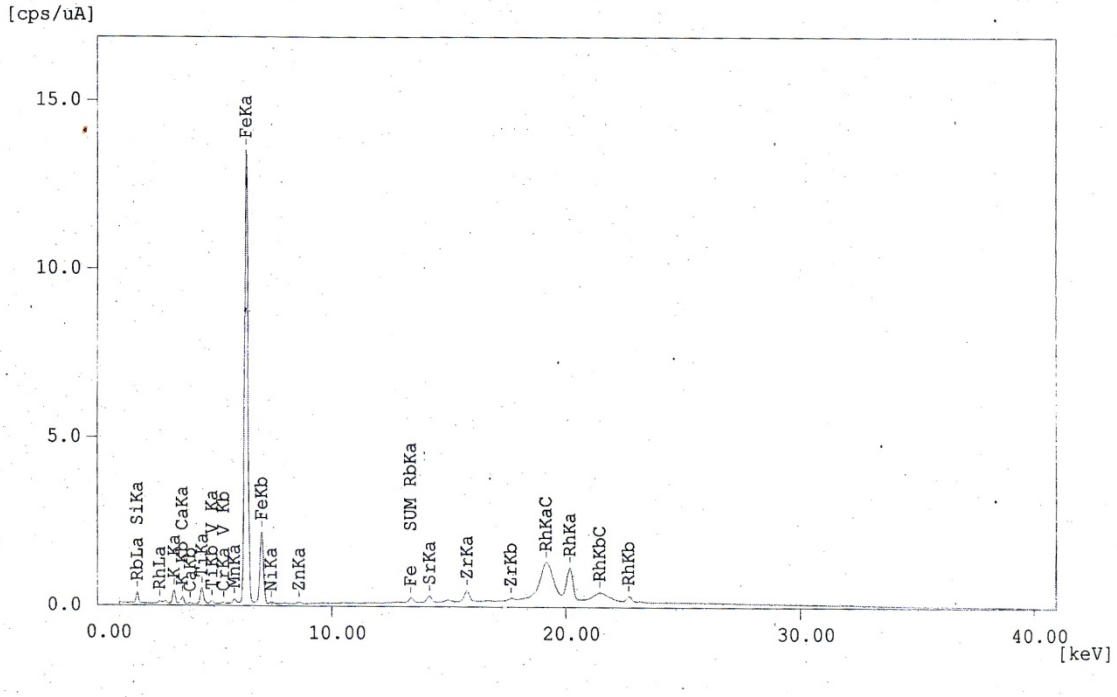

Figure 3(b) EDXRF pattern for sample M2

Table 1 Elements concentration for samples M1 and M2

Element	Sample M1(cps)	Sample M2(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 Result

Pelleted samples M1and M2 are analyzed by XRD technique and the results were examined with Joint committee on Powder Standard (JCPDS) data library file:Cat.No 85-0795 for XRD to study the content of silicon dioxide SiO_2 and 23-1009 for aluminium oxide Al_2O_3, that were properties of cement. All samples show sharp peaks of $SiO_2$and Al_2O_3 peaks were studied. The results were shown in Figure 4(a), (b) and table 2 respectively.[Callister,1997]

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 S2 which (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. [Guy,1992]

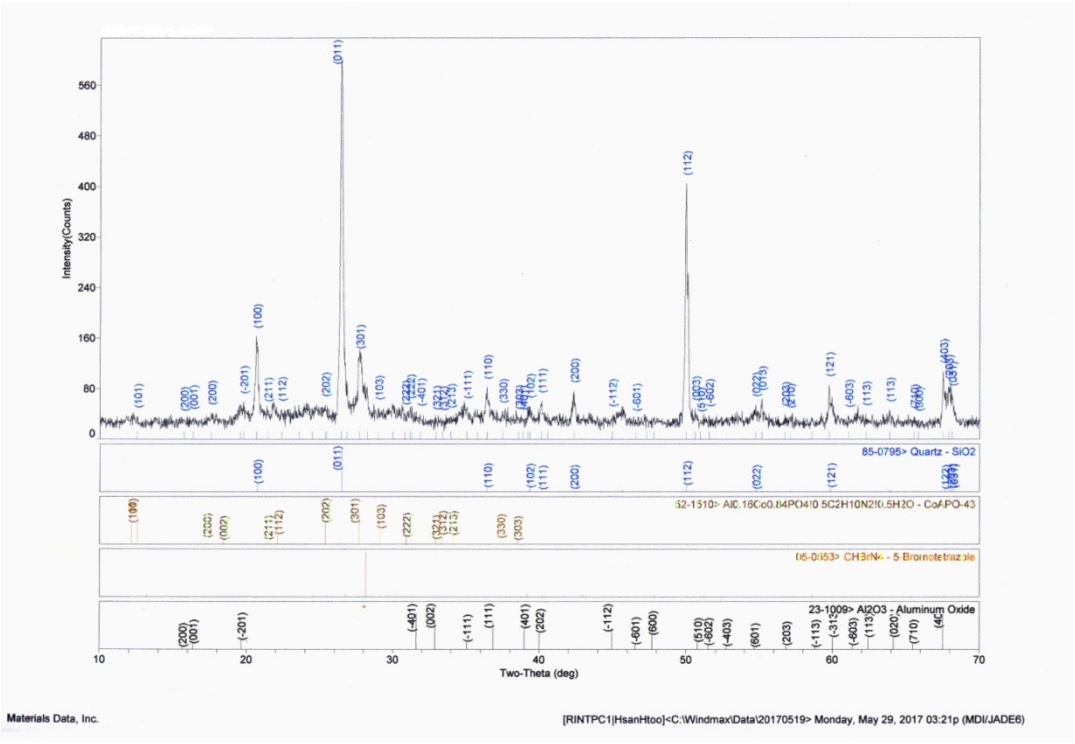

Figure 4(a) XRD pattern for sample M1

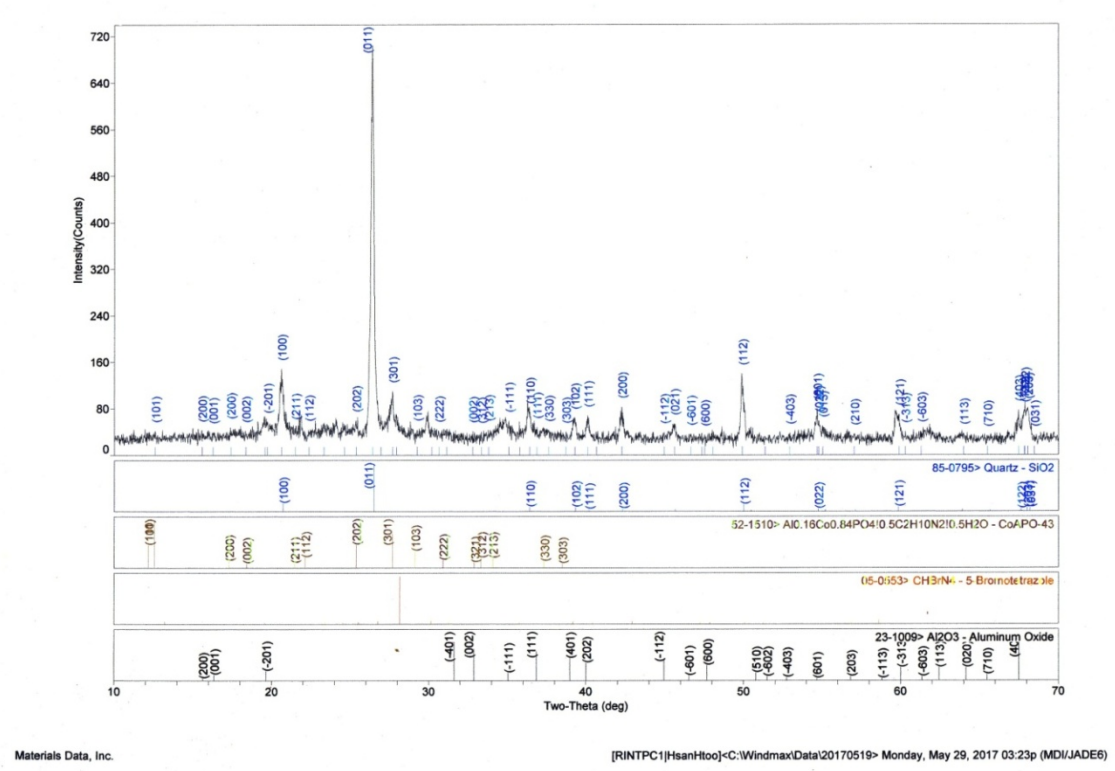

Figure 4(b) XRD pattern for sample M2

Table 2 XRD results for samples M1 and M2

	Plane	
	M1	**M2**
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 and Density Results

The compressive of brick sample were determined by compressive strength testing machine (RBU-250), shown in Figure 5,from the structural laboratory at department of civil engineering in Yangon Technology University.

The density of bricks or weight per unit volume depends mostly on the type of clay used and the method of brick molding. The results of compressive strength and density are shown in Table 3.

Table 3 Results of Compressing Strength and Density

Test Name	**None (without fibres)**	**One layer**	**Two layers**	**Three layers**
Average value of compressiveStrength (psi)	947.1	2543.5	2880	2288.5
Average value of density (gcm^{-3})	2.074	1.605	1.5529	1.4615

Figure 5 Compressive strength testing machine

Conclusion

According to EDXRF results, iron (Fe) contains the highest concentration of 107.3177cps in M_1 and 106.3175cps in M_2. The elements Si, K, Ti, Ca, Mn, Zr, Sr, V, Cr, Zn, Ni and Y are contained in sample M_1 and M_2 but different in little values. Rb element contains in M_1 as the value of 0.0318cps and contains in M_2 as the value of 0.0784 cps. Very small amount of some metal elements are also contained in clay powder samples from Hmawza village. From the results of XRD, silicon dioxide and aluminium oxide are contained in clay powder samples. Silicon dioxide peaks are more dominant than aluminium oxide peaks. Both silicon and aluminium are contents of cement elements and so the property of cement can be seen in those clay samples. [Chris,1992]

The average value of compressive strength of brick samples were made by the mixture of natural clay and paddy shell without inserting coryphe fibres is 947.1 psi (lb in^{-2}). This value is very agree with the BIS (Bureau of Indian Standard, BIS 1077-1992) standard values of ordinary class clay brick.So that conventional bricks currently used in Hmawza village is safe in construction. When the coryphe fibres of one and two layers were inserted in bricks, the compressive strength are increasing to 2543.5 psi and 2880 psi respectively. For the three layers of coryphe fibres, the value is decreasing to 2288.5 psi. According to the measurement results, the graph shows that the compressive strength of the bricks with two fibred layers is optimum. The observation is shown in Figure 6. [https://civilseek.com ,2019]

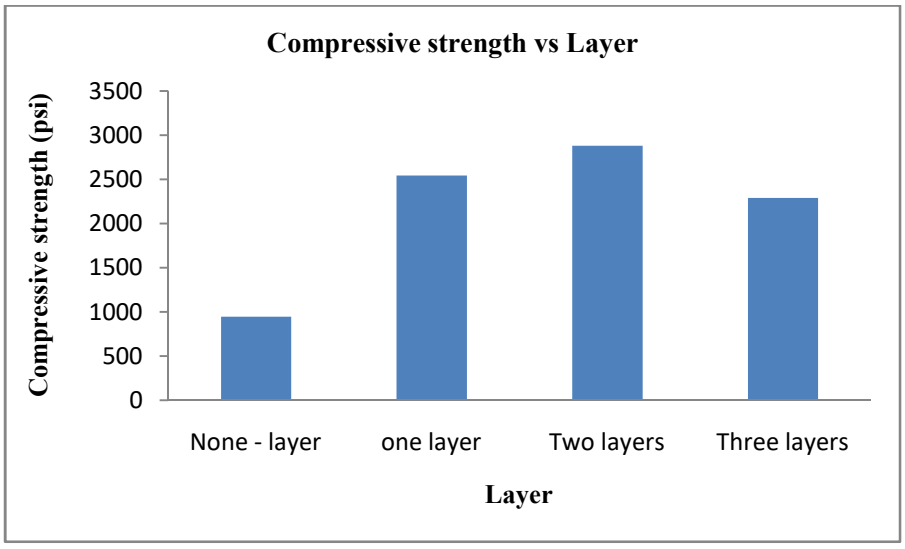

Figure 6 Compressive strength vs layer graph

The heat and sound conductivity of bricks vary greatly with their density. Very dense and heavy bricks conduct heat and sound at a greater rate. They have, therefore, poor thermal and acoustic (sound) insulation quality. For this reason, bricks should be so designed that they are light, strong and give adequate insulation. In this event, it shows that density of brick is decreasing continuously with increasing fibre contains. The sample bricks made from coryphe fibres are comparatively lighter than non-fibred layered bricks. The density of all layered bricks decreased with increased in volume fraction of coryphe fibres. Result of density test is shown in Figure 7. [https://civilseek.com, 2019]

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

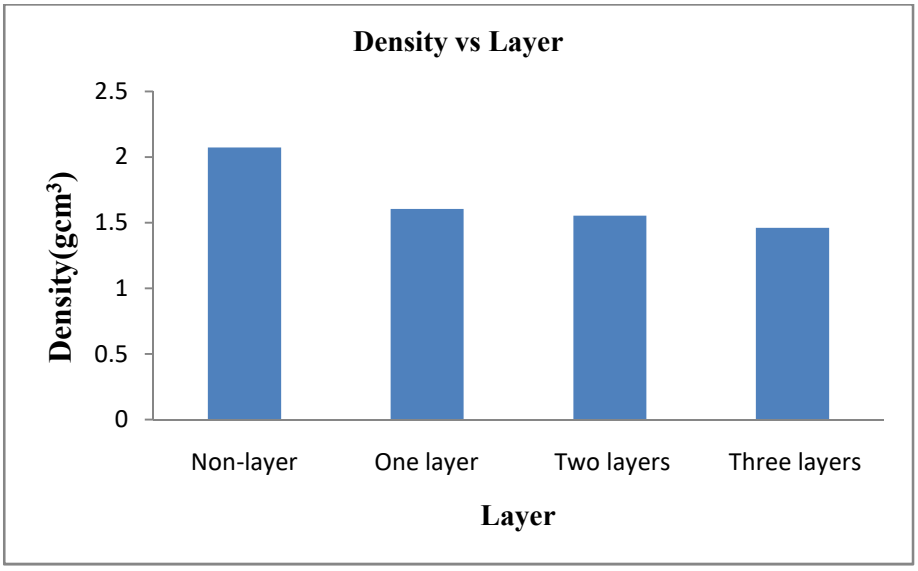

Figure 7 Density vs layer graph

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References

Callister.W.D., (1997), *Materials Science and Engineering* (Toranto: Wiley)

Chris Pellant, (1992), *Rocks and Minerals* (Dorling Kindersley limited, London)

CM Chan,World Academy of Science, Engineering and Technology International Journal of Civil and Environmental EngineeringVol:5, No:1(2011) scholar.waset.org/1307-6892/4241

Guy.A.G., (1992), *Introduction to Materials Science* (London: Mc Graw-Hill)

https://civilseek.com>Properties of Brick| A Complete Guide (15-3-2019)

https:// en.m.wikipedia.org