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CLEANING STRATEGIES OF POTTERY OBJECTS EXCAVATED FROM KHIRBET EDH-DHARIH AND HAYYAN AL-MUSHREF, JORDAN: FOUR CASE STUDIES

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ABSTRACT

Any cleaning process for pottery objects has to consider not only the effectiveness of the treatment but also the potential damage for the art object. Cleaning is one of the most common of the treatment processes used on pottery conservation. A variety of mechanical and chemical methods is currently used in restoration practice. Unfortunately, pottery objects are subjected to various deterioration factors, starting in manufacturing process and passing through burial and excavation stages. This study aims to present and explain an application of already established cleaning methods to four pottery pots excavated from the archaeological sites of Khirbet edh-Dharih and Hayyan al-Mushref in Jordan. It also tackles the decision making problems about which methods should be applied to which pots, according to the conservation state and the technological features. Addition to the visual examination, SEM was used to investigate the surface morphology of each object. XRD was used to determine accurately the mineralogical composition of pottery objects as well as the different kinds of dirt which deposited on their surfaces. It could be concluded that the selected pottery objects were very dirty and covered with dust, soil particles, soot and calcareous crusts. The selected pottery objects were cleaned using refiring, mechanical, wet and chemical cleaning methods according to the type of dirt and nature of each object. Finally, objects were consolidated and strengthened to ensure their safety in the condition of storage or display, and to prevent them against the various environmental conditions.

KEYWORDS: Khirbet edh-Dharih, Hayyan al-Mushref, Pottery, Cleaning, Dirt, Encrustation, Cleaning methods

INTRODUCTION

Archaeological Background

The excavation works were carried out at the archaeological sites of Khirbet edh-Dharih and Hayyan al-Mushref by the Institute of Archaeology and Anthropology at Yarmouk University with the cooperation of the Department of Antiquities under the directorship of Zeidoun al-Muheisen. Both the sites have important architectural structures such as churches, wine presses, public building, necropolis and other features. Pottery shards and objects are the common finds excavated from these sites. The earliest pottery from these sites showed signs of settlement dated to the late Hellenistic period and continued throughout the Islamic periods (Al-Muheisen 1997 and Gregg *et al.* 2009).

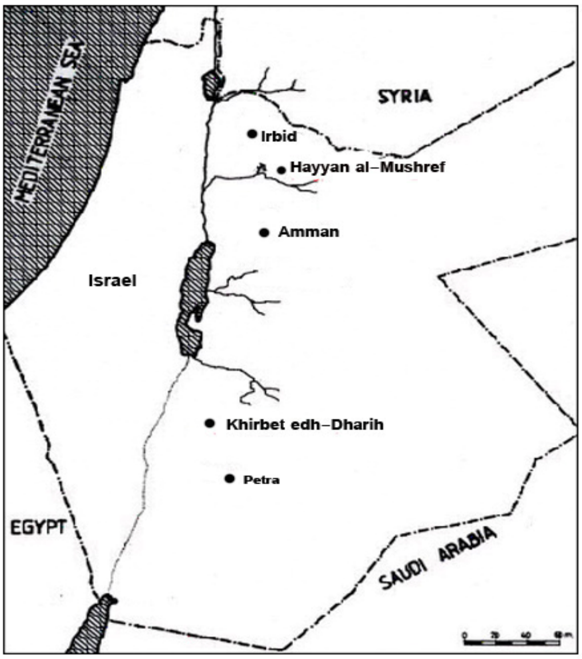

Fig.1: Map of Jordan showing the locations of Khirbet edh–Dharih and Hayyan al–Mushref archaeological sites

The site of Khirbet edh-Dharih is located at southeast of Jordan and far around 100 km north to Petra (Fig. 1). This site was discovered since 1818 by the two British Irby and Mangle who discovered the temple without knowing the name of the site. Since 1979, a Canadian team directed by Mac Donald started a detailed census about all the sites situated in the area of Wadi el-Hesa. In 1983, a short investigation work was performed by Al-Muheisen and Villeneuve. Under the joint directorship of Zeidon al-Muhesien and Francois Villeneuve, consecutive seasons of archaeological excavations were conducted from 1984 to 2007, by the Institute of Archaeology and Anthropology at Yarmouk University and the French Institute of Oriental Archaeology with the cooperation of the Department of Antiquities of Jordan. Many architectural structures were uncovered in the site. Furthermore, a great collection of pottery objects of different typology and function have been uncovered together with numerous types of glass, metals and mosaics floors. Archaeological studies confirmed that this site has been settled during Bronze, Iron, Roman, Byzantine, Nabataean and Islamic periods (Al-Muhesien and Villeneuve 1991).

The site of Hayyan al-Mushref is located at northeast of Jordan, approximately eight km southwest of Mafraq city (Fig. 1). In 1970, archeological surveys have been conducted by Metman. The location of this site has been identified in terms of geography and time periods in which the site was settled. Under the directorship of Ziedoun al-Muheisen, three seasons of archaeological excavations were conducted from 1995 to 1997 by the Institute of Archaeology and Anthropology at Yarmouk University with the cooperation of the Department of Antiquities of Jordan. Excavation results indicated that this site has been occupied from the late Roman period to the Umayyad and Abbasid periods. During these seasons significant architectural structures, pottery objects, glass artifacts, mosaic floors, metal artifacts, and coins were uncovered. Among these findings a considerable collection of pottery pots was uncovered especially in the residential area. Unfortunately most of these pottery objects were randomly restored in situ during excavation works.

Literature context

Addition to the preliminary reports and papers published by Al-Muheisen and Villeneve, numerous studies were performed on the archaeological sites of Khirbet edh-Dharih and Hayyan al-Mushref from the historical and archaeological approaches. The provenance and technology of the Umayyad pottery from Hayyan al-Mushref has been studied by Ata (1998). Whereas the provenance and technology of the Nabbatian painted pottery excavated from Khirbet edh–Dharih has been performed by Hijazi (1999). Sababbah (2000) stated that the Byzantine-Islamic glasses excavated from Hayyan al-Mushref are of soda-lime-silica type. Unfortunately no studies have been performed on the conservation of pottery excavated from the both sites.

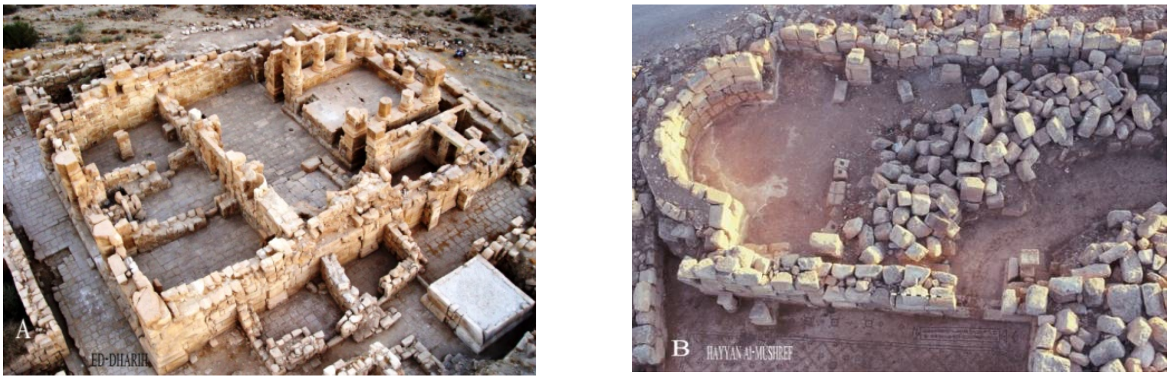

Fig. 2 : Views of archaeological remains excavated at (a) Khirbet edh-Dharih and (b) Hayyan al-Mushref, in which great collections of pottery were found.

On the other hand, numerous studies were carried out on pottery conservation in general, but few specialized researches were deal with the evaluation of cleaning methods of pottery objects. However it was stated that the term "cleaning" is used to describe the removal of any foreign matter that is not part of the original fabric of any object. According to Caple (2003) cleaning describes the removal of soiling and decay products from the surface of an object. Cleaning is probably the most common of the treatment processes used on pottery objects, not only in the conservation studio but also in a domestic context. It was stated that a major objective of all conservation treatment is to increase the chemical stability of the object being treated. Cleaning often forms an important part of stabilizing process. This because dirt on an object can be a potent source of deterioration (Abd-Allah 2007).

In 1993, Buys and Oakley emphasized that removing of original material is highly undesirable, and is contrary to all the codes of practice. The ceramic conservator is in a danger of removing original material in many of his treatment processes unless great care is taken. Mechanical cleaning of break edges of friable surfaces, washing of low-fired pottery and abrading of filling material all carry a risk of damage to the original material. Techniques such as dowelling and riveting, and grinding and scoring of break edges, are essentially unacceptable within this limitation.

In the past it was common to grind down break edges to compensate for bad binding practice and to grind flush with the surface the stumps of broken handles etc. (Klein 1962 and Khazanova 1981). Eleston (1990) affirmed that certain old restoration may be important in the context of the study of the history of restoration techniques. If it is necessary to remove the restoration material for any reason, either a sample of the material, or all the material, may be retained and stored separately so that the information it contains is not lost. Williams (1989) reported that removal of any material should be carried out after thorough documentation of both the condition of the object and the location and extent of the former treatment material. The safety of the object during the removal processes should always be considered, and it is essential to ensure that the object is adequately supported at all times so that, should bonds or fillings give way unexpectedly, damage will not occur. According to Khazanova (1981) when using solvents on porous bodied ceramics some conservators pre-soak the objects in water for a few minutes to reduce their porosity. However, care must be taken when there is a possibility that underlying fillings or bonds are water soluble, as immersion in water may cause them to collapse.

Since many years, it was acceptable that the nature of dirt and deposits and the strength of their attachment to the pottery surface vary widely. Dust and grease may be held loosely to the surface by electrostatic force or weak chemical bonds, whereas deposits such as calcium salts may be intimately associated with the surface, especially that of an unglazed object. A removal of surface dirt from high-fired, glazed pottery does not generally present problems. However, when the surface of the object is matt or textured, or is unstable, or when the object is porous, removal can be more difficult (Moncrieff and weaver 1983).

In 1990, Cronyn observed that the heavy carbonate crusts on marine pottery objects are mechanically removed before they allowed to dry out. Where these crusts are harder than the underlying surface, it is not possible to remove them completely by these methods. Resort to chemical removal of carbonate and sulphate crusts has to be made. Sease (1994) emphasized that in situ, it is usually desirable to remove surface dirt sooner rather than later in order to avoid the danger of it becoming drawn into the body or into cracks. In the case of wet or damp excavated objects it may be important to remove surface dirt before it dries, both because it is often easier to do so before the dirt has hardened and because the dirt may shrink and cause damage as it dries.

The analytical study performed by Linnow *et al* (2007) concluded that calcium acetate efflorescence can be widely formed on ceramic tiles in a museum environment. Paper pulp, Laponite RD or sepiolite packs can be used for desalination. They are used in the same way for stain removal, using deionized water or distilled water as the solvent. Furthermore, it was recently stated that washing in still water is suitable method for removing salts from within the fabric of a pottery object if the object is in sound condition (Buys and Oakley 1993). On the other hand, refiring has been successfully used for the removal of carbon deposits on the surface of pottery that have been subjected to accidental fire or used culinary purpose. Davison and Harrison (1987) refired Greek pottery shards blackened with carbon to 450^{o}C, a temperature that, owing to knowledge of the original manufacturing temperatures, was deemed to be save. The carbon was safely removed in a few hours and the appearance of the original material seemed unaffected. However, laser cleaning in conservation represents a new approach for treatment; further assessments should be carried out to confirm it in pottery cleaning (Cooper 1998 and Aligizak et al. 2008). Other specialized studies on cleaning pottery and ceramics stated that mechanical methods still the most suitable for conducting cleaning pottery (Gibson 1971 and Gedy 1979). The use of Paraloid B-72 as an adhesive has been evaluated and recommended for archaeological ceramics by Koob (1986).

EXPERIMENTAL WORK

Selected pottery objects

Four pottery objects excavated from both Khirbet edh-Dharih in 1987 and Hayyan al-Mushref in 1997 have been stored in the store of Faculty of Archaeology, Yarmouk University in Jordan since that date. They were selected according to several criteria to suit the subject of this study. They extensively affected and attacked by various environmental conditions, causing many stains and accumulation of dust and dirt on their surfaces. The following is an elaborate description of these objects which are labeled by the authors as A, B, C, and D arbitrarily:

Object (A): a pottery pot excavated from Hayyan al-Mushref archaeological site in 1997 from area D 03, square C, locus 014. It appears to be a cooking pot, refers to late Byzantine to early Umayyad period. It has a short neck with a thick rim that is grooved in the middle. The two opposed handles are attached from the edge of the rim to the shoulder. The inner diameter of the rim is 9 cm; where the outer one is 10 cm. The total height is 14 cm without the lost base. The paste texture is coarse with a brownish colour. It is wheel-mad with thick walls, and the body is ripped (Fig. 3).

Object (B): an incomplete pottery pot excavated from Hayyan al-Mushref in 1997 from area D 03, square B, locus 018. It appears to be a cooking pot, refers to Byzantine period. Except small parts of the neck and shoulder, the neck and attached handles are completely lost. Therefore it was difficult to measure the rim diameter and the total height of the pot. The base is well rounded with 10 cm in diameter. The paste texture is coarse with a blackened brown colour. It is also wheel-made with thick walls. It is obvious that this pot is subjected to Incompatible restoration process in the past (Fig.4).

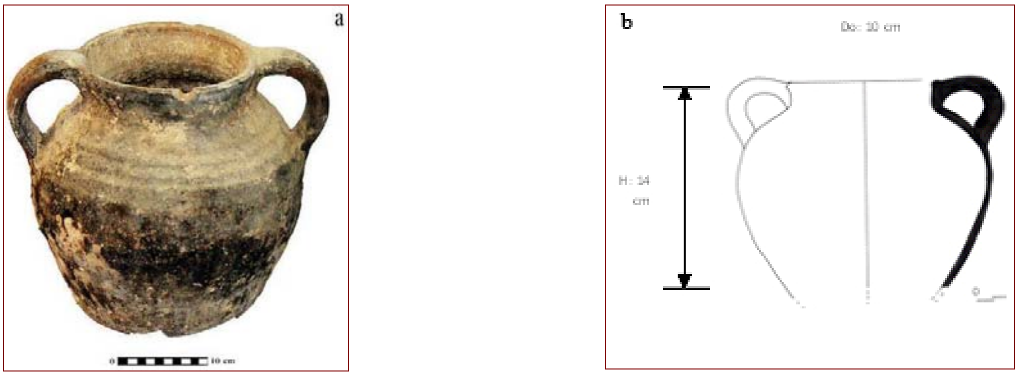

Fig. 3 a, b: a photograph and illustrative drawing of pot (A).

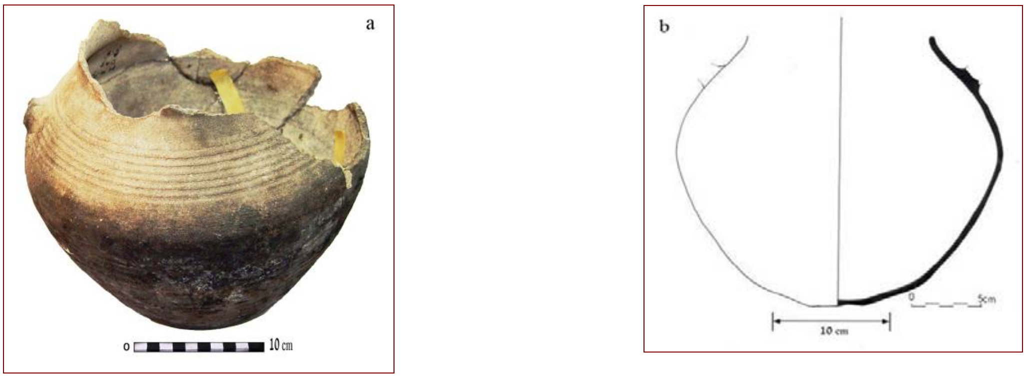

Fig. 4 a, b: A photograph and illustrative drawing of pot (B).

Object (C): a pottery pot excavated from Khirbet edh-Dharih in 1987 from area V 10, square B, locus 103. It appears to be a cooking pot and dated to late Roman to early Byzantine period. It has a short neck with a thin rim. The two handles are present and attached from the edge of the rim to the shoulder. The inner diameter of the rim is 11.5 cm where the outer one is 12 cm. The base is well rounded with 8 cm in diameter. The height is 21 cm. The paste has a fine texture and reddish color. It is wheel-made with thin wall, and the body is ripped. A compatible restoration process was performed to this pot in the past. (Fig. 5).

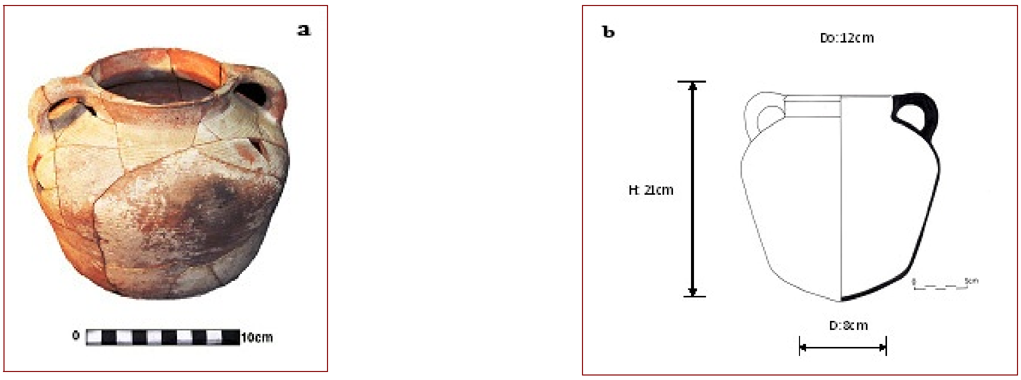

Fig. 5 a, b: a photograph and illustrative drawing of pot (C).

Object (D): a complete pottery pot excavated from Khirbet edh-Dharih archaeological site in 1987 from area V 10, square A, locus 103. It appears to be a Jar for boiling water dated back to the Umayyad period. It has a short neck with thick grooved rim, and without handles. The inner diameter of the rim is 9 cm where the outer diameter is 11 cm. The base is flat and its diameter is 7.5 cm. The total height is 20 cm. The paste has a rough texture and reddish color. It is wheel-made with thick wall (Fig. 6).

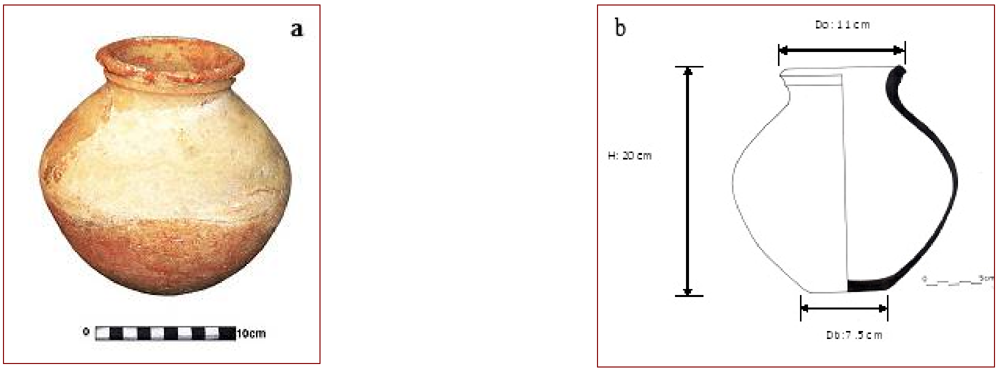

Fig. 6 a, b: a photograph and illustrative drawing of pot (D).

Condition assessment

The preliminary examination by the naked eye and a magnifying hand lens (x10) of the four pottery pots indicated that they were subjected to various deterioration factors and phenomena, starting in manufacturing process and passing through burial, excavation and storage. During these stages, depositions of dirt, soiling, dust, calcareous remains and foreign matters were held loosely to the pottery surface by electrostatic forces or weak chemical bonds. The finding of these objects together with another tools, fuel ash and kiln fragments related to culinary processing strongly suggests the use of these objects as cooking pots. Furthermore, pots A , B and C are covered with intensive layers of coherent black soot or carbon deposits correspond to trace of use, and distributed to whole the object surface with cracks and cavities. Based on the results of mineralogical analysis explained below, calcite is only detected in pot C, and it is mainly of primary mineral phase which indicates that the initial firing temperature of pottery did not exceed 750 ^{0}C. Obvious dissimilarities in color and texture were observed during examining the body section. So only the pot C is of low firing temperature, where other pots A, B, and D are relatively of high firing temperature. Addition to that, pots B and C subjected to previous restoration works, remains of cellulose nitrate adhesive were identified (Fig. 7).

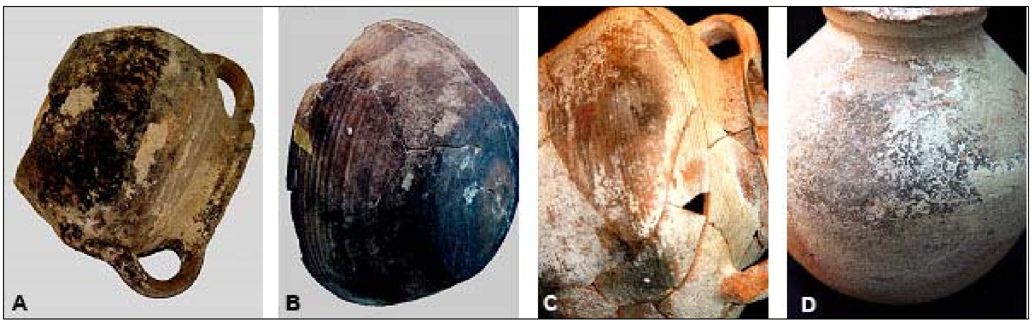

Fig. 7 a, b, c, d: Deterioration forms and deposits observed on the surfaces of the four pottery pots.

Microscopic examination observation

Additions to the visual examination of pottery objects, small samples of pottery were investigated by scanning electron microscopy (SEM model FEL Quant 200). SEM was operated in a secondary electron mode to examine the surface morphology and body structure of the pottery material and dirty layers. The Scanning electron micrographs (Fig. 8-a and b) of the pots A and B from Hayyan al-Mushref show that the particles are irregularly shaped and varied in sizes. Whereas other aspects of fractured surface, and highly fissured nature of decayed surfaces were observed on the pots C and D from Khirbet edh–Dharih (Fig. 8-c and d). Furthermore, SEM examination was carried out on cross-sections of the same pottery samples to examine the structure morphology of inner core of every pot.

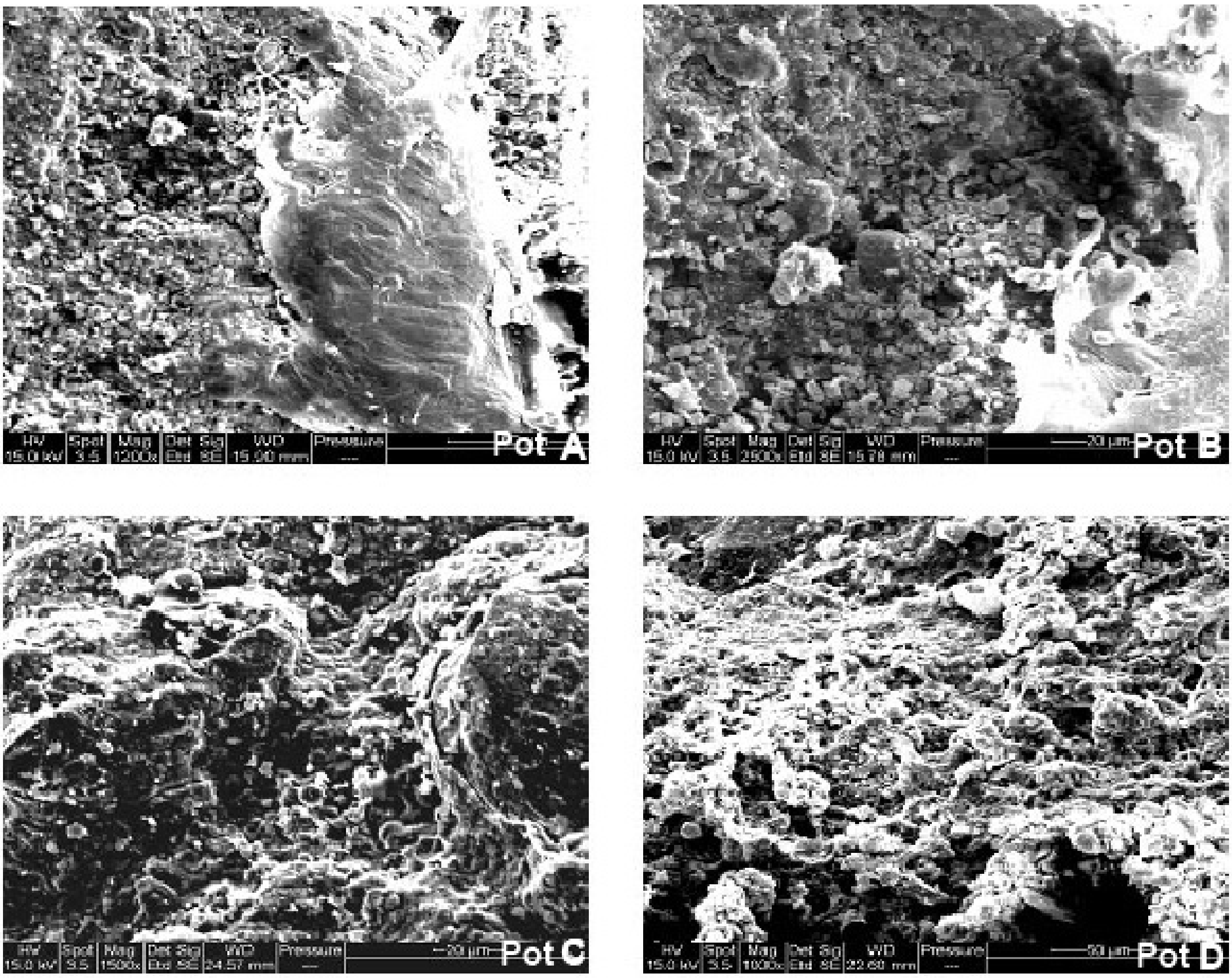

Fig. 8 a, b, c, d: Secondary electron micrographs of pottery samples representing the four pots (A, B, C and D) showing aspects of surface morphology and defects.

SEM images in Figure 9 have shown how the inner body relatively differs from the outer surfaces illustrated in Figure 8. The Scanning electron micrographs (Fig. 9-a and b) of the pots from Hayyan al-Mushref show the bodies are not compact; reveal that the particles were heterogeneously shaped and less-vitrified with a lot of incisions. Besides, there is a slight evident structural and compositional continuity between the surface and the bulk. Whereas the micrographs 9-c and d of the pots from Khirbet edh-Dharih show the bodies are more compact, nearly heterogeneous and fairly vitrified. However, obvious dissimilarities in color and texture were observed during examining all the body sections.

Mineralogical composition determination

A Shimadzu-6000 X-ray powder diffractometer (XRD) was used to determine the mineralogical composition of pottery and surface deposits. Furthermore, it is an accurate technique is used for determining the source of raw materials and estimating the firing temperature of pottery (Al-Naddaf 2006). For the powder method employed, the pottery samples were perfectly cleaned from any dirt and deposits, finely powdered and prepared for analysis.

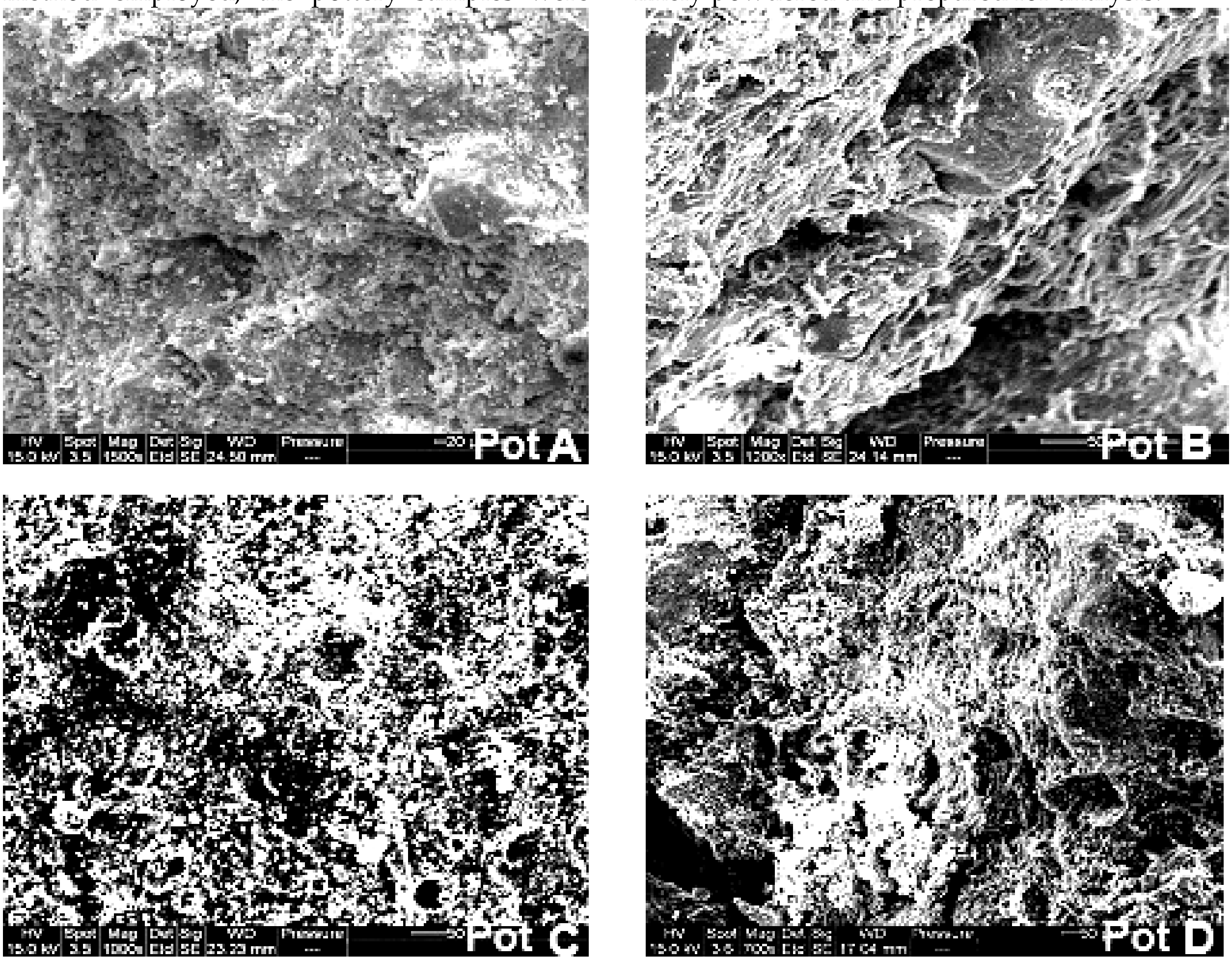

Fig. 9 a, b, c, d: Secondary electron micrographs of inner sections of pottery samples representing the four pots (A, B, C and D) showing aspects of body structure and morphology.

The identifications given in Figure 10 and Table 1 reveal that quartz (SiO_2) is the major composed mineral of all individuals. Whereas witherite (BaCO3) presents as a trace mineral in all samples even dirt on pot D (*Witherite is a barium carbonate mineral, $BaCO_3$, in the aragonite group. It crystallizes in the orthorhombic system and virtually always is twinned. The mineral is colorless, milky white, grey, pale yellow, green, to pale brown. It forms in low temperature hydrothermal environments. It is commonly associated with fluorite, celestine, galena, barite, calcite and aragonite,* De Villiers 1971). Clay minerals could not be detected as they decomposed and vitrified during firing process. Calcite ($CaCO_3$) only detected in a trace level in pot C. According to the fact that calcite is destroyed when fired to a temperature above 750 0C, thus the detected calcite in pottery object C is mainly of primary nature (*Before firing process takes place, it is present either as impurities in the clay raw materials or intentionally added as fillers to decrease the plasticity of the clay* Al-Naddaf 2006), which indicates that the initial firing temperature of pottery did not exceed this temperature, i.e. .low firing temperature. The presence of secondary calcite cannot be suggested (*This precipitates in the porous pottery body during burial.* Al-Naddaf 2006). On the other hand, the surface deposits collected from pot D mainly composed of quartz and calcite which suggests that these deposits are corresponding to calcareous soil remains during burial.

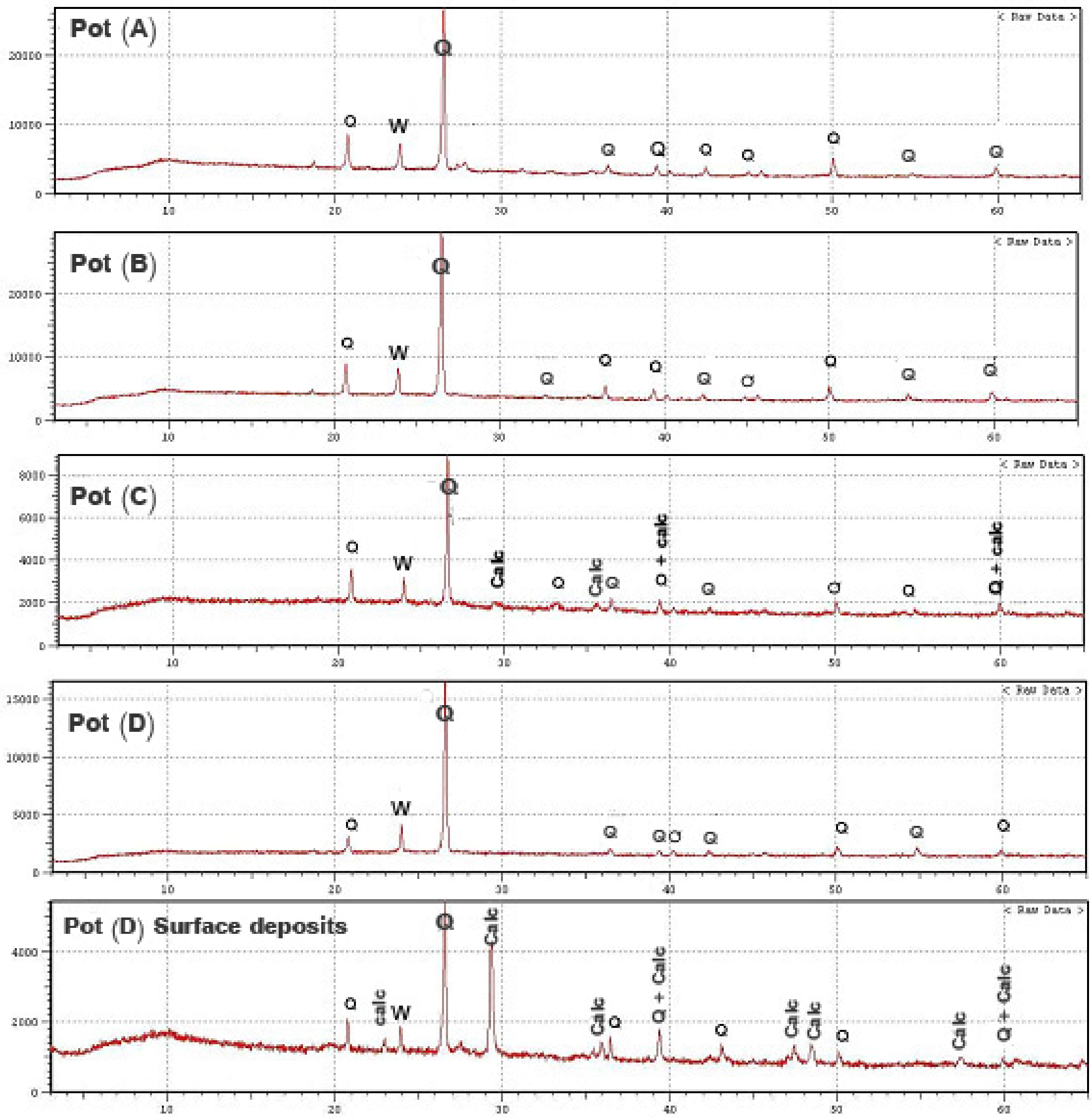

Fig. 10: X-Ray powder diffraction patterns of analyzed samples showing the mineralogical composition of pottery pots (A, B, C and D) and surface deposits from pot D (Q= Quartz, Calc= Calcite, W= Witherite).

Table 1. Mineralogical compositions of the four pottery pots and surface deposits obtained by XRD.

Samples	Minerals	Formula	Card No.
Pottery pot (A)	Quartz	Silicon dioxide (SiO_2)	46-1045
	Witherite	Barium carbonate ($BaCO_3$)	5-0378
Pottery pot (B)	Quartz	Silicon dioxide (SiO_2)	46-1045
	Witherite	Barium carbonate ($BaCO_3$)	5-0378
Pottery pot (C)	Quartz	Silicon dioxide (SiO_2)	46-1045
	Calcite	Calcium carbonate ($CaCO_3$)	5-586
	Witherite	Barium carbonate ($BaCO_3$)	5-0378
Pottery pot (D)	Quartz	Silicon dioxide (SiO_2)	46-1045
	Witherite	Barium carbonate ($BaCO_3$)	5-0378
Surface deposits Pot (D)	Quartz	Silicon dioxide (SiO_2)	46-1045
	Calcite	Calcium carbonate ($CaCO_3$)	5-586
	Witherite	Barium carbonate ($BaCO_3$)	5-0378

Cleaning processes

Before cleaning, it is essential to identify the type of pottery, its mineralogical composition and the nature of dirt and deposits. It is also important to understand that cleaning means the removal of soil or deposits and encrustation but not removal of original material or any opaque weathering crust or a patina, which has a protective action and archaeological feature. Agreement that removal of original material is highly undesirable is common to all code of ethics. The pottery conservator is in danger of removal of original material in many of his treatment processes unless great care is taken. Therefore in the present cases, the complete removing of the remains of black soot (the evidence of culinary use) from cooking pots surfaces considerably was avoided; this is destruction, for it is removing some of original artifact or trace of use. Three methods of cleaning were used to obtain satisfying results of cleaning as following:

Mechanical cleaning

Mechanical cleaning was firstly used to remove the fragile or non-coherent deposits on all the selected pottery pots. The advantages of using mechanical cleaning that they are, on the whole, more easily controlled than chemical methods and there is no danger of dirt being drawn in solution into the body of the pottery. This obviously more of a danger with low-fired, porous bodied pottery than with high-fired ones. For instance, if mechanical cleaning techniques were used inexpertly or carelessly, there is a danger of scratching, abrading, removing some of the object surface or physically damaging the fabric of pottery.

In the case of object A where the dirt is not strongly adhered to the surfaces and is not greasy, dusting was used effectively to remove it. Dusting was carried out using a brush of appropriate size and using dry cotton wool swabs. Whereas the more closely adhered, solid surface deposits, such as hardened burial dirt on object A, old restoration materials on objects B and C, and white encrustations on object D were required picking or cutting of the surface with the tool such as a needle, sharp scalpel, and wooden tools. The objects were carefully supported on a padded surface, only the minimum pressure necessary is applied and sharp tools can scratch pottery surface were avoided. Removing of Insoluble calcareous deposits on the outer surface of object D was partially carried out using abrading method. Glass fiber brush and dental brushes were successfully used. Because this object is relatively sound, satisfactory results were obtained (Fig. 11).

Fig. 11-a, b, c, d: The selected pottery pots after cleaning processes.

Refiring technique

Before wet and chemical methods take place, Refiring has been successfully used for the partial removal of soot and carbon deposits from the surface of the cooking pot A. Refiring is ranging between 200 to 250 °C, a temperature that, owing to knowledge of the original manufacturing temperatures, was deemed to be save. Dry cotton swaps were used to remove the refired layers of soot. The carbon was safely removed in a few hours, and the appearance of the original material seemed unaffected (Fig. 11). Pots B and C cannot be refired because they are previously restored and the adhesion joints may be affected by high temperatures.

Wet cleaning

In all cases, mechanical cleaning techniques was not enough to remove all dirt and spots from the pottery surfaces; therefore wet cleaning method was applied. Water is often the safest, cheapest, and most effective solvent to use for removing surface dirt and deposits. It was stated that low-fired pottery may retain a certain degree of water solubility, and some elements may be removed during prolonged contact with water during conservation treatment. Clay areas rehydrate and swell if subjected to prolonged wet condition (Buys and Oakly 1993). Furthermore, high-fired earthenwares may contain, as body fillers, mineral particles, some of which may soluble in water. For these reasons wet cleaning was locally used in a limited range with the certain low-fired pot C, and also cautiously was used with the relatively sound pots A, B and D.

Burial and other non-greasy dirt have been effectively removed by using gentle brushing and swabbing with water, and detergents were also added to give the water degreasant properties when greasy dirt is to be removed. Deionized and distilled water was used instead of tap water which can contain mineral elements. In addition laboratory detergents were used rather than commercial household detergents which may contain coloring, perfumes, and bleaches, sequestering agents and other additives that could affect the pottery material. Cotton poultices were effectively used to soften hard crusts on the surfaces and make it easy to remove. Cleaning process was regularly carried out from top to the bottom of the surface.

It should be noticed that this process was carefully controlled on the adhesion areas of the restored objects B and C to avoid the solubility of adhesive used in joining pottery fragments. Caution also was considered when cleaning objects A and D which, their bodies are porous and containing iron and carbon staining. Movement of water through the body could cause such stains to spread, and consequently it was safest to use cotton wool swabs in such case. The cotton swap was wrapped around the end of a swap stick, dipped in water and then rolled across the surface of the object. A rolling action was used rather than a wiping one and the swabs were kept damp rather than wet, in order to pick up the dirt from the object surface rather than being pushed into any surface irregularities; cracks or pitting. In the cases where water is ineffective as a solvent or where a dry cleaning method is required rather than wet cleaning, some organic solvents topically were used. Preliminary tests indicated that acetone and amyl acetate are certain highly volatile solvents and can result in blooming on the surface of porous wares. Thus they were applied on swabs in the manner described for water to all the pottery objects. Fresh swabs being used until no more dirt appears to be coming off on the swabs (Fig. 11).

Chemical cleaning

Although the selected pottery pots are not decorated or glazed, the using of chemicals for cleaning them was as possible as avoided. Diagnostic examination by naked eye and SEM indicated that these objects are fairly durable, extensively damaged, porous, and previously restored. Further irreversible damage can be occurring if untested chemicals were excessively used. It was stated that high-fired pottery objects generally have good resistance to chemical attack more the low-fired ones.

However, an alkaline solution of the chelating agent tetrasodium salt of EDTA [Na_3 EDTA] was applied to remove undue weathering crusts on the surfaces of objects A and B. The solution (5% concentration and 11.5 pH) was topically applied with cotton poultices, which were replaced every ten minutes for a total time of exposure 30 min. to ensure that the chelation completely occurred and the crusts are softened (Paul (1978). This treatment allowed removing hard crusts mechanically by using fine brushes and wooden tools. Coherent encrustations of calcium carbonates formed on the surface of object C and D, were topically removed using cotton poultices dropped with 10 % hydrochloric acid (HCl). In all cases, the inner remains of organic stains of a greasy or waxy nature were effectively cleaned by using poultices of sepiolite past (Hydrated magnesium trisilicate). Sepiolite pasts were spread over the surface of the object in an even layer 1-2 cm thick. In the all applications, assistant mechanical tools and brushes were used to remove the softened crusts. Addition to that, localized and controlled washing by distilled water was carried out to the pottery surfaces to eliminate the presence of chemicals used.

CONSOLIDATION

Because the selected pottery pots were excavated from the ground and either have lost binding constituents through leaching or have suffered damage through the absorption of soluble salts and subsequent cycles of drying and wetting, therefore consolidation of these objects became necessary to undertaken to strengthen their structure and prevent the effect of moisture and relative humidity during the coming storage or exhibition stage. In addition, successful consolidation will allow the object to be handled safely.

Paraloid B-72 is an acrylic resin that is a good, all-purpose consolidant. It is a colorless, durable, stable resin with a T_g of 40 °C and a refractive index of 1.49 and, when applied properly, should not appreciably alter the appearance of the material to which it has been applied (Horie 1987, Newton and Davison 1989, Sease 1994 and Abd-Allah 2007). A 5% solution of paraloid B-72 dissolved in acetone has been applied using brushing technique for each pottery object. The consolidant is brushed onto the surface in repeated applications until it no longer sinks in. It should be noticed that before consolidation treatment carried out all the surfaces of every pot was carefully cleaned from any organic remains by using poultices of sepiolite past and detergents to avoid problems that consolidation treatment could imply for possible organic remains in the walls, especially considering that the studied objects correspond to cooking pots.

CONCLUSIONS

In many instances the first action of a conservator after initial examination of pottery objects is to clean the object and remove any foreign materials from the surface. The choosing of cleaning methods depends on the nature of both the pottery and dirt; therefore it varies from case to another. Removal of material that has simply become deposited on the surface of pottery is generally not difficult if the object is intact, sound and has a glazed surface. However, removal can become more problematical if the object is low-fired, less durable, unglazed and previously restored. It is important to understand that cleaning means the removal of soil or deposits and encrustation but not removal of any opaque weathering crust or a patina, which has a protective action and archaeological feature of pottery. Just because it is possible to clean an object, does not mean that it should be cleaned. A conscious decision is required as to what the conserved state of the object should be, and reasons for it being in that state need to be given. All the materials and chemicals used for cleaning pottery objects must be evaluated and experimented before cleaning process is carried out, as well as the condition of pottery object should be assessed. However, mechanical cleaning still the preferred technique used for cleaning pottery. Refiring has been successfully used for the partial removal of soot and carbon deposits from the surface of the sound pottery cooking pots. In the case of restored or reconstructed objects, refiring should be avoided. EDTA [Na_3 EDTA] was successfully applied to remove undue weathering crusts on the pottery surface. Coherent encrustations of calcium carbonates were topically removed using hydrochloric acid. Remains of organic stains of a greasy or waxy nature were effectively cleaned by using poultices of sepiolite.

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