The British Museum

Stabilising low-bound paint on a 22nd Dynasty Egyptian Coffin using Funori

by Alicia de la Serna Saenz

Introduction

This poster explores the use of funori, an agar gel extracted from species of red algae, for stabilising the painted surface of the coffin of Iahmose (1891,0511.209), which dates to the early period of the 22nd Dynasty (943 BC – 716 BC). The coffin of Iahmose showed extensive areas of loss in the decorative layers. The surface of this Egyptian coffin displayed a number of paint degradation patterns: powdery matt paint, lifting paint layers detaching from the ground layer or the wooden substrate, and actively degrading varnish layers.

It also compares the use of funori with three other adhesives commonly used for treating ancient Egyptian painted surfaces: two acrylic adhesives and one cellulosic adhesive. Once funori was selected for the consolidation of the low-bound paint, two methods of application were tested, as a mist with an airbrush and brush application through a paper barrier layer, called facing, with two different Japanese papers.

Funori's properties have extensively been studied for consolidating matt paints, particularly in paper conservation and traditional Asian paintings conservation. These properties include good cohesion, minimal staining, good ageing stability and retains the matt properties of original paint (2; 3). In chemical terms, funori is a polysaccharide chain (3); that includes sulphates which gives it anti-microbiological characteristics (4).

Discussion & Results

Comparing adhesives/consolidants

The empirical observations and published ageing properties are compared below (Table 1). Although inappropriate for consolidating the low-bound paint, Primal B-60A and Lascaux 4176 MFC both had suitable properties for re-adhering paint flakes (Fig. 2). Primal B-60A worked well to re-adhere thicker flakes consisting of ground and paint layer. It was unable to penetrate underneath very thin lifting paint, into cracks, or consolidate low-bound paint, also resulting in staining (even after pre-wetting). Lascaux 4176 MFC worked treating thin lifting paint layers and small cracks. However, it is not ideal for low-bound paint as it caused staining even after pre-wetting.

For low-bound paint, 1% funori in deionised water allowed good penetration due to its low viscosity (Fig. 2). It did not cause staining but occasionally left a tide mark (usually removable by slightly humidifying the area). Both funori and the 1% Klucel G in IMS (Industrial Methylated Spirit) allowed good penetration due to low viscosity and hence did not create a strong bond between layers: ideal for low-bound paints. The Klucel G, however, caused a slight darkening on some of the areas tested. To consolidate the coffin, funori was chosen.

Properties	75% Primal B-60A in deionised water	Lascaux 4176 MFC	1% Funori in deionised water	1% Klucel G in IMS
Solubility in water	Yes	Yes	Yes	Yes
Penetration	Low-medium	High	High	High
Risk of staining	Medium: low when pre-wetting with a low evaporating hydrophobic solvent (1)	Medium: low when pre-wetting with a low evaporating hydrophobic solvent (1)	Low	Low
Toxicity	High: pre-wetting needed with aromatic solvent	High: pre-wetting needed with aromatic solvent	Low	Low-medium
Bond strength	Very high	High	Low	Low
Ageing stability	Good	Good	Good	Medium
Yellowing	None	None	None	None
Viscosity	Medium	Low	Low	Low

Table 1. Comparison of the characteristics of each adhesive solution.

Figure 1. Testing of Klucel G. © Trustees of the British Museum

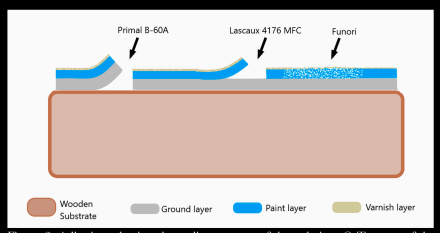

Figure 2. Adhesive selection depending on type of degradation. © Trustees of the British Museum

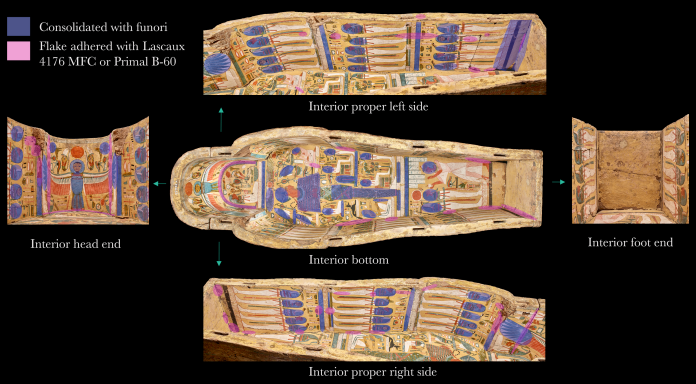

Figure 3. Coffin of Iahmose: treated areas. © Trustees of the British Museum

Comparing application methods for funori

Compared to brush application of funori through facing, airbrush applications requires more expensive equipment which is not always readily available. However, an airbrush can treat a larger area of an object in a shorter amount of time, making it both more efficient and economic (Table 2). In summary, both methods are valid: if the area is large or fragile to the touch, airbrush application might be advisable; if the area is small, local treatment using a brush application might be more appropriate.

Methodology

Comparing adhesives/consolidants

Four adhesives were tested with the view of addressing different issues relating to the degradation of the paint and varnish layers: Primal B-60A (water-based acrylic emulsion), Lascaux 4176 Medium for Consolidation (acrylic dispersion), funori (polysaccharide) and Klucel G (hydroxypropyl cellulose). All were applied with a small brush to areas in need of consolidation or stabilisation. The empirical and research results were compared and the most appropriate adhesive for each degradation pattern selected.

Comparing application methods for funori

Two methods were tested: brushing through a facing layer and using an airbrush, with a portable and a non-portable one.

Comparing barrier layers for facing

The application of funori with a brush was made through a facing. Two papers were tested: Rayon paper 'Usukuchi' and 'Bib Tengujo' paper.

	Airbrush application	Brush application
Advantages	• Quick to use once equipment is set up. • Economical if using a generic portable airbrush. • Treatment can be carried out quicker than with brush when a large area needs treatment. • No direct contact between the airbrush and the paint surface. Important if the paint surface is too fragile for any direct contact. • Even quantity of consolidant is distributed. • Continuity of application helps to avoid tide marks.	• Quick to set up. • Economical • Tool easily available. • Better at targeting specific areas of the object that need treatment. • Paint surface is protected by barrier layer, which can be left to dry in area. Facing can be used to temporarily protect the surface of an object (i.e. if object needs to be moved during treatment). • More controlled application.
Disadvantages	• Setting up equipment for the first time is time consuming. • Equipment is expensive when using a non-portable equipment. • Risk of condensate build-up on mouth of airbrush, that could drip onto the object; can be mitigated by blotting with a tissue but makes handling more difficult. • The pen gets stuck at times, needing removal of water from the air pressure container. • Air pressure containers need to be replaced frequently. • Not possible to accurately target the area to be treated, although the point on the non-portable airbrush is adjustable and application area can be quite small.	• Application in large areas more time consuming than with airbrush. • Risk of softening of paint layers due to amount of water being introduced. • Risk of tide marks, though this can be avoided if application follows the design, and the edges of the area to be treated are slightly wetted with a dampened swab with deionize water. • Application and removal of barrier layer might disturb fragile paint surfaces.

Table 2. Advantages and disadvantages of funori applied with airbrush and brush through facing.

Figure 4. Testing a non-portable airbrush. © Trustees of the British Museum.

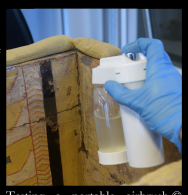

Figure 5. Testing a portable airbrush.© Trustees of the British Museum

Figure 6. Application of funori with a brush through facing. © Trustees of the British Museum

Comparing barrier layers for facing

Rayon paper 'Usukuchi' proved to be a much more suitable material than 'Bib Tengujo' for facing. It is easy to handle and comes off cleanly, which is important when dealing with very fragile painted surfaces (Table 3). Funori seems to penetrate better through Usukuchi than through Bib Tengujo. Using the latter, the consolidant seems to stay near the surface.

	Rayon paper 'Usukuchi'	'Bib Tengujo' paper
Material information	Regenerated cellulose from wood pulp, 12 gsm	100% Manila hemp, 12 gsm
Qualities	Soft to the touch Non-woven fibers	Rough to the touch Non-woven fibers
Penetration for facing	Very good: the paper has good wet strength while being thin and very soft. When removing after the application of the consolidant, it peels off easily without pulling.	Poor: the paper has good wet strength ; but the strong non-woven fiber structure grips the surface after consolidation. Difficult to remove safely. Using a lower weight paper might mitigate this.

Table 3. Comparison of characteristics of 'Usukuchi' and 'Bib Tengujo' paper.

Conclusion

The chosen treatment combined the use of a consolidant and two adhesives: funori to consolidate the low bound paint, Lascaux 4176 MFC for re-adhering small thin paint flakes and Primal B-60 for re-attaching thicker paint flakes. The treatment was successful: no visible changes to the decorative surface were noted and sufficient strength was imparted to allow the coffin to be displayed as part of an international exhibition.

The results of this study were arrived at empirically. However, this approach is often used by conservators to make day-to-day decisions. Further scientific studies could investigate how the different methods of applications impact on the effectiveness of funori as an adhesive.

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