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Formulating Glazes for UNP Ceramic Products

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Abstract

This study investigated on the best formulation of rice hull ash (), Wigan clay () and DT (D) mixed with oxide and water that would yield better quality glaze of Wigan clay products.

Three oxides, namely: copper oxide (CuO), zinc oxide (ZCnO), and calcium carbonate (CaCO) were used and 16 formulations were made using every oxide. Seventy five percent DTa and 160ml HO were constant in all the 48 different formulations.

Among the 16 RVD+CuO formulations it was found out that two formulations yielded glazed products without deficiencies, namely: Cu10 (40-10-75-4 RVD+CuO) and Cu16 (30-20-75-5 RVD+CuO).

Among the 16 RVD+ZnO formulations the eight formulations having 3-4% zinc oxide yielded glazed products without deficiencies.

Among the 16 RVD+CaCO, formulations only two formulations yielded glazed products without deficiencies, namely: Ca4 (30-30-75-2 RVD+CaCO) and Ca8 (30-20-75-3 RVD+CaCO).

Introduction

Glaze makes the fired piece impervious to liquids, gives it a durable surface, and adds color and visual interest to pottery or sculpture. No glaze, however, can make an unsuccessfully formed pot into a thing of beauty.

A glaze can be applied very thinly, allowing the textures of the clay to show through, or so thickly that it develops its own texture quite apart from the clay itself. The decorative effects hat are possible with glazes vary from accidental drips running down the sides often really controlled by the potter to carefully painted designs.

Modem chemistry helps people analyze the composition of glaze and leam exactly what materials are needed to change its composition to achieve certain effects. Glaze testing is simpler and faster because one can start with the basic chemical knowledge. ht is necessary to test, however, one may find that the best glaze is the result of experimentation. Indeed, there is no reason why excellent glaze could not be made by measuring out of the basic ingredients within the generally known proportions, adding and subtracting materials, and then testing the glaze. Measuring cups, spoons, and a creative approach can be successful for those who wish to avoid the chemistry and there is no need to be turned off by the 'mystery' of glaze.

Objectives

This study attempted to find out which of the different formulations of rice hull ash (R), Vigan clay (V), and DTa D) mixed with different percentages of oxides would yield an effective glaze of Vigan clay products.

It sought to **answer the** following questions:

1. Which of the different formulations of rice hull ash, Vigan clay, and DT3a mixed with copper oxide would yield an effective glaze of Vigan clay products in terms of appearance, texture, and color?

2. Which of the formulations of rice hull ash, Vigan clay, and DTa with zinc oxide would yield an effective glaze of Vigan clay products in terms of appearance, texture, and color?

3. Which of the different formulations of rice hull ash, Vigan clay, and DT_{24} with calcium carbonate would yield an effective glaze of Vigan clay products in terms of appearance, texture, and color?

Scope and Delimitation

This study was focused on the effects of rice hull ash (R), Vigan clay (V), and DT, (D) mixed with different proportions of copper oxide (CuO), zinc oxide (ZnO), and calcium carbonate ($CaCO_3$) in glazing Vigan clay products.

It was limited to the analysis of 48 glaze formulations that would give the best appearance, texture, and color of Vigan clay products. These formulations were divided as follows: 16 formulations of rice hull ash, Vigan clay and DT_{24} mixed with copper oxide (Table 1); 16 formulations of rice hull ash, Vigan clay, and DT mixed with zinc oxide (Table 2); and 16 formulations of rice hull ash, Vigan clay, and DTu mixed with calcium carbonate (Table 3). A constant amount of DT3 (75%) and water (160ml) was used in all the formulations.

This study was conducted in the Ceramics Research and Productivity Center (CRPC) of the University of Northern Philippines (UNP), Vigan, Ilocos Sur.

Table L. Mixing formulations of rice hul ash, Vigan cay, and DTa with copper oxide analyzed in the study.

FORMULATION	GLAZE MATERIAL P			
	RICE HULL ASH (R)	VIGAN CLAY V	DT, D)	COOPPER OXIDE (CuO)
Cul	45	05	75	2
Cu2	40	10	75	2
Cu3	35	15	75	2
Cu4	30	20	75	2
Cu5	45	05	75	3
Cu6	40	10	75	3
u7	35	15	75	3
Cu8	30	20	75	3
9	45	05	75	4
Cu10	40	10	75	4
Cull	35	15	75	4
cu12	30	20	75	4
Cul3	45	05	75	5
Cul4	40	10	75	5
Cu15	35	15	75	5
u16	30	20	75	5

Table 2. **Mixing formulations of rice hull ash, Vigan cday, and DT,a with zinc oxide analyzed in the study.**

FORMULATION	GLAZE MATERIAL Pe			
	RICEHULL ASH (R)	VIGAN CLAY(v)	DT, O»	ZINC OXIDE ZnO
Zl	45	05	75	2
z2	40	10	75	2
Z3	35	15	75	2
Z4	30	20	75	2
z5	45	05	75	3
Z6	40.	10	75	3
27	35	15	75	3
78	30	20	75	3
729	45	05	75	4
210	40	10	75	4
211	35	15	75	4
212	30	20	75	4
Z13	45	05	75	5
Z14	40	10	75	5
Z15	35	15	75	5
Z16	30	20	75	5

Table 3. Mixing formulations of rice huil ash, Vigan cay, and DT,, with calcium carbonate analyzed in the study.

FORMULATION	GLAZE MATERIAL PERCENT)			
	RICEHULL ASH R)	VIGAN CLAY (V)	DT,, D)	CALCIUM CARBONATE (CaCo)
Cal	45	05	75	2
Ca2	40	10	75	2
Ca3	35	15	75	2
Ca4	30	20	75	2
Cas	45	05	75	3
Ca6	40	10	75	3
Ca7	35	15	75	3
Ca8	30	20	15	3
Ca9	45	05	75	4
Cal0	40	10	75	4
Call	35	15	75	4
Cal2	30	20	75	4
Cal3	45	05	75	5
Cal4	40	10	75	5
Cal5	35	15	75	5
Cal6	30	20	75	5

Methodology

Research design. This study made use of the experimental method of research observing the operational procedures.

Materials and tools/Equipment.. Table 4 shows the materials and tools/equipment used in the study.

Table 4. Materials and tools/equipment used in the study.

Materials and T	Description/Use
Rice hull ash	One of the ingredients to the base glaze of Vigan clay products
Vigan clay	A clay material to be added to the base glaze like rice hull ash and DT.
	A transparent glaze to be added to the base glaze in glazing Vi clay products.
Copper oxide (CuO)	Used as coloring agents in pottery and glass. It normally gives a green hue but under reducing conditions it produces red color due to the formation of collidal
Zinc Oxide ZnO)	Used in glasses, glazes, enamels, and more recently in ial c ceramics.

Table 4. Continued.

MaterialsandT ment	Description/Use
Calcium Carbonate (CaCO,)	The mineral constituent of limestone chalk and marbles. ft is used in ... bodies.
Water	To be added to the ingredients of glaze in order that the ... will stick to the articles.
Basin	Used as container of the ingredients of glaze
Graduated cylinder	Used in measuring the amount of water needed in the mixture of
	For getting glaze materials to be placed at the wei scaJe.
Plastic cups	For placing the glaze ingredients of samples in glazing Vigan clay products
Weighing Scale (Trial beam)	For measuring the required amount of the different ins ientsof in Vi c 1cts
Sponge (wet)	For cleaning the bottom of the articles after glazing to free them from
Kiln	A high temperature installation used for firing *ceramic* articles or for calcinin

Definition of Terms

Appearance In this study it refers to any of the following characteristics on the surface of the test pieces: gloss point (GP); pin holes on the surface (PHS); bubbles (B); slight bubbles (SB); glaze absorbed in the body (GAB); glaze urunelted (GU); *matt* glaze (MG); and glaze ununiformly spread (GUS)

Bubbles. A fault on the surface of the ware; bubbles appear on the surface and arranged to produce a decorative effect on some purposes.

Glaze absorbed in the body (GAB). A fault in the wares after firing; glaze applied to the body disappears and is absorbed in the body after firing,

Glaze unmelted (GU). Glaze applied to the body did not properly melt after firing,

Glaze ununiformly spread (GUS) A fault in the wares which shows that the glaze in some parts are thinner than in other parts.

Matt gaze (MG). A ceramic glaze that has partially vitrified, the effect is delberately achieved, for example, on some types of glaze wall tile. This type is good for the flooring of comfort rooms. The firing temperature at which the constituents of a glaze have reacted to form a glass that when the wall has been cooled, appears to the eye to be homogeneous and free from bubbles.

Pin holes on the surface (PHS) A fault in vitreous enamelware. It is a result of a blister that has burst and partially healed; the usual sources of the gas that gave rise to the blister are a hole on the base-metal or a spark of combustible foreign matter in the cover coat.

Gloss point (GP). When a layer of glaze powder is heated, a temperature is reached at which the surface changes its appearance from dull to bright.

Slight bubbles (SB). A fault on the surface of the ware after firing; bubbles appear on some portions of the surface of the ware.

Texture. In this study it refers to any of the following characteristics on the surface of the test pieces: malt surface – a ceramic glaze that had partially divitrified, the effect is deliberately achieved, this type of glaze is good for flooring of comfort rooms; rough – not smooth or level; uneven surface; slight smooth – the surface is not perfect, there is a problem on the surface that hinders it from becoming a smooth surface.

Color. In this study it refers to any of the following colors of the test pieces: green- the color is characteristic of growing grass; white-temm used for a white vitreous enamel of high capacity used for one coat app:ication; having the color of pure snow or milk.

Technical Description of a Process

Basically the ensuing nine steps were followed in the preparation of the formulated glaze until such time that the results were obtained

Pulverizing. Rice hull ash was pulverized through the use of a ball mill.

Weighing. The required amount of each of the different ingredients in the different formulations were weighed through the use of a trial beam (weighing scale).

Mixing, The required amount of formulated glaze was placed in plastic cups. The required *HO* was mixed thoroughly with the ingredients until it was ready for screening.

Screening, This was done by using a 100 mesh.

Glaze application. After screening the glaze, it was applied to the test pieces by dipping the test pieces into the glaze mixture for three to four seconds.

Loading. The test pieces were arranged on the kiln slabs inside the kih at a distance of '⁄ of an inch between pieces.

Firing, After having been loaded, the kihn was closed and firing started. While firing the researchers observed the temperature from the pyrometer. When temperature had reached 102OC the kiln was switched off The firing was done for 3 ½ hours.

Cooling. This was done for 12 hours after firing,

Evaluation. After cooling, the test pieces were brought out and arranged according to formulation used. Then the results of the experiment were recorded and interpreted.

Results and Discussion

Characteristics of Test Pieces Glazed With Formulations Having Copper Oxide

Appearance. Generally, bubbles appeared on the surface of the test pieces glazed with rice hull ash (R), Vigan clay (V), and DT24 (D) mixed with copper oxide (CuO). Only formulations Cu10 (40-10-75-4 RVD+CuO) and Cu16 (30-20-75-5 RVD+IO) yielded test pieces that were rated GP (gloss point). The rest had either gloss point with slight bubbles or glaze absorbed in the body (Table 5).

Texture. Most of the test pieces had rough surfaces. Again, formulations Cu10 and Cu16 yielded smooth surfaces of the test pieces (Table 6).

Color. All test pieces glazed with the 16 formulations of rice hull ash (R), Vigan clay (V), and DT24 (D) mixed with copper oxide (CuO) became green (Table 7).

Characteristics of Test Pieces Glazed With Formulations Having Zinc Oxide

Appearance. Table 8 shows that among the test pieces glazed with 16 RVD formulations mixed with zinc oxide (ZnO), Formulations Z5-Z12, which contain 3-4% ZnO were rated GP or gloss point. Formulations Z13-Z16, which contain 5% ZnO yielded test pieces having glaze ununiformly spread over the surface. The rest had either bubbles, glaze unmelted, glaze absorbed in the body, or matt glazed surfaces.

Texture. All the test pieces glazed with RVD formulations mixed with ZnO, except Z1, Z2, and Z5 had smooth surfaces (Table 9). This type of glaze is good for walls and floors of comfort rooms.

Color. Table 10 shows that all the test pieces glazed with RVD formulations mixed with ZnO had white surfaces.

Table5. Appearance oftestpiecesglazedwith 16 formulations ofricehull ash(R), Viganclay V), and DT,A D) mixed with copper oxide (CuO).

FORMULATION	CHARACTERISTIC		
	SAMPLE1	SAMPLE2	SAMPLE3
Cul (45-05-75-2RVD+CIO)	B	B	B
Cu2 (40-10-75-2RVD+uO)	B	B	B
u3 35-15-75-2RVD+uO)	B	B	B
Cu4 30-20-75-2 RVD+CuO)	GPSB	GP/SB	GP/SB
Cu5 (45-05-75-3 RVD+CuO)	B	B	B
u6 (40-10-75-3 RVD+CuO)	B	B	B
u7 35-15-75-3 RVD+IO)	B	B	B
Cu8 30-20-75-3RVD+CIO)	B	GP/SB	GP/SB
9 (45-05-754RVD+uO)	GP/SB	B	B
ul0 (40-10-74RVD+IO)	GP	GP	GP
ul1 (35-15-754RVD+CO)	GP/SB	B	B
u12 (30-20-75-4RVD+CO)	B	GP	GP
Cul3 (45-05-75-5 RVD+CuO)	GP	GP	GP/SB
Cu14 (40-10-75-5RVD+IO)	GAB	GAB	SB
Cu15 (35-15-75-5 RVD+CuO)	GAB	GAB	GAB
Cu16 (30-20-75-5 RVD+CuO)	GP	GP	GP

Legend: B – Bubbles
GP/SB – Glosspointwithslight bubbles
GP – Gloss point
GAB – Glazeabsorbed in the body

Table 6. Texture of test pieces glazed with 16 formulations of rice hull ash (R), Vigan cay (V), and DTa D) mixedwithcopper oxide (CuO).

FORMULATION	CHARACTERISTIC		
	SAMPLE1	SAMPLE2	SAMPLE3
Cul (45-05-75-2RVD+O)	**R**	R	**R**
Cu2 (40-10-75-2RVD+CO)	**R**	R	R
Cu3 35-15-75-2RVD+IO)	**R**	S	S
Cu4 (30-20-75-2 RVD+CuO)	R	**R**	**R**
Cu5 (45-05-75-3 RVD+CO)	**R**	**R**	**R**
Cu6 (40-10-75-3 RVD+uO)	**R**	**R**	**R**
Cu7 35-15-75-3RVD+IO)	**R**	**R**	**R**
u8 30-20-75-3 RVD+O)	**R**	**R**	R
u9 (45-05-75-4RVD+CuO)	*SS*	**R**	R
ul0 (40-10-754RVD+IO)	S	S	S
ul1 35-15-74RVD+O)	**SS**	R	R
Cul2 30-20-75-4RVD+Cu.O)	**R**	S	S
Cul3 (45-05-75-5 RVD+uO)	S	S	***SS***
u14 (40-10-75-5 RVD+CuO)	R	**R**	**R**
Cul5 35-15-75-5RVD+CuO)	R	**R**	**R**
Cul6 30-20-75-5RVD+CO)	S	S	S

Table 7. **Color of test pieces gazed with 16 formulations of rice hull ash R), Vigan clay V), and DTa D) mixed with copper oxide (CuO).**

FORMULATION	CHARACTERISTIC		
	SAMPLE 1	SAMPLE2	SAMPLE3
Cul (45-05-75-2RVD+Cu0)	G	G	G
Cu2 (40-10-75-2RVD+uO)	G	G	G
3 35-15-75-2RVD+IO)	G	G	G
Cu4 (30-20-75-2 RVD+uO)	G	G	G
Cu5 (45-05-75-3RVD+CIO)	G	G	G
Cu6 (40-10-75-3 RVD+IO)	G	G	G
u7 35-15-75-3RVD+BO)	G	G	G
Cu8 30-20-75-3 RVD+CuO)	G	G	G
Cu9 (45-05-74 RVD+IO)	G	G	G
Cu10 (40-10-75-4RVD+XO)	G	G	G
Cul1 (35-15-754RVD+IO)	G	G	G
Cu12 (30-20-75-4 RVD+CIO)	G	G	G
Cul3 (45-05-75-5 RVD+CO)	G	G	G
Cul4 (40-10-75-5 RVD+XO)	G	G	G
Cu15 35-15-75-5 RVD+CuO)	G	G	G
Cu16 (30-20-75-5 RVD+CuO)	G	G	G

Legend: G-Green

Table 8. Appearance of test pieces glazed with 16 formulations of rice hull ash R), Vigan clay V), and DTa (D) mixed with zinc oxide (ZnO).

FORMULATION	CHARACTERISTIC		
	SAMPLE1	SAMPLE2	SAMPLE3
Z1 (45-05-75-2RVD+ZnO)	B	MG	GU
72 (40-10-75-2RVD+ZnO)	GU	**MG**	GU
73 35-15-75-2RVD+ZO)	GAB	MG	GAB
Z4 30-20-75-2 RVD+ZnO)	GAB	GAB	GAB
Z5 (4505-75-3RVD+ZnO)	GP	GP	GP
Z6 (40-10-75-3 RVD+ZnO)	GP	GP	GP
Z7 35-15-755RVD+ZnO)	GP	GP	GP
78 30-20-75-3 RVD+ZnO)	GP	GP	GP
Z9 (45-05-75-4RVD+ZO)	GP	GP	GP
Z10 (40-10-75-4RVD+ZIO)	**GP**	GP	GP
Z11 35-15-75-4RVD+ZO)	GP	GP	GP
Z12 (30-20-75-4RVD+ZnO)	GP	GP	**GP**
Z13 (45-05-75-5RVD+ZnO)	GUS	GUS	GUS
Z14 (40-10-75-5RVD+ZnO)	GUS	GUS	GUS
Z15 35-15-75-5 RVD+ZnO)	GUS	GUS	GUS
Z16 (30-20-75-5 RVD+ZAO)	GUS	GU	GUS

Legend: B – Bubbles
MG---Matt glaze
GU – Glaze unmelted
GAB – Glaze absorbed in the body
GP – Gloss point
GUS – Glaze ununiformly spread

Table 9. 'Texture of test pieces glazed with 16 formulations of rice hull ash (R), Vigan clay V), and DTa D) mixed with zinc oxide ZnO).

FORMULATION	CHARACTERISTIC		
	SAMPLE1	SAMPLE2	SAMPLE3
Z1 (45-05-75-2RVD+ZnO)	R	S	R
Z2 (40-10-75-2RVD+ZO)	R	S	R
Z3 35-15-75-2RVD+ZnO)	S	S	S
Z4 (30-20-75-2RVD+ZO)	S	S	S
Z5 (45-05-75-3RVD+ZnO)	S	R	S
Z6 (40-10-75-3 RVD+ZnO)	S	S	S
Z7 (35-15-75-3RVD+ZnO)	S	S	S
Z8 30-20-75-3RVD+ZnO)	S	S	S
Z9 (4505-75-4RVD+ZnO)	S	S	S
Z10 (40-10-75-4RVD+ZnO)	S	S	S
Z11 35-15-75-4RVD+ZnO)	S	S	S
Z12 30-20-75-4RVD+ZnO)	S	S	S
Z13 (45-05-75-5RVD+ZO)	S	S	S
Z14 (40-10-75-5RVD+ZnO)	S	S	S
Z15 35-15-75-5RVD+ZO)	S	S	S
ZI6 (30-20-75-5 RVD+ZnO)	S	S	S

Legend: R–Rough
S–Smooth

Table 10. Color of test pieces glazed with 16 formulations of rice hull ash (R), Vigan clay V), and DT; D) mixed with zinc oxide (ZnO)

FORMULATION	CHARACTERISTIC		
	SAMPLE1	SAMPLE2	SAMPLE3
Z1 (45-05-75-2RVD+ZnO)	W	W	W
Z2 (40-10-75-2RVD+ZnO)	W	W	W
Z3 (35-15-75-2RVD+Zn0)	W	W	W
Z4 30-20-75-2RVD+ZnO)	W	W	W
Z5 (45-05-75-3RVD+ZnO)	W	W	W
Z5 (40-10-75-3 RVD+ZnO)	W	W	W
Z7 35-15-75-3RVD+ZO)	W	W	W
Z8 (30-20-75-3 RVD+ZnO)	W	W	W
Z9 (45-05-75-4RVD+ZnO)	W	W	W
ZIO (40-I0-75-4RVD+Zn0)	W	W	W
Z11 35-15-75-4RVD+ZO)	W	W	W
Z12 (30-20-75-4RVD+ZnO)	W	W	W
Z13 (45-05-75-5RVD+ZnO)	W	W	W
Z14 (40-I0-75-5RVD+ZO)	W	W	W
Z15 (35-15-75-5RVD+ZO)	W	W	W
Z16 (30-20-75-5RVD+ZnO)	W	W	W

Legend: W--White

Characteristics of Test Pieces GHazed With Formulations Having Calcium Carbonate

Appearance. Table 11 shows that of the 16 RVD formulations mixed with calcium carbonate (CaCO), only Ca4 (30-20-75-2 RVD+CaCO) and Ca8 (30-20-75-3 RVD+CaCO,) produced test pieces rated GP or gloss point. The other formulations yielded test pieces with the following deficiencies: glaze unmelted, glaze absorbed in the body, and pin holes on the surface.

Texture. Most of the test pieces had smooth or matt surface (Table 12). Matt glazed tiles are good for flooring; of comfort rooms and other purposes.

Color. All the test pieces glazed with the 16 RVD+CaCO formulations became white (Table 13).

Table 11. Appearance of test pieces glazed with 16 formulations of rice hull ash R), Vigan clay V), and DT, (D) mixed with calcium carbonate (CaCO,).

FORMULATION	CHARACTERISTIC SAMPLE1	SAMPLE2	SAMPLE3
Ca1 (45-05-75-2 RVD+CaCO,)	GU	GU	GU
Ca2 (40-10-75-2 RVD+CaCO,)	GAB	GAB	GAB
Ca3 (35-15-75-2 RVD+CaCO,)	GAB	GAB	GAB
Ca4 (30-20-75-2 RVD+CaCO,)	GP	GP	GP
Ca5 (45-05-75-3 RVD+CaCO,)	GU	GU	GU
Ca6 (40-10-75-3 RVD+CaCO,)	GU	GU	GU
Ca7 35-15-75-3 RVD+CaCO,)	GAB	GAB	GAB
Ca8 (30-20-75-3 RVD+CaCO,)	GP	GP	GP
Ca9 (45-05-75-4 RVD+CaCO,)	GU	GU	GU
Ca10 (40-10-75-4 RVD+CaCO,)	GAB	GAB	GAB
Ca11 35-15-75-4 RVD+CaCO,)	GAB	GAB	GAB
Ca12 (30-20-75-4 RVD+CaCO,)	GAB	GAB	GAB
Ca13 (45-05-75-5 RVD+CaCO,)	PHS	PHS	PHS
Ca14 (40-10-75-5 RVD+CaCO,)	PHS	PHS	PHS
Ca15 (35-15-75-5 RVD+CaCO,)	PHS	PHS	PI-IS
Ca16 (30-20-75-5 RVD+CaCO)	PHS	PHS	PI-IS

Legend: GU--Glaze unmelted
GAB–Glaze absorbed in the body
GP–Gloss point
PHS–Pinholes on the surface

Table 12. Texture of **test pieces glazed** with 16 formulations of rice hull ash (R), **Vigan clay** V), and DTa D) **mixed with calcium carbonate (CaCO).**

FORMULATION	CHARACTERISTIC		
	SAMPLE I	SAMPLE 2	SAMPLE 3
Ca1 (45-05-75-2 RVD+CaCO,)	R	R	R
Ca2 (40-10-75-2 RVD+CaCO,)	R	R	R
Ca3 35-15-75-2 RVD+CaCO,)	S	S	S
Ca4 (30-20-75-2 RVD+CaCO,)	S	S	S
Ca5 (4505-75-3 RVD+CaCO,)	R	**R**	R
Ca6 (40-10-75-3 RVD+CaCO,)	R	R	**R**
Ca7 (35-15-75-3 RVD+CaCO,)	S	R	R
Ca8 30-20-75-3 RVD+CaCO,)	MS	MS	MS
Ca9 (45-05-75-4 RVD+CaCO)	R	R	R
Ca10 (40-10-75-4 RVD+CaCO,)	S	S	S
Ca11 35-15-75-4 RVD+CaCO,)	S	S	S
Ca12 (30-20-75-4 RVD+CaCO,)	S	S	S
Ca13 (45-05-75-5 RVD+CaCO,)	MS	MS	MS
Ca14 (40-10-75-5 RVD+CaCO,)	MS	MS	MS
Ca15 35-15-75-5 RVD+CaCO,)	MS	MS	MS
Ca16 30-20-75-5 RVD+CaCO)	MS	MS	MS

Legend: R – Rough
S – Smooth
MS – Matt surface

Table 13. Color of test pieces ______ with 16 ______ rice hull ash ____ Vigan clay V), and DT, D) mixed with calcium carbonate (CaCO,)

FORMULATION	CHARACTERISTIC		
	SAMPLE I	SAMPLE 2	SAMPLE 3
Ca1 (45-05-75-2 RVD+CaCO,)	W	W	W
Ca2 (40-10-75-2 RVD+CaCO,)	W	W	W
Ca3 35-15-75-2 RVD+CaCO,)	W	W	W
Ca4 30-20-75-2 RVD+CaCO,)	W	W	W
Ca5 (4505-75-3 RVD+CaCO,)	W	W	W
Ca6 (40-10-75-3 RVD+CaCO,)	W	W	W
Ca7 35-15-75-3 RVD+CaCO,)	W	W	W
Ca8 30-20-75-3 RVD+CaCO,)	W	W	W
Ca9 (45-05-75-4 RVD+CaCO,)	W	W	W
Ca10 (40-10-75-4 RVD+CaCO,)	W	W	W
Ca11 35-15-75-4 RVD+CaCO,)	W	W	W
Ca12 30-20-75-4 RVD+CaCO,)	W	W	W
Ca13 (45-05-75-5 RVD+CaCO,)	W	W	W
Ca14 (40-10-75-5 RVD+CaCO,)	W	W	W
Ca15 (35-15-75-5 RVD+CaCO,)	W	W	W
Ca16 30-20-75-5 RVD+CaCO,)	W	W	W

Legend: W - White

Conclusions and Recommendations

Based on the findings, the following conclusions and recommendations were drawn:

1. Among the formulations mixed with copper oxide, formulations Cu10 (40-10-75-4 RVD+CuO) and Cu16 (30-20-75-5 RVD+CuO) yielded test pieces without deficiencies. Thus, when using copper oxide with rice hull ash, Vigan clay, and DT:W as base glaze, these formulations are recommended.

2. Among the formulations mixed with zinc oxide, all formulations having 3% and 4% zinc oxide yielded test pieces without deficiencies. When using zinc oxide with RVD as base glaze, 3-4% zinc oxide is recommended

3. Among the formulations mixed with calcium carbonate, Formulations Ca4 (30-20-75-2 RVD+CaCO,) and Ca8 (30-20-75-3 RVD+CaCO,) produced test pieces without deficiencies. When using calcium carbonate, 30-20-75 RVD mixed with 2-3% calcium carbonate is recommended. .

4. It is further recommended that further studies relative to this study be conducted to improve the quality of Vigan clay products.

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