Current Science International
ISSN: 2077-4435

Volume : 07 | Issue : 02| April- June | 2018
Pages: 176-190

Archaeometry Study and Deterioration of Some Pottery Objects of Suhail Island in South Western Aswan, Egypt: Case Study

Walid Kamel Ali ELghareb

Conservation Department, Faculty of Archaeology, Aswan University, Aswan, Egypt

Received: 16 Jan. 2018 / Accepted: 29 Mar. 2018 / Publication date: 21 April 2018

ABSTRACT

Examination and analysis of the pottery components of Suhail island in south western Aswan has played an important role in identification of Archaeometry and deterioration of pottery objects dating back to new kingdom.The examinations and analysis such as Polarized Microscopy "PLM", Scanning Electron Microscope with Energy dispersive X-ray unit "SEM-EDX" , X-Ray Diffraction analysis "XRD", Thermogravimetric analysis "TGA" and Differential thermal analysis "DTA" have proved that the used clay was Nile clay, Tempers are Grog, Sand, Calcite, Granite powder, Surface Treatment is slip layer, and the firing atmosphere is different mix of oxidizing and reducing atmosphere. The type of archaeological pottery fabric in this site was fine to medium pottery fabric. The research has proved that the firing temperature is 645° C for the first pottery sample, 750°C for the second pottery sample, 786°C for the third pottery sample and 591°C for the fourth pottery sample.The research also proved deterioration of the pottery vessels such as low firing temperature degree, crystallization of salts such as halite, gypsum, and phosphates, spread of gaps, peeling of slip layer, cracks, poor physical structure, and surface deformation by soiling, and sediments. The research recommends in the future that restoration and maintenance of these pottery vessels should be based on their results of examination and analysis that were identified in this archaeological site.

Key words: Pottery, Manufacture, Fabric, Slip layer, Firing Atmosphere, Deterioration

Introduction

The ancient Aswan consists of three provinces, extended from Philae to north of Esna, the first Territory is the land of the goddess satet "goddess of Suhail Island" which was one of the most important centers of that ancient region, including many Inscriptions, The second province was Minty Hur "Edfu", and The third territory is Nikhn that extended up to the north of Esna (Mahran, 2002). The geographical location of Aswan played an important role in its ancient history where it was a commercial and military center, and the link between Egypt and Africa. It was the source of gold in ancient Egypt (Al-Urath, 2002). Aswan Included temples of Edfu, KomOmbo, Philae, Kalabsha, Elsobooa and Abu Simbel, it also included some quarries of limestone, sandstone and granite, such as quarry unfinished obelisk. It included many of the tombs such as the nobles and Fatimid tombs (Noureddine, 2002). Suhail island located south western Aswan, a rocky granitic island containing hundreds of hieroglyph inscriptions, carved by the ancient Egyptians who went to the south to receive their rest, and take viands, these inscriptions included different political, religious, social subjects, (Malik, 2002) and cartridges and some small pyramids for some ancient Egyptian kings (Qantair,2002) as shown in fig.(1).

Figure1. The rock inscriptions in Suhail, A: Famine plate, B: Rock art of King Ramses 11

Corresponding Author: Walid Kamel Ali ELghareb Conservation Department, Faculty of Archaeology, Aswan University, Aswan, Egypt. E-mail:drwalidelghareb@yahoo.com

Aswan was considered the southern frontier of Egypt, Aswan was anciently important not only from its strategic geographic location but also from the variety of stone (Bonnie, 2017) .The process of examination and analysis is an important processes in understanding physical and chemical mineral characterization(Megahed, 2015). It played an important role in identification of Characterization of the objects (Mairinger *et al*., 1982) , Analysis process has played an important role in the identification of weathering forms and its deterioration such as salts (Bader,2015) ,the process of examination and analysis are used to discover the structure of ceramics (Abdel Rahim,2014) ,the objects substrates should be studied to understand deterioration process, chemical and mineral composition before treatment (Ghoniem,2016) scientific examination and analyses were used to investigate morphological features, deterioration, and elementary composition of the objects (Al-zahrani *et al*.,2012). The objects were examined to characterize structure components of archaeological materials (Abdel Aal, (2014),they also illustrate kind of clay , pottery fabric and the mineral components due to different firing temperatures degrees inside the kiln The examination also plays an important role in determining of firing temperature degree of the pottery heritage ,it also showing firing atmosphere in the kilns,they played an important role in diagnosis of the causes and deterioration phenomena of the pottery heritage, and establishing a scientific strategy for its treatment and conservation consistent with the nature of damage(Elgareb,2017).

Materials and Methods

Study materials

Four pottery samples of various shapes and colors were selected from Suhail Island in south western Aswan, and were used in the process of examination and analysis as in fig.(2).

Fig. 2: The pottery samples used in The Examination and Analysis

Scanning Electron Microscope with Energy Dispersive of X-Ray Unit "SEM- EDX"

It was used for identifying, mineral composition (Ali, 2011), the morphology, present condition, deterioration features (Bader *et al*., 2013) .The pottery samples were examined without prior preparation using FEI Quanta 250 UK coupled with an energy dispersive X-ray spectrometer (EDX), operating conditions "20 kV and 1×10^{-9}A, and this examination was conducted at Electron Microscopy unit at the National Research Center in Cairo, Egypt.

X-Ray diffraction analysis

This analysis was used to identify crystallography of the materials, minerals, components (Bader, 2014), it also shows archaeological material and deterioration compounds (Meghahed, 2014). Four pottery samples were prepared for XRD analysis, the used device was Philips PW 1830 diffractometer XRD equipped with a fine-focus tube, ICDD search/match program,Operating conditions using at 40kv and 10mA, X - ray diffraction pattern between 4:70 Ɵ, this analysis was conducted at the Analytical Center at Zagazig University.

Thermal Analysis

Thermal Differential Analysis "DTA" and Thermogravimetric Analysis "TGA", were used to determine firing temperature of archaeological pottery due to the loss of weight and mineral changes that occurred during firing of the pottery. Four archaeological pottery samples in Suhail island were analyzed by thermal analysis device Known as Perkin Elmer STA 6000, the temperature program ranged from room temperature to 1500°C,measurement range: ±0.2 to ±1000 µV, heating speed: 0 to +50°C/min, temperature ,weight loss and mineral changes were recorded on the chart.

Results

Visual Examination

The visual examination showed that shaping was done by the wheel or coiling method, it also showed the pottery samples were different in their colors, firing temperature degree was different, it also showed that deterioration of Suhail island pottery vessels in southwestern Aswan such as black core, gaps, exfoliation of slip layer, cracks, crystallization of the salts, and soiling due to agricultural environment close to the archaeological site as shown in fig. (3).

Fig. 2: Agricultural environment close to the archaeological site

Polarizing microscope examination

The examination of the first pottery sample showed sub-round quartz grains, angular quartz grains , rutile, grog, fine pottery fabric in an iron oxide-rich matrix as shown in fig.(4 A-B) .

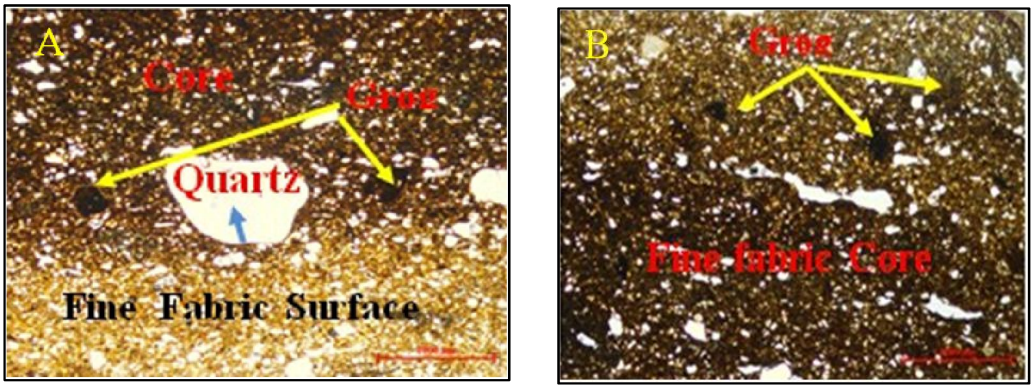


Fig. 4: Petrography micrograph of the first pottery sample, A: quartz grains, grog and rutile, B: fine quartz grains and grog (10X-CN).

The examination of the second sample showed medium quartz grains, round and sub-round and angular quartz grains quartz grains, it also showed existence of calcite, biotite pyroxene, olvine and grog as in fig.(5).

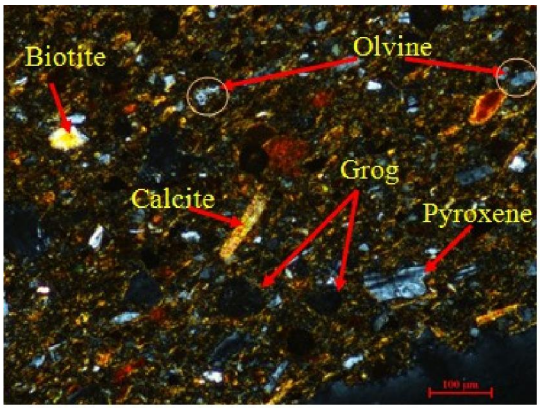


Fig. 5: Petrography micrograph of the second pottery sample shows existence of quartz, calcite, biotite, olvine, pyroxene and grog (10X-CN).

The examination of The third sample showed medium quartz grains, round and sub-round quartz grains, it also showed existence of calcite, olvine and grog in an iron oxide-rich matrix, as in fig.(6).

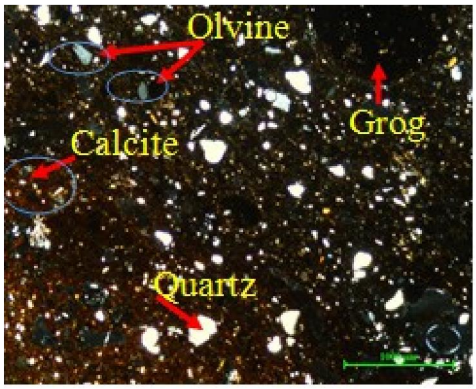


Fig. 6: Petrography micrograph of the third pottery sample showing quartz, calcite and olivine and grog (10X-CN).

The examination of the fourth pottery sample in Suhail island in Aswan showed round , sub-round, and angular quartz grains, as well as calcite biotite, pyroxene and grog, as in fig (7).

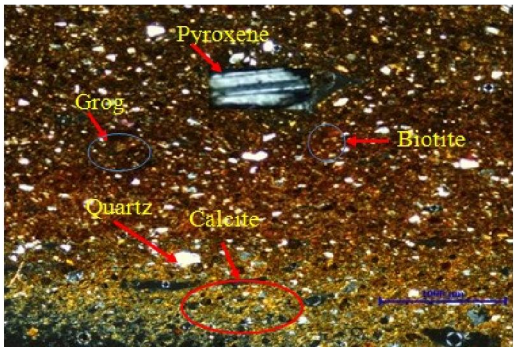


Fig. 7: Petrography micrograph of the fourth pottery sample showing quartz, calcite, pyroxene, grog and biotite (20X-CN).

Examination and Analysis by Scanning Electron Microscope coupled with the Energy Dispersive of X-Ray Unit "SEM-EDX".

Four archeological pottery samples in Suhail Island in Aswan were examined by SEM-EDX, which deals with the samples without any prior preparation.

Examination by Scanning Electron Microscope.

The examination by SEM- EDX for the first pottery sample showed fine pottery fabric of fine quartz grains. It also showed surface treatment using the slip layer, as well as presence of some gaps ,Peeling of slip layer and salts as shown in fig.(8). While the second sample showed presence of medium pottery fabric containing added coarse quartz grains, as well as presence of some salts, cracks ,exfoliation of slip layer and gaps as shown in fig.(9).

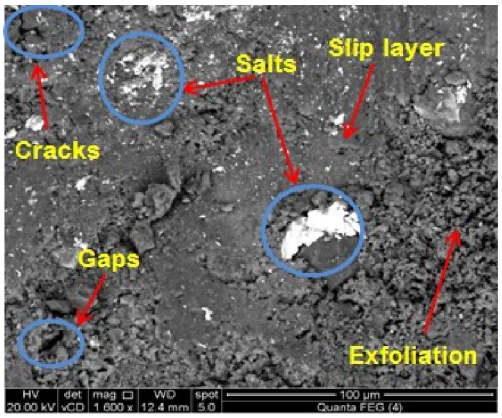


Fig. 8: SEM photomicrograph of the first pottery sample.

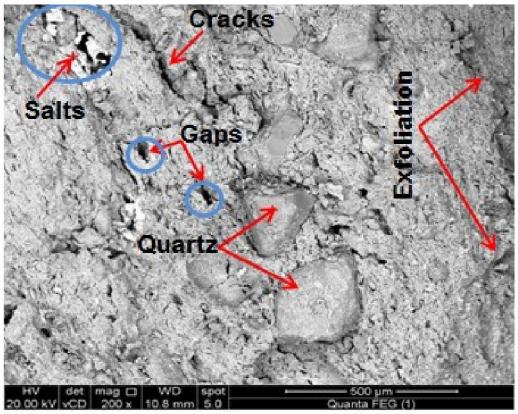


Fig. 9: SEM photomicrograph of the second pottery sample.

The third pottery sample in Suhail island showed presence of medium pottery fabric of medium quartz grains, as well as some salts and peeling of the slip layer, as shown in fig.(10).The examination of the fourth pottery sample showed presence of fine pottery fabric containing the added quartz grains "additive materials", as well as presence of some salts, peeling of slip layer ,cracks and gaps as shown in fig. (11).

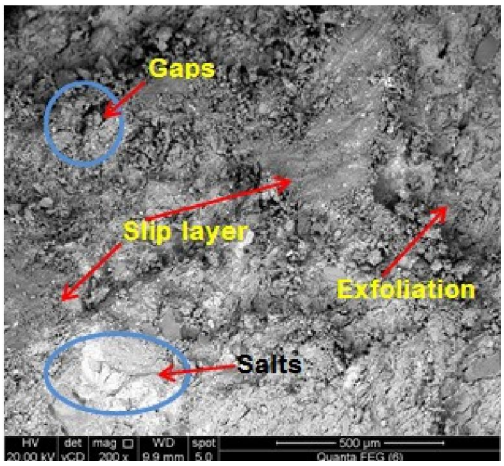


Fig. 10: SEM photomicrograph of the third pottery sample

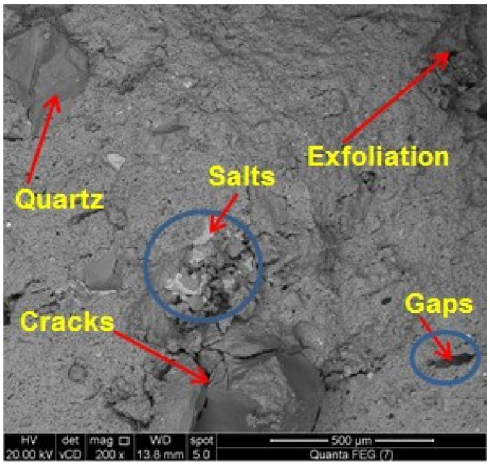
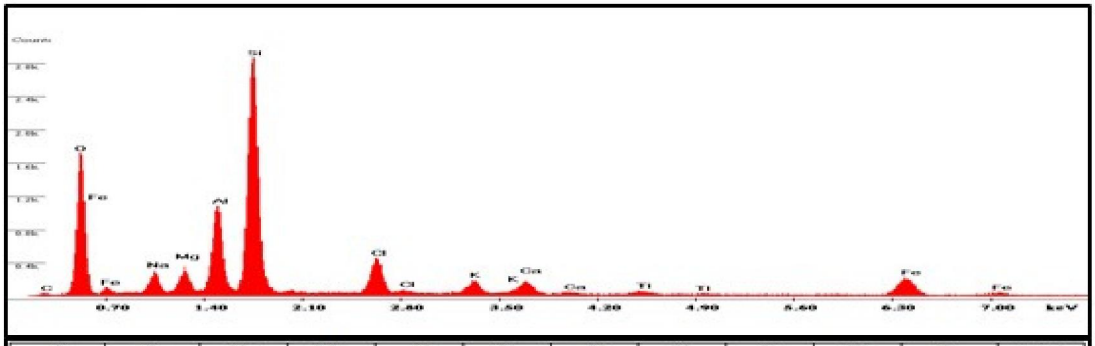


Fig. 11: SEM photomicrograph of the fourth pottery sample.

Analysis of the scanning electron microscopy with EDX.

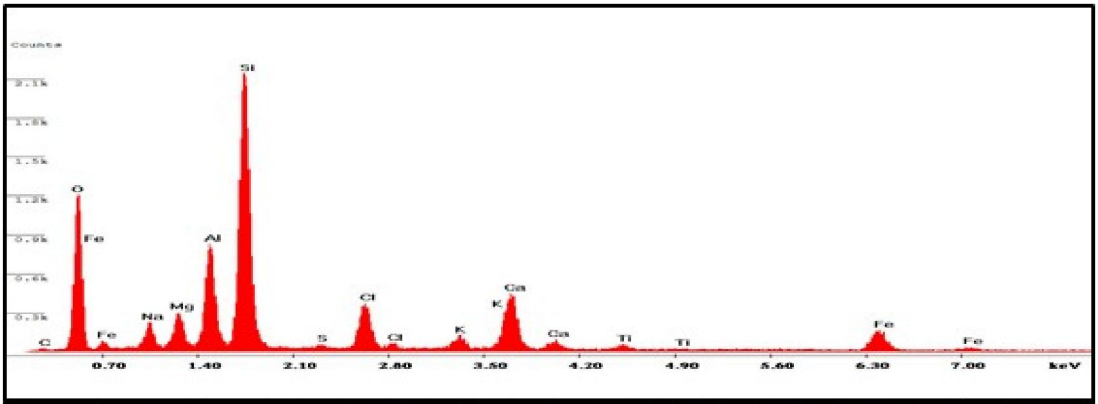
The results of the analysis of the first pottery sample showed the presence of carbon, sodium, magnesium, aluminum, silica, chlorine, potassium, calcium, titanium and iron as shown in fig.(12).



C	O	Na	Mg	Al	Si	Cl	K	Ca	Ti	Fe	total
1.32	26.80	2.76	2.39	9.89	28.49	6.17	2.76	3.04	1.28	15.14	100%

Fig. 12: EDX pattern of the first pottery sample.

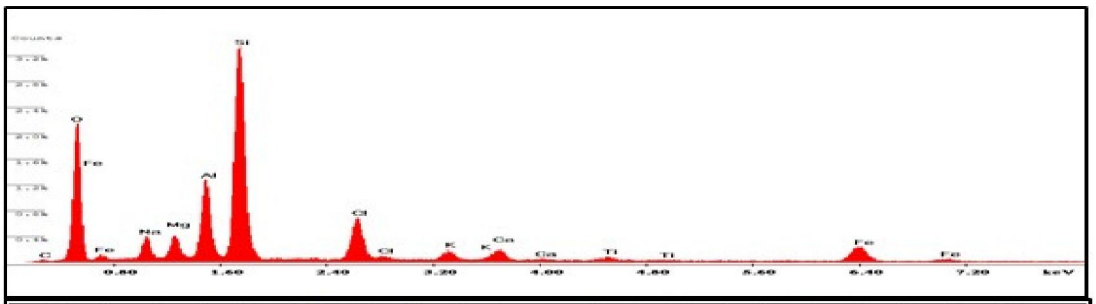
The results of the analysis of the second pottery sample as shown in fig.(13) showed the presence of carbon, sodium, magnesium, aluminum, silica, sulfur, chlorine, potassium, calcium, titanium and iron.



C	O	Na	Mg	Al	Si	S	Cl	K	Ca	Ti	Fe	total
1.16	26.06	2.57	2.80	7.88	25.48	1.42	6.92	2.07	8.26	1.24	14.14	100%

Fig. 13: EDX pattern of the second pottery sample.

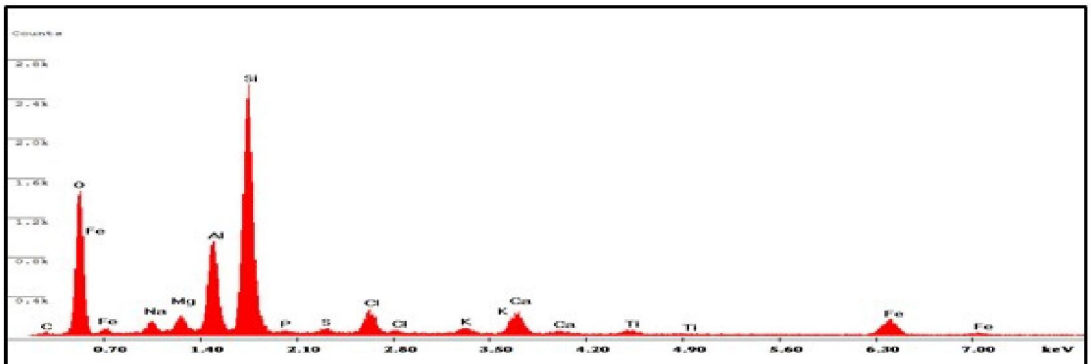
The results of the analysis of the third pottery sample as shown in fig.(14) showed the presence of carbon, sodium, magnesium, aluminum, silica, chlorine, potassium, calcium, titanium and iron.



C	O	Na	Mg	Al	Si	cl	K	Ca	Ti	Fe	total
1.20	27.54	3.16	2.71	9.67	28.05	7.70	2.08	2.62	1.45	13.81	100%

Fig. 14: EDX pattern of the third pottery sample.

The results of the analysis of the fourth pottery sample showed the presence of carbon, sodium, magnesium, aluminum, silica, phosphor, sulfur, Chlorine, potassium, calcium, titanium and iron as in fig. (15).



C	O	Na	Mg	Al	Si	P	S	Cl	K	Ca	Ti	Fe	total
1.84	28.81	1.49	1.68	8.64	29.39	1.16	1.61	3.87	2.30	6.22	1.64	11.36	100%

Fig. 15: EDX pattern of the fourth pottery sample.

X-Ray diffraction analysis

The first pottery sample was analyzed by X-Ray Diffraction, the pattern of XRD contains quartz (SiO_2), magnetite (Fe_3O_4), albite ($NaAlSi_3O_{10}$), Calcite ($CaCo_3$) and microcline (KALSi3O8) ,halite (NaCl) as shown in fig. (16). It is clear from the results of the pattern of X-Ray Diffraction that the pottery sample is low firing being contains magnetite (Fe_3O_4).

XRD pattern of the second sample contains quartz (SiO_2), hematite (Fe_2O_3), anorthite (CaAl2Si2O8), halite (NaCl) and calcite ($CaCo_3$) as in fig. (17) . The results of XRD pattern show that the sample is good firing because it contains hematite (Fe_2O_3).

The third pottery sample in Suhail island was analyzed by XRD as shown in fig. (18). The pattern contains quartz (SiO_2), albite ($NaAlSi_3O_{10}$), halite (NaCl) ,Calcite ($CaCo_3$) and hematite (Fe_2O_3).The results of XRD pattern show that the sample is medium firing.

The fourth pottery sample was analyzed by X-Ray Diffraction .The XRD pattern contains quartz (SiO_2), magnetite (Fe_3O_4) , albite ($NaAlSi_3O_{10}$), calcite ($CaCo_3$) and gypsum ($CaCo_4.2H_2O$), halite (NaCl, it is clear from the results of XRD pattern that the pottery sample is low firing being contains magnetite (Fe_3O_4),as shown in fig.(19).

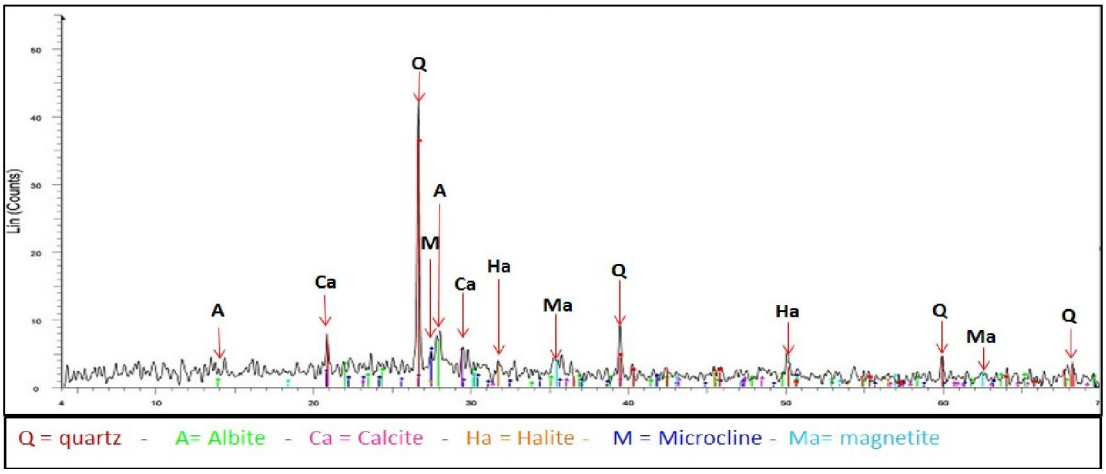


Fig. 16: XRD pattern of the first pottery sample.

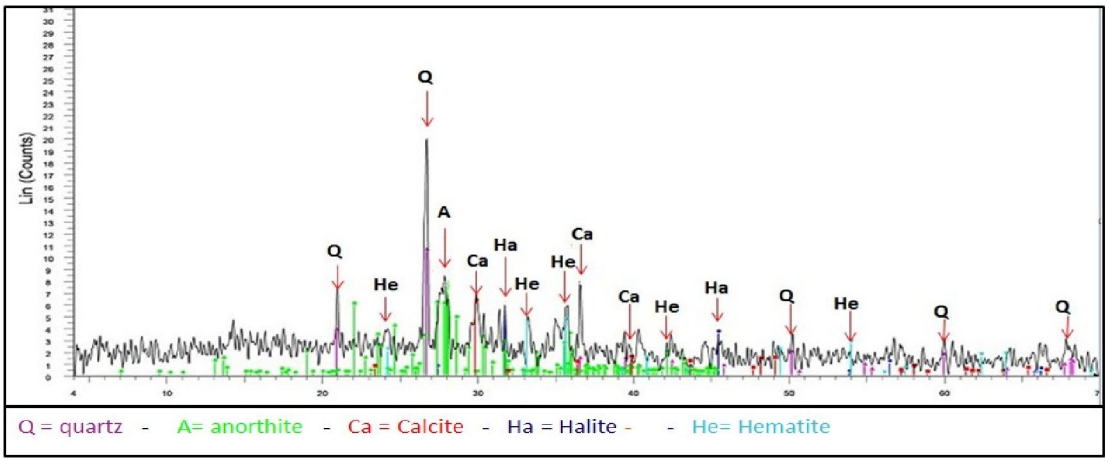


Fig. 17: XRD pattern of the second pottery sample.

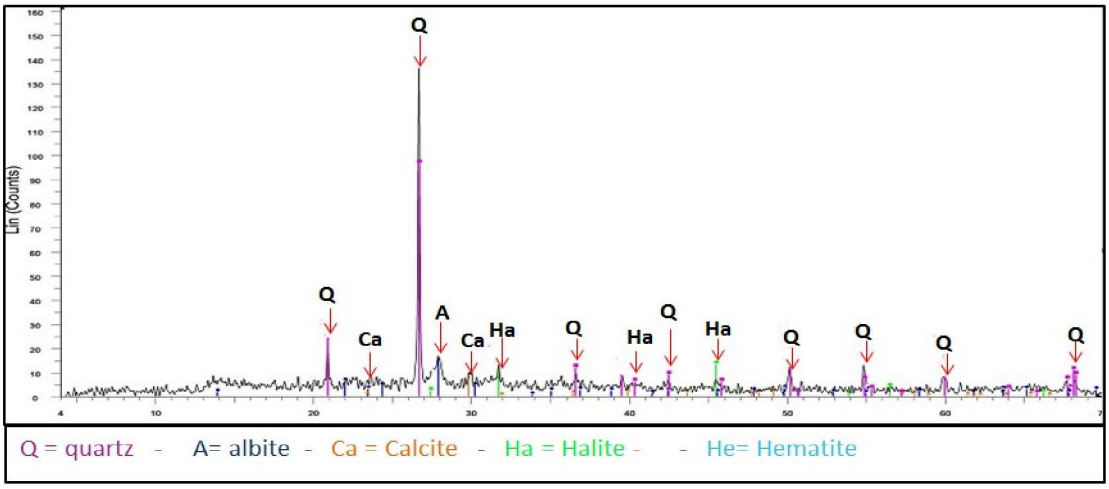


Fig. 18: XRD pattern of the third pottery sample.

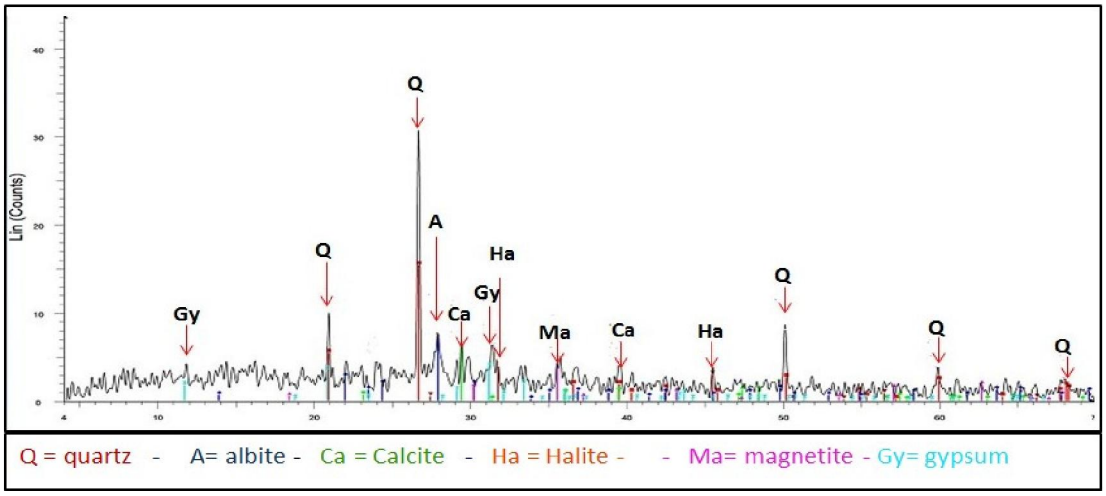


Fig. 19: XRD pattern of the fourth pottery sample.

Thermal Analysis

The thermal analysis TGA showed the weight loss of the first pottery sample due to firing temperature. The result of weight loss was 0.941 milligrams at firing temperature from 49.01 ° C to 126.63 ° C., The weight loss continued to 2.122 mg from 198.80 ° C to 306.24° C, The weight loss was decreased to 4.135 mg from 306.24 ° C to 645.43 ° C, The weight loss was stable at firing temperature from 645.43 ° C to 1000 ° C, The results of weight loss indicated that the firing temperature was 645.43 ° C as in fig. (20).

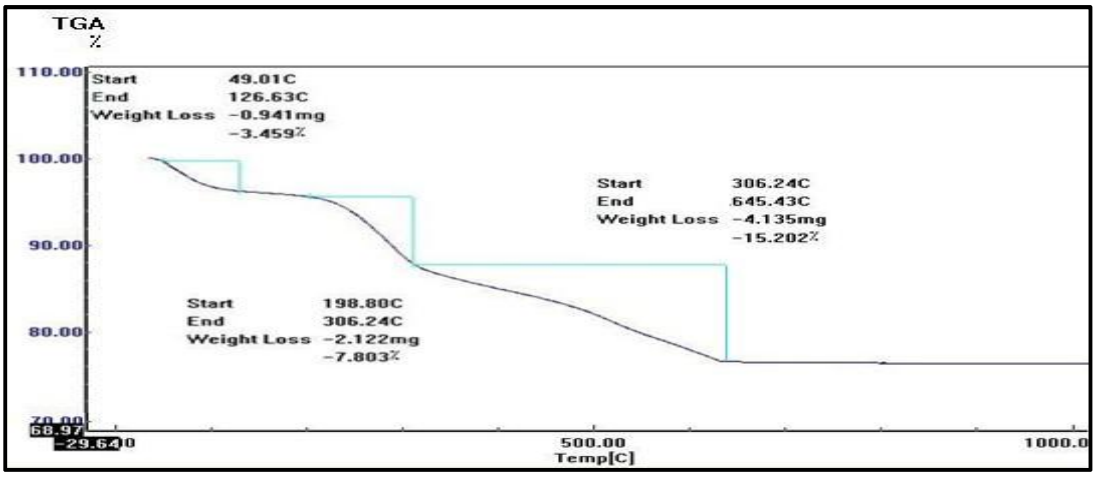


Fig. 20: TGA pattern of the first pottery sample.

Differential thermal analysis "DTA" of the first sample showed slight minerals changes in firing temperature from 128.16 ° C to 181.08 ° C., the minerals changes increased from 297.01 °C to 358.10 ° C, , the intensity of mineral changes increased from 357.56 °C to 641.23 °C and the stability of the mineral changes from 641.23 °C to 1000 °C. The results of mineral changes indicated that the firing temperature was 641 ° C as in fig. (21).

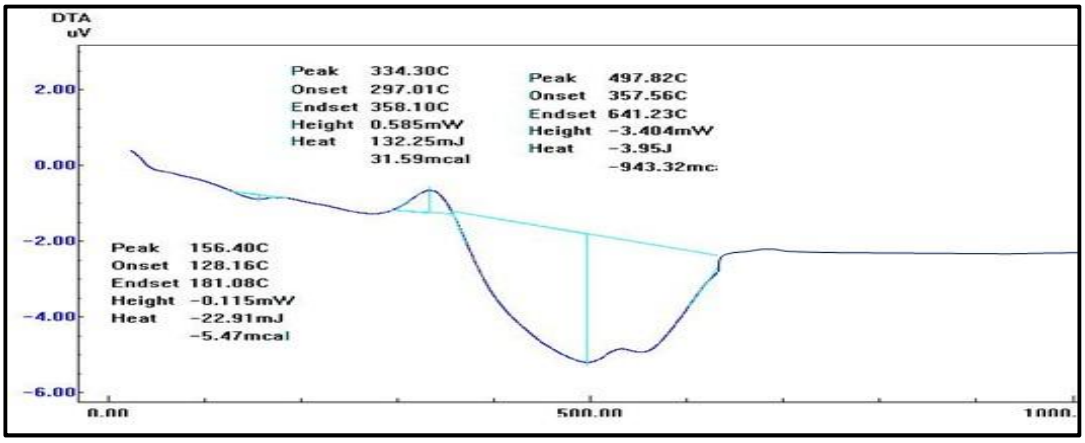


Fig. 21: DTA pattern of the first pottery sample.

The thermal analysis TGA showed the weight loss of the second pottery sample due to firing. The result of weight loss was 0.721 milligrams at firing temperature from 36.83 ° C to 115.07 ° C., The weight loss was decreased to 0.561 mg from 138.30° C to 414.01° C, The weight loss was Clearly decreased to 0.149 mg from 499.09 ° C to 750.03 ° C, The weight loss was stable at firing temperature

from 750.03 ° C to 1000 ° C, The results of weight loss indicated that the firing temperature was 750° C as in fig. (22).

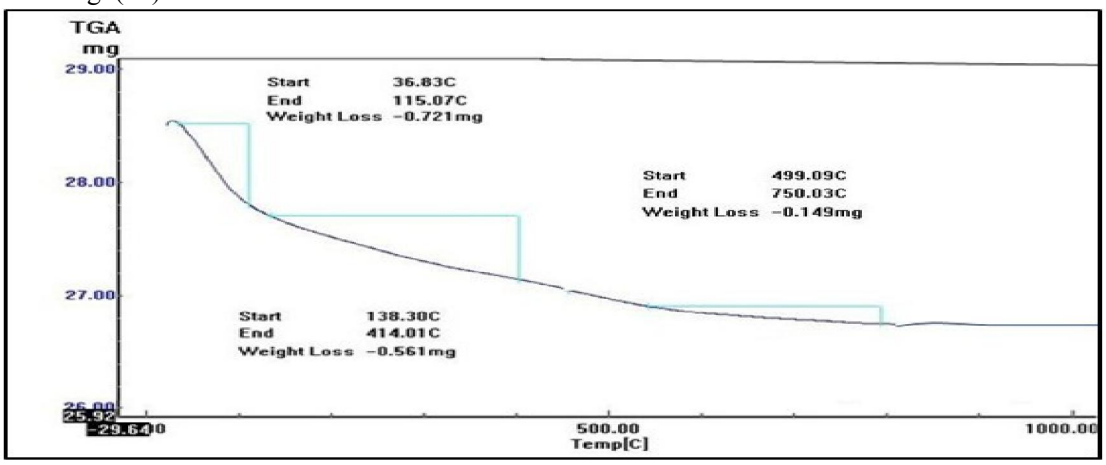


Fig. 22: TGA pattern of the second pottery sample.

Differential thermal analysis "DTA" of the second sample showed minerals changes in firing temperature from 28.06 °C to 125.27 °C., the intensity of mineral changes increased from 404.16 ° C to 559.07 ° C, mineral changes decreased from 624.03 ° C to 720.81 °C and the stability of the mineral changes from 720.81 °C to 1000 °C. The results of mineral changes indicated that the firing temperature was 720 ° C as in fig. (23).

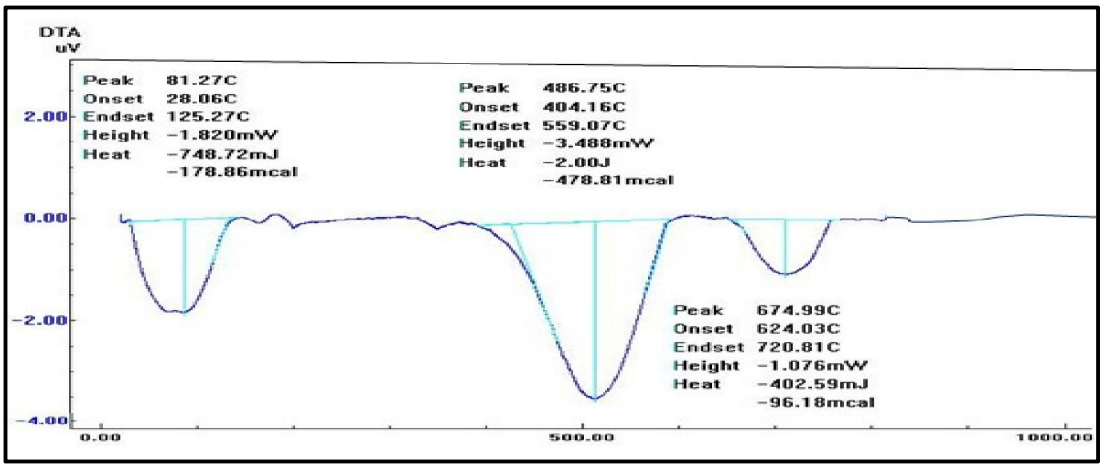


Fig. 23: DTA pattern of the second pottery sample

The thermal analysis TGA shows the weight loss of the third pottery sample due to firing. The result of weight loss was 1.522 mg at firing temperature from 130.37 ° C to 171.44 ° C., The weight loss was decreased to 0.523 mg from 184.73° C to 394.38° C, The weight loss was decreased to 0.399 mg from 584.88 ° C to 786.46 ° C, The weight loss was stable at firing temperature from 786.46 ° C to 1000 ° C, The results of weight loss indicated that the firing temperature was 786° C as in fig. (24).

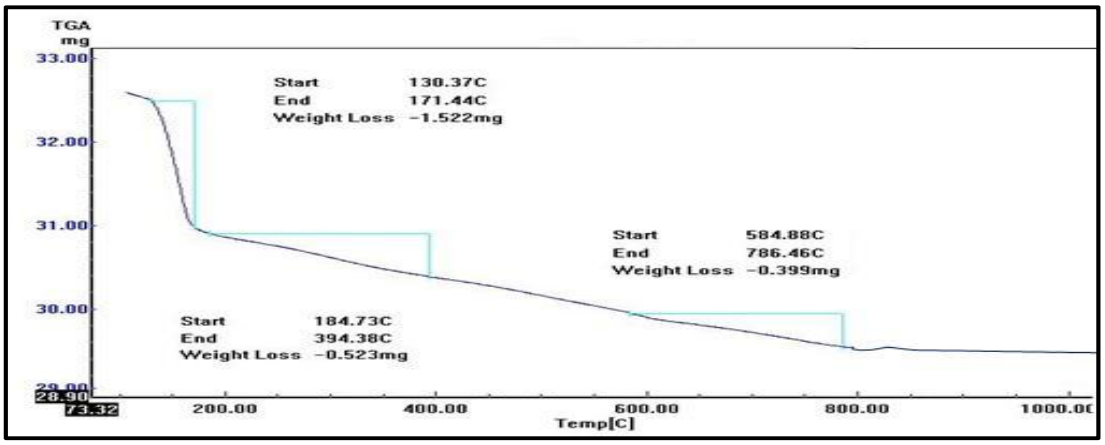


Fig. 24: TGA pattern of the third pottery sample.

Differential thermal analysis "DTA" of the third sample showed Severe minerals changes in firing temperature from 110.99 ° C to 527.44 ° C., the intensity of mineral changes decreased from 573.45 ° C to 756.48 ° C, and the stability of the mineral changes from 756.48 ° C to 1000 ° C. The results of mineral changes indicated that the firing temperature was 756 ° C as in fig. (25).

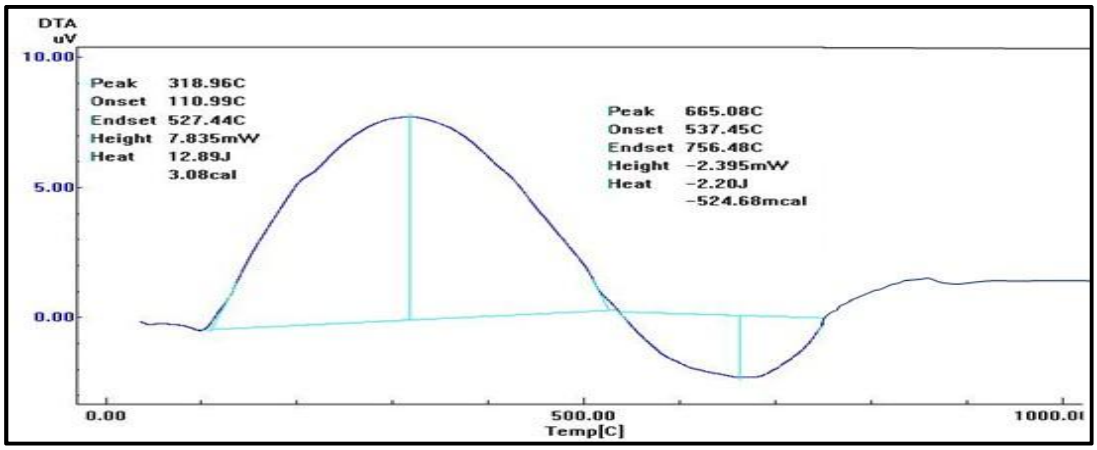


Fig. 25: DTA pattern of the third pottery sample.

The thermal analysis TGA shows the weight loss of the fourth pottery sample due to firing. The result of weight loss was 3.961 mg at firing temperature from 39.02 ° C to 135.57 ° C., The weight loss was decreased to 1.095 mg from 457.64° C to 591.23° C, The weight loss was stable at firing temperature from 591.23 to ° C to 1000 ° C, The results of weight loss indicated that the firing temperature was 591° C as in fig. (26).

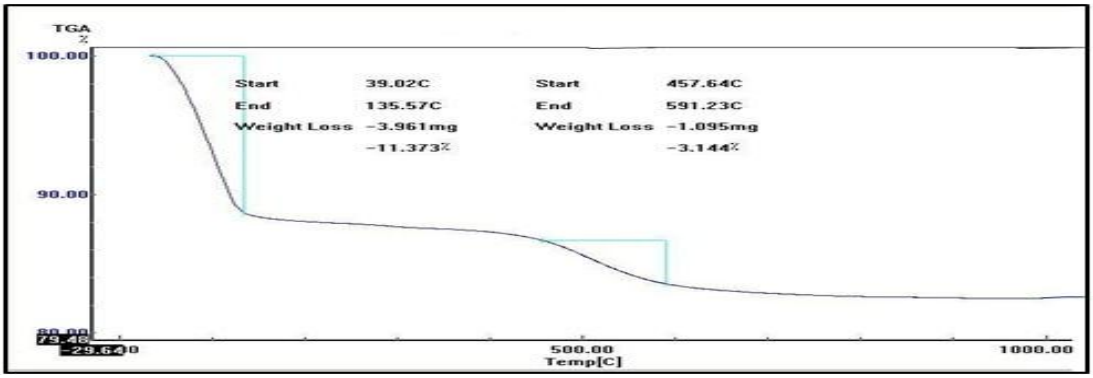


Fig. 26: TGA pattern of the third pottery sample.

Differential thermal analysis "DTA" of the fourth sample showed minerals changes in different firing temperature from 36.66 °C to 63.36 °C., minerals changes continued from 230.02 °C to 291.68 °C. The intensity of mineral changes increased from 363.36 °C to 636.17 °C, mineral changes was stable from 636.17 ° C to 1000 °C. The results of mineral changes indicated that the firing temperature was 636° C as in fig. (27).

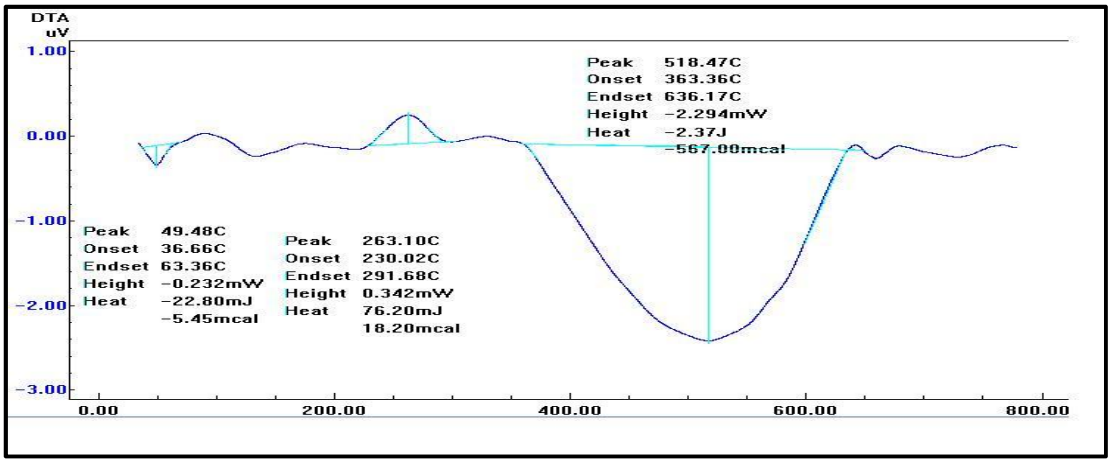


Fig. 27: DTA pattern of the fourth pottery sample.

Discussion

The results of the research showed that the visual examination proved that pottery samples were shaped by the potter Wheel, the surface treatment was slip layer, polishing of samples was medium. Tempers were quartz, the pottery samples suffered from soiling, crystallization of salts, peeling of slip layer, black core, and most of the objects suffered from breaking.

The polarized microscope examination showed that the used clay in the manufacture in Suhail Island in south western Aswan is Nile clay because of existence of biotite, pyroxene and rutile (Mahapatra, 2015). The polarized microscope examination also proved presence of additives materials such as sand, grog , calcite and granite powder. This was confirmed by the presence of calcite , olvines and heavy minerals due to the chemical decomposition of granite (Reddy,2012). Minerals such as olvines, pyroxene, amphibole, And biotite decomposed to iron oxides(Simmons, 2002), These minerals are soluble in acidic aqueous solutions (Misra,2014)

The polarized microscope examination showed that the surface treatment of pottery samples was slip layer containing fine quartz grains.

The polarized microscope examination proved that firing atmosphere of the first sample was reduced atmosphere for the presence of magnetite (Fe_3O_4) in the sample. The firing atmosphere of the second and third pottery sample were oxidized atmosphere for presence of hematite (F e_2O_3). The examination of the fourth sample showed that the firing atmosphere was reduced for contain the magnetite in the sample.The polarized microscope examination showed tempers " additives materials " used in pottery samples , grog in the first pottery sample, grog ,calcite in the second , third and fourth pottery samples . as well as The polarized microscope examination showed that granite powder as local tempers " additives materials " used in the second and third pottery sample for presence of olivine, being one of products of decomposition of granite by physicochemical weathering, it is characteristic of the Pottery Manufacturing in Aswan as one of the local additives,The polarized microscope examination showed fine pottery fabric in the first pottery sample, medium pottery fabric in the second and third sample, fine fabric in the fourth pottery sample, The examination and analysis of SEM- EDX showed that the used clay in the pottery samples was Nile clay for existence sodium, potassium, calcium, iron, and titanium oxides in the raw materials (clay).

The examination and analysis of SEM- EDX showed that firing temperature degree was low to medium firing for containing carbon, where its percentage in the first pottery sample was 1.32 %, the second sample was 1.06%, the third sample was 1.20% and the fourth sample was 1.84 %.

The examination and analysis of SEM- EDX also showed fine fabric in the first pottery sample, medium pottery fabric in the second and third pottery sample, fine pottery fabric in the fourth pottery sample. The examination and analysis of SEM- EDX has proved presence of some salts such as halite (Cl) and gypsum (S) and phosphates (p) in archaeological pottery samples in Suhail Island. The examination of SEM- EDX also showed that pottery samples had suffered from soiling , peeling of slip layer , some gaps , crystallization of salts and cracks in the pottery samples, X-Ray Diffraction analysis showed that the used clay in the pottery samples in Suhail Island is Nile clay because of containing biotite, pyroxene and albite.

X-Ray Diffraction analysis showed that firing atmosphere of the first sample was reduced atmosphere, being magnetite (Fe_3O_4)in the sample, the firing atmosphere of the second and third pottery sample were oxidized atmosphere, being hematite (Fe_2O_3) in pottery samples.. The analysis of the fourth sample showed that the firing atmosphere was reduced where magnetite (Fe_3O_4) confirmed that.

X-Ray Diffraction analysis showed that pottery samples suffered from crystallization of some salts such as chlorides (halite, NaCl), sulphates (gypsum, CaSo4.2H2O) due to the burial in the soil.
Thermogravimetric analysis" TGA" of the first pottery sample showed that the firing temperature was 645°C, weight loss was done for losing mechanical combined water of clay at firing temperature of 49.01 °C to 126.63 °C, loss in weight continued due to the loss of chemical combined water of clay and burnt organic matter from 198.80 °C to 306.24 °C, the weight loss was significantly reduced from 306.24 °C to 645.43 °C as a result of decomposition of carbonate into CaO and Co_2, burnt organic residues into Co_2 and chlorides.

Differential thermal analysis "DTA" of the first pottery sample showed the firing temperature was 641°C, where the hydroxyl group of mechanical combined water for clay was lost at firing temperature from 128.16 °C to 181.08 °C. The minerals changes increased by hydroxyl group loss of chemical combined water of clay, burning and oxidation of organic matter from 297.01 °C to 358.10°C and then the minerals changes were significantly increased due to decomposition of carbonate into CaO and Co_2, organic residues and chlorides.

TGA of the second pottery sample showed that the firing temperature was 750 °C where mechanical combined water for clay was lost at firing temperature of 36.83 °C to 115.07 °C, followed by loss in weight due to chemical combined water of clay was lost, burnt organic residues from 138.30 °C to 414.01 °C, and then the weight loss continued from 499.09 °C to 750.03 °C due to decomposition of carbonate into CaO and Co_2, organic residues into Co_2 and chlorides.
DTA of the second sample showed that firing temperature was 720°C where hydroxyl group of mechanical combined water of clay was lost at firing temperature of 28.06 °C to 125.27 °C. The mineral change was increased by chemical combined water loss for clay, oxidation of organic residues from138.30°C to 404.16°C and then the mineral change significantly increased from 624.03 °C to 720.81 °C due to decomposition of carbonate into CaO and Co_2, organic residues into Co_2 and chlorides.
TGA of the third pottery sample showed that the firing temperature was 786 °C where mechanical combined water of clay was lost at firing temperature of 130.37 °C to 171.44 °C, followed by loss in weight due to chemical combined water loss for clay, burnt organic matter from 184.73 °C to 394.38 °C, and then the weight loss of the sample continued from 584.88 °C to 786.46 °C due to decomposition of carbonate into CaO and Co_2, organic residues into Co_2 and chlorides.

Differential thermal analysis "DTA" of the third sample showed that firing temperature was 756°C where hydroxyl group of mechanical, chemical combined water of clay was lost and oxidation of organic matter was done at firing temperature from 110.99 °C to 527.44 °C. Then the mineral change significantly increased from 573.45 °C to 756.48 °C due to decomposition of carbonate into CaO and Co_2, organic residues into Co_2 and chlorides.

Thermal analysis by TGA of the fourth pottery sample showed that the firing temperature was 591 °C where mechanical combined water of clay was lost at firing temperature of 39.02 °C to 135.57 °C, loss in weight increased by chemical combined water loss for clay, burnt organic residues from 457.64 °C to 591.23 °C, due to decomposition of carbonate into CaO and Co_2, organic residues into Co_2 and chlorides.

Differential thermal analysis "DTA" of the fourth sample showed that firing temperature was 636°Cwhere the hydroxyl group of mechanical combined water of clay was lost at a temperature from 36.66 °C to 63.36 °C. The mineral change was increased by loss of chemical combined water and

oxidation of organic matter from 291.68 °C to 230.02°C. Mineral change continued from 363.36°C to 636.17°C due to loss of hydroxyl group of chemical combined water of clay and gypsum or by decomposition of carbonate to CaO and Co_2, oxidation of organic residues into Co_2 and chlorides.

Conclusion

The research showed pottery manufacture process in Suhail Island in southwestern Aswan where the used clay in pottery samples was Nile clay, tempers were sand, grog, calcite, and granite powder. The surface treatment was slip layer. The firing atmosphere was reducing and oxidizing atmosphere in the pottery samples. The pottery fabric was fine to medium pottery fabric in the pottery samples. The Research has proved that the firing temperature is 645° C for the first pottery sample, 750°C for the second pottery sample, 786°C for the third pottery sample and 591°C for the fourth pottery sample. The research also proved deterioration of pottery samples proving that firing was low to medium firing temperature degree, black core, peeling of slip layer, cracks, salt crystallization such as halite , gypsum, and phosphate , spread of gaps, poor physical structure, and surface damage by soiling and dirties. The research recommends in the future that the restoration and maintenance of these pottery vessels should be based on their results of examination and analysis in this archaeological site.

Acknowledgment

I extend my sincere thanks and appreciation to Prof. Dr. Gharib Taha, Professor of chemistry at the Faculty of Science at Aswan University for his encouragement and practical support. I also extend my deep thanks and gratitude to Dr. Abdel - Moneim Said General Director of Aswan and Nubia monuments at the Ministry of Antiquities for his help and cooperation in the archaeological site.

References

Abdel Aal, S., 2014. Characterization and examination of pigments, grounds and media from ancient Egyptian Cartonnage. Egyptian Journal of Archaeological and Restoration Studies, 4(1), p.35.

Abdel Rahim, N., 2014. Study and reconstruction of archaeological ceramic dish from mumlok period (13th to 15th century), Alfustat, Egypt. American International Journal of Contemporary Scientific Research, U.S.A, pp.2349.

Abdel Rahim, N., 2016. Restoration of an archaeological Ceramic jar from Mamluk Period (1250-1517 A.C.)Al-Fustat, Egypt: an analytical study. Egyptian Journal of Archaeological and Restoration Studies,6(1): p.7.

Ali, N., 2011. Study of deterioration and degradation of overl aid wooden doors in Ottoman Caravansary in Bulaq, Cairo. Egyptian Journal of Archaeological and Restoration Studies, 1(2): p.34.

Al-Urath, O., 2002. Nubia Museum. Journal of The Faculty of Arts, University of Aswan, 2002, p.75.

Al-Zahrani, A., and M. Ghoniem, 2012. A characterization of coins from the Najran Hoard, Saudi Arabia, prior to conservation. International Journal of Conservation Science, (3)3: p.149.

Bader, N. A., 2015. Mechanisms of the deterioration of the wall reliefs at Shenhur temple, Upper Egypt and Concepts for Conservation. Open Journal of Geology, 5(11): p.832.

Bader, N., 2014. The Deterioration Problems of The Wall Reliefs of Komir Temple, Esna, Egypt. Mediterranean Archaeology and Archaeometry, 14(1): p.206.

Bader, N., and W. K. El-gharib, 2013. Restoration and Preservation of engraved of lime stone blocks discovered in Abu Mousa Excavation, Suez, Egypt. International Journal of Conservation Science. 4(1): 26-27.

Bader, N., and A. Mahran, 2013. Conservation of the Mural Stucco Ornaments of the mausoleum of Emir Ulmas Al-gib in Cairo, Egypt. Journal of e-Conservation, No.25, pp.157-158.

Bader, N., and W. Rashedy, 2014. Analytical Study of paint layer in mural painting of Krabia School, (19th C.) Cairo, Egypt. Journal of Mediterranean, archaeology, and Archaeometry, 4(2) p.355.

Bonnie, M.S., 2017. The geology of Egypt, American University of Cairo Press, Egypt, pp.56-58.

Elghareb, W.K.,2017. Analytical Study of Some Unfinished Obelisk Quarry Pottery Vessels in Aswan, Egypt, Case Study. American International Journal of Contemporary Scientific Research, 7(4): pp.2349.

Ghoniem, M., 2016. Characterization and Scientific Conservation of A Group of Archaeological Bronze Egyptian Statues. International Journal of Conservation Science 7(2):p.459.

khallaf, M., 2012. Deterioration and Conservation of Srabamoun Church building materials, Al-ptanon City, Menoufia, Egypt. Egyptian Journal of Archaeological and Restoration Studies, 2(1): p.3.

MahaPatra, G., 2015. A text book of geology, New Delhi, India, pp.16-20

Mahran, M.B., 2002. Aswan in Ancient History. Journal of The Faculty of Arts, University of Aswan, pp. 2-7.

Malik, M., 2002. Al-Fanteen Island through Historical Ages. Journal of The Faculty of Arts, Aswan University, p.86.

Megahed, M., 2014. Assessment of some Ag-based coins from Ayyubid period, Yemen, Corrosion and Methods of Treatment . International Journal of Conservation Science, 5(3): p.313.

Megahed, M., 2015. The role of chemical composition of leaded bronze alloy in deterioration process, applied on some archaeological statues from Dhamar Museum, Yemen. International Journal of Science and Research, 4(3): p.7.

Miringer, F., and M. Schreiner, 1982. New methods of chemical analysis: a tool for the conservators. Proceeding of science and technology, London, pp.5-12.

Misra, A., K., 2014, Engineering Geology, New Delhi, India, pp.16-20

Nazel, T., 2014. An illustrated index of granite deterioration grades and patterns. International Journal of Restoration of Building and Monuments, 20(4): p.266.

Noureddine, A., 2002, Ancient Egyptian Antiquities Sites in Aswan, Journal of The Faculty of Arts, Aswan University, pp. 42-46.

Qantair, S.H., 2002. Aswan Pyramids, Journal of The Faculty of Arts, Aswan University, p.5.

Reddy, D., 2012. Applied Geology, New Delhi, India, pp.27-30

Simmons, L., H., 2002. Construction : Principles , Materials and Methods, 7th edition, New York, P.92.