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MEGALITHIC TRADITION OF KHAMMAM DISTRICT: A STUDY OF POTTERY MAKING TECHNOLOGY THROUGH FTIR SPECTROSCOPY

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Abstract

The present work is focused on the characterization study of ancient pottery Pieces excavated recently from the grounds of SR&BGNR Govt. Arts &Science College, Khammam. The study is intended to identify the firing temperature, firing conditions and morphology of the ancient pottery samples. The samples were analyzed using FTIR spectroscopy. The FTIR studies were used in mineralogical characterization of potteries. The firing temperature and conditions were interpreted by studying the difference in mineral composition in the samples using FTIR. The results showed that all the samples fired in a oxidizing condition. Firing temperature is also estimated for the samples under study.

Keywords: - Ancient Pottery, FTIR, Firing temperature Analysis.

Introduction

Archaeology is the study of past societies through the material remains left by those societies and the evidence of their environment. Potteries are the most abundant findings among the archaeological artefacts. Pottery analysis reveals information regarding the daily life and cultural aspects of the society of the ancient period.[1] Potteries were made form clay as raw material. In addition the nature and quality of the potteries depend on the firing temperature, firing atmosphere and the technical skill of potters. The technical skills of the ancient potters have been the subject of active research for gaining a deep insight of forgone culture.[2]

The scientific investigation greatly contributes the archaeology providing definite and undoubted data about materials, production techniques of potteries to solve the attributed questions. The identification of firing minerals is in an essential requirement for the elucidation of firing temperature of potteries. The knowledge of firing tem temperature and condition of firing gives us better understanding of the culture that created potteries and provides us the information for conservation and restoration techniques.[3] A thermal transformation in constituent mineral of clay is considered irreversible. The change in the mineral composition will be observed only if the shred fired above its original temperature applied by the potter.

This is the key factor for the investigation of ancient potteries.[4] By analyzing the mineral trapped in the sample one can elucidate its firing temperature. Using spectroscopic technique one can search back the composition and processing which were applied during production time.

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FTIR spectroscopy is considered to be an important tool to analyze the clay minerals and mineral transformation due to thermal effects. Infrared spectra of archaeological artefacts reveal the type of clay and temperature of firing[5] to identify the firing temperature the IR spectra of pottery shreds in the received state (VS) were compared with the spectra of the refired shreds correspondingly.

Excavation Site

The excavation site Khanapuram Haveli is located in the Khammam District between northern latitude 11.0851 deg and eastern longitude 79.8545 deg, Andhra Pradesh, India. An archaeological excavation was performed under the superintendence of Department of History, University of Hyderabad and Department of History, SR&BGNR GOVT. Arts &Science College, Khammam, Andhra Pradesh in March 2012. Numerous shreds of potteries and ceramics with different size and style were recovered in a trench of dimension 3 by 3 meter and depth of 1.8 m from the surface of the site location. The artefacts recovered were treated conventionally for removing the dirt and stain and categorized. Few samples were selected at random for the present study. Out of them, pilot study was carried our on the present sample (VS). The geographical location of the excavation site is given in Fig.1.

Fig. 1

Visual Characteristics of Samples

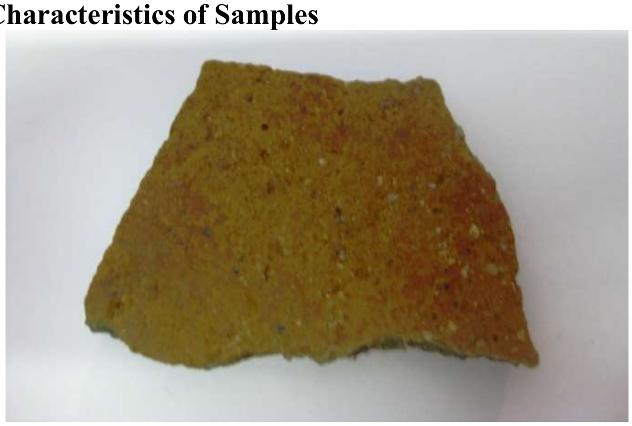 

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Fig.2

The macroscopic view of specimen named as VS is shown in fig.2 the pot shred from which the sample is taken is thick walled the outer surface of the sample is red in colour and inner side of the sample is pale Red In colour the sample sand witching portion is black in colour.

Experimental Details: FTIR Spectrometry

The infrared spectra were recovered in the mid IR region 400-4000 cm -1 using Alpha Bruker FTIR interferometer in Vaagdevi College of Pharmacy, Warangal. A technique known as attenuated total reflection (ATR Technique) or internal reflection spectroscopy is used for obtaining qualitative spectra of solids regardless of thickness.

The FTIR spectrum of VS is shown in the Fig.3. The FI-IR vibrational assignments of received state and refired samples are given in the Table 1. Palanivel and Velraj have stated in their study that the absorption band at 1629 cm-1 is due to the H-O-H bending of water molecule.[6] A medium absorption band appearing at 1632 cm-1 is due to H-O-H bending of water exists in all the refired samples owing to the absorption of moisture present in the sample. The presence of wollasonitie was observed in the sample with strong intensity peak at 1085 cm-1.[7 & 8]

It was reported that the band around 1034 cm-1 due to red clay origin of kaolinite.[9] The sample VS showed the peak centered at 1040 cm-1 with the strong intensity indicating the red clay origin of kaolinite used in the making of potteries.[10] The appearance of absorption band at 795 cm-1 and 695 cm-1 indicates the presence of quartz. Kieffer stated that the absorption band appearing at 668cm-1 is due to the presence of anorthite.[11] The sample VS showed the weak intensity peak at 668 cm-1 relevant to anorthite.

Velraj et al. in their study stated that the presence of absorption band around 580 and 540 cm-1 is due to magnetite and hematite respectively.[12 & 13] The absorption band at 581 cm-1 and 535 cm-1 in VS, 583 cm-1 is attributed to the presence

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of magnetite and hematite respectively. The formations of these two minerals depend on the firing atmosphere prevalent at the time of manufacture. The presence of low intensity peak of due to magnetite refers the transformation of Fe3 O4 to Fe2 O3 during the firing process. The appearance of absorption peak at 535 cm-1 in all sample at 2000^0 C implying that the potteries were fired in an oxidizing condition. This indicates that the artisans of Khanapuram haweli were well aware of technique of firing the potteries in an oxidizing atmosphere. The presence of absorption and around 465 cm -1 is due to the presence of microcline, as reported by the studies carried out by the earlier studies of similar nature by farmer.

The Firing Temperature of Potteries

According to Ahlem Chakchouk et al. and Shoval the decomposition of kiaolinite and formation of meta kaolinite occurs around 500 to 650^0 C.[14] The appearance of kaolinite in VS suggests that the firing temperature was not high enough to complete fthe decomposition of this ineral indicating that the firing did not exceed 650^0 C Ramaswamyand kamalakannan have stated that the IR absorption band aft 915 cm-1 is due to AI(OH) vibrations in octahedral sheet structure which begins to disappear at the temperature 500^0.[15] But in the sample chosen for the study have no such band. It can be concluded that this pottery was fired above 500^0 C. therefore; this pottery could have been fired between 500 and 650^0 C.

Conclusion

Ancient pottery samples were characterized by FTIR. The FTIR results showed that samples were fired in an oxidizing condition. From FTIR it is inferred that the sample I was fired between 500 to 750^0 C.

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