CHARACTERIZATION OF CLAYS DEPOSITS AND THEIR APPLICATION

RESEARCH MANAGEMENT INSTITUTE (RMI)
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR
MALAYSIA

BY :

HAZMAN SELI (K)
SITI HAJAR ANAZIAH MUHAMAD

DECEMBER 2013

Table of Contents

List of Figure

List of Table

5. Report

5.1 Proposed Executive Summary

The study will begin with the the collection of raw materials in Matang area with the help of Jabatan Mineral Dan Geosains Malaysia, Cawangan Sarawak. The experimentation will be conducted in lab facilities in the School of Materials Engineering USM. Raw materials collected will be cleaned and prepared in powder form and in fired body. Then the samples are chemically, physically and mechanically characterized in the laboratory to identify the important properties for ceramic industry applications. All data collected will be analyzed and discussed in a complete research report.

5.2 Enhanced Executive Summary

Matang clay deposits were characterized and evaluated for their potential as industrial raw materials through chemical, mineralogical and fired body (1200^{o} C) physical properties determinations. Eight different sample of clay deposits have been investigated for their chemical composition, mineralogical and firing properties. The samples were taken from different point in Matang area and then were prepared and fired at temperature of 1200 ^{o}C in order to determine the firing properties such as linear firing shrinkage, bulk density, porosity and flexural strength. XRD indicates that Quartz and mullite present as dominant mineral phases in the samples. Results also showed that the main oxides in the samples are SiO_2 and Al_2O_3, whereas the other oxides present only in small quantity. The fired samples exhibit the significant densification when the samples have higher fluxing agents of K_2O and Fe_2O_3 like in MTG4 sample. Flexural strength of the pressed and sintered samples were ranging from 17 to 53MPa. Based on the finding, it also shows that MTG4 has the highest flexural strength associated with the lowest porosity and bulk density. Matang clay demonstrated that it can be utilized as raw materials for making pottery, brick, wall and floor tiles.

5.3 Introduction

Background of study

Clays and clay minerals are very important in process industries, agriculture, engineering, construction, geology, environmental, and miscellaneous applications. They have been widely used as the main raw materials in the fabrication of diversified ceramic products for construction materials such as brick and tiles due to its mechanical properties (Mohmoudi et al., 2008; Lee and Yeh, 2008; Murray, 2007). The properties of clay are significant with ceramic industry, due to its plasticity features that facilitates the shape of the body, chemistry, mineral composition, thermal property, color, refractoriness and mechanical strength after firing (Baccour et al., 2009). The knowledge of these characteristics can optimize the usage of new clay deposits in local or regional ceramic industries. For this reason, particular attention should be paid to the investigation of clay deposits in Sarawak for ceramic applications.

Sarawak has extensive clay deposits which can be found in almost all parts of its state. These clays are currently used for the traditional production of small-scale ceramic factories. There are hundreds of small traditional pottery factories in all over the state using local clays. Generally clay quarries from different areas indicate differences color, texture and quality of the clay used for ceramic wares but contain considerable contents of iron oxide. Content of iron oxide is sensitive to firing conditions and often produces unexpected results in color and texture of the fired clays (Rooney, 1984).

Due to its inherently complex physical, chemical and mineralogical characteristics, clays usually have unique properties related to their own natural diagenesis (Gomes, 1988; Hajjaji et al., 2002; Bauluz et al., 2003). Normally, for economic reasons, ceramic factory has to use clays from nearby deposits. As a consequence, the characterization and quality control of each clay is important for the technical performance of local products (Fabbri, 1994). Moreover, a specific deposit may have distinct layers associated with different clays. Its gives an opportunity againts regional industry to mix

different clays in order to adjust the properties of both the unfired ceramic body and corresponding final product.

Since the microstructure and properties of any ceramic are depending on the characteristics of the raw materials and processing parameters, a complete characterization of the clay as a function of the firing temperature is needed to assure the quality of ceramic products (Vieira et al, 2008). From previous study, except porosity the firing properties as linear shrinkage and bulk density has been found to be increased for firing temperature ranging from 800 to 1200 °C (Ngun et al., 2011).

Problem Statement

The development on Sarawak clays so far were only done in studio by several potter artists and some relevant institution bodies. These ceramic products are widely used for civil constructions especially in the capital city. Traditional methods of the ceramic production, which do not take into account chemical and mineralogical characteristics, are still being practiced in Sarawak. Most of Sarawak clays, unfortunately, have not been clearly characterized or detailed according to their mineralogical, chemical, thermal and technological properties.

So far it is very limited studies on the quality and potential use of Sarawak clays have been done, although clay is a primary material for local ceramic manufacturers. In this study, the characteristics of clay deposits from Matang, Kuching area will be investigated on their physical, chemical, mineralogical, and thermal properties and also on their ceramic behaviours. These knowledges are very crucial to evaluate their potential suitability as raw materials in various possible ceramic in near future.

Objectives

The objective of the study were to characterized the clays based on manufacturing standards and to analyse the mineralogical composition and firing properties of Matang clay for evaluating their potential suitability as raw materials in various ceramic application.