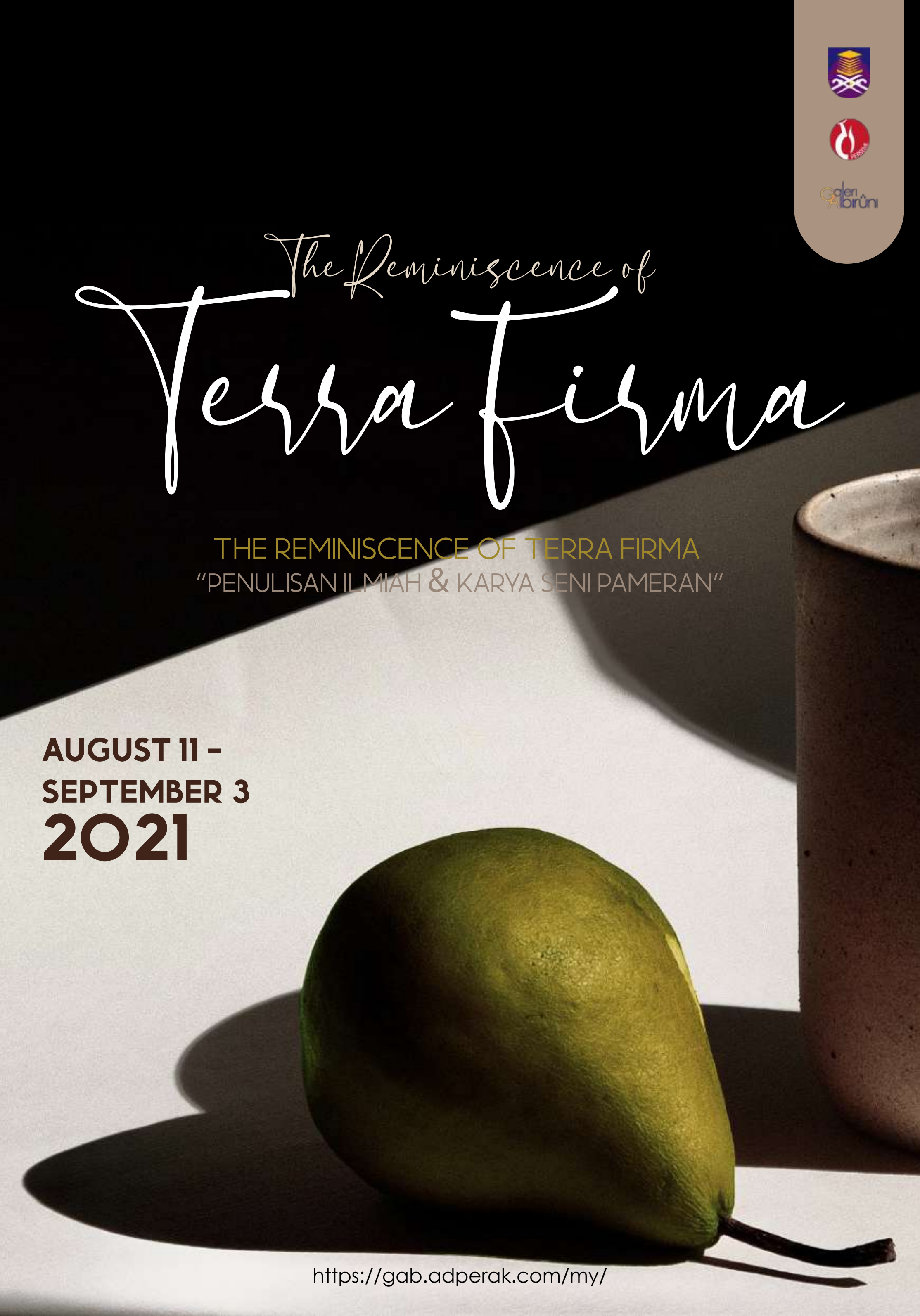
The Reminiscence of
Terra Firma
THE REMINISCENCE OF TERRA FIRMA
"PENULISAN ILMIAH & KARYA SENI PAMERAN"
AUGUST 11 -
SEPTEMBER 3
2021
https://gab.adperak.com/my/

The Reminiscence of Terra Firma

"PENULISAN ILMIAH & KARYA SENI PAMERAN"

Published by UiTM Perak Press

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THE REMINISCENCE OF Terra Firma

AUG 11 - SEPT 3, 2021

Perpustakaan Negara Malaysia

Cataloguing in Publication Data

Published by UiTM Perak Press

No e ISBN : 978-967-25697-9-4

Cover Design : Seri Darayani Kamarullah
Typesetting : Ts. Zulkarnian Hassan

Foreword

By
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The Covid-19 Pandemic nowadays has put the ceramic art scene in a diversity of perspectives. It challenges ceramic artists to channel their physical artwork exhibitions into digital platforms. This pandemic also has changed the way of teaching and learning in the ceramic programme in Universiti Teknologi MARA (UiTM). Conventional methods of teaching and learning usually involve the face to face learning style, which nowadays requires some changes. This ceramic virtual art exhibition titled The Reminiscence of Terra Firma shows one of the examples of a new style of exhibition management in the ceramic course in UiTM. This virtual exhibition is one of the course's components that students need to complete their project. The course in ceramic programme titled; Ceramic Exhibition Management, aims to educate students to manage an exhibition and to work in groups. It helps students to understand the exhibition event's standard which is the knowledge that can be used for their employability in the future.

This virtual exhibition is organized for the first time. Before the pandemic, the students managed the exhibition in the gallery, which was more exciting. Although this is the first time for the students to arrange the virtual exhibition, they managed to overcome their struggle to learn new things and performed well to realize this exhibition. All the lecturers who participated in this exhibition will always support the event. This virtual exhibition displays the selected best lecturers' artworks and also features the lecturers' expertise in their disciplines. Many artworks in this exhibition explore issues that are related to the artists' interests and concerns which are developed in the artworks with aesthetic and artistic manners.

The participation of the ceramic programme's lecturers in The Reminiscence of Terra Firma virtual ceramic art exhibition proved that they are not just teaching the students with the theories and demonstration of ceramic forming, but they also have produced quality artworks. This exhibition is one of many ways to celebrate this academic expertise.

Thus, congratulations to all exhibition committee members that have organised this event. Thank you to all lecturers who participated in this exhibition.

"If you trust your materials and you trust your instincts, you will see things of beauty growing up in front of you, without you having anything to do with it."
(Micheal Cardew, English Studio Potter)

The Beauty Of Crystalline Glaze By Oryza Sativa Straw Ash

AMIRULAZANI IBRAHIM, NOR NAZIDA AWANG, SALWA AYOB, VERLY VETO VERMOL

INTRODUCTION

Glazes are put onto ceramic to colour, or protect the surface, allowing it to be used for many different functions (Fairbairn, 1999). There are many types of glazes, designed for a variety of applications and firing at different temperature ranges such as special effects glazes like matt glazes, satin glaze, crystalline glaze, crackle glaze and others. There is also a wide variance in the appearance of finished glazes. That glazes must be designed to fit a specification (Taylor & Bull, 1986).

There are two major types of crystalline glazes. Micro crystalline, which have crystals so small that need a microscope to see, and macro crystalline, which have crystals large enough to be seen with the naked eye. The type of glaze which is central to this study is the macro crystalline glaze or more commonly, the crystalline glaze. However, since the beginning of the 19th century ago until now, crystalline glaze is gaining attention as a coating on the ceramic body to be able to provide aesthetic value to the body. In addition, many studies have been carried out in respect of these glazes (Creber, 1997; Karasu et al., 2001; Karasu et al., 2000; Karasu & Turan, 2002; Knowles & Freeman, 2004).

Apart from identifying the effects of adding rice straw ash (RSA) in crystalline glaze, this research was conducted to identify a method that may reduce the firing temperature of crystalline glaze but still be able to produce crystal formation with various patterns. Therefore, the use of certain raw materials in glaze formulations has been identified as one of the appropriate methods. The use of alkali metals such as lithium, sodium, and potassium as well as alkaline earth metals calcium, barium, magnesium, and strontium are found to be suitable because they act as flux. Generally, the function of flux is to lower the melting point of frit and glaze by adding fluidity to Tgloss as well as increasing production of glaze.

Crystalline glaze is chemically known as zinc-silicate crystals. According to Draney, (1969), he said in his study about macro crystalline glaze, crystals form an ionic bond between zinc and silica. Hence, silica is course of the principal acidic oxide and the basis of all glazes since it is a glass former. In crystalline glazes silica functions as it does in conventional glazes and is proportioned to control the melting temperature of the glaze. Silica is also bond with zinc oxide to form the crystalline seed structure. From that, this study is to identify the possibility of replacing conventional silica in crystalline glaze formulation with rice straw ash.

CALCINATION OF RICE STRAW ASH (RSA)

Oryza sativa straw (rice straw) is a natural resource that has potential as a raw material in the ceramic field. Rice straw ash (RSA) contains high silica (SiO_2) after through the calcination process. The purpose of this oryza sativa straw was to investigate on the effects of crystalline glaze using a rice straw ash as alternative substance for silica in the glaze formulation. Silica is significant material was used in the crystalline glaze to react with zinc oxide to seeding crystals as willemite (Zn_2SiO_4) in the form of spherulites during the firing process.

Rice straw ash is particularly rich in silica, alkaline and alkaline earth metals and being used as a source of alkalis and silica for the production of triaxial ceramics. RSA are the conversion of the straw to ash and grinding of the ash to a suitable practical size. This aspect is common to all processes currently in operation. The calcination process extracts the organic matter and leaves silica-rich residue in the conversion of rice straw ash.

According to a Guzmán A et al. (2015), when the calcination temperature increased, the moisture content and loss of ignition (LOI) values of different rice straw ash decrease. In fact, an increase in temperature also causes the silica content in RSA begins to show a more crystalline character, as confirmed by the mineralogical analysis. According to their study as well, at 800°C of calcination temperature the RSA are composed in their inorganic phase by a high percentage of silica (SiO_2) 79.62%, chlorine (Cl) and potassium oxide (K_2O), to a lesser extent by calcium oxide (CaO), phosphorous (P), and sulphur (S), and even lower levels by other elements such as Mg, Mn, Fe, Al and Na. The bands associated with the organic part begin to disappear (T > 500 °C) when the calcination temperatures of RSA samples are increased.

The differences of calcination temperature are also a factor in the colour changes of the RSA. Mostly at 700°C of calcination temperature, the RSA colour turns from grey to whitish-grey for the ashes obtained through the calcination processes, whereas those obtained from 800°C to 1000°C tended to turn pink. In addition, the ash from rice straw that has been subjected to leaching by water to extract potassium and chlorine uniformly exhibits a bright white colour. So, the RSA colour is strongly related to the concentration of potassium in it.

Then began the process of producing rice straw ash by using simple steps that refer from previous study that is wash and dry process and followed by calcination the rice straw at temperature 1000°C which aims to determine the most optimal calcination temperature. This process continues with soaking the RSA in distilled water for sedimentation after which it is dried at a temperature of 100°C.

CRYSTALLINE GLAZE

Next, the preparation of crystalline glaze mixing according to the calculated glaze formula. As revealed the glaze is transform from dry powder to glaze slip with mixed water and milling for 1 hour and then continued by aging in 24 hours as it is intended for homogeneous mixture. The firing process is carried out after the bisque porcelain clay is apply with crystalline glaze. After all the testing has been done, the crystalline glaze was applied on final product that is vessel sink. Lastly, all the result were observed using digital camera for visual observation.

According to Coffey, (2011), crystalline glaze process will be through the glaze thickness, colourants in the glaze, firing time, maturation temperature, soaking time at maturation temperature, furnace atmosphere, impurities in the furnace atmosphere and cooling cycle. However, the glaze composition and firing schedule are the important thing for crystal growth.

Raw materials that used in crystalline glaze is a Frit 3043, Silica (SiO_2), Zinc Oxide (ZnO), Barium Carbonate ($BaCO_3$), Titanium Dioxide (TiO_2), Kaolin, Lithium Carbonate (Li_2CO_3) and colourant pigment is Nickel Oxide. It has varieties formulation of crystalline glaze that using in this study. The rice straw ash was added in crystalline glaze formulation proportionally by weight percentage. The glaze is added with rice straw ash until the conventional silica are using in original formulation replaced with rice straw ash. This study would like to investigate the potential of rice straw addition in crystalline glaze formulation.

After that, the study was continued with formulation of crystalline glaze by addition of RSA with one range of firing profile at 1180°C for gloss temperature soaking for 25 minutes. The temperature was drop to crystallization temperature at 1060°C and soaking this temperature range for 5 hours then the furnace shut down for cooling process ash shown in Figure 1. The crystallization of nuclei is due to the presence of material variance in glaze formulation. In this study, the aim to investigate the potential addition of RSA in a crystalline glaze formulation. Zinc oxide, titanium dioxide, and lithium carbonate were used in the formulation because these three substances are agents for encouraging the crystal seed.

Furthermore, silica is combined with zinc oxide to form the crystal seed structure. Beside that, the silica additions used to control crystal growth, especially for the size of crystal morphology with appropriate and accurate calculations in the percentage of glaze formulation. Additionally, lithium carbonate was added to encourage nickel oxide to produce yellow colour, meanwhile zinc oxide was added to produce steal blue, and with a more massive amount of zinc the lavender blue colour can occur, and nickel is one of the oxide pigments that give unpredictable result after going through the firing process.

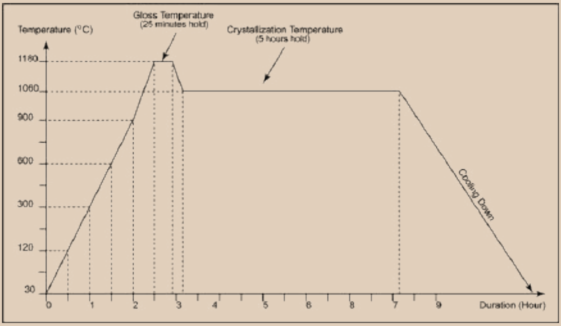

Figure1: Firing profile at 1180oC for gloss temperature and 1060oC of crystallization temperature

In Figure 2 show the sample without RSA (basic formula) and addition of RSA (17%) were fired at 1180°C of gloss temperature with soaking five hours at 1060°C of crystallization temperature. The result indicates material that used in glaze formulation has been fuse with the surface of glaze is gloss and crystal growth occur in scattered position. Furthermore, with the presence of nickel oxide has produce a blue colour on the willemite crystal while yellowish colour on background of the glaze and the crystal formation looks like an acicular needle shape. From the result, it shows that firing at 1180°C can produce crystal formation using this glaze formulation.

(a) (b)

Figure 2: The sample of (a) 17% conventional silica and (b) 17% of RSA with gloss temperature at 1180°C and 1060°C of crystallization temperature with 5 hours of soaking period.

The amount of zinc oxide is 24% used in the crystalline glaze formulation and 17% of RSA in (b) formulation. The crystalline glaze occurs because of silica bind together with zinc oxide for formation of crystal. Generally, the basic formulation of crystalline glaze ensures some crystals will grow and is adjusted up or down to control their development.

Furthermore, the crystals demonstrated the phenomenon of phase separation, where a glass melt separates into two or more liquids. The colourant materials tend to gather at preferentially and selectively one of these. One colourant oxide material was colouring the crystals and another the glassy areas or background of glaze. For sample (a), the result showed that the crystal appeared in two pattern that is needle shape and axe head. The crystals are in a scattering state and had opened space for the glassy area with yellow colour. However, for (b), the result showed that the crystals grew densely on the surface of the sample thus covering the glassy area and ruby red colour appeared. This is due to the zinc oxide that seeks to free silica and form zinc silicate crystals of willemite during cooling (Hamer, 2004). In short, the presence 89.7% of SiO2 content in RSA, zinc and silica oxide molecules can attaching themselves to the nucleus crystal and crystal grow as well as 98.1% SiO2 of conventional silica.

The application of crystalline glaze on vessel sinks has made new discoveries to the crystal formation. There had been halos shape formed on almost the entire surface of the sink vessel as shown in Figure 3 and it is very different from the previous testing samples that produced more to the acicular needle and axe head shape. This is due to a wide surface area were provided enough planetary to facilitate crystal formation occurs at crystallization temperature used. According to Sorrell et al., (1988) they found the formation of crystal patterns that occur during firing is produce spherical or halos shape at lower crystallization temperature around 1100 to 1050°C depends on soaking period and wide surface area of products to facilitate the formation of crystals during firing.

However, the formation of crystals could not grow more widely because of extremely crystal nucleation occur and there was overlap and clashes with each other as shown in Figure 3. There is no space for yellowish background of glaze to appear as compared to the crystal effect on the testing samples before this. That are clearer of yellowish background on glaze because a small number of crystals. In addition, the vessel sink shrinkage is 16.62% after firing from wet condition.

Figure 3: The top view of vessel sinks fired at 1180°C of gloss temperature

CONCLUSION

The firing profile is especially important in the production of crystalline glaze for nucleation and formation of willemite crystal. Furthermore, with the addition of RSA a change has occurred in the melting point of the glaze. The addition of RSA is 17% in formulation due to the glaze able to fuse or melt at temperature below then using 17% conventional silica. This research shows that the addition of rice straw ash in ceramic crystalline glaze formulation has given new discoveries. An instance of SiO2 content in RSA can produce formation of crystals and side effect of red ruby colour on glaze layer due to chemical composition in RSA have iron oxide content and caused by nickel oxide that give unpredictable result. In comparison, for samples not further added with RSA is just show peacock blue colour for crystal formation and yellowish colour on crystal background due to nickel oxide as a colourant pigment.

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