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SEM Analysis o Archaeological Pottery Samples from Karur, Tamilnadu, India

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Abstract: ***The aim of the present study is to find out the presence of minerals, raw materials used and the ceramic technology of the past in the selected pottery samples from the important archeological site Karur of Karur district, Tamil Nadu, India. Two Pottery samples of the period 250BC are collected from different depths of the excavated site are used for the present analysis. Scanning Electron Microscopy (SEM) has been used for the analysis. Examination of pottery samples under SEM is an excellent micro analytical technique used for the study of clay mineral configuration, fabric, texture and growth mechanisms. The presence of quartz, feldspar, montmorillonite, kaolinite, mullite in the selected pottery samples has been identified. Firing the pottery samples in the reducing atmosphere technique is also brought out.***

Keywords: SEM, mullite, feldspar, kaolinite, montmorillonite, quartz.

I. INTRODUCTION

Potteries are made up of natural and heterogenic clays and they are the most durable artifacts made by the ancient artisans. These artifacts were used for many purpose including cooking, conserving the food. The study of the pottery leads to identify, understand and characterize civilizations. This study is also useful to bring out the cultural sequence of the past of particular archeological site, the trade and cultural links it had. The historical period involved in making the potteries, the technological advancement made by the ancient artisans can also be revealed out. The Clay mixtures of the potteries are significant because they are economical raw materials which have been used since earliest times. Extensive investigations have been made on the various aspects of ancient materials excavated from different sites in countries like Greece, Rome, Bulgaria, Egypt, Iraq and China .But in India such studies are scanty and this is more so in South India.

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So in this work an attempt has been made to study the pottery sample obtained from Karur which is one of the important archeological site of Tamilnadu with a view to analyze the characteristics of the selected pottery samples which belongs to period of 250 BC.

A brief account of the available history of the selected site and their importance are given below.

Karur:

Karur is situated about 70 km from Tiruchirapalli of latitude 8o21'03"N and longitude 78o03'34"E in India.This historical place was excavated by Tamilnadu state department of Archaeology in three seasons-1973, 1977 and1979.The results of excavations at Karur have shed much light on the identification of Karuvur-Vanchi.Further, the findings of large number of ancient Roman coins in Karur gives the evidence for its trade links with the Roman empire in the historical past. The excavations at Karur revealed a house-site with a brick-flooring and a drain joining a brick structure. Arretine ware and Kaolin (white clay) pot shreds were also found in the Karur excavations.

II. SAMPLE MATERIALS AND METHOD

Two ancient pottery samples namely KRU 1 and KRU 2 were collected from different depths.

Table: The depth of collection and nature of the selected Karur pottery samples.

S.No	Sample	Depth below ground level(cm)	Nature
1	KRU 1	140-200	Dull red colour, slightly concave, fine texture (6mm).
2	KRU 2	200-240	Red ware, Uniform thickness, Interior dull red, coarse, outside reddish brown colour (7mm).

Examination of pottery samples under scanning electron microscope (SEM) is an excellent micro analytical technique used for the study of clay mineral configuration, fabric, texture, growth mechanisms and to estimate firing temperatures.

The primary reason for the SEM's usefulness is the high resolution which can be obtained when the bulk objects are examined; values of the order of 10 nm are usually quoted for commercial instruments. Another important feature of SEM images is the three dimensional appearance of the specimen, which is the direct result of the large depth of focus. The greater depth of focus of the SEM provides much more information about the specimen than that could be obtained from any other techniques. The SEM is also capable of examining very small objects.SEM offers several modes of operation. The most widely employed one is the secondary electron imaging, which gives images of better than 100Ao resolution almost unlimited depth of field and good contrast between most mineral components.

A specimen of 1mm thickness and about 1mm X 1mm area chipped out from ancient pottery samples with the help of a fine chisel and it is mounted on the specimen stubs using fevicol and coated with gold to a thickness of 100Ao using a Hitachi Vacuum evaporator (Model HVS 5GB).The coated samples were viewed in a Hitachi S450 Scanning Electron Microscope operated at 15KV and Photographed of 10000X.

III. RESULTS AND DISCUSSIONS

The selected two archaeological samples KRU 1 and KRU 2 have been examined by SEM in their 'as received state' with a view to find the clay mineral configuration. The results obtained from SEM photographs of KRU 1and KRU 2 pottery samples are given figure 1 & 2.

The SEM photograph of KRU 1 in the 'as received state' shows the incipient stage of development of spheroids of mullite in association with the pseudomorphic calcined kalolinite flakes in several thick massive grained montmorillonite lamelle.

Fig. 1. SEM Photograph of KRU 1 sample

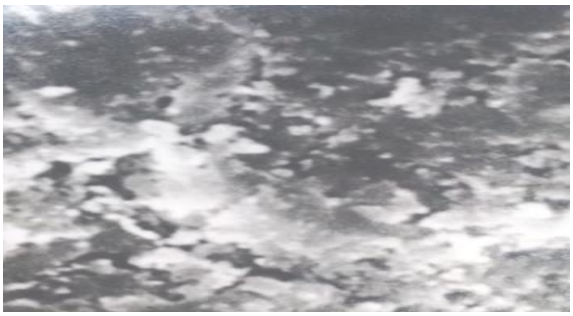

Fig. 2. SEM Photograph of KRU 2 sample

The fractured surface of transvall chert reveals euhedral quartz crystal. The presence of plagioclase is also identified from very slightly weathered granodiorite .The SEM shows etch pits located at dislocations. The etch pits commonly have prismatic form which indicates the presence of K-Feldspars. Grains are of uniform size. Some of the clayey matrix is surrounded by felsic constituents. Some significant number of voids is also seen. The appearance of isolated smooth surfaced area or filaments of glass in the fracture surface indicates the development of vitrification in fired clay. This structure being referred to subsequently as the initial vitrification. The development of vitrification also depends on the atmosphere in which the clay is fired. Firing in a reducing atmosphere results in the formation of a distinctive pattern of bloating pores and these pores are seen in the photograph. From the figure of the other sample KRU 2, it can be seen that they exhibit more or less similar features as KRU 1 and clayey matrix are abundant with quartz and felsic minerals. The presence of laths and prisms of potash feldspars are also seen. The development of initial vitrification is observed by the presence of filaments of glass in the fractured surface. The development of initial vitrification depends on the distinctive pattern of bloating pores.

IV. CONCLUSION

The SEM analyses give final confirmation that the ancient potteries were made of a mixture of kaolinite and montmorillonite clays. These studies also show that the montmorillonite clay fraction was higher. This means that the local clay was used for pottery making. Thus the usage of natural clay available in the respective locality by the ancient artisans for making pottery has also been firmly confirmed. The studies also confirm the use of natural clay, quartz and feldspars as the raw materials for pottery work in the ancient period of 250 BC.

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