PRODUCTION OF LOCAL GLAZES – KEY TO DEVELOPING THE CERAMIC INDUSTRY IN GHANA

Isaac K. Oteng

Introduction

A glaze as defined by Rhodes (1977) is a glassy coating melted in place on a ceramic body which may render the body smooth, non-porous and of a desired colour or texture. A glaze therefore is a glass-like substance coated on a ceramic body to become durable and attractive.

Glazes are essentially made from common rocks, earthy minerals and substances, such as clay, feldspar, limestone and dolomite. Some glazes can also be made from common salt, wood ash and shells. Most of these natural glaze materials can be found in several locations in Ghana.

The results of earlier studies conducted by me indicate that very useful local glaze materials such as Feldspar, Green rocks, Nepheline syenite, Dolomite and several other fusible clays are available and abundant in several parts of Ghana. I believe that it is possible to produce glazes locally using the clues provided in this paper.

The objective is to enhance the development of local glazes through research for the ultimate development of the ceramic industry in Ghana.

Types of Glazes

There are basically, two main types of glazes. They are the

- Low temperature or earthenware glazes. These are low firing glazes and would mature below 1140°C in a kiln.

  Low temperature or earthenware glazes are glossy or shinny. They appear very smooth and apparently beautiful on most clay objects like bowls, cups and flower vases.

- High temperature or stoneware glazes. These mature between 1180°C and 1250°C. The high temperature or stoneware glazes appear smooth but not glossy yet they are aesthetically pleasing on most domestic and industrial ceramic wares such as bowls, plates, vases, floor and wall tiles.

  Research conducted in (1999) indicate that most of the glaze materials found in Ghana are suitable for the production of high temperature or stoneware glazes between 1180°C and 1250°C. However with a conscientious and systematic effort it can be possible to produce glazes that may mature between 1160oC and 1250oC from certain types of fusible clays and rocks.

It is not quite possible to produce earthenware glazes below 1140°C wholly from local materials. The handicap is that low melting fluxes such as borax which can cause refractory glaze materials such as silica and alumina to melt considerably at lower temperatures have not yet been found in Ghana. However, there are other kinds of low melting rocks rich in Barium (Ba) and Boron (B), that can be found in Ghana. Lustre, and fusibility for example are useful clues that may help to identify some clays and rocks as potential glaze materials. For instance, the colour of most earthenware clays may be associated with the presence of iron and other metallic minerals as impunities in them. Such clays may be reddish, brownish, greenish, yellowish or greyish in the raw state. The presence of iron and other impunities, such as calcium, manganese, lime and other alkaline substances in clays and rocks can cause them to fuse and melt into a liquid substance when fired sufficiently to the required temperature. Rhodes (1977, p. 77) says "a substance which we think of as being permanently solid, such as a rock may be reduced to a liquid or to a vapour if sufficient heat is applied to it".

From the above, clay and rocks are fusible materials or minerals. However their fusibility depends upon the amount of mineral impunities present in them. These impunities act as fluxes to lower the melting point of substances at high temperatures. For instance, clay which is reddish, greenish, or yellowish etc., contain iron and other mineral impunities in sufficient quantity to cause the clay to become tight and hard fired at about 950°C-1100°C. In this condition the clay could be suspected as fusible at higher temperatures depending on its chemical properties and the condition of the firing.

Fusibility test is therefore very important when selecting or determining clays or rocks for glazes because it can provide a more practical clue about the melting temperatures of the materials being dealt with. The selected materials must be prepared and fired in an electric or gas kiln.

Though recognizing a type of rock or clay by its mineral constitution is the job of the expert, some clues could help the Ceramist to identify useful rocks and clays in Ghana for glazes. Those colour rocks and clays that have been tested and found useful for glazes include; Green rocks and Green clays from Winneba, Dark plastic clays from Gomoa Awombrew, Soda Feldspar from Agona Kwanyako and Potash Feldspar from Moree, all in the Central Region. Others are Trabuom clay from Trabuom in the Ashanti Region, Nepheline Syenite from Abutia in the Volta Region and Dolomite from La beach in the Greater Accra Region.

The table below gives the amounts of the mineral contents of the respective clays and rocks from their chemical analyses conducted at the Ghana Geological Survey department in Accra Ghana.

Materials	SiO_2	$A1_2O$	Fe_2O_3	K_2O	Na_{22}	MgO	CaO	TiO_2	P_2O_5	Li_2O	BaO
Winneba Green Rock	49.38	9.65	11.97	0.24	0.32	3.02	22.43	1.0	0.32	_	_
Winneba Green Clay	48.42	10.34	11.73	0.14	0.16	0.50	21.03	9.08	0.14	_	_
Kwanyarko Feldspar	78.53	2.40	0.09	1.14	3.95	_	1.34	_	3.93	_	_
Trabuom Clay	48.48	7.59	8.89	3.14	1.08	1.46	2.39	6.56	1.5	0.04	4.12
Awomberew Clay	57.42	7.59	3.66	0.66	1.69	6.66	12.9	_	0.35	_	_
Nepheline syenite	40.0	17.84	4.57	9.08	14.35	1.01	4.93	1.98	0.32	0.08	0.45
Dolomite	8.0	0.68	0.48	1.04	2.8	28.48	30.0	_	4.22	_	_

The physical and chemical analyses of raw materials (when available), may also help to identify lustre which describes the appearance of unweathered surface of a rock in an ordinary reflected light. Under ordinary light, a rock may appear vitreous, metallic, resinous, pearly or silky suggesting the presence of varying amounts of some useful metallic and non-metallic minerals. Information on the luster of a material therefore may become a reliable pointer to some potential glaze materials. For instance glaze material like feldspar is pearly, nepheline appears resinous and talc is silky. Important glaze materials such as Feldspar, Calcite or Limestone are soft and are quite distinguishable from granite and other hard rocks which may be unreliable for glazes.

Developmental Procedures

The following developmental procedures are recommended for the production of local glazes.

- **Identification of materials :**

  1. Raw materials can be identified by their colour, lustre, hardness and analysed to determine the type and kinds of oxides in them to be able to critically assess their behavior under thermal conditions. For example analyses of raw materials are quite expensive so they should be considered when the material has been found reliable after testing.

- **Selection and labeling :**

  Select and store materials and label them separately for easy identification.

- **Preparation of materials:**

  5. Pulverize materials manually or mechanically, sieve, weigh in smaller quantities and soak for a day or two. After sieve soaked materials into smaller plastic containers and label them. Allow the slip to settle sufficiently.

- **Application of glaze samples :**

  6. Decant excess water on top of the slip or raw glaze. Apply samples on separate test pieces by dipping or pouring as appropriate.

- **Test Firing**
  7. Fire samples of raw glazes on test pieces in an electric or gas kiln to about 1250°C. The initial firing of samples at 1250°C is ideal for most materials. At this temperature most high fire or stoneware glazes would fuse or melt to appear smooth, brilliant or matt on the surface. Such glazes may be considered for further adjustments and firings to improve their surface texture or colour as required.

  Study the development of surface textures on the test pieces and analysis them. At this point a critical analysis of the surface textures is important. The surface textures of the melted glazes that appear smooth and matty at 1250°C could be described as stoneware or high temperature glazes. Those glazes that appear burnt on the test pieces may be tested again by applying the raw glazes on new test pieces and firing them to about 1180°C or below. At lower temperatures the surfaces textures may be smooth, brilliant or shiny. These may be described as earthenware or low temperature glazes. Glazes that mature sufficiently between 1160°C and 1180°C are also described as Mid-temperature glazes. Glazes that appear, hard and rough at 1250oC may be discarded or rejected because they are too refractory.

The different glazes materials may be blended and fired in several text firings as described above to achieve the required results.

To improve, change, or alter the colour of the glazes, local colouring oxides such as manganese, iron and rutile may be added in smaller quantities to yield black, brown or yellow colours respectively. Colouring oxides such as cobalt, copper, tin oxide (if available) may be added to yield blue, green or white as desired. Quantities between 1%-2% of colouring oxides are desirable in most glazes.

Conclusion

Good high-fired and mid-temperature glazes can be made from simple combinations of local glaze materials obtained from several parts of the country. More of these need to be located, identified and processed them for glazes.

There is the need to lower the high cost of power/fuel, to make it possible to fire stoneware or high temperature local glazes. Most of these local glazes have several unique and desirable qualities. They are stronger, more durable and resistant to acids and decay. Furthermore they are not easily scratched, defaced or peeled from surfaces of floor tiles, wall tiles, sanitary wares and table wares.

Between 1160ºC-1180ºC, low temperature/mid-temperature or earthenware local glazes are colourful, brilliant, glassy and decorative in appearance on domestic and industrial ceramic wares.

In view of the benefits of stoneware and earthenware glazes, a consortium of Ceramic Art Educators, Researchers and Entrepreneurs in collaboration with Government and Private Agencies would be an opportunity to exploit the abundant local glaze materials to establish a ceramic industrial revolution in Ghana.

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