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**A Simple Method For Production Of Eco Green Glaze From Imperata  
Cylindrical Ash**

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**Abstract**

Imperata Cylindrical Ash (ICA) a waste product is nature growth is rich in silica. A simple method based on ceramic glaze formulation followed by adding oxide as colourant was developed to produce pure eco green glaze from ICA, with minimal mineral contaminants. The silica mineral produced from ICA were heated to 200oC for 6 h to obtain ash. Silica and mineral contents were determined by X-ray Fluorescence spectrophotometer. Silica produced from ICA had 84% silica. The major impurities of silica produced from ICA at an extraction yield were Al<sub>2</sub>O<sub>3</sub>, at 2.45%, Fe<sub>2</sub>O<sub>3</sub> at 1.20% and CaO 6.56%. However ICA contain a large proportion of monovalent oxides, which give strong fluxing action at stoneware temperatures and it creates the decorative effect known as stringing. The effect of surface are also discover by crawling, shine and durability of the glaze. ICA subsistence, due to its chemical characteristics, can be used as a good and aesthetically pleasing glaze effect.

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**Introduction**

Ceramic art is one of the oldest art forms in the world; most recently this art has recently received new attention after a stunning new revolution based on upon creativity. Ceramic craft that were once used only as daily pottery had since then gone beyond its normal usage. Ceramic design has since gone through a contemporary renaissance with a combination of various uses and aesthetic that produce material, crafts, decorations and colors.

Ceramic glazes generally contain silica to form glass, in combination with a mixture of metal oxides such as sodium, potassium and calcium which act as a flux and allow the glaze to melt at a particular temperature, alumina (usually from added clay) to stiffen the glaze and prevent it from running off the piece, colorants such as iron oxide, copper carbonate or cobalt carbonate, and sometimes opacifiers such as tin oxide or zirconium oxide. Glaze is a layer or coating of a vitreous substance which has been fused to a ceramic object through firing. Glaze can serve to color, decorate, strengthen or waterproof an item:-

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Silica :-High silica content in fly ash (60%)in form of SiO<sub>2</sub>

Alumina:- High alumina content in fly ash (20%) in form of Al<sub>2</sub>O<sub>3</sub>

Flux :-High flux content in RTi in form of CaO (30%) and other oxides (10%)

Colorant:- Availability of colorant component in form of Fe<sub>2</sub>O<sub>3</sub> (17%) in RTi

The abundance of Imperata cylindrical in Malaysia has inspired me to carry out research that will be beneficial for Malaysian ceramics industries. More than 30 million tons of Imperata cylindrical (lalang) is nature growth in Malaysia annually. However, this substance has not been fully exploited by other industries, in particular by those working with ceramics. This study has shown that the Imperata cylindrical can make significant contribution to local glaze industries which utilize ceramics surface design, such as, tiles, roofing tiles, tableware, sanitary ware, handicrafts and various artistic products.



*Figure. 1: Imperata Cylindrical*

‘Egg’ is short form for Eco Green Glaze. Term “eco” is drawn from the idea that the glaze is both economical as well as ecological. It is economical because I use 70 % of nature plant wasted as a main ingredient in the formula. The word Green is describes the powerful energies of nature, growth, and desire to expand or increase. Balance and a sense of order are found in the color Green. Change and transformation is necessary for growth, and so this ability to sustain changes is also a part of the energy of Green. The need for reducing consumption, reusing and recycling products, steps that will help preserve the planet for future generations. A side from being cost efficient, this glaze is also aesthetically pleasing compared to the usual commercial glazes.

#### Contexture

This study on the chemical composition of imperata cylindrical has been conducted using XRF method (X-Ray Fluorescence Spectrophotometer) conducted by the Ceramic Technology Group Structural Materials Programme, SIRIMBerhad. A study carried out by SIRIM is as a way to support data obtained. This study also includes rational analysis of material expressed as proportions of theorotically. The rational analysis is ascertained by combination of physical and chemical processes and therefore give information about raw material and some indication of its glaze behaviour. The research in the creative laboratory of ceramics which is going to test the formula to produce a glaze. Two (2) packs of ash sample

(about 100g each) labeling as sample A and sample B were submitted for chemical composition analysis. Based on full analysis of the mineral content there are twenty (20) of mineral materials in the Imperata cylindrical ash. Mineral materials such as Silica, Aluminum oxide, Iron Oxide, Titanium Oxide, Magnesium, Calcium Oxide, Sodium Oxide, and Phosphorus oxide.



Figure. 2: Imperata Cylindrical ash # Mineral Composition Test

The objective was to make transparent glaze using Imperata Cylindrical Ash (ICA) which has a high content of CaO and contains  $\text{Al}_2\text{O}_3$ . However, the melting point of Imperata Cylindrical Ash (ICA) is above  $1340^\circ\text{C}$ , making it difficult to make transparent glaze using only Imperata Cylindrical Ash (ICA). In order to lower the melting point of Imperata Cylindrical Ash (ICA), flux materials were mixed to Imperata Cylindrical Ash (ICA) and melting characterization was carried out. Feldspar, which is largely composed of  $\text{Na}_2\text{O}$  and  $\text{K}_2\text{O}$  and limestone largely composed of CaO were used as the flux materials. The materials were added 10, 20 and 30wt%, respectively, in order to produce the glaze. Depending on the type and amount of flux materials added, the samples were fired at temperatures between  $1040\sim 1240^\circ\text{C}$  in the reducing atmosphere. As the amount of feldspar added was increased, the melting point decreased substantially.

Results from the analysis of ash samples A and B show that Silicon oxide,  $\text{SiO}_2$  content, 63.41% (Sample A) 84.77% (Sample B) where it is shown highest percentage. The glassy substance which is the most important constituent of pottery glaze. The accompanying table.1 shows how the imperata cylindrical element reaches the ceramic fusions as oxides. It will be seen from the imperata cylindrical ashes are the most complex. A few contain sufficient silica to fuse to a glass alone, but the majority of ashes contain mostly fluxing oxides. Imperata Cylindrical ashes are therefore considered as fluxing oxides, especially for glazes. They also introduce coloring and crystallizers, which give textures. An analysis also show that Alumina Oxide,  $\text{Al}_2\text{O}_3$ , 5.45% (Sample A), 2.45% (sample B).  $\text{Al}_2\text{O}_3$ , an important oxide in ceramics. It is second only to silica in importance. It combines with silica in the clay crystal and it is aluminium oxide's presence that causes a flat crystal and thereby gives clay its plasticity. In glaze aluminum oxide is an intermediate oxide and serves to stabilize the combination of fluxes and glass- formers. It affects the stiffness of the molten glaze.

Calcium oxide. **CaO**, from Imperata Cylindrical ash contain 13.18% (Sample A) 6.56% (Sample B). It is used as filler in low temperature bodies and glazes; and as flux in high temperatures glazes. Large amounts encourage crystalline growth during cooling. Even so, the ash is only a half-way stage between the original matter and the required oxides. Imperata cylindrical ashes contain sulfur, fluorine and chlorine.

Table 1:  
Report Of Determination Of Chemical Composition

**TABLE 1: REPORT OF DETERMINATION OF**

Oxide	Percentage%	
	Sample A	Sample B
Silicon oxide, SiO <sub>2</sub>	63.41	84.77
Alumina Oxide, Al <sub>2</sub> O <sub>3</sub>	5.45	2.45
Iron oxide, Fe <sub>2</sub> O <sub>3</sub>	2.91	1.20
Titanium, TiO <sub>2</sub>	0.35	0.18
Calcium oxide, CaO	13.18	6.56
Magnesium oxide, MgO	0.68	0.35
Potassium oxide, K <sub>2</sub> O	7.12	1.82
Sodium oxide, Na <sub>2</sub> O	0.05	0.02
Manganese oxide, MnO	0.20	0.10
Phosphorus oxide, P <sub>2</sub> O <sub>5</sub>	2.00	0.95
Sulfur trioxide, SO <sub>3</sub>	3.14	1.03
Zirconium dioxide, ZrO <sub>2</sub>	0.04	0.02
Barium oxide, BaO	0.03	0.02
Rubidium oxide, Rb <sub>2</sub> O	0.03	0.01
Chlorine, Cl	0.03	0.01
Zinc oxide, ZnO	0.02	0.03
Copper oxide, CuO	0.02	0.02
Strontium Oxide, SrO	0.02	0.01
Chromium Oxide, Cr <sub>2</sub> O <sub>3</sub>	0.02	0.01
Nikel oxide, NiO	0.01	0.01
Lose on Ignition (LOI)	1.32	0.44

The burning of the original matter is not intended to, and in fact cannot completely, create a new material composed of required oxides and non-volatile compounds. The burning is preparation, controlled calcinations, which removes the bulk of unwanted carbon, hydrogen and sulfur and renders the material to a usable form. The elements involved have reached

stable states for dry conditions as oxides, carbonates, sulfates, phosphates, chlorines and fluorides. Some unwanted compounds could be removed during the firing when the presence of silicates will cause decomposition of the compounds to oxides and volatiles. Mineral content of various materials and is divided into several percentage have made the Eco Green Glaze has different characteristics than other glaze. Each mineral has a material interest and function either as an alternative to facilitate the process of production work or it works as a media character that embody the aesthetic surface for pottery.

### The Experimenting With Eco Green Glaze (Egg)

The exploration of Imperata cylindrical contains its own importance and benefits specifically giving it a new alternative in terms of usage and the selection of raw ingredients (that comprise of natural ingredients and waste materials) to raise the process in the production of ceramic glaze products. This research will use the experimental research with scientific methodology approach in the form of experiments to measure the level of compatibility of the natural ingredient that is mixed with the essence of clay that has been chosen.

These experiments were evaluated scientifically as accordance to Standards and Industrial Research Institute of Malaysia (SIRIM) test standard (CER 11104). Testing samples of Imperata cylindrical produced were tested for their determination of chemical Composition. The experimental research is meant to gather specific evidence that is detailed and supported by an explanation to enable a prediction to be made with the fullest of confidence.



Figure.3: Imperata Cylindrical ash # transparent glaze test

Experimentation to eco green glaze also is an important symbolism to appreciate nature as a source of material to maximize creative ideas potters. This study uses some basic formulas to produce a glaze. Tests are based on the analysis of the suitability of the formula for the glaze mixture. Testing is also made on the appropriate level of firing. Firing applied to three (3) celsius degree of temperature in 1040<sup>0</sup>c, 1200<sup>0</sup>c and 1250<sup>0</sup>c. The effect of surface are also discover by result show in the fig. 6 and 7, which show the crawling, shine and durability of the glaze.

Many imperata cylindrical ashes contain a large proportion of monovalent oxides, which give strong fluxing action at stoneware temperatures. If sufficient ash is used, and it is the glaze's only flux, it creates the decorative effect known as stringing. This is seen in the photograph of test pieces of Eco Green Glaze. Two example recipes are given for Eco green glaze to fired at 1250 °c (2282 F). The first is to go on bisque: -

Feldspar	50%
China clay	10%
Quartz	10%
(ICA) Ash	30%



Figure. 4 : Imperata Cylindrical ash # glaze test

The second recepies is for a slip-glaze and contains a second (divalent) flux to stabilize the fusion:

Frit	30%
Ball clay	25%
(ICA) ash	25%
Whiting	40%



Figure 5: Eco Green Glaze # Test pieces

## Conclusion

The experiment combining Imperata cylindrical with other raw materials and oxides proves that nature wasted is capable of producing an attractive glaze with perfect characteristics. Wasted imperata cylindrical is abundant and can be obtained without incurring highly costs. The process of making “egg” (eco green glaze) is simple. The equipment used to produce “egg” is simple and cheap. The usage of 70-80% of wasted imperata cylindrical as the main ingredient may reduce the costs of glaze production. Imperata cylindrical subsistence, due to its chemical characteristics, can be used as a good and aesthetically pleasing glaze composition.



Figure. 6 :Eco Green Glaze # Test pieces No. 3

Glazing is for earthenware vessels, unsuitable for holding liquids due to porosity. Eco green glaze is also used on stoneware and porcelain. In addition to the functional aspect of glazes, aesthetic concerns include a variety of surface finishes, including degrees of gloss and matte, variegation and finished color. which are removed and discarded after the firing. Small marks left by these spurs can sometimes be visible on finished ware. Eco green glaze may also enhance an underlying design or texture which may be either the "natural" texture of the clay or an inscribed, carved or painted design.



Figure 7: Eco Green Glaze # Test pieces No. 3

Eco green glaze may be applied by dry dusting a dry mixture over the surface of the clay body or by inserting salt or soda into the kiln at high temperatures to create a sea of sodium vapor that interacts with the aluminium and silica oxides in the body to form and deposit glass liquid glazes suspensions of various powdered minerals, and metal oxides can be applied by dipping pieces directly into the glaze, pouring the eco green glaze over the piece, spraying it onto the piece with an airbrush or similar tool, with a brush, or with any tool that will achieve the desired effect. To prevent the glazed article sticking to the kiln during firing either a small part of the item is left unglazed or special refractory supports, kiln spurs, are used as supports functionally which would important.



Figure 8: Eco Green Glaze # The Final Product.

This invention is aimed to utilize the natural waste into useful material by providing a new method and new formula of combine natural resources. The present invention is to provide new eco green glaze and to produce economical functional glaze and decorative ceramic product. Simple and innovative methods were developed to produce component glaze from imperata cylindrical. Waste to wealth. The raw material is biowaste, thus the product is very economical to produce.

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