FORMULATION OF STONE - WARE BODIES FOR SMALL SCALE CERAMIC INDUSTRIES IN NIGERIA

Akpole, J. Enoch

Abstract

Small scale ceramic industry in rural areas is of fundamental importance in nation building especially as a factor of promoting industrial self reliance. The quality of raw materials for producing ceramic wares has an important effect on the industry.
This important factor therefore becomes a basic problem, which is relevant to this research. The focus of this research was on how to formulate stoneware bodies from those ceramic raw materials for prospective ceramic industries in Nigeria.

Introduction

The historical beginning of pottery in Nigerian traditional societies is not known. According to Counts (1991) " pottery was characteristically a symbol of settled life, and that its appearance and development marked an important stage in the progress of man".
Pottery become increasingly complex as modern potters experimented with various ceramic materials and processes to satisfy not only the domestic need, but also the industrial and aesthetic needs of man. According to Kenny (1976) "all pottery, no matter when or where it was made belongs to one of three types- earthenware, stoneware or porcelain".

According to Aluiwain et al. (1991) different people of the world advanced in making pots at different rates and at different times. Those with early civilization improved the technique of making pots thus proficient techniques were reached which are being used by modern potters today. These with retarded progress still use the pre-historic techniques of pottery making with little or no improvements.
In Nigeria pottery has been in use for long. It is still in the stage it has been because of non technological development in pottery. Thus pottery is still in the crude and brittle form due to low firing temperature of between 500°c.

Stoneware is relevant to the study and is therefore discussed further: characteristics include denseness, great compressive strength, hardness, impermeable to liquids, resistant to abrasion and with or without translucency. Leach (1945:35) contended that there is no single natural clay which combines in itself all the qualities of stoneware: therefore modern ceramists tend to blend various ceramic raw materials available locally to achieve pottery of stoneware quality.

To achieve a good stoneware body Cardew (1969:73) suggests the use of porcelain convention, because analysis shows that Kaolin, feldspar and quartz form the basic raw materials for porcelain, and since both are stoneware, what is needed is elimination and substitution of Kaolin by a blend of ball clay and kaolin by proportion.

Rhodes (1969:45) concludes that there is no scientific or exact way of arriving at body composition except clays one makes, with some intelligent trials, such as mixing clay with other related materials at various ratios which is best achieved through empirical method of porcelain triangle.

The basic raw materials required for the study are ball clay, kaolin, feldspar, quartz, and limestone. They provide different physical and firing properties suitable for stoneware body and glaze. The ball clay provides plasticity while kaolin provides whiteness, and refractoriness, and in a glaze body it provides bulk in the slop suspension. The quartz according to Hamer (1975:265) is a glassy substance and an important constituent of pottery glazes and many potter's materials.

Quartz in a body decreases body's thermal contraction during cooling. Quartz in a glaze reduces crackles and prevent flowing and makes glaze glossy.

Feldspar, according to Green (1963:101) covers a number of alkali and alkaline earth alumina silicate and also contains all the active minerals essential for a glaze.

Cardew (1969:49) stated that potash and soda feldspar have high translucence without collapsing. Explaining this, Singer and Singer (ibid) state that in a mixture of feldspar, quartz and

clay when 11 red, the feldspar becomes soften or even liquid and is distributed through the pores while the clay and quartz remain as solid particles.

The sources of local substitutes of raw materials are Akabe land quartz, feldspar and limestone, Magana ball clay and Kankara Kaolin. They have been investigated and found to meet industrial requirements due to their high content of ceramic minerals.

Purpose Of The Study

The purpose of this study is;

To create awareness of locally available ceramic raw materials which are basic for setting up of small scale ceramic industry.

To test the extent to which these locally available materials could be utilized for the production of ceramic wares through experimentation.

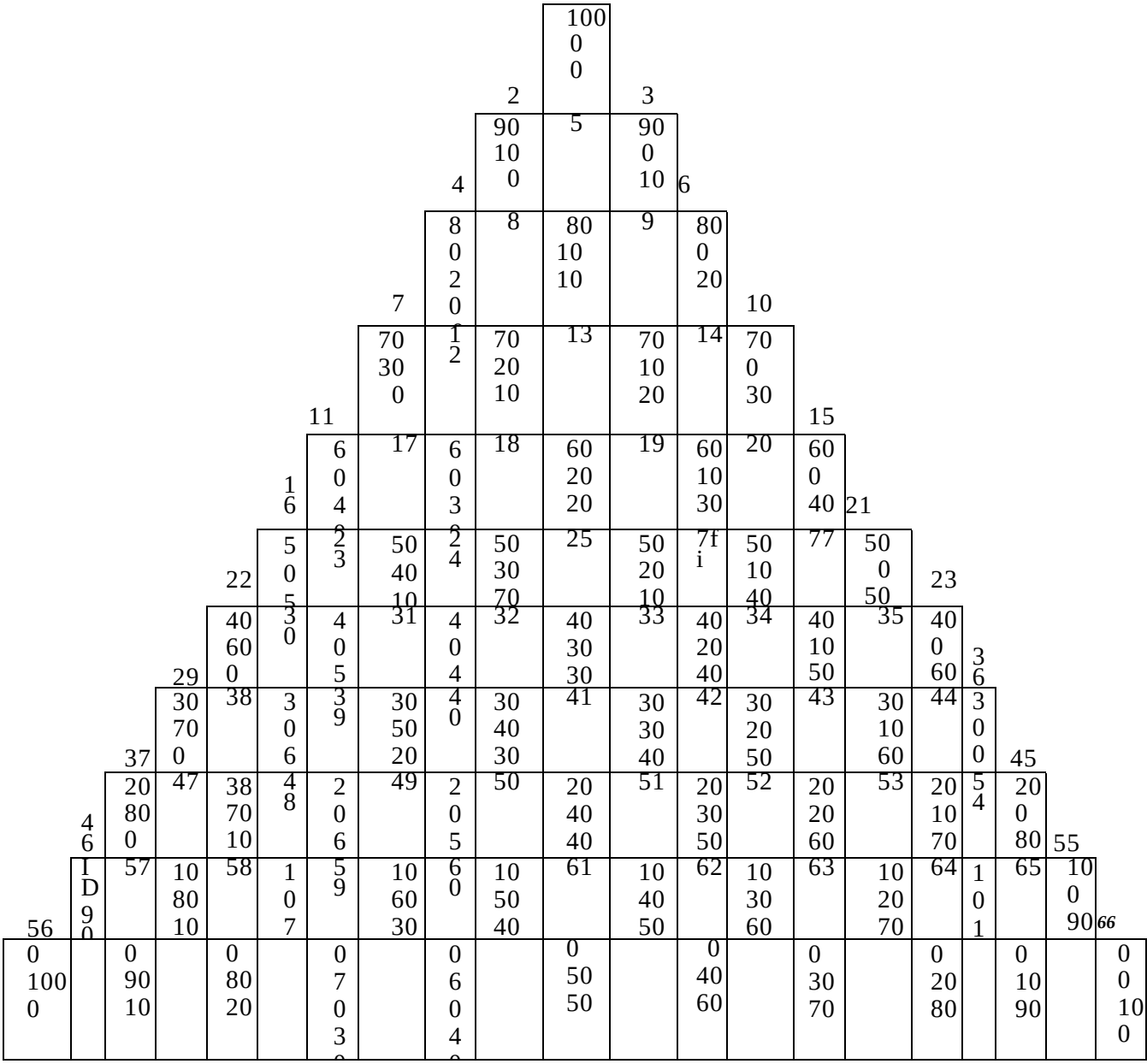
To have a prepared document from investigations on the problems and possibilities of utilizing the locally available ceramic raw materials found in Nigeria in the production of modem qualitative ceramic items.

Methodology

Some of the raw materials involved in this study have not been analysed chemically and are therefore not convenient to calculate from known ultimate and molecular methods. Rather, an empirical blending by percentage weight has been adopted for the study. In this experiment the triaxial blend and the triaxial blend tests were employed. Rhodes (1960) confirmed that the triaxiaI blend yield a very interesting variations of body and glaze compositions.

In the triaxial blend, three different materials were blended at one time to get grades of stoneware bodies and glazes. The three raw materials were blended at various ratios up to 66 different compositions. Only 36 out of the 66 blends were selected for the study some proportion of each of the three raw materials, namely; Magana clay, Akabe quartz and

FELDSPAR



BALL CLAY. Distribution of Body Composition of the Triaxial QUARTZ Blend tests (Proceiain Triangle).

The biaxial blend, involved series of variations between two clays or bodies. In this blend, eleven mixtures were compounded. Each contained mixtures such as 10 and 0, 9 and I, 8 and 2, 7 and 3, 6 and 4, 5 and 5, 4 and 6, 3 and 7, 2 and 8, I and 9, 0 and 10.

	1	2	3	4	5	6	7	8	9	10	11
Magana clay	10	9	8	7	6	5	4	3	2	1	0
Kankara clay	0	1	2	3	4	5	6	7	8	9	10

Fig. 2: Biaxial blend compositions.

The whole compositions (bodies) were fired once at the same temperature (1200"C. After the firing five tiles were selected based on the surface properties exhibited by the compounded bodies on the tiles.

A manageable quantity of selected compositions were made into test bars for the physical property tests such as:

1. plasticity - to find out the possible manipulation of the body so formed from the tests.
2. Shrinkage - to determine the rate of reduction of the body from wet to gloss stage.
3. Porosity - to determine the denseness/compactness of the body after firing: by measuring its water of absorption.
4. Colour and texture- to determine its colour and surface characteristics after firing.

Raw materials	T. 5	T. 14	T. 24	T.32	T.34
Akabe feldspar	80	60	40	30	30
Magana clay	10	10	40	40	20
Akabe quartz	10	30	20	30	50

Fig. 3 Source: Studio Test (2000)

Results of Physical and Firing Property Test.

	T. 5	T. 14	T.24	T.32	T.34
1. Plasticity	V. low	Low	Good	Good	Good
2. Dry shrinkage	2%	5 %	5 %	6.5 %	7 %
3.Biscuit shrinkage	2 %	5 %	5 %	6.5 %	7 %
4.Gloss Shrinkage	Fused	Fused	19%	20%	20 %
5. Colour at	1280%	Dark & opaque	Black	Dark Brown	Black
6. Texture		Glossy	Glossy	Fine	Fine

Source: "est.

Firing

All test specimens were first fired to bisque temperature in a kerosine kiln. The specimens again were finally fired in a kerosine kiln to 1280 °C

Discussions of Results

From the results of the studio tests conducted, the following findings were made:

1. some societies and locations in Nigeria have over 75% high quality ceramic raw materials for setting up small scale ceramics industry.
2. The Magana limestone, feldspar, and quartz are high quality ones.
3. The Magana clay - the major source of plasticity in the test fused to a dense, glossy but dark body, possibly because of the presence of iron oxide. The clay quality highly discolored the triaxail test bodies where it was prominent.
4. The Magana clay substituted Kaolin in the study was found to be of good quality. Ewule (1985) Ahmad (1986) Counts (1991) confirmed that the Kankara Kaolin meet industrial specifications. 10% to 20%> of the kaolin in the study was found to provide enough whiteness and improved the plastic quality of the casting slip: while 50% to 70% gave a very nice plastic mixture with Magana clay for wheel works.
5. It was also observed that the kerosine firing produced variation in colour effect due to temperature layering and the oxidation atmosphere in the kiln.

From the result of the property test in the table, all the selected specimen bodies had various defects ranging from plasticity to colour, except for some of the tests selected from the biaxial blend. Since biaxial test number 1 (100% Magana clay) indicated over firing and produced bland surface colour and test number 11 at the extreme (100% Kankara clays) indicates under firing and produced white surface colour, a blend of the two clays by proportion in place of 100% Magana clay in the selected triaxial blend was adopted.

Rhodes (1960) recommends 10% ball clay in a stoneware casting slip body.

Following this recommendation recorded a huge success in this study.

The Magana clay was therefore reduced to 10% in the castable bodies, while those considered for wheel works were still reduced from the biaxial blend test specimens, feldspar was also introduced in the proportion of 40% into two of the throwing bodies, simply, to provided building property and bringing down eutectic point.

Adjusted Body Composition

Raw materials	1	2	3	4	5	6	7
Magana clay	10	10	10	10	20	30	30
Akabe Quartz	30	40	20	25			
Akabe Feldspar	40	40	20	25			
Akabe Feldspar	40	40	40	25	40	40	
Kankara clay	20	10	30	40	40	30	

Nos 1 - 8 = Eight compounded

bodies **Source: Studies Tests.**

Recommendations

Taking into consideration the importance of skill development for technology education, establishment of small scale ceramics industry is of paramount importance.

1. Government, through tertiary institutions, should provides modern research equipment for ceramic education.
2. The federal government should encourage any co-operate body or bodies who may wish to establish ceramic industries (large or small): by giving credit loans.

Conclusion

The result of this study confirm that good quality ceramic raw materials such as quartz, feldspar, limestone and clay, available locally in Nigeria and it is therefore viable to set up small scale ceramic industry with minimum problem of material resources.

Following the body formulation tests, the Kankara clay - the body material becomes an essential sources of kaolin in porcelain for the prospective small scale ceramic industry.

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