International Journal of Research and Review
Vol.7; Issue: 10; October 2020
Website: www.ijrrjournal.com
Research Paper E-ISSN: 2349-9788; P-ISSN: 2454-2237

Improvement of Air-Dried Earth Bricks Characteristics by Adding Oil Palm Shells

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ABSTRACT

The present study aims to determine the optimum dosage of oil palm shells in the soil to achieve better compressive strength of earthen bricks. The first part of this study is devoted to determining the characteristics of oil palm shells and soil. Then air-dried bricks are made by mixing soil, water and oil palm shells. The bricks made are kept in shade. Some of these bricks are regularly watered until the day of testing. The tests carried out on the bricks are the measurement of the compressive strength and the shrinkage on the 14th and 28th day of age. From this study it emerges that oil palm shells are a light and very resistant material that contains few fine elements. The earth used is predominantly clayey with a spread grain size and does not contain humus. Bricks compressive strength increases with in oil palm shells dosage and with age. The shrinkage decreases with oil palm shells rate. Watering improves bricks compressive strength and reduces their shrinkage.

Keywords: oil palm shells, compressive strength, clay soil, air-dried brick, watering.

INTRODUCTION

Earth has always been a very accessible building material. Its use, simple and economical, has many advantages which make it particularly interesting for obtaining ecological, aesthetic and comfortable housing. This is a material that has been used for thousands of years in many places around the world. Today, it is still in use in many countries. Earth can be used in different forms: wattle, mud, adobe, air-dried brick, burnt brick, compressed earth brick, stabilized earth brick. [1-4]

Raw earth offers many advantages such as high thermal inertia, good sound insulation, energy saving in air conditioning, low environmental impact, and reintegration into the earth at the end of the useful life of the construction, high stability and great resistance to fire. However, it has some drawbacks which are the limitation of the height of buildings due to its resistance, vulnerability to water and sensitivity to the effects of earthquakes. These drawbacks can be corrected by choosing appropriate solutions. Earth strength can be improved by compression (compressed earth brick) or by stabilization usually using cement or lime (stabilized earth brick). [3-5] It is also possible to incorporate plant matter such as straw, reeds, rice husk ashes, etc. into the soil. [6-9]

In this study, it is considered the mixing of the earth with oil palm shells (OPS) in order to improve the characteristics of air-dried earth bricks.

MATERIALS & METHODS

Table 1: Clay soil characteristics

Characteristics		Value
Sand and clay content	Sand content	46.05
	Clay content	53.95
Density	Absolute density	2.30
	Apparent density	1.29
Atterberg limits	Liquidity limit	60.29
	Plasticity limit	20.13
	Plasticity index	39.98
	Consistency index	1.05
Water content (%)		17.97

The clay soil sample used in this study comes from the northern suburbs of Lomé, the capital of Togo. It is a plastic soil containing no organic matter (Table 1) with a continuous particle size ranging from the 0.1 to 1.3mm sieve (figure 1).

OPS are the shells that are obtained after removal of the pericarp and endocarp, following abrasion of the palm nut. OPS used in this study come from Kovié, a village located 27 km north of Lomé. They are light, hard and strong (Table 2). They have a continuous particle size that ranges from 0.8 to 12.5 mm sieve (Figure 1) with a water absorption rate of approximately 11% of its total weight after 24 hours of immersion (Figure 2).

Table 2: OPS Characteristics

Characteristics		Value
Impurity rate (%)		7.15
Micro Deval coefficient (%)		3.3%
Los Angeles coefficient (%)		3.56%
Apparent density	Dry state	0.535
	Wet state	0.71
Absolute density	Dry state	1.11
	Wet state	1.34
Absorption rate (%)		11%

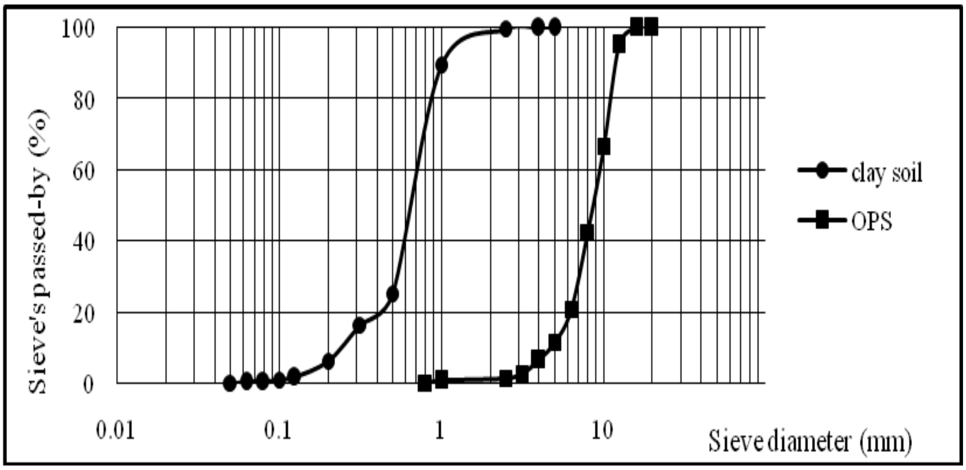

Figure 1: Clay soil and OPS grading curve

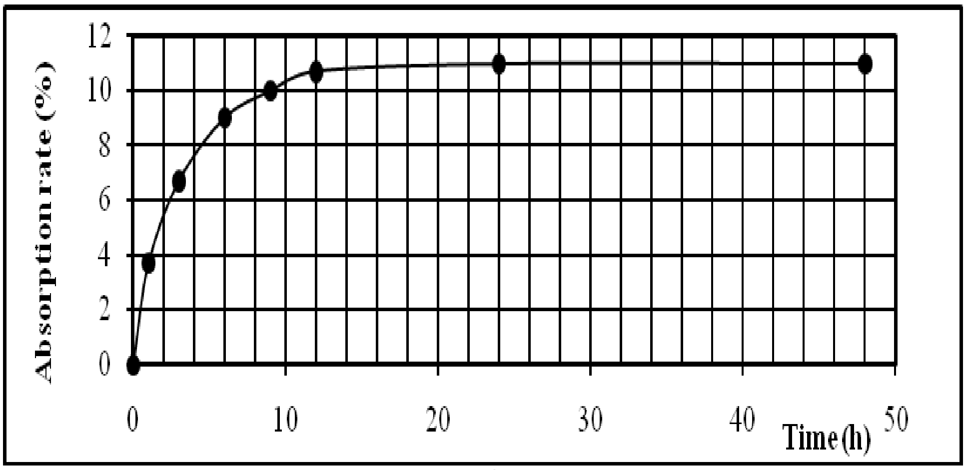

Figure 2: Kinetic curve of OPS water absorption

The formulation of bricks based on clay soil and OPS is made by varying the OPS rate from 0 to 40% and in steps of 5%. OPS were pre-wetted for 24 hours in order to obtain an acceptable absorption rate before use. Table 3 summarizes the various dosages which were used for bricks production.

Table 3: Quantity of materials used

OPS rate	Clay soil mass (g)	OPS mass (g)	Water volume (ml)
0%	7000	0	1000
5%	6650	350	1000
10%	6300	700	1000
15%	5950	1050	1000
20%	5600	1400	1000
25%	5250	1750	1000
30%	4900	2100	1000
35%	4550	2450	1000
40%	4200	2800	1000

The manufactured bricks are kept in the shade at rest for seven (7) days after their manufacture before some of them are watered.

Thus, the twenty-four (24) bricks manufactured for each type of dosage were used as follows:

six (06) were watered for four (4) days. That is, from the 8th day to the 12th day of age, before being tested on the 14th day;

six (06) were watered for eighteen (18) days, that is, from the 8th to the 26th day of age, before being tested on the 28th day;

six (06) were not watered until tested on the 14thday;

six (06) were not watered until tested on the 28thday.

The tests carried out on the bricks on the 14th and 28th day of age relate to the measurement of density, shrinkage and compressive strength according to standard EN 772. [10]

RESULTS & DISCUSSION

Table 4 shows the results obtained at the end of the various tests.

Table 4: Results of the various tests carried out on the bricks

Conservation mode	OPS rate (%)	Density		Compressive strength (MPa)		Shrinkage (%)	
		At 14th day	At 28th day	At 14th day	At 28th day	At 14th day	At 28th day
Watered bricks	0	1,89	1,834	1,129	1,431	1,82	2,079
	5	1,803	1,786	1,426	1,854	1,362	1,872
	10	1,787	1,698	1,627	2,377	1,352	1,778
	15	1,758	1,687	1,576	2,021	1,221	1,581
	20	1,738	1,637	1,286	1,829	0,978	1,404
	25	1,685	1,638	1,053	1,609	0,59	1,352
	30	1,564	1,525	1,018	1,503	0,443	0,919
	35	1,372	1,333	0,975	1,134	0,437	0,737
	40	1,295	1,307	0,933	0,955	0,36	0,615
Non-watered bricks	0	1,815	1,763	1,018	1,427	2,039	3,259
	5	1,79	1,743	1,21	1,609	1,68	2,627
	10	1,723	1,676	1,459	2,021	1,545	2,272
	15	1,68	1,637	1,286	1,853	1,363	2,105
	20	1,673	1,608	1,21	1,41	1,1	2,08
	25	1,66	1,566	1,018	1,21	0,997	1,913
	30	1,48	1,492	0,975	1,082	0,823	1,751
	35	1,345	1,323	0,933	1,045	0,721	1,583
	40	1,286	1,292	0,856	0,94	0,559	1,358

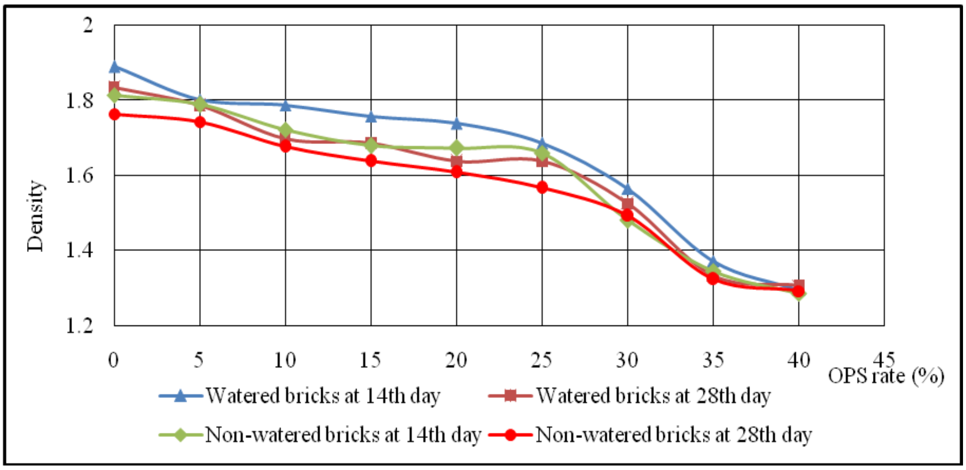

Figure 3: Bricks densities variation

From the results of Table 4, we plot the curves in Figure 3 representing the bricks density variations as a function of OPS rate for each age. It is generally observed that the densities of bricks decrease when the rate of OPS increases. This is because the OPS is lighter than the earth used. So, the more their dosage increases, the more the density of the bricks decreases. In addition, for each type of dosage, the density decreases with the age of the bricks. The decrease in the density of the bricks with age for each dosage reflects the gradual departure of the mixing water, thus making the bricks less heavy. The watering of some bricks did not prevent this decrease, because the amount of water absorbed during watering is less than that lost.

The curves in Figure 4 represent the variation of bricks compressive strength as a function of OPS rate for each age.

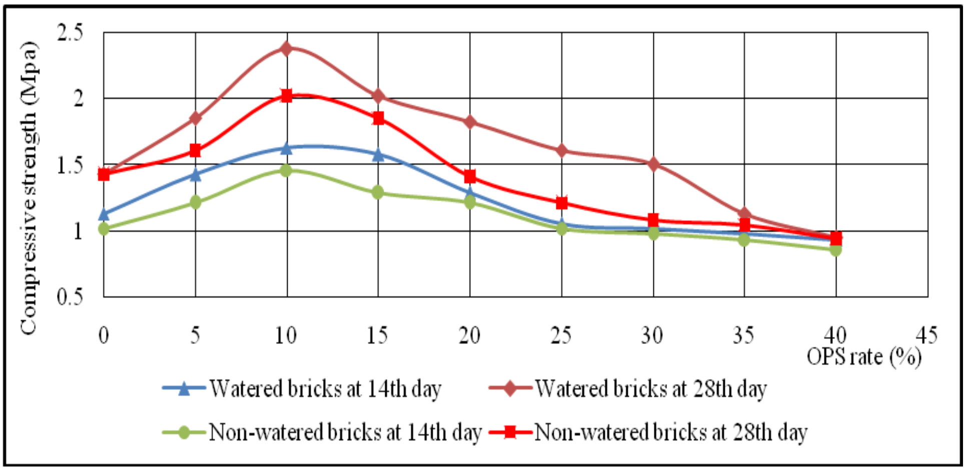

Figure 4: Bricks compressive strength variation

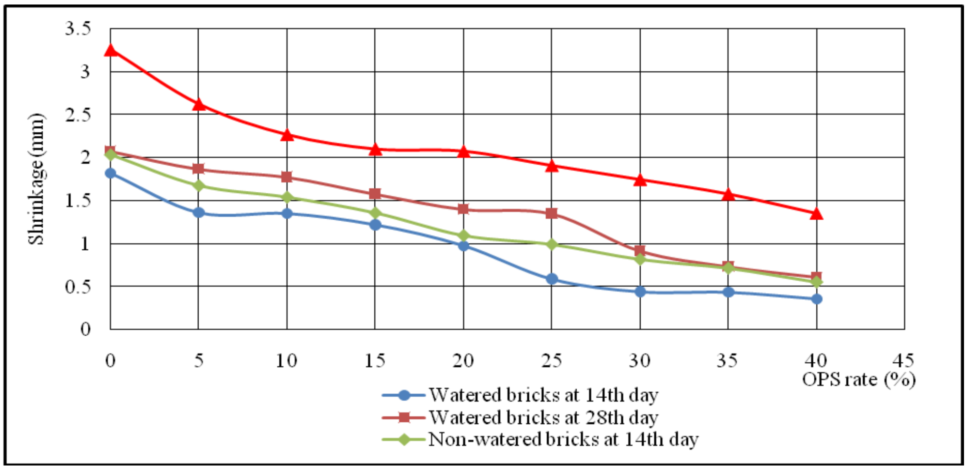

Figure 5: Bricks shrinkage variation

At 14 days of age, we notice that compressive strength increases in the interval [0%; 10%] then decrease in the interval [10%; 40%]. They therefore have a maximum of 10%. Watered and non-watered bricks at 14 days of age and dosed at 10% of OPS offer the best compressive strength. From 0% to 10% the compressive strength of watered bricks increased on average by 57.69% at 14 days and by 69.39% for non-watered bricks. From 10% to 40% it fell by 58.67% for the watered bricks and 40.18% for the non-watered bricks.

The same trend is observed for resistance measured at 28 days of age: they also show a maximum at 10%. From 14 to 28 days, all resistance increased by an average of 28%. Bricks containing more than 30% of OPS exhibit the smallest variations and the lowest resistance; this is due to a mixture containing a little too much OPS compared to the clayey soil. Watered bricks have better resistance than non-watered bricks. In fact, watering makes it possible to prevent the clay contained in the soil from drying out, resulting in reduced shrinkage. Watered bricks have a more or less constant humidity level, which maintains the cohesion in the material and promotes good resistance. Figure 5 shows that shrinkage is less for watered bricks than for non-watered bricks. It also shows that adding OPS reduces brick shrinkage.

CONCLUSION

The objective of the work is to study the influence of OPS on the compressive strength and shrinkage of air-dried earthen bricks. From the results obtained, it emerges that:

- OPS remarkably increase the resistance of earthen bricks by more than 60% and decrease the shrinkage of bricks;
- earthen bricks dosed with 10% of OPS offer the best compressive strengths;
- watering the manufactured bricks increases their compressive strength and decreases their shrinkage.

REFERENCES

1. HOUBEN H. & GUILLAUD H. (1989) :‘‘Traité de construction en terre’’.Copyright, Marseille, Volume 1.
2. GUILLAUD H., JOFFROY Th., ODUL P. & CRA-Terre-EAG, (1995) : ‘‘Blocs de terre comprimées, Volume II, Manuel de conception et de construction’’.
3. DANSOU. A : ‘‘Terre stabilisée, matériau de construction’’; Centre de la Construction et du Logement du Togo, Bulletin d’information N°2, Avril-Mai- Juin 1975.
4. DANSOU. A : ‘‘Terre stabilisée, matériau de construction-Suite et fin’’; Centre de la Construction et du Logement du Togo, Bulletin d’information N°3, Juillet- Août -Septembre 1975.
5. ARS 680 (1996). Blocs de terre comprimée, renseignant sur les bonnes pratiques pour la préparation des mortiers de terre. ARS.
6. D. Eliche-Quesada, M.A. Felipe-Sese, J.A. López-Pérez, A. Infantes-Molina. (2017). Characterization and evaluation of rice husk ash and wood ash in sustainable clay matrix bricks. Ceramics International, Volume 43(1), Part A, 463-475
7. Dolores Eliche Quesada, Jose A López-Pérez and Manuel A Felipe-Sesé. Recycling of rice husk ash as secondary material to produce eco-friendly construction bricks. 2nd World Congress and Expo on Recycling July 25-27, 2016 Berlin, Germany. International Journal of Waste Resources 2016, 6:3(Suppl) http://dx.doi.org/10.4172/2252-5211.C1.003
8. Sasui, Watcharin Jinwuth, Sirimas Hengrasmee (2018). The Effects of Raw Rice Husk and Rice Husk Ash on the Strength and Durability of Adobe Bricks. Civil Engineering Journal, Vol 4, N° 4, 732-742.http://dx.doi.org/10.28991/cej-0309128
9. AYITE Y. M. X. D.*, PACHOUKOVA I., AGBO K. E. and BEDJA K. ‘‘Study of improvement of mud bricks stabilized with cement characteristics by addition of rice husks ashes’’, Research Journal of Material Sciences, Vol. 5(7), 1-4, December (2017)
10. European Standards CSN EN 772 (2015). Methods of test for masonry units.
11. NF EN ISO 17892-4:Geotechnical investigation and testing-Laboratory testing of soil-Part 4:Determination of particle size distribution, January 2018
12. NF P94-051:Soil:investigation and testing-Determination of Atterberg's limits-Liquid limit test using Casagrande apparatus-Plastic limit test on rolled thread. March 1993
13. NF EN ISO 11272:Soil quality-Determination of dry bulk density, June 2017
14. Soudagar Ahemad Mohamadali, Effect on properties of concrete using agro-west as replacement of sand, International Research Journal of Engineering and Technology, Volume: 04 Issue: 06, (2017), 2410-2414.
15. K. H. Mo, S. P. Yap, U. J. Alengaram, M. Z. Jumaat, and C. H. Bu, “Impact resistance of hybrid fibre-reinforced oil palm shell concrete,” Construction and Building Materials, vol. 50, (2014), 499-507.

How to cite this article: Yawovi Mawuénya Xolali Dany Ayite, Pachoukova I, P’kla A. Improvement of air-dried earth bricks characteristics by adding oil palm shells. International Journal of Research and Review. 2020; 7(10): 513-517.

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