Current Conservation Practices of Metallic Objects at Archaeological Sites in Jordan

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This paper discusses the utilization of the technological and condition survey approach developed by PROMET, as applied at Umm Qais museum, and for the purpose of classifying metal artefacts, for the identification of treatment priorities and needs for efficient conservation of metal artefacts at the museum. It also highlights the traditional methods applied at the Department of Antiquities (DoA) laboratories in conserving and restoring excavated artefacts using three case studies.

Keywords: Conservation practice, copper alloys, artefacts, survey, Jordan

1. INTRODUCTION

Jordan is located in the heart of the Middle East, enjoying a range of geographical features starting from the Jordan Rift Valley in the West ending at the desert plateau of the East, with a range of small hills running the length of the country in between. Jordan houses many archaeological and historical sites of which 25,000 are registered. However, it is believed that there are more than 100,000 sites, if Jordan is fully surveyed.

Umm Qais is one of the important sites located North of Jordan for being one of the cities of the Decapolis. Housing an important archaeological museum built at the end of the Ottoman period, with oriental style of structure. It is worth mentioning that Umm Qais is still under excavation and more artefacts are expected to be excavated. The museum at the site houses typical archaeological collections with great variety of artefacts (sculptures, building elements, pottery, marble, metals, etc).

2. TECHNOLOGICAL AND CONDITION APPROACH

RSS introduced a new approach to survey the metal objects at Umm Qais museum using an approach developed by TEI of Athens [1]. Most of the artefacts were not treated after excavation and little information is available type of burial environment of the site and the museum's condition.

This paper considered the sites of Umm Qais and Mafraq as a sample to represent the condition of metal artefacts in North of Jordan, representing very humid area as in Umm Qais to very dry condition as in Mafraq. The artefacts surveyed were from the following periods:

- Early Bronze
- Mid Bronze
- Roman
- Byzantine
- Islamic

Technological survey dealt with:

- Classification of different types of objects in the collection based on their technological/ morphological characteristics
- Representative sample of each type is selected for further scientific analyses

While, condition survey dealt with:

- Collecting information concerning the deterioration state of the object, and other factors that affect the condition to predict the treatment priority

2.1 Results of Technological Survey

All metallic artefacts of Umm Qais museum as well as Mafraq museum were assessment using statistics and is representative of similar collections of the same condition in other museums in the Kingdom.

In Table 1 the artefacts are categorized in general groups according to the archaeological type. An example is applied to the "Bracelets", a small group of items. The archaeological and technological typology is characterized as given in Table 2 using a classification tree (Figure 1). Figure 2 shows pie charts of the obtained results (Figure 2).

2.2 Results of Condition Survey

93 artefacts were pre-selected and studied for technological survey, as well as considered for the condition survey. Table 3 shows the variables selected for the condition survey, and the number of artefacts for each category.

3. CURRENT CONSERVATION PRACTICES IN JORDAN

The Department of Antiquities in Jordan set a mandate that all archaeological sites document all artefacts after excavation in a logbook to include:

- Designation number
- Date of excavation
- Artefact name (and photographed if possible after excavation)
- Description and material
- Artefact excavation area
- Storing area

When the artefacts are transferred to the laboratories for restoration, the lab documents the following:

- Designation number
- Dimension
- Condition on receipt
- Treatment required
- Conserved and photographed after treatment.
- General remarks
- Conservator name and application date

3.1 Metals Restoration:

The main objective of conservation is to restore the metal artefacts to its original shape and surface. This is achieved by mechanical and chemical cleaning of the material using appropriate tools, chemicals, and cleaning solvents, as well as joining broken parts using suitable adhesion materials that can be coloured to be of the same colour of the artefact. Finally, the objects are coated by brushing or dipping to strengthen the artefact.

Corrosion inhibitors such as benzotriazole (BTA) (3% BTA solution in ethanol) are applied by either brushing or immersion depending on the extent of corrosion and the size of the object. This treatment is intended to inhibit the active corrosion as an attempt to preserve such artefacts [2].

3.2 Case Studies:

Three case studies from the lab were selected based on the surface condition (i.e. extent of corrosion and roughness of the surface), since most of the artefacts at Umm Qais are not treated.

Case Study 1: Saddle Holder
Material: Copper base alloy
Historical period: Byzantine

General: The saddle holder was excavated in 1997 and treated in 2005. The artefact was in a good condition with slight layer of greenish corrosion.
Treatment conducted: Cleaned mechanically using scalpel and brush till corrosion layer was removed (20g of corrosion layer was removed). Then the object was coated with one layer of 3% Paraloid® B-72 in acetone using a brush.

Case Study 2: Censer
Material: Copper base alloy
Historical period: Byzantine

General: Censer was excavated in 1997 and treated in 2005. The artefact was in a good condition with slight layer of greenish corrosion especially at the chain area, the surface is rough and able to initiate corrosion if the coating removed.
Treatment conducted: The object was cleaned mechanically using scalpel and brush especially in thick areas till corrosion layer is removed. Then the object was immersed in 5% citric acid solution for half an hour, and three times in total to ensure full removal of the corroded layer and to avoid damaging the metal substrate. After that the object was washed with distilled water to remove any acidic residues and dried by natural light. Finally, the censer is coated; carefully especially in chain area, with two layers of 3% Paraloid® B-72 by brushing.

Case Study 3: Bayonet Heads
Material: Copper base alloy
Historical period: Late Bronze

General: The objects were excavated in 1992 and treated in 2005. The artefacts were extensively damaged by corrosion and in a very bad condition.
Treatment conducted: Cleaned mechanically using scalpel and brush for short periods and carefully tried to remove corrosion layers as much as possible. After that the objects were immersed in 3% BTA solution in ethanol for 24 hours to act as a corrosion inhibitor. Finally, the bayonet heads were coated with two layers of 3% Paraloid® B-72 in acetone by brushing to protect the object.

4. DISCUSSIONS AND CONCLUSIONS

The main objective of conservators is to restore metal artefacts to its original shape and to preserve them for a long time. Conservators have the choice to decide on the appropriate way to restore the artefacts depending on the artefact's condition and the availability of conservation materials.

Three case studies have shown that conservators need more training and more non-toxic environmentally friendly material for conservation and restoration. The case studies have show the real situation in Jordan's site, where excavated artefacts can be either in a very good condition needing slight cleaning or in moderate condition but need careful treatment.

The time between excavation and conservation in the case studies is too long. Besides, the artefacts were kept in storage rooms after excavation with no records showing the condition of the artefacts before conservation, to distinguish whether corrosion was active during the storing period. Moreover, limited varieties of protection materials are used such as Paraloid® B-72 is the only protection materials used.

To improve on the conservation practices in Jordan, condition and technological survey were conducted at Umm Qais and Mafraq Museums; North of Jordan, with

the activities of PROMET project to decide on the treatment priorities of those artefacts. The results of the survey are as follows:

- Treatment needs: 62.8% are in urgent, 31.9% can benefit and 5% does not require treatment.
- Material value: 31.9% have no metal core, 35.1% have little metal and 33% are of metal core.
- Corrosion: 62.8% are still under active corrosion.
- Joining: 37.2% are joint Mechanical/Metallurgical, and the rest are not joint.
- Soil: 16% were excavated from Wet soil, and the rest were excavated from Dry soil (note that Mafraq site is very dry, while Umm Qais is very humid. Therefore, at Umm Qais site 28.8% were excavated from wet soil).
- Manufacturing: 38.3% were Forged, 18.1% were Cast, 40% were manufactured using Both techniques (forging & casting), 4.3% Bowled and 30.9% were Rolled.
- Value: 68.1% were of Aesthetic, 26.6% Technological, 7.4% Political, 4.3% Economic, 2.1% Admiration and 14.9% were of Religion value.

5. RECOMMENDATIONS:

- More training is recommended for Jordanian conservators especially for metal artefacts.
- Advanced diagnostic and cleaning equipment for conservation to facilitate the conservator's duty and reduce failure responsibilities especially from chemical cleaning (i.e. ultra-sonic cleaners, sand pasting, radiography etc.)

REFERENCES

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[2] Training course on "Conservation and Restoration of Glass and Metals", Archaeological and Anthropology Institute, Yarmouk University, 2003.

APPENDIX

Copper-Base Alloy Artefacts	
Tools-Instruments	7
Accessories of Doors & Furniture	9
Decorative Artefacts	27
Vessels	25
Figurines-Statuettes	7
Weapon	4
Steel Artefacts	
Tools-Instruments	2
Accessories of Doors & Furniture	7
Weapon	2
Gold Artefacts	
Decorative Artefacts	2
Lead	
Decorative Artefacts	2

Table 1 – Categories of artefacts

		Circle		Twisted		Decorated		*Circular*		*Flat*	
		Full	*Open*	*Yes*	*No*	*Yes*	*No*	*Thin*	*Thick*	*Thin*	*Thick*
Circle	*Full*	4			8		8	5	3		
	Open		10	3	7	1	9	3	5	1	1
Twisted	*Yes*		3	3			3	1	2		
	No	8	7		15	1	15	7	6	1	1
Decorated	*Yes*		1		1	1					11
	No	8	9	2	15		17	7	9	1	
Circular	*Thin*	4	3	1	7		6	1			
	Thick	4	5	2	7		9		3		
Flat	*Thin*		1		1		1			1	
	Thick		1		1	1					1

Photo (1) Photo (2) Photo (3) Photo (4) Photo (5)

Bracelet 1 open thick flat not twisted and decorated (Photo 1)
Bracelet 2 open thin flat not twisted and not decorated (Photo 2)
Bracelet 3 open thick circular twisted and not decorated (Photo 3)
Bracelet 4 open thin circular not twisted and not decorated (Photo 4)
Bracelet 5 close thin circular not twisted and not decorated (Photo 5)

Table 2 - The archaeological and technological typology of bracelets

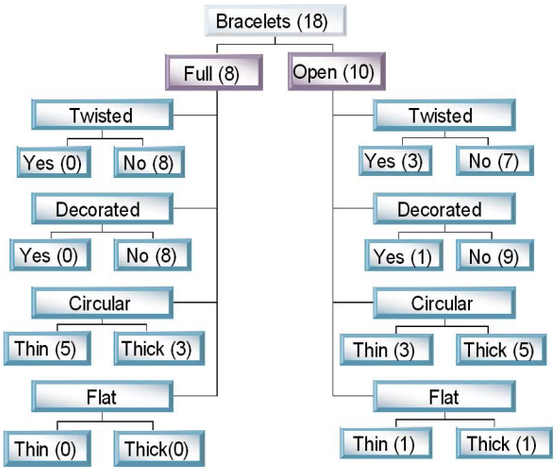
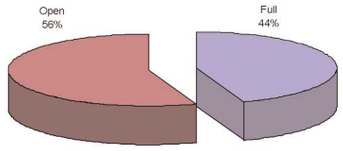


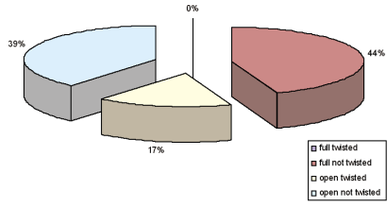
Figure 1 – Classification Tree: The archaeological typology and technological typology of bracelets

Condition		Number of Artefacts
Burial environment		
Dry Soil		15
Wet Soil		79
Treatment needs		
Urgent		59
Benefit		30
Not required		5
Condition		
Amount of metal remaining	No metal core	30
	Little metal	33
	Metal core	31
Corrosion products	Active	59
	Stable	35
Technology		
Metal	Iron	11
	Copper	79
	Gold	2
	Lead	2
Manufacture	Cast	17
	Forged	36
	Both	38
	Rolling	29
	Blowing	4
Joints	Metallurgical/ Mechanical	35
	None	59
Value		
Aesthetic		64
Technological		25
Political		7
Economic		4
Admiration		2
Religion		14

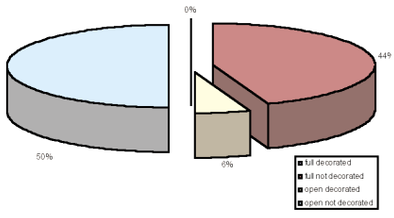
Table 3 - The variables selected for the condition survey, with their respective artefacts number



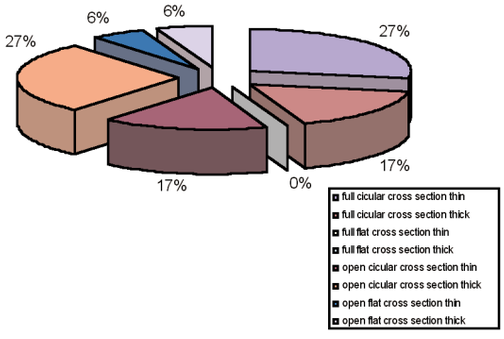
Pie Chart 1: Bracelets condition



Pie Chart 2: Bracelets twisting



Pie Chart 3: Bracelets decoration



Pie Chart 4: Bracelets cross section

Figure 2 – Pie charts presenting the characterisation of the bracelets