Journal of Tropical Resources and Sustainable Science

journal homepage: jtrss.org

Fabrication of Mambong Pottery by Using Slip Casting Method

A.I.A. Termizi[1], J.J. Mohamed[1,2*]

[1]Faculty of Earth Science, Universiti Malaysia Kelantan, Kelantan, Malaysia
[2]Advanced Materials Research Cluster, Universiti Malaysia Kelantan, Kelantan, Malaysia

Received 15 December 2016
Accepted 21 December 2016
Online 30 December 2016

Keywords:
pottery, slip casting, Mambong clay.

⊠*Corresponding author:
Assoc. Prof. Dr. Julie Juliewatty Mohamed, Advanced Materials Research Cluster, Faculty of Earth Science, Universiti Malaysia Kelantan, Kelantan, Malaysia.
Email:
juliewatty.m@umk.edu.my

Abstract

Mambong pottery in Kuala Krai, Kelantan is one of the types of potteries in Malaysia other than Sayong, Terenang and Sarawak pottery. Mambong pottery was being made by traditional technique like pinching and throwing. In this research, Mambong pottery was made by using slip casting method. This method used porous mould which can absorb the water content from the clay slip. Different composition of water and clay was used and its effect on product properties was investigated. Samples with different composition of water and clay were labelled as 50C50W, 60C40W, 70C30W and 80C20W samples with addition of 0.7% of sodium silicate, Na_2SiO_3. The samples were characterized by its specific gravity (S.G.) of clay slip, drying and firing linear shrinkage, density and porosity and strength of the clay samples. Finding from this research showed that 70C30W sample is the optimum composition in fabricating pottery by using slip casting among other samples.

1. Introduction

Ceramic is a material that was produced by burning in kiln. The term ceramic comes from a Greek word 'keramikos' which stand for 'burnt stuff' as most of ceramic product is produced by exposing them to high temperature [1]. Ceramic can be categorized into advanced ceramic and traditional ceramic. Traditional ceramic products are structural ceramic like bricks and tiles, refractory ceramic and pottery. Pottery can be referred as clay body form into any objects of desired shape and heated to high temperatures in a kiln to sinter the green body and become solid strengthened object [2]. Exposing clay body to high temperatures will remove the water content in the clay body and induced a reaction that leads to the permanent changes while increase its strength [3]. The art of making pottery by forming and burning clay has been practiced from the earliest civilisation. It is one of the ways to observe the development of the culture and civilisation during Mesolithic, Paleolithic and Neolithic era. In Malaysia, there are several types of potteries known which are Sayong pottery in Kuala Kangsar, Perak, Terenang pottery in Tembeling, Pahang, Sarawak pottery and Mambong pottery in Kuala Krai, Kelantan.

In Kelantan, Malaysia, Mambong pottery had been traced since 1868 years ago [4] with products like steam pots and covered water jars. There are several techniques used in pottery fabrication since earlier time of its being introduced as basic application in daily life until this current new era of urbanisation. The first technique used by ancient civilisation is hand building or hand forming, followed by wheel throwing which used potter's wheel to give shape to plastic clay. Then, potters turn to casting technique in fabricating pottery. This technique is mostly used by the manufactures of clay based product like pottery in large mass production.

However, Mambong pottery is fabricated by using hand forming technique which is the conventional technique in producing pottery. With this technique, Mambong pottery has low quality due to variation between product and low mass production. In this research, slip casting method was introduced and used in producing pottery. This method used porous mould to absorb water content from the clay slip. With this technique, the mass production of Mambong pottery can be increase and more fine pottery can be made. The fineness of pottery is implied by the approximately same weight between pottery products due to uniformity of pottery's body wall [5]. This research was conducted to fabricate the Mambong clay samples by using slip casting method with different composition of water and study its effect on the pottery properties. Then, the samples were characterized by its physical and mechanical properties such as specific gravity (S.G.) of clay slip, drying and

eISSN Number: 2462-2389

firing linear shrinkage, density and porosity and strength of the clay samples.

2. Materials and Methods

The materials needed in this research were mould made from Plaster of Paris (PoP) for slip casting process, clay which was taken from Mambong village and sodium silicate, Na_2SiO_3 which acts as deflocculated to increase the fluidity hence decrease the viscosity of the clay slip.

The particle size of Mambong clay used in this research was controlled to below 425 μm by using screening sieving. Weight percentage was used in varying the composition between clay and water. All the samples were labelled as 50C50W, 60C40W, 70C30W and 80C20W. 0.7% of sodium silicate, Na_2SiO_3 was used in preparation of clay slip. The samples were characterized by its specific gravity (S.G.) of clay slip, drying and firing linear shrinkage, density and porosity and strength of the clay samples.

3. Results and Discussion

3.1. Specific gravity (S.G.) of clay slip

Specific gravity test is done by comparing the ratio weight of volume of clay slip with the weight of water at equal volume. This test is a measurement by using water as a reference. Figure 1 showed the comparison of the S.G. value between 50C50W, 60C40W and 70C30W samples. In this test, the sample appeared to be the best composition to be used for slip casting method was 70C30W sample. The S.G. of clay slip of 70C30W sample was 1.78 while other 50C50W and 60C40W samples were too slurries with S.G. of clay slip at 1.42 and 1.54 respectively. Too slurry and have higher water composition of clay slip will produced a sample that has crack. 80C20W sample formed bulk of clay which not suitable for slips casting method.

Based on Figure 1, the S.G of clay slip was seen increased from 50C50W sample to 70C30W sample. Nature of clay slip was very essential that it must have high S.G of clay slip value yet very fluid and pourable [1]. The best S.G of clay slip value was in the range of 1.75 to 1.80 [6]. If the S.G slip value was lower than 1.75, this indicated that the clay slip was too slurry and more clay was needed to add into the slip. If the S.G clay slip value was more than 1.80, this indicated that the clay was too thick or viscous and more water needed to be added to decrease its viscosity and increase its fluidity.

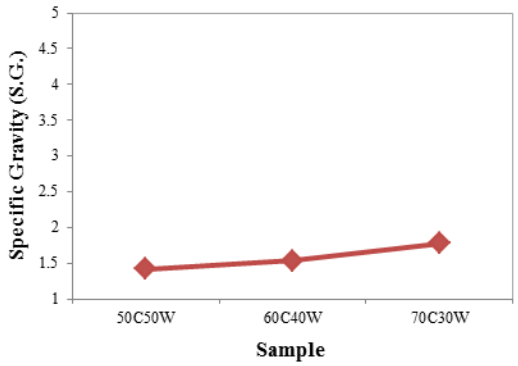

Figure 1: Comparison of S.G of clay slips value between 50C50W, 60C40W and 70C30W samples.

3.2. Percentage of linear shrinkage

Figure 2 presented the comparison of drying and firing linear shrinkage between 60C40W and 70C30W samples. 60C40W sample was seen to have higher percentage of drying and firing shrinkage compare to 70C30W sample. Shrinkage was closely correlated with the composition of water present in the clay slip. Higher composition of water in clay slip will rapidly increase the rate of shrinkage. The grater the water composition, the extensive the shrinkage process [1].

60C40W sample had shrunk to 6.08% during drying process compared to 70C30W sample which shrunk to 5.81%. As for firing shrinkage, 60C40W sample have 0.96% while 70C30W sample have 0.77%. In pottery making, potters must need the green body to have low percentage of shrinkage to avoid variation in size of pottery been made. For example the problems that rise due to non-equilibrium of shrinkage process, the Mambong clay lid's size and its round bottom jar mouth's size was not matched.

Finding the percentage of shrinkage was very crucial as it is very important property of clay especially for the structural clay product because it involved with the loss of original dimension of the clay product [7]. 70C30W sample have low percentage of both drying and firing linear shrinkage compared to 60C40W sample due to low composition of water present in clay slip.

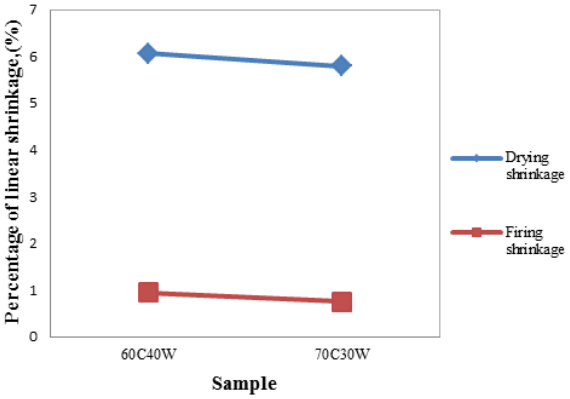

Figure 2: Comparison of drying and firing linear shrinkage between samples 60C40W and 70C30W.

eISSN Number: 2462-2389

The Mambong clay 70C30W sample had lower percentage of drying shrinkage than Sayong clay. The percentage drying shrinkage of 70C30W sample was 5.81% compared to Sayong clay that had 6% [8]. But for 60C40W sample, the drying shrinkage was approximately same with Sayong Clay at 6.08%. For firing shrinkage, Sayong clay had percentage at 10% [8]. This showed that Sayong clay had higher percentage of firing shrinkage than both Mambong clay 60C40W and 70C30W samples which have 0.96% and 0.77% respectively.

3.3. Density of sample

Figure 3 showed the comparison between density of 60C40W and 70C30W samples. 60C40W sample tend to have higher density compared to 70C30W sample at 1.472 g/cm^3 while 70C30W sample at 1.461 g/cm^3. The density was related to the composition of clay present in sample. High composition of clay should produce sample that was denser than the sample that have low composition of clay. There were some errors had been occurred during conducting the density test like calibration error of the density kit.

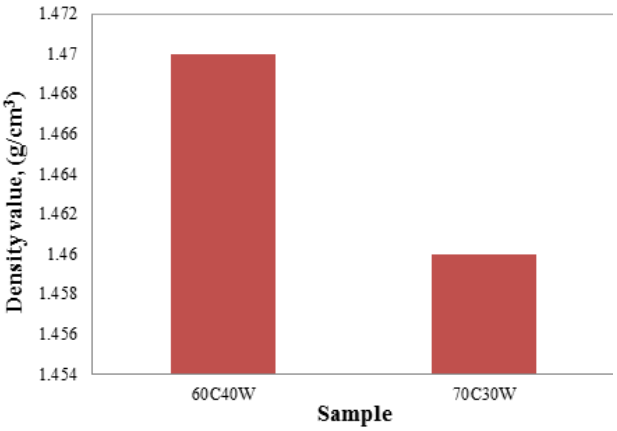

Figure 3: Comparison of density between 60C40W and 70C30W samples.

3.4. Percentage of porosity

Figure 4 showed comparison of the percentage of porosity between 60C40W and 70C30W samples. According to Nawi and Badarulzaman [9], sample with higher percentage of firing shrinkage has the higher percentage of porosity due to the densification occurred during the sintering process. In this test, 60C40W sample had higher percentage of porosity compared to 70C30W sample which was equivalent with the result percentage of firing shrinkage of 60C40W and 70C30W samples which showed in Figure 2. The percentage of porosity of 60C40W sample was 36.30% while 70C30W sample at 35.80%.

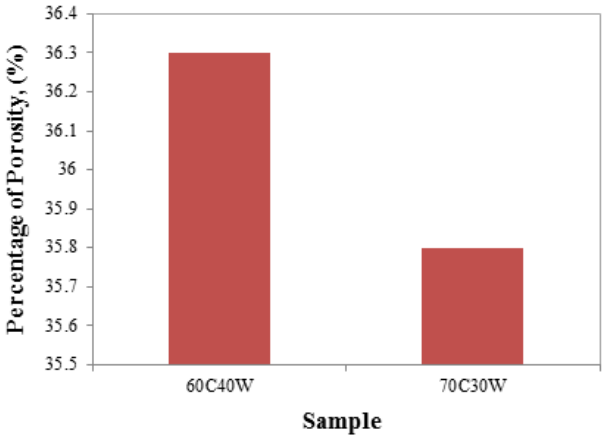

Figure 4: Comparison of percentage of porosity between 60C40W and 70C30W samples.

3.5. Modulus of rupture (MOR)

Figure 5 showed the comparison of MOR between 60C40W and 70C30W samples. The MOR showed higher for 70C30W sample compared to 60C40W sample. MOR was affected by the composition of the clay and water in clay slip. Higher composition of clay and low water composition was present in 70C30W sample than 60C40W sample. Higher composition of clay and low composition of water made the sample denser and less porosity than the sample with low composition of clay and high composition of water.

Density had major influenced in the modulus of rupture which higher density tend to have higher value of modulus of rupture [10]. Porosity was also deleterious to the modulus of rupture by two reasons which were the pores will reduced the cross-sectional area across which load was applied and it acted as stress concentrators [1]. Higher composition of clay and low water composition in clay slip gave higher density of sample that also have low percentage of porosity present, thus, increase the modulus of rupture of clay sample.

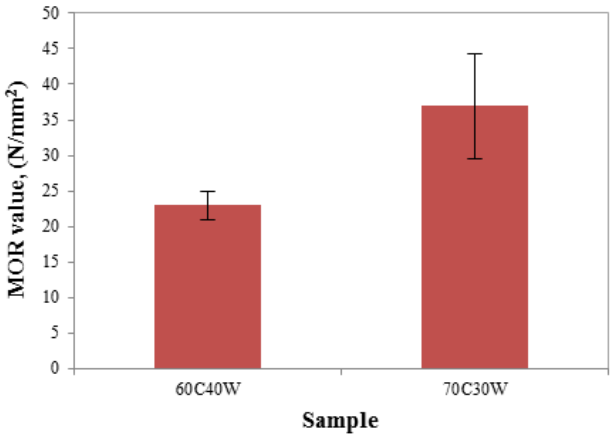

Figure 5: Comparison of modulus of rupture between 60C40W and 70C30W samples.

eISSN Number: 2462-2389

4. Conclusion

This research was conducted to characterize the physical and mechanical properties of Mambong clay samples with different composition of clay and water. From the research, the optimum composition to fabricate pottery by using slip casting method was from 70C30W sample. It had the optimum S.G. of slip value and the lowest percentage linear shrinkage. It had the highest MOR value. 70C30W sample have low percentage of porosity and should have low density but the test result showed vice versa of the density value. This might due to some errors occurred during the test.

References

[1] Callister W.D., Rethwisch D.G., (2011), Materials Sciences and Engineering, 8th Ed., Asia, John Wiley and & Sons, Inc.

[2] Gani N. A., Shamsuddin M. S., Koo W. K., Masri M. N., Sulaiman M. A., (2015), Chemical Composition of Clays for Pottery in Malaysia: A Review, Journal of Tropical Resources and Sustainable Science,3, pp 144-153.

[3] Enoch O.F, (2012), The Act of Mass Production in Kelantan Traditional Pottery, Malaysia, Art and Design Studies, 3, pp 18-26.

[4] Said T. S., Ramli H., Sedon M. F., (2011), Local Genius of Mambong Pottery in Kelantan, Malaysia, International Journal of Humanities and Social Science,1 , pp 147-155.

[5] Hamdzun H, Liza M. M. N., Noor H. I., Salina A. M., Narimah A. M., (2014), Aesthetic Aspects of Moulded Clay Pitcher, Middle-East Journal of Scientific Research, 8, pp 1264-1275.

[6] Ahmad Z. A., Jamaludin A. R., Sulaiman M. A, (2014), Seni Tembikar, 1st Ed., Pulau Pinang, Penerbit Universiti Sains Malaysia.

[7] Emiroglu M., Yalama A., Erdogdu Y., (2015), Performance of Ready-Mixed Clay Plaster Produced With Different Clay/Sand Ratios, Applied Clay Sciences, 115, pp 221-229.

[8] Oskar H. H., Shariman Z. A., Rusmadiah A., Fairus K. M., (2015), Proceedings of The International Symposium on Research of Arts, Design and Humanities, pp 212-215.

[9] Nawi A. M., Badarulzaman N. A., (2015), Effect of Plaster Waste and Sintering Temperatures on Physical Properties of Pottery, Global Conference on Sustainable Manufacturing, 26, pp 752-755.

[10] Bragança S. R., Bergmann C. P., (2004), Traditional and Glass Powder Porcelain: Technical and Microstructure Analysis, Journal of the European Ceramic Society, 24, pp 2383-2388.

eISSN Number: 2462-2389