Developing of Clay Bricks Quality into Community Standard Product using Rice Husk Ash and Perlite

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ABSTRACT

The purpose of this work was to find the optimal raw materials mixing ratio in the clay bricks manufacturer into Community Product Standard. (CPS.601/2547). Clay from Nayom Sub-district, Amnat Charoen Province, Mukdahan Sub-district, Mukdahan Province, Chanuwan Sub-district, Roiet Province and Warinchamrab Sub-district, Ubon Ratchathani Province are provided for manufacturers. In traditional process give low and uncertain quality of clay brick, because of non-certain clay and rice husk ash quality. This worked investigation optimal mixing ratio of rice husk ash and Perlite with clay for clay bricks manufacturers with mixing ratio of 0, 2.0, 2.5, 3.0, 3.5 and 4.0%. The result indicated 3.5% of Perlite added into Roiet clay provided maximum compression test at 15.65 MPa. While, maximum water absorption found in Mukdahan clay at 12.07% from 3.0% of Perlite added. Finally, the compressive strength and water absorption of clay bricks which developed from this work could be acceptable into the Community Product Standard.

Keywords : *Clay bricks, Perlite, Rice Husk Ash, Community Product Standard*

1. INTRODUCTION

A clay brick is a material used in construction. It's made of clay and rice husk ash, wood chips or other materials, baked with fire to make it strong and stable. It's an important material in construction due to its strength, bearing capacity, suitable size, and lightness. The usage of bricks has long been in Thai history as shown in buildings from the former times. A clay brick is a well-known and popular material because it can be produced locally [1]. So it's used not only for construction but also decoration purpose.

In Thailand, a clay brick is produced throughout the country, from a household to large industry. This research aims to study bricks production from 4 areas: Nayom, Muang, Amnat Charoen, Muang, Mukdahan, Chanuwan, Phanompai, Roi-Ed and Warin, Warin Chamrap, Ubonratchathani.

A clay brick is produced during the non-harvest season when the locals are free from the farm. The average amount of products from each area is around 4,000,000 unit/ year [2]. However, according to the information gathered from the 4 areas, there are still some rooms that need to be improved; the quality, composition of raw materials and its local standard.

The researcher has recently studied a research named "The Production and development of Clay bricks in Singburi" where the clay brick is made of clay and rice husk ash. It says that the result is satisfying and the quality of product is improved. The ratio to make the best product is the percentage of 3 to the product weight, bearing capacity at 13.50 MPa to the density 1.69 g/cm^3 and water absorption at the percentage of 11.50. This makes the product meet the industrial standard (TIS. 77 - 2545) And from the study of the materials to increase the quality, it indicates that the Perlite is of the same quality as the rice husk ash. Perlite is a type of volcanic glass that expands and becomes porous when it is heated. It has high quantity of SiO_2. When heated at 850 -900 ^oC,[5] it expands immediately and becomes light, porous and it has density at around 80 -200 kg/m^3, with the amount of SiO_2, Ai_2O_3 and Fe_2O_3 at the percentage of 71.02, 16.08 and 0.71[3], relatively. The research aims to improve the producing procedure of a clay brick at the size of 57x147x57 mm by examining the clay bricks from 4 areas; Amnat Charoen, Mukdahan, Roi-Ed and Ubonratchathani. It aims to control the quality which will lead the products to meet local product standard (CPS. 601/ 2547)

2. EXPERIMENT PROCEDURES

In fig. 1 the samples are clay and rice husk ash fron 1) Nayom, Muang, Amnat Charoen 2) Muang, Mukdahan, 3) Chanuwan, Panompai, Roi-Ed and Warin, Warinchamrap, Ubonratchathani.

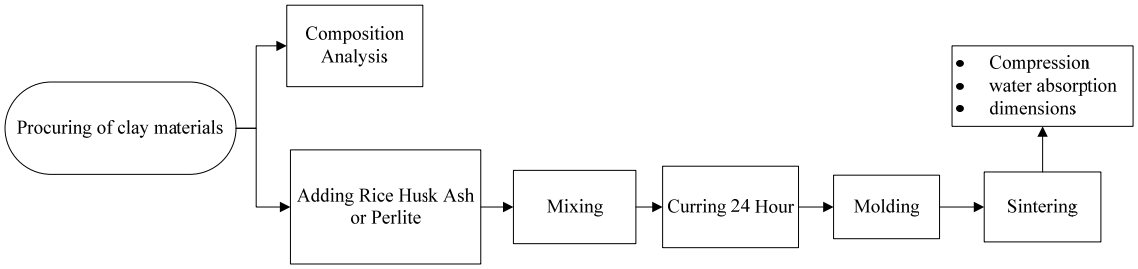

Fig. 1 *Schematic Diagram of experiment*

The Clay from the manufacturer, the four sources which are mixed with rice husk ash or Perlite powder form ratio different from 0.0, 2.0, 2.5, 3.0, 3.5, and 4.0, respectively, add water so that the soil becomes homogeneous, leave it on for 24 hours led to forming the mixing and molding to brick it size 57 x 147 x 57 mm.

Then, mix them at the propotion of 0.0, 2.0, 2.5, 3.0, 3.5, and 4.0 relatively. Fill in some water and leave them for 24 hours. Shape them and leave them dry outdoor for approximately 72 hours. Then use Vernier Calipers at the scale 0.05 mm to measure the dimension: width x length x thickness as mm. Take notes. When the mix is dry, bake them in the open oven, fuelled by burning rice husk ash that can be found locally at 750 – 850 ^{o}C for 120 – 168 hours.

The qualities of a good brick are as follow [6]:

- made neatly either by hand or a machine
- tough, not easily broken
- strong, has high bearing capacity
- nicely shaped, well-proportioned
- clean cut in every angle
- identical size in each unit (in average)
- not porous inside
- identical weight in each unit (in average)
- has the same color throughout the piece
- water absorption rate is less than 10% of its weight, when soaked in water for 24 hours
- sound dense as metal when knocked

The baked bricks will be analyzed in terms of local product standard, compressive strength and the dimension.

3. RESULTS AND DISCUSSION

3.1 Composition of raw materials

The result of the study of the composition of raw materials found in the clay bricks from 4 areas by using ED-XRF is shown in Table 1.

Table 1 *Composition of law materials*

Sustance	Amnatcharoen	Mukdahan	Ubonratchatani	Roiet	Rice husk Ash	Perlite
SiO_2 %	59.87	64.62	74.88	70.12	86.9	74.45
Al_2O_3 %	27.13	20.9	17.83	22.77	9.34	22.24
Fe_2O_3 %	9.77	10.24	5.45	5.47	0.81	0.61

According to table 1, the raw materials found in the 4 areas are quite similar. The highest substance is SiO_2%, most found in Ubonratchathani, Roi-Ed, Mukdahan and Amnat Charoen relatively. SiO_2% is a necessary substance to make the bricks baked faster and solid. The second highest substance is Al_2O_3 which makes the bricks able to endure fire. And Fe_2O_3% makes the bricks red. The main substance in perlite and rice husk is SiO_2, so to add them in the raw materials will make the products more solid.

3.2 Compressive strength

Resistance to compressive strength is another one that shows the difference between the bricks of the component Perlite and Rice Husk Ash as in Fig. 2.

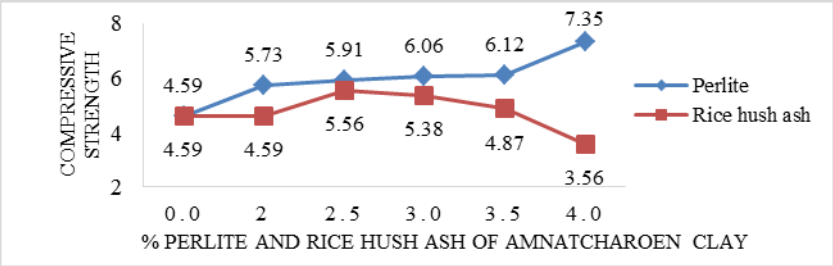

Fig. 2 *The relation between the mixed clay and compressive strength of the sample from Amnat Charoen.*

The compressive strength is one the difference between the bricks with perlite and rice husk clay, and those without one. Perlite and Rice Husk Ash increase the compressive strength. In fig. 2, the bricks samples with perlite from Amnat Charoen can endure compression at 4% at 7.35 MPa. And the brick samples with Rice Husk Ash from Amnat Charoen can endure the compression at 2.5 % at 5.56 MPa.

In fig. 3: The brick samples with perlite from Ubonratchathani can endure the compression at 3.5% at 12.81 MPa. Ones with Rice Husk Ash can endure the compression at 3% at 8.73 MPa.

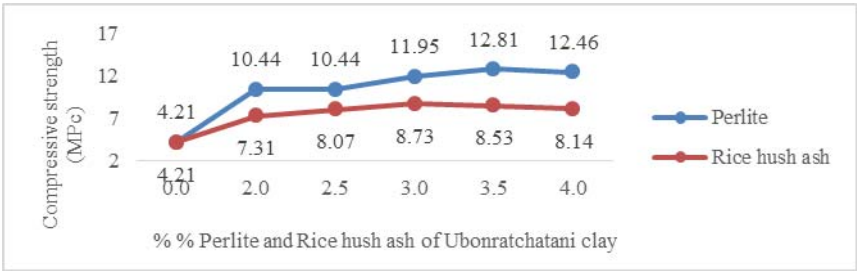

Fig. 3 *The relation between the compressive strength and the Perlite and the Rice Husk Ash of Ubonratchathani.*

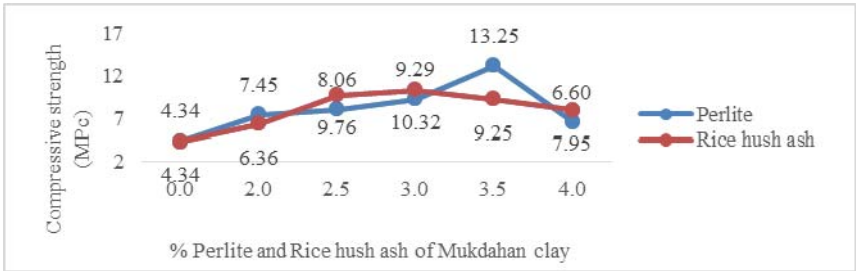

Fig. 4 *The relation between the compressive strength and the Perlite and the Rice Husk Ash of Mukdahan.*

In Fig. 4 The brick samples with Perlite from Mukdahan can endure the compression at 3.5% at 13.25 MPa. Ones with Rice Husk Ash can endure the compression at 3% at 9.29 MPa.

In Fig. 5 The brick samples with Perlite from Roi-Ed can endure the compression at 3.5% at 15.65 MPa. Ones with Rice Husk Ash can endure the compression at 3% at 12.61 MPa.

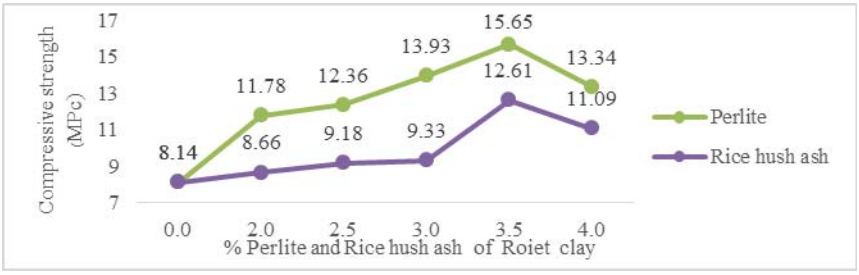

Fig. 5 *The relation between the compressive strength and the Perlite and the Rice Husk Ash of Roi-Ed.*

3.3 Water absorption

From the study of the relation of the suitable portion of Perlite and Rice Husk Ash to the clay and water absorption, the result is:

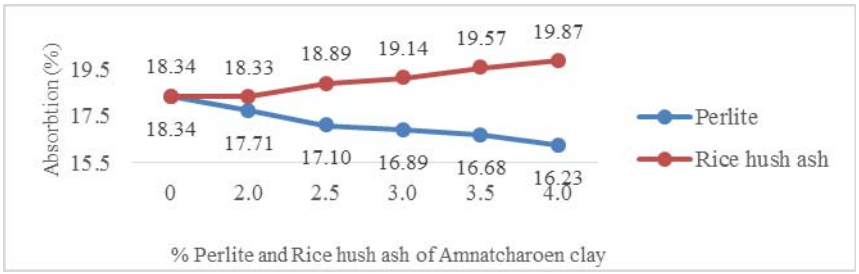

Fig. 6 *the relation of the suitable portion of Perlite and Rice Husk Ash to the clay and water absorption of Amnatcharoen clay.*

From Fig. 6, it indicates that the brick sample with Perlite has the least water absorption rate at the ratio of 4.0, water absorption at the percentage of 16.23. While the brick samples with Rice Husk Ash has the least water absorption rate at the ratio of 2.0, water absorption at the percentage of 18.33.

From Fig. 7, it indicates that the brick sample with Perlite has the least water absorption rate at the ratio of 4.0, water absorption at the percentage of 13.15. While the brick samples with rice husk ash has the least water absorption rate at the ratio of 3.0, water absorption at the percentage of 14.89.

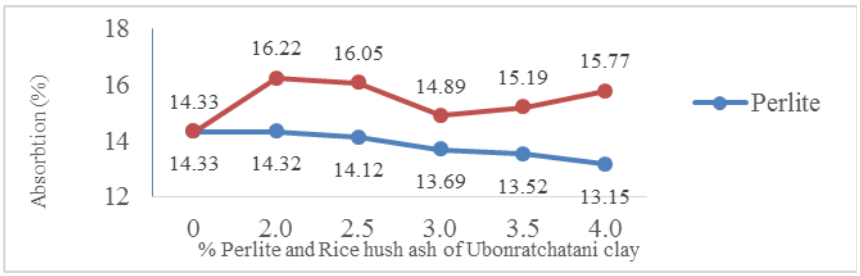

Fig. 7 *the relation of the suitable portion of Perlite and Rice Husk Ash to the clay and water absorption of Ubonratchathani clay.*

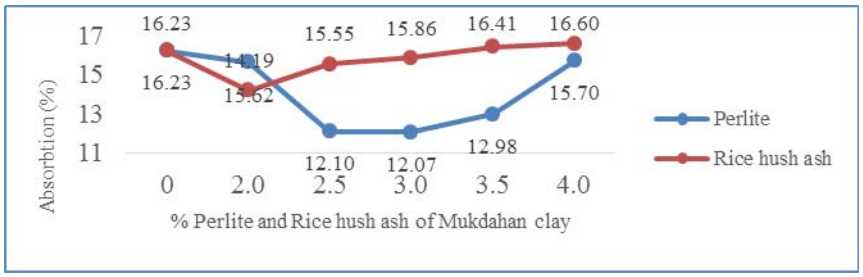

Fig. 8 *The relation of the suitable portion of Perlite and Rice Husk Ash to the clay and water absorption of Mukdahan clay*

From Fig. 8, it indicates that the brick samples with Perlite has the least water absorption rate at the ratio of 3.0, water absorption at the percentage of 12.07. While the brick samples with Rice Husk Ash has the least water absorption rate at the ratio of 2.0, water absorption at the percentage of 14.19.

From Fig. 9, it indicates that the brick samples with Perlite has the least water absorption rate at the ratio of 3.5, water absorption at the percentage of 13.06. While the brick samples with Rice Husk Ash has the least water absorption rate at the ratio of 3.5, water absorption at the percentage of 15.73.

From the study, it indicates that to add Perlite and Rice Husk Ash in the clay decreases its water absorption because it becomes less porous. The water absorption for the clay with Perlite are: Amnat Charoen clay: ratio of 4.0, 16.23 % Ubonratchathani clay: ratio 4.0, 13.5 % Mukdahan clay: ratio 2.5, 12.10 % and Amnat Charoen clay: ratio 3.5, 13.06 %. All meet the local product standard which suggests the water absorption rate at not exceeding 25 %.

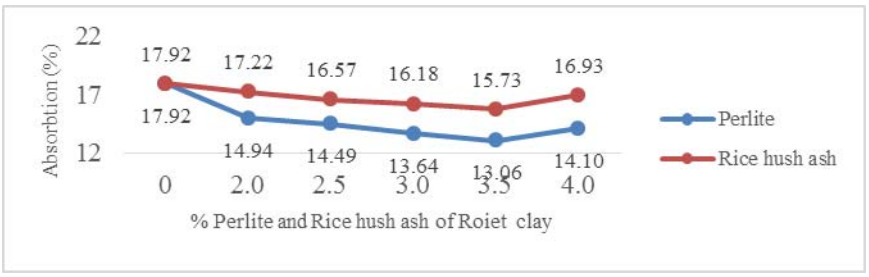

Fig. 9 *The relation of the suitable portion of Perlite and Rice Husk Ash to the clay and water absorption of Roi-Ed clay.*

3.4 Dimension of Bricks

The measuring result of the brick samples from 4 areas in terms of width x length x thickness is shown in table 2.

From table 2; by analyzing the samples' dimensions, the result is the samples with perlite and rice husk ash from 4 areas are of the required local product standard, within the deviation of ± 5 mm.

4. CONCLUSIONS

From this research, it can be concluded that clay from different areas need different portion of materials to increase quality as follow:

Clay from Amnat Charoen: perlite should be added at the ratio of 4.0 by weight, water absorption at 16.23, compressive strength at 7.35 MPa. Clay from Ubonratchathani: Perlite should be added at the ratio of 4.0 by weight, water absorption at 13.15, compressive strength at 12.46 MPa. Clay from Mukdahan: perlite should be added at the ratio of 3.5 by weight, water absorption at 12.98, compressive strength at 13.25 MPa. Clay from Roi-Ed: perlite should be added at the ratio of 3.5 by weight, water absorption at 13.06, compressive strength at 15.65 MPs.

All above are the most suitable portion for clay in each area. This makes it pass the local standard which requires the compressive strength at no less than 7 MPa, water absorption rate at not exceeding 25 % and the deviation of dimension at ± 5 mm.

The suggested ratio of perlite is the most suitable for clay in each area. If there's too little perlite, the product will be less solid. Perlite has high quantity of SiO_2 which speeds up the burning process. SiO_2 is in the form of Quartz when heated. It reacts and occurs the phase (Solidstate Sintering) which makes it crystallized faster [4], resulting in better compressive strength. If there's too much perlite, the bricks will become more porous which in turn lessens the brick quality. The clay in each area has SiO_2, AI_2O_3 and Fe_2O_3 as the main substances. Perlite as the material to increase quality has SiO_2 and AI_2O_3, so it may be in the form of Mullite. The strong structure makes the bricks solid. And to bake clay at the temperature of 600 – 1,200^oC, brings up chemical reaction from soil to Mullite[7]. As a result, the products are well-baked, not porous, and solid.

***Table 2** displays the samples' dimensions.*

Specimen	Material increase the quality	Width (mm.)	Length (mm.)	Thickness (mm.)	CPS. 601/2547
Amnatcharoen	Perlite	60.82	144.47	60.78	Dimensional tolerances are not exceeded. ± 5 mm.
	Rice hush ash	61.62	144.88	61.02	
Ubonratchatani	Perlite	59.94	142.84	59.46	
	Rice hush ash	61.07	144.87	61.36	
Mukdahan	Perlite	63.23	150.04	63.57	
	Rice hush ash	63.41	151.19	62.62	
Roiet	Perlite	60.49	142.74	60.46	
	Rice hush ash	60.75	144.64	57.60	

5. COPYRIGHT

Funded from Research and Researchers for Industries (RRI) and Somkuan Itdang. All information in this research is the analysis of the researcher, RRI and Somkuan Itdang do not necessarily need to agree.

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Natthon samart, photograph and biography not available at the time of publication.

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