The Effects of Rice Hull Ash on Ceramics Glaze

Alfredo R. Rabena, Ph.D.
Ronald N. Amano
Esteban T. de Peralta

Abstract

This study determined the effects of rice hull ash as particle designs of white wares constituting transparent base DT 24 at high firing temperature.

The results of this study showed that rice hull can be used as designs on pre-fired white clay ceramics. Burned rice hull did not disappear at a firing temperature of 1,100°C in gas kiln.

The mixture of rice hull ash and transparent base DT24 on white ware ceramics manifested clear dotted black and white designs on wares.

Introduction

Background of the Study

Our present world is confronted with crises. One of which is the fast deterioration of the environment. This is brought about by the fast fluctuations of earth temperatures due to climate change. Many parts of the earth have been the sites of natural calamities, catastrophies and bad scenarios akin to environmental changes which paved the way to the sufferings of people that end to a perennial poverty.

The root cause of all these events is due to man's action and doings. The lack of care and concern on the proper disposal of wastes generate a unprecedented build of materials which when not appropriately manage lead to societal problems.

In the local scenario, many kinds of wastes proliferate in the villages. Such wastes are generated by farms, small industries and households. These wastes must be appropriately planned in order that they will be utilized properly and will not

contribute to bad emissions that may contaminate the atmosphere and enhance global wanning. Wastes generated must be utilized in order to mitigate poverty in the locality.

Agricultural wastes like rice hulls are abundant in Ilocos. These are produced from rice mills and are burned into the atmosphere. The excessive volume of rice hulls generated must be given attention in order to prevent the litter in the environment. As of the moment, rice hulls are just utilized in keeping ice from melting which is minimally reducing their existence in the community.

It is timely that these materials are to be utilized as mixture in the production of good quality ceramics. Rice hulls are burned and their ash are mixed with desired chemicals to produce fine decorations. and designs and innovations which provide new motivations for consumers and collectors to buy ceramics products.

Objective

This study attempted to find out the effects of rice hull ash mixed with transparent base DT 24 to white ceramic wares.

Review of Related Literature

Rice Hull. Rice hull is an agricultural waste from the milling of rice grains. Dr. Paul Olivier in his Ph.D. dissertation at the Louisiana State University, USA, found out that it contains 20% opaline silica in combination with a large amount of the phenyl propanoid structural polymer. Rice hulls are used as fiber source, premix and pellet binder in the animal feed industry. In the local villages of Ilocos, rice hulls are used as cover for storing ice. It is found efficient in preventing the melting of ice. In livestock activities, they are placed on soil surface to prevent slippery areas. People transporting livestock using trucks and wagons, place rice hulls inside the vehicles usually on floors to prevent slippages of livestock. Rice hulls in pottery is as old as the ceramics industry. They are mixed with Vigan clay to come up with durable and strong potteries and moulds.

Ash

Colorants **and Designs.** One way of attracting consumers, collectors and designers is to put designs and colors to ceramics products. Attempts were made and Rabena (1994) found out that indigenous plants using their barks, fruits, leaves and flowers could be used to dye cloth. He utilized *bagbagotot (Phyllantus reticulatus)* and showed significant effects in cotton, nylon and silk. In 2003,

Rabena and Amano determined the effects of *bagbagotot* and *atswete (Bixa orel/ana)* fruit dyes on ceramics. They found out that there **were** no colorings retained in white ceramics glaze. It was discovered that firing the ceramics at 1,000"C coated with plant dye and transparent glaze is of no color retention. The plant dye evaporated at high temperatures.

Glaze Materials, Speight (1976) states that modem chemistry has given the potter much useful information about the behavior of glaze materials. However, the potter still depends on trial and error testing. Slight changes in the amount of certain ingredients can change the glaze radically and there is no way to be sure what a particular glaze looks like without making a test or series of tests. Test allows the researcher to alter the proportion of one material slightly and see what happens to the glaze. At all times potters, no matter how experienced, test constantly and always look for new and better glaze formulas.

Speight further states that in making the ingredients, a potter must use a balance scale, weigh the dry ingredients, and then add them to a small quantity of water to form a thick, soupy mixture. Next, he must put this mixture on a sieve with 60 or 80 mesh, refine the materials and mix them thoroughly. Then, he should add more water to bring the mixture to a good consistency for dipping or brushing the glaze onto the articles – the mixture like cream is generally satisfactory. Many potters use a hydrometer to measure the water content. By doing this, they can make the water content constant and the glaze at the same consistency at all times, adding more water as it evaporates. Mix the ingredients thoroughly and continuously or else the solid ingredients settle at the bottom.

Costales and Olson (1959) states that the materials for glaze must be properly prepared to be usable. This preparation when done in a ceramic materials industry includes filtering, chemical purification, and such processes especially designed for machines and equipment that prepare the materials automatically. But when the preparation is done by hand or with inadequate facilities, only crushing, grinding, pulverizing, washing, and screening are possible. Crushing can be done with a heavy hammer until the largest piece is as small as a match head. Grinding and pulverizing can be effectively done with the use of porcelain mortar and pestle. The particles of most ceramic materials should be fine enough to pass through a 200-mesh or fiber screen. Wire screen or nylon – lawn are available for this purpose. When such screen is not available, the grindings should be sieved through at least 100-mesh net. Then, they should be ground further until they are reduced to powder with several rinses of water to remove undesirable materials which come to the top.

Definition of Terms

Appearance . In this study, it refers to either fritted or gloss point.

Color. It was based on the Mariwasa tile samples.

Frit. This fonns an important part of the batches used in compounding enamels and glazes. The purpose of this pre-fusion is to render any soluble and/or toxic components insoluble by causing it to combine with silica and other added oxides. In this study, the glaze was not able to reach its melting point.

Gloss Point. When a layer of glaze powder is heated, a temperature is reached at which the surface changes its appearance from dull or bright.

Texture. In this study, it refers to the smoothness of the surface of the articles/product.

Methodology

Rice hull were burned. The rice hull ash was collected. The ash were mixed with transparent base. Commercial glaze (DT 24) was used as transparent base.

The ceramic glazes containing the commercial glaze (DT-24) and the rice hull ash was fired at I 100 C. The rice hull burning was done in Nagsangalan, Vigan City, Ilocos Sur and the firing was conducted at the Ceramics Research and Productivity and Training Center, University of Northern Philippines, Vigan City, Ilocos Sur.

The following tools and materials were used in this study.

Materials and Tools/Equipment	Use and Other Details
DT24	A transparent glaze to be added to the base glaze for white wares.
Rice Hull Ash	The substance tested for the creation of new innovations in ceramics products .
White ceramics ware	The nature of the ceramics ware used was intended to observe the real effect on color and the other characteristics that manifest.

Technical Description of the Process

Basically, steps were followed in the preparation of the fonnulated glaze; namely, burning the rice hull, weighing, mixing, screening, glazing, firing, and evaluation.

Burning of the Rice Hull. Rice hull were burned until they were transfonned into ash.

Weighing. The required amount of base glaze was weighed and then placed into plastics cups. Likewise, the required amount of ash was weighed and put into plastic cups.

Mixing. In mixing the glaze, a graduated cylinder was used to measure the water content of the glaze in order to ensure the right amount of water and the glaze was kept at the same consistency at all times. Water was added to the dry ingredients in the plastic cups.

Screening. Screening was done by using 100-mesh screen to remove foreign particles in the mixture. After screening the ash was put into a plastic cup. The screen was cleaned to be ready for the mixture.

Glaze application. Test pieces were free from dust and were handled minimally to avoid soiling them with oily fingerprints. The test pieces were wiped with a dump sponge or rinsed quickly under tap water. Then, they were marked at the bottom with similar marks on the plastic cups. The glaze was stirred and the articles were dipped into it for two to three seconds. Then, the article was shaken to get rid of extra glaze. Finger marks left on the piece were covered by retouching with a brush.

Glaze firing. After the test pieces were applied with glaze, they were dried and prepared for glaze firing. Before loading, the kiln lining had no loose fragments that might fall on the articles.

The kiln was loaded and the kiln shelves were on posts to fit around the articles. The tests pieces and other articles inside the kiln were properly arranged and maintained at one fourth distances to prevent the articles from sticking to each other when the glaze melted.

After the kiln was loaded, it was covered, the thermocouple was put, and the kiln was switched on. Between three to four hours of firing, the researchers observed and read the temperature scale. When the temperature reading was 1100 "C the kiln was switched off. Twelve hours after the start of firing, the kiln was opened and the test articles were unloaded.

Evaluation. This was done by arranging the test pieces according to their tag marks.

They were checked individually and data on the appearance, texture, and color of each piece was recorded. The results were analyzed and interpreted.

Preparation of the Rice Hull Ash

Rice hulls were collected from Nagsangalan, Vigan City, Ilocos Sur. Fifty grams (50g) of hulls were burned and added with water to a mixture.

The rice hull ash with transparent base DR4 was applied on the surface of white ceramic wares. The proportion of rice bull ash to the transparent base is 50 *g of rice hull* to 100 % transparent base.

The white ware containing transparent base DT_4 and the rice hull ash were put into the kiln.

Results and Discussion

Preparation of the Ceramics

The ceramic wares were made of white clay and bisquette-fired at low temperature. The ceramics were molded and pre-fired at low temperature in order to prepare it for the application of colorants at 900 "C- 950 %C,

The Rice Hull Ash with Transparent Base $DT_,$

Pre Firing. The rice hull ash was mixed with transparent base $DT_,$ on white clay ceramics. The mixture (rice hull ash + $DT_,$) was absorbed by the ceramics manifesting a change of color from original white to paler white. This was possible due to the high porosity of the bisquette-fired ceramics.

Kiln Firing. The white clay ceramic wares applied with the mixture (rice hull ash + DT 24) were placed into an gas kiln ready for firing. The gas kiln was set at 1100C. The ceramics with the mixture (rice hull ash + DT,a) fired at 1100C showed a discoloration from clear white to dirty white with black spots, This manifested a deposition of the ash components from rice hull as on the white clay ceramics.

Table 1. The Effects of Rice Hull Ash as Component Mixture on Ceramic Glazes in Different Amounts.

Rice Hull Ash e	Transparent Base Dr–24)(G)	Water	Results
0	1000	1500	White shiny ceramics No spots
150	1000	1500	Paler white ceramics with black spots in thinner distribution
200	1000	1500	Paler white ceramics with black spots unevenly distributed
250	1000	1500	Paler white ceramics with black spots in thicker distribution

Conclusions and Recommendations

It is concluded that white clay bisquette-fired ceramics absorbed rice hull ashes and transparent base DT. The absorption manifested black spots on clear white ceramics.

It is recommended that a gadget be designed to evenly distribute the rice hull ashes mixed with the liquid DT are placed on white ceramics. It is further recommended that a higher temperature be tested on the firing of the clay bisquette –fired which absorbed rice hull ashes.

References

Aguilar, N. 2003 *Phyllanus reticulatus Nomenclature & Taxonomy.* Personal Interview. UPLB College , Laguna.

Amano. R. 2003 Personal Interview. *Ceramics Manufacture Ceramics Research and Productivity Center.* Personal Interview. UNP, Vigan City.

Costales, F. and D. Olson. 1959. *Ceramics for Schools and Industry in Developing Countries.* Manila, Philippines

Quinto, J.E. 1992. *Anatomical Study on Some Dyes Containing Species of Family Verbarance and Stability of their Dyes.* M.S. Botany Thesis, University of Philippines at Los Banos, Laguna.

Rabena, A.R. 1994. *The Isolation and Washed Fastness Testing of Crude Natural Dyes of Bagbagotot (Phyllantus reticulatus) Berries from Wigan* City UNP Research Joural, UNP, Vigan City.

Rabena, A.R. and R. Amano. 2003, *Utilization of Bagbagoto (Phyllantus reticulates) and Atswete (Bixa orellano) Dyes as Ceramic Colorants.* UNP Research Journal, UNP, Vigan City.

Ragasa, V. and R. Arano. 1999. *The Effect of Banana Curls, Wigan Clay DT 24 & Other Oxides in Glossy Cotta Vases.* UNP Research Joural, UNP, Vigan City.

Ragasa, V. 1999. *Formulating Glory from UNP Ceramic Products.* UNP Research Journal, UNP, Vigan City.

Speight, C.F. 1976. *Hands in Clay: Introduction to Ceramics.* USA: May Field Publishing Co.