CHAPTER 1
INTRODUCTION

Ancient pottery has been widely used in a long life of human society since its beginning in the Neolithic age of primitive society. Pottery vessels have been developed with different conformations to suit the modern lifestyle of people. At the same time, the pottery processes have progressed continually from crude to refine. Major types of pottery can be divided from materials including earthenware, stoneware and porcelain [1]. Pottery forming process is usually made by the different imagination of the artist and then fired at high temperature in a kiln. Mechanical strength of green body has improved due to the elimination of pores during sintering process. It was well known that different sources of raw materials can produce the unique characterization. Therefore, ancient pottery can be proved from the characterization of body and unique pattern on the body.

Ancient Nan pottery is one of the most important archaeological sites in Northern Thailand. Nan kiln site is located at Ban Bo Suak, Sub district of Suak, Muang district in Nan Province. The "Community Archaeological Site" is located at Ban Bo Suak, 17 kilometers from the town centre. The site covers 3 to 4 square kilometers. In October 1999, Ban Bo Suak kilns were discovered in the area of the residence of Police Sergeant Major Manas and Sunan Tikham [2]. A comparative study indicated that Nan ceramic type and firing technique were similar to those of Lan Na kiln groups at Wieng Kalong. The manufacturing period of this kiln site was approximately during the second half of the15th century. After it had been annexed by the Lan Na kingdom at the end of the 14th Century AD, the cultural appearance in Nan Town obviously reflected the influence of the Lan Na culture pattern. The main ceramic wares of the site include plates, bowl and jars in greenish, brown, creamy white and green glazes. Nan kiln indicated that it had cross draft feature and saggars were used as support structure during firing process [3]. The study of physical properties of clay source near this archaeological kiln sites found that clay source had high sand content but the organic substances was still enough to cause the adhesion

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when it was combined with the water. The chemical composition of Ban Bo Suak clay contained quartz (SiO_2) content, while the organic matter and the impurities of Titanium (TiO_2) and hematite (Fe_2O_3) were slightly observed. However, Fe_2O_3 had an influence on solid red color of Ban Bo Suak products. It was thus observed that Ban Bo Suak products had different colors, such as orange-red, orange-brown and dark-brown. It was well known that iron oxide played an important role in producing the color tone from red to dark. Initially, iron was formed as iron hydroxides (FeO(OH)) that resulted in orange or brown colors, while iron trioxide (Fe_2O_3) resulted in red/brown color. These clay sources were considered the basic properties and colors were compared with the ancient potteries. However, determining deterioration of the ancient Nan pottery was only a guess from the history. Therefore, the study of deterioration of the ancient Nan pottery had been attractively studied to consider the transformation of the ancient Nan pottery and the production process. It was found that there were many methods used for determining the age of ancient pottery such as radiocarbon **(^{14}C)**, thermoluminescence, archaeomagnetic, fluorine and dedrochronology testing method [4]. Radiometric dating was based on the constant rate of decay of radioactive isotopes. Given an initial and a present quantity of such an isotope and its half-life, the time elapsed may be calculated [5]. Various methods applied to different materials and time scales. If a very short period of time has passed, as measured in number of half-life, a particular technique would be less accurate and more susceptible to statistical fluctuations in the inherently random decay events. If many half-life of the isotope of interest has passed, too much of the sample may have decayed to provide an accurate reading. Thermoluminesence technique was based on the principle that all objects absorbed radiation from the environment. This process freed electrons within minerals that remained caught within the item [6].

The research findings revealed that the condition of alteration of a ceramic piece depended primarily on their physical-chemical, mechanic properties and also on the characteristics that were correlated with the time of alteration. Another important features was the degradation potential caused by the aggression of the environment, affecting the durability of the material. The main problem found in ceramic materials

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regarding their durability was deterioration in ceramics resulting in cracks and pore infiltration. The autoclave technique was used to consider the loss of crack in ceramic products under constant steam pressure at different times (ASTM C424-93). The equipment of crack defect testing used in autoclave was designed to control periods of temperature variation and precipitation of the solution. In this research, autoclave was used as an equipment to consider the deterioration rate of ceramics. An autoclave was tested with high pressure saturated steam at 126 °C and pressure at 127 Psi. However, physical property of unmodified natural clay has not been widely studied. The most important parameters were the chemical and mineralogical composition of raw material and mixing ratios of them, many factors affected temperature, color and shrinkage, and characteristic of final products. It was also important to know the degree of composition variability in the raw material of the area that may help in understanding the production which was an important factor for the correct interpretation of the ceramic analytical data.

Therefore, the objectives of this research were to study the characterization and physical properties of ancient pottery from the Ban Bo Suak in Nan Province. The degradation of fired samples was tested by autoclave and bury. Both autoclave and bury test indicated phase structure, chemical composition and microstructure by XRD, XRF and SEM, respectively. After that, the samples were tested weight of drying mass to confirm the loss of mass after degradation test. Drying mass was weighted to compare with the samples before test.

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1.1 Objectives of this thesis

1.1.1 Study the characterization regarding the relationship of history and scientific properties of ancient pottery from Ban Bo Suak in Nan Province.

1.1.2 To trace back the processing techniques of ancient pottery by comparative study using autoclave equipment including the prediction of degradation in ancient pottery from the Ban Bo Suak in Nan Province.

1.2. The scope of work

Different clay sources in this work were selected from Ban Bo Suak district in Nan province.

1.2.1 Determination of raw materials

- The particle size distribution of Ban Bo Suak clay from different Nan clay sources were sieved through No 60 mesh.

- Characterization and microstructure of different Nan clay sources were studied.

- The samples were fired at 800ºC, 1000ºC, 1200ºC, 1250ºC and 1280 ºC.

- Characterization, microstructure and physical properties of the fired samples were studied to compare with ancient Nan pottery.

1.2.2 Degradation of ancient pottery

- Autoclave testing method was studied at different time.

- Buried testing method was studied at different time.

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