The archaeological pot shreds, bricks and tile fragments excavated from five different sites namely Alagankulam, Salavankuppam, Gangaikondacholapuram, Porunthal and Nagapattinam of Tamilnadu are characterized by spectroscopic, microscopic and X-ray diffraction analysis in order to obtain the information about mineralogical composition, manufacturing technology, vitrification factor and chemical composition of the ceramic materials under investigation.

Firstly an attempt has been made to determine the mineralogical composition of the artifacts using FT-IR and XRD techniques. The FTIR spectra were taken in the mid-IR region. From tentative vibrational assignments of the infrared absorption bands and relative intensity the clay minerals and clay type of the representative samples were inspected using reported data acquired in the reviewed literature. While from the X-ray diffraction pattern and its relative intensity the crystalline phases are identified using JCPDS data file. These two techniques are complement to each other.

Subsequently based on the mineral assemblages determined, the firing temperature achieved and firing condition adopted by the artisan during the manufacture of the artifacts was revealed. Principally, the hydroxyl and silicate band of clay minerals and high firing temperature minerals were used to estimate the firing temperature whereas the open/closed firing atmosphere were indicated by the presence of hematite, magnetite and hercynite minerals.
On the other hand, SEM-EDS provide microstructure and elemental composition of the samples of interest. From the SEM photomicrographs the vitrification factor was exemplified which is then correlated with the firing temperature range. The obtained firing temperature ranges are coexistent with the $T_F$ evaluated using FTIR analysis. The calcareous/non-calcareous nature of the clay, temper inclusion and elements present are determined by means of EDS.

Finally, chemical composition of representative relics was performed using XRF technique through qualitative and quantitative multi-elemental composition in oxide form. From this study, the silica, alumina, alkalis and earth-alkaline content are determined. Moreover, the % of CaO concentration and total flux concentration the calcareous nature and refractory behavior respectively of the artifacts were established. The higher percentage of trace elements represents the geological diversity of the particular site.

Conclusively, the FT-IR, XRD, SEM-EDS and XRF scientific techniques with different aspects allowed us to characterize and distinguish the vestiges of dissimilar sites. From the results, it is also possible to know the ceramic raw materials and technical skills of the predecessors.

The archaeological importance of the investigation is as follows

1. The archaeological finds of SLK bricks, GKS tiles, POL and NPM bricks have revealed only the open air firing and perfectly oxidizing atmosphere conditions. So the people lived at the time of manufacture of these ceramic products in the respective areas of the excavations were aware of the technology of perfection to achieve good quality of their products.
2. The Alagankulam site artisans and Gangaikondacholapuram craftsman and brick makers of the ancient times were have knowledge of utilizing two types of atmosphere condition i.e. the perfectly oxidizing and reducing conditions.

3. The Salavankuppam tile making artisans has used a more complicated sequence of firing conditions, changing on purpose or incidentally. The tile samples are strong reduced atmosphere and air was admitted during cooling. Hence the presence of inner black and outer red color of the tile samples studied may be due to the blow of air into the closed kiln during the process of firing at reduced atmosphere. It could be shown that with the necessary skill and expertise this reduced atmosphere following the air blowing of ceramics can be achieved in simple kilns of this site.

4. Among 35 relics, only one Alagankulam shred (AGMP-2) showed higher firing temperature >1000ºC. It reveals different raw material (kaolin) and advanced manufacturing technology. This type of raw material is not available at this location. Therefore the AKM shred may be originated from other origin through trade.

5. Out of 15 pot shreds, only GKS shred (GKSP-5) is made of calcareous clays. The result suggests that, it must be used for storage and/or transport of foodstuff. But the calcium deficiency in the remaining samples of this site may indicate that the raw clays were extracted from a non-calcareous deposit. Hence, two types of clay were utilized by the artisans of GKS site.

6. Among five sites, the Gangaikondacholapuram brick makers have the knowledge of making adobe bricks. It is sun dried bricks with good mechanical
strength and environmental friendly. Thus the artisans at this site are very conscious about their surroundings and technology.

7. The exploitation of quartz-rich raw material or quartz-tempered artifacts were used by the artisans of Alagankulam, Salavankuppam and Gangaikondacholapuram locations while the quartz/feldspar-rich raw clay or quartz/feldspar-tempered relics for the Porunthal and Nagapattinam site peoples.

8. Gangaikondacholapuram (except GKSB-3), Porunthal and Nagapattinam brick samples are rich in hematite.

9. Salavankuppam briquettes and tiles (except SLKT-3) are well-off both in hematite and magnetite.

10. GKS tile and pot fragments (except GKSP-1 and GKSP-4) and Alagankulam pot shreds (except AGMP-1 and AGMP-3) are also affluent in hematite. Hence all the artifacts belong to five archaeological sites of Tamilnadu contain different iron minerals in their composition.