A Preliminary Investigation into the Use of Wet Cleaning Treatments for the Conservation of Pacific Island Barkcloth

By

Ruby Antonowicz-Behnan

Supervisor: Prof. Frances Lennard

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ABSTRACT

This investigation looked into the compatibility of tapa and water, and the logistics nd safehandling of the material, as well as how this could potentially impact on pigments, decorative media, adhesives and layers. A range of wet cleaning methods were tested, based on suggestions and comments from participants of a survey on conservation wet cleaning of barkcloth, as well as methods drawn from the conservation literature.

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Chapter 1: Introduction

Barkcloth, or tapa is a non-woven material made from the beaten and felted inner bark of various tree and plant species, found across the tropical regions of Oceania; Asia; Africa; and the Americas.

In the Pacific islands, tapa was essential in all aspects of life before western contact and the introduction of new textiles. It was traded and exchanged; presented and gifted at important ceremonial events.

Tapa is both strong and soft, which makes its uses vast. Tapa was used to furnish the house and clothe the body through life and at death. Fashioned and wrapped either as plain unadorned cloth or richly coloured and decorated, it could indicate the wearer's hereditary rank and status.[1] Important in religious practice, it has provided protection for sacred objects, and metres were hung in the temples, as a link to the deities. In certain places, such as in Tonga, tapa or *Ngatu* as it is locally called, still holds great value in ceremonial practices and as a tourist export, and the art of tapa making is still very much alive.[2]

Tapa is called a "cloth", as it has been used in much the same way as any textile across the globe. However, its properties are quite different from a woven textiles and in some ways has a lot in common with paper. Not fitting into any one box has meant that treatment methods have been approached from many angles, including textiles, paper and organics conservation.

[1] Pauline Reynolds, "Tapa Cloths and Beaters: Tradition, Innovation and the Agency of the Bounty Women in Shaping a New Cult". *Journal of Textile History* 47, no. 2, (2016): 194.
[2] Adrienne L. Kaeppler, "Culture, Conservation and Creativity: Two Centuries of Polynesian Barkcloth". In *Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014,* ed. Peter Mesenhöller and Annemarie Stauffer. (Newcastle upon-Tyne: Cambridge Scholars Publishing, 2015), 6.

The use of crease removal, repair and support methods for tapa have been widely covered in the literature, however, the use of aqueous cleaning has remained a less commonplace treatment method.

1.1 Scope of this investigation

This investigation will look broadly at tapa from the Pacific island regions of Polynesia, Micronesia and Melanesia. However, the primary focus will be on Polynesia as a parallel to the three-year research project, *Situating Pacific Barkcloth Production in Time & Place* based at the Centre for Textile Conservation and Technical Art History, University of Glasgow.[3] As the aim is for it to be meaningful and of use to the ongoing barkcloth project.

The fibre arts of New Zealand will not be covered in this research project as the primary source of material for cloth on these islands was the New Zealand Flax and furthermore, the Paper Mulberry tree (*Broussonetia papyrifera)* did not grow successfully in the temperate climate.

In order to keep within the set parameters and to keep the focus on the previously stated lines of investigation, the experiments will not look to compare washing methods in terms of effectiveness at soil removal, and for this reason, the use of detergents or artificially soiled samples will be ruled out.

As it would not be possible to have samples which represent what is a broad and diverse type of object. It will be a starting point, to make predictions for the potential implications for a given situation. The investigation will look primarily at the use of water alone as a solvent for cleaning.

[3] "The Project" Tapa: Situating Pacific Barkcloth in Time and Place, accessed September 7, 2017. http://tapa.gla.ac.uk/project/

It will not be possible to investigate the effects washing may have on the tensile strength of barkcloth. In addition, the effects of wet cleaning at a molecular level and what is removed, for example the reduction in lignin content after wet cleaning will not be study in this dissertation.
The focus of the project will be on two-dimensional (flat) tapa objects, as cleaning 3D objects will present their own unique challenges which cannot be covered within this project.

1.2 Primary research aim

The intention of this research project, is to be a preliminary investigation into the compatibility and behaviour of tapa and water, the practicalities and safe handling of wet cloth, as well as the effectiveness of drying methods. In order to be able to make predictions for how adhesive pastes, dyes, paints, beaters marks and layers may be affected by water.

1.3 Research questions

- Why is wet cleaning an uncommon treatment method for the conservation of barkcloth?
- In what circumstances are the wet cleaning methods commonly used in paper and textile conservation suitable for application in barkcloth conservation?
- Can wet cleaning recommendations be made which can be adaptable to conservators across disciplines working with barkcloth?
- Can wet cleaning ever have a more mainstay place within the tapa conservation repertoire, or do the risks far outweigh any potential benefits?
- Are the concerns about risks universally shared across the field?

1.4 Research objectives and methodology

1.4.1 Literature Review

The intention of the literature review is to firstly, get a broad overview of the research, conservation and display of tapa, to look for trends and how this area of conservation has developed. Building on this, will be to get a comprehensive view of wet cleaning treatments, in order to learn about the range of projects undertaken, any issues conservators have encountered and to identify areas for further investigation.

Whilst literature on Pacific island culture and the region's history will be consulted throughout, to put the dissertation into context, and to search out references to indigenous wet cleaning practices, as in some instances, knowledge of past washing practices may be a rationale for conservation wet cleaning.[4]

1.4.2 Questionnaire

Following on from a review of literature, a survey could potentially fill in some of the gaps and provide the most up to date information on wet cleaning project. Whilst tailoring the questionnaire would provide an opportunity to ask very specific questions on methods and the rationale for or against wet cleaning and more generally, to find out what conservators have encountered.

Another objective was to ask the respondents about their areas of expertise or conservation specialities in order to get a wider picture of the profession and the conservators diverse skillset, as it was assumed that the majority of conservation professionals would not be working exclusively on barkcloth.

[4] Wilhelm Bauer and Roswitha Zobl, "Rindenbaststoffe aus der Wiener Cook-Sammlung. Technologie - Konservierung – Restaurierung (Bark Objects in the Vienna Cook Collection". *Conservation-restoration of leather and wood; Training of restorers; Sixth International Restorer Seminar*, 1987 Veszprém. (Hungary. Budapest: National Centre of Museums, 1998): 48.

As responses from the questionnaires began to be received during the experimental phase, the information provided by the conservators would be incorporated into the project later on as the tests progressed.

1.4.3 Experimental investigation

The aim of the experimental investigation was to apply the theory and test out methods detailed in the literature and questionnaire.

Chapter 2: Introduction to Barkcloth (Tapa)

2.1 Etymology

The word 'tapa', derived from the Hawai'ian word kapa has become a globally accepted term for barkcloth, although individual islands have their own specific names. For example, in Samoa the material is known as *Siapo*, in Niue it is *Hiapo* and Fiji, *Masi.* Actually, in Western Polynesia the word "tapa" more correctly describes the unpainted border of a cloth.[5]

The spread of the term was in part due to the whalers operating from outposts in the region in the late 18th - early 19th century, who collected barkcloth and taught by local indigenous crew members to call the cloth by that name.[6]

2.2 Plant Cultivation

There are several species of tree and plant which are a source of bark for the production of *tapa* cloth: the Paper Mulberry (*Broussonetia papyrifera*); breadfruit (*Artocarpus*), mamaki or nettle plant (*Pipturus albidus*); and types of fig (*ficus*) including the Banyan tree (*Ficus bengalensis).* The most widely used and only tree to be specially cultivated for the manufacture of tapa is the Paper Mulberry, which produces the finest quality and

[5] Serge Tcherkezoff, "On Cloth, Gifts and Nudity". In *Clothing the Pacific*, ed. Chloë Colchester (Oxford: Berg, 2003), 52.

[6] Simon Kooijman, *Tapa in Polynesia*. (Honolulu: Bishop Museum Press, 1972), 4.

also most highly prized material.[7] The other species, usually producing a coarser material, have been manufactured on a smaller scale. Whilst, sometime barks have been combined together to make particular varieties of cloth.

The paper mulberry was once grown in special plantations, often beside kitchen gardens, where the young trees were carefully pruned so that the bark could be free of holes and imperfections.[8] Its cultivation has traditionally been a male role, whereas the processing, manufacture and decoration of tapa cloth has in most cases been the labour of women across the Pacific islands.[9] The high importance placed upon products of women's labour including barkcloth is directly linked to their fertility and as such, women had high status in Pacific Island society,[10] and their produce were a symbol of *koloa* (wealth)[11]

2.3 Manufacturing process

The methods in the initial stages of manufacturing tapa are closely related across Polynesia, Micronesia and Melanesia.

The bark is stripped from the tree and the inner bark is scraped and separated from the outer. The inner material may then be kept dry or soaked for anything from a few hours to several days either in fresh flowing or stagnant water or seawater and sometime wrapped in leaves to ferment. This would help to soften and macerate the fibres, making them ready for beating.

A beater or mallet and anvil, carved from a hardwood, are the basic tools for beating the bark strips. The wooden beater commonly has two to four sides of vertical grooved

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[7] Reynolds, "Tapa Cloths and Beaters," 194.
[8] Sarah Wolf Green, "Conservation of Tapa Cloth from the Pacific". *Preprints of Papers Presented at the Fourteenth Annual Meeting, Chicago, Illinois, 21-25 May 1986.* (Washington, D.C.: American Institute for Conservation of Historic and Artistic Works, 1986),17.
[9] Adrienne L. Kaeppler, *The Pacific Arts of Polynesia and Micronesia*. (Oxford: Oxford University Press, 2008), 11.
[10] Simon Hooper, *Pacific Encounters: Art & Divinity in Polynesia, 1760-1860*. (London: The British Museum Press, 2006), 38.
[11] Billie Lythberg and Phyllis Herda, "*Ngatu'uli*: Exhibiting the Fine Art of Contemporary Tongan Black Barkcloth in New Zealand". *Journal of Museum Ethnography*, no. 29 (March 2016): 131.

lines, with each side having a different size width of lines (sometimes one side may be left smooth). The bark strips can either be dry or kept wet through the beating process which begins with the widest set of grooves to stretch out the strips into a sheet. The cleaned and prepared sheets are often then rolled up or tied in bundles and stored until enough have been prepared to begin joining together.

In the next stages of the process, there is more variation and diversity across the regions, whilst there is also a general division between Western and Eastern Polynesia, with the method of felting or pasting to join the beaten sheets.[12] In western Polynesia, pieces are generally joined by slightly overlapping sheets and pasting (gluing) together and any holes in the sheet are filled with small pasted pieces. The adhesive pastes are normally starch-based, made from arrowroot,[13] cassava,[14]overripe breadfruit, [15]tapioca or taro, which grow well and are a staple food in the region. Pasting the sheets can sometimes be performed at the same time as decorating to produce very large cloths.

In eastern (and marginal) Polynesia there is a stronger tradition in felting sheets together.[16] Strips of bark are slightly overlapped, ends are sometimes folded under and the beating process felts the strips or layers together to form a smooth, unbroken surface. Whilst there are some places, such as in Tahiti, where felting has been used in combination with pasting to make certain types of tapa.[17] In Hawai'i, felting has been used in combination with sewing to join layers together and in a single tapa cloth can be found a range of stitches.[18]

Once completed, the sheets of tapa were dried out in the sun to bleach and weighted with stones to ensure a smooth finish.[19] At night as protection from damp, the tapa

[12] Kooijman, Tapa in Polynesia, 415.
[13] Kaeppler, The Pacific Arts of Polynesia, 98.
[14] Wolf Green, "Conservation of Tapa Cloth from the Pacific," 17.
[15] Kooijman, Tapa in Polynesia, 216.
[16] Kooijman, Tapa in Polynesia, 415.
[17] Kooijman, Tapa in Polynesia, 415.
[18] Roswitha Zobl, "Barkcloth in the WorldMuseum Vienna". In *Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014* ed. Peter Mesenhöller and Annemarie Stauffer. (Newcastle upon Tyne: Cambridge Scholars Publishing, 2015): 119.
[19] Kooijman, Tapa in Polynesia, 114.

sheets were brought inside and sometimes slept upon by the makers to help keep the pieces flat.[20]

2.4 Patterning and finishing

The styles and techniques of patterning and finish are diverse and depending on the particular island groups, tapa could be watermarked; painted free-hand; stencilled; stamped; cut, printed or rubbed with dye; bleached or smoked.

There were a number of trees and plants, as well as mineral sources across Oceania which were utilised for making dyes; paints and oils. A reddish-brown dye with a high tannin content was processed from the bark of the *Bischofia Javanica (*Bishop wood), known las *'o'a* in Samoa.[21] Turmeric (*Curcuma longa*) was widely used for making yellow dyes,[22] and it was key in the colouring for men's scented *malo* (loincloth). The yellow colour from turmeric was sacred, and as it was labour intensive to make, was often reserved for noble people.

Another important source of natural colourant came from the candlenut tree (*Aleurites moluccana)* known as *Kukui* or *tuitui*. [23]A special black dye was also obtained from juice extracted from the root or by burning the nut to produce a sooty powder,[24] which could be rubbed onto the cloth. Black dye was rarely made, reserved for high-ranking persons, for like turmeric, it was a complex to produce. The oil extracted from the Kukui also had an important use as a binding agent for colourants,[25] and resinous saps from other indigenous plants were used as fixatives for dyes.[26]

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[20] Fanny Wonu Veys, "A Feast For the Senses: Barkcloth During Royal Ceremonies in Tonga." In *Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014* ed. Peter Mesenhöller and Annemarie Stauffer (Newcastle upon-Tyne: Cambridge Scholars Publishing, 2015): 48.

[21] Kooijman, Tapa in Polynesia, 217.
[22] Wolf Green, "Conservation of Tapa Cloth from the Pacific," 18.
[23] Kooijman, Tapa in Polynesia, 117.
[24] Billie Lythberg and Phyllis Herda, "*Ngatu'uli*: Exhibiting the Fine Art of Contemporary Tongan Black Barkcloth in New Zealand," *Journal of Museum Ethnography*, no. 29 (March 2016): 135.
[25] Anne-Claire de Poulpiquet, "Conservation of a Hawaiian *Kapa*: use of size-exclusion chromatography (SEC) for the evaluation of cellulose degradation caused by oil and sodium chloride," *Journal of the Institute of Conservation.* Vol. 35, no.1 (March 2012): 52.
[26] Kooijman, Tapa in Polynesia, 217.

Blues and some red dyes were extracted from berries, leaves and tree bark. Whilst the volcanic, mineral rich environment also provided a natural abundance source of red dyes such as ochre.[27]

All these colours were applied in a variety of ways. In Hawai'i, painting by free-hand and decorative watermarking with a specially carved beater was important,[28] Fiji's traditions were in stencilling, and in Samoa and Tonga, design tablets (*kupesi)* were rubbed with dye to leave a pattern.[29]

Colouring could also be achieved achieved by smoking the cloth. This involved hanging the sheets around an open fire, sometimes after first rubbing with coconut cream to help fix the colour.[30] It certain places, it could be dyed by burying in tannin rich soil such as the mamaki from Hawai'i, which was left in marshy patches used for growing taro.[31] Tapa could also be bleached white to produce a be highly prized cloth. In Tahiti, the elite sought to produce and use the finest white tapa, which stood as marker of their power and status in the society.[32]

Candlenut, kukui, kamani and also coconut oil were utilised for glazing the surface of tapa, giving it a glistening surface. In hawai'i, kamani oil was used for practical purpose for giving the cloth a waterproofing finish.[33] Special *Malo* (loincloths) garments reserved for chiefs which were worn for bathing, were covered in oil to make them waterproof.[34] Coconut oil could be blended with sweet smelling flowers, ferns and sandalwood and

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[27] Kooijman, Tapa in Polynesia, 204.
[28] Kooijman, Tapa in Polynesia, 218.
[29] Adrienne L. Kaeppler, The Pacific Arts of Polynesia and Micronesia. (Oxford: Oxford University Press, 2008): 98.
[30] Kooijman, Tapa in Polynesia, 218.
[31] Natalie Firnhaber and David Erhardt, "Hawaiian Oiled and Mamaki Tapa: Characterisation and Conservation" in *Symposium 86*: *The Care and Preservation of Ethnological Materials, Ottawa, September 1986,* ed. R. Barclay, M. Gilberg, J. C McCawley and T. Stone. (Ottawa: Canadian Conservation Institute,1986), 182.
[32] Pauline Reynolds, "Tapa Cloths and Beater," 194.
[33] Anne-Claire de Poulpiquet, "Conservation of a Hawaiian *Kapa*: use of size-exclusion chromatography (SEC) for the evaluation of cellulose degradation caused by oil and sodium chloride". *Journal of the Institute of Conservation* 35, no.1 (March 2012): 52.
[34] Firnhaber, "Hawaiian Oiled and Mamaki Tapa," 178.

could be rubbed onto very special types of cloth to make them fragrant. In Hawai'i, tapa sheets were folded up for storage interleaved with fragrant sachets of flowers. [35]

2.5 Uses of tapa

In western Polynesia, barkcloth was essential for ceremonial presentation and gift exchange, at important events and celebrations. Large bales of tapa were displayed as markers of wealth and prosperity. In central and eastern Polynesia tapa had important sacred status and religious functions. In Fiji, fine white sheets of masi were hung in long lengths inside the temples (*bure kalou)*, which was said to serve as a passageway for the gods.[36] In Rarotonga, in the Cooks Islands, the carved wooden staff gods, were wound and bound around long strips of tapa.[37]

In everyday use, tapa was made into bed sheets and blankets which could be comprised of several layers of tapa sewn together (called *kapa moe* in Hawai'i).[38] It was also made for floor coverings and mosquito curtains,[39] and when not in use, could be rolled up and stored in bundles above the house rafters.[40]

Tapa, as clothing was most important for people of rank, as it displayed their status, and covered the parts of the body which were said to be *tapu* (forbidden), such as the head of a royal person.[41] The key form of clothing was the *malo* (loincloth), comprised of a long narrow piece of tapa for men, which was drawn up between the legs and wound and tucked up around the waist,[42] and the *Pa'u,*(a wraparound layered skirt) for women. [43] Upper body coverings in the form of a poncho-like garment (*tiputa)* were known to

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[35] Katia Johansen, "Perfumed Textiles". *Textile Society of America. 11th Biennial Symposium Proceedings*. *Honolulu, Hawaii* (2008): 8, accessed Sep 7, 2017, http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1217&context=tsaconf.

[36] Jara Hulkenberg, "Masi: House and Cloth of the Vanua". *Journal of Material Culture* 21, no.2 (2016): 189.

[37] Hooper, Pacific Encounters, 41.

[38] Susan Nash Munro, "The Conservation of a Hawaiian Sleeping Tapa," ICOM Committee for Conservation: 6th Triennial Meeting, Ottawa, 21-25 September 1981; Preprints, Volume 4. (Paris: International Council of Museums, 1981): 1.

[39] Kaeppler, "Culture, Conservation and Creativity," 11.

[40] Gerry Barton and Sabine Weik, "The Conservation of Tapa". *The Conservator* 18, no.1 (1994): 31.

[41] Hooper, Pacific Encounters, 37.

[42] Kooijman, Tapa in Polynesia, 243.

[43] Kaeppler, The Pacific Arts of Polynesia, 95.

have been worn in Tahiti, and later, in Samoa and Niue.[44] This was mainly worn by the elite, while lower ranking people were expected to go bare chested in the presence of those of higher status.[45]

Chapter 3 Literature Review

3.1 Introduction: Condition

Bark fibres can contain between 5 and 30% lignin content, which is highly reactive to photo-oxidation and the by-product of this is acidic and can be a catalyst for degradation.[46]

Manufacturing processes can also be a major cause of deterioration, having long-term detrimental effects, evidenced in a low pH, yellowed appearance, embrittled and fragmentary condition. Investigations into the causes of deterioration have been undertaken by Erdhart (1987), Norton (1990), Daniels (2001), Hill (2001), and Poulpiquet (2012).

Hill (2001) notes that hemicellulose and pectins are removed during the process of beating and felting the bark, exposing more of the lignin and cellulose to oxidation.[47] Whilst, Norton highlights that while wetting the bark during manufacture does not appear to cause damage, the accidental embedding of mineral and metallic salts into the fibres may contribute to later condition problems.[48]

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[44] Nicholas Thomas, "Savage Island' Hiapo," In *Hiapo: Past and Present in Niuean Barkcloth.* By John Pule and Nicholas Thomas. (Dunedin, N. Z: Otago University Press, 2005): 58.
[45] Nicholas Thomas, "The Case of the Misplaced Poncho: Speculations Concerning the History of Cloth in Polynesia," *Journal of Material Culture* 4, no. 1 (1999): 11.
[46] Rowena Hill, "Traditional barkcloth from Papua New Guinea: materials, production and conservation," *Barkcloth: Aspects of Preparation, Use, Deterioration, Conservation and Display: Seminar Organised by the Conservators of Ethnographic Artefacts at Torquay Museum on 4 December 1997* ed. Margot M. Wright (London: Archetype Publications, 2001): 41.
[47] Hill, "Traditional barkcloth from Papua New Guinea," 42.
[48] Ruth E. Norton, "Conservation of Artifacts Made from Plant Material," in *The Conservation of Artifacts Made from Plant Materials* ed. Mary-Lou E. Florian, Dale Paul Kronkright, Ruth E. Norton, 83-138. (Los Angeles, Calif: Getty Conservation Institute, 1990): 86.

Poulpiquet has confirmed the use of seawater for soaking the bark during manufacture, with particular reference to Hawai'ian kapa and has investigated the long-term effects of both salts and oils on tapa fibres. Her tests indicated that, although salt alone did not accelerate degradation, the combination of oils and salt in the fibres lead to significant depolymerisation of the cellulose chain.[49]

Whilst Erhardt and Firnhaber (1987) undertook analysis and identified particular oils used in the manufacture and the factors contributing to the deterioration of Hawai'ian tapa. The authors found that hardening of unsaturated oils, and the oxidative effects producing dicarboxylic acid, lowered the pH and contributed to the brittle and fragmentary conditions of oiled tapa in the Bishop Museum collection. [50]

Daniels (2001) has also investigated causes of deterioration in tapa cloth, finding that both iron and tannins contributed to the poor condition. Surveying barkcloth in the British Museum collection, examples of tapa with high iron content were found to be in poor condition due to the acid-catalysed hydrolysis and iron-catalysed oxidation, finding that plant polyphenol dyes may be a significant cause of the acidic degradation.[51]

Soiling and staining on tapa in some cases be linked to its former use or to manufacture Brown coloured substance observed on a Hawai'ian kapa for example, was thought to be either a binding medium or a design outline, or remnants of perfumed oils.[52]

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[49] Anne-Claire de Poulpiquet, "Conservation of a Hawaiian *Kapa*: use of size-exclusion chromatography (SEC) for the evaluation of cellulose degradation caused by oil and sodium chloride," *Journal of the Institute of Conservation.* Vol. 35, no.1 (March 2012): 50-61.
[50] David Erhardt and Natalie Firnhaber, "Analysis and Identification of Oils in Hawaiian Oiled Tapa". *Recent Advances in the Conservation and Analysis of Artifacts.* Compiled by James Black (London: University of London Institute of Archaeology Summer School Press, 1987): 227.
[51] V. Daniels, "An Investigation into the Reasons for the Deterioration of Barkcloth." *British Museum Conservation Research Group Report,* no. 3, (London: British Museum, 2001): 10.
[52] Roswitha Zobl, "Barkcloth in the WorldMuseum Vienna," in *Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014* ed. Peter Mesenhöller and Annemarie Stauffer (Newcastle upon Tyne: Cambridge Scholars Publishing, 2015): 118.

Conservators have also highlighted the potential for soiling to convey evidence of former household practices. Tapa cloths were commonly folded up and stored in bundles above the house rafters when not in use, and while in storage would have built up a layer of soot from the cooking fires below.[53] While this would also have been the case for sheets which were hung on the walls of the home, sometimes called mosquito curtains. The removal of this type of soiling has been discouraged as it may help to date a tapa cloth, as after Christian missionaries interventions in the nineteenth century, cooking fires were moved outside.[54]

However, sooty particulate soiling can in some cases be attributed to the build up of "museum dirt" after years of open storage. Both Pullan (2015) and Johnson (2001) noted examples of soiling on tapa cloths that was characteristic of industrial city pollutants.[55]

Water staining and mold are both frequently encountered on tapa cloth. Relevant to this study, are investigations undertaken in paper conservation on the effects of water staining found that tidelines are not just disfiguring but can be actively damaging the cellulose. As the brown staining forming tide lines is commonly water-soluble, in theory it can be removed to halt the rate of cellulose degradation.[56]

3.2 Dry Cleaning

Mechanical cleaning with lower power vacuum suction is the basic method for removing surface particulate soiling.[57] Whilst ingrained dirt often require greater cleaning efficiency with the aid of sponges. Depending on how fibrous or robust the tapa cloth is,

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[53] Hill, "Traditional barkcloth from Papua New Guinea," 35.

[54] Sara J.Wolf and Gladys Fullman, "Notes on the Treatment of Fijian Tapa Cloths." *AICCM Bulletin* 6, no. 3-4 (1980): 58.

[55] Monique Pullan, " An Introduction to the Conservation of Barkcloth at the British Museum," in *Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014* ed. Peter Mesenhöller and Annemarie Stauffer, (Newcastle upon-Tyne: Cambridge Scholars Publishing, 2015): 129.
Emily Johnson, "The Deacidification and Conservation of a Samoan Tapa at the Manchester Museum" in *Barkcloth: Aspects of Preparation, Use, Deterioration, Conservation and Display: Seminar Organised by the Conservators of Ethnographic Artefacts at Torquay Museum on 4 December 1997* ed. Margot M. Wright. (London: Archetype Publications, 2001): 73.

[56] Zied Souguir; Anne-Laurence Dupont and E. Rene de la Rie. "Formation of Brown Lines in Paper: Characterization of Cellulose Degradation at the Wet-Dry Interface". *Biomacromolecules* 9, (2008): 2546-2552.

[57] Pullan, "An Introduction to the Conservation of Barkcloth at the British Museum," 129.

a variety of sponges can been utilised including smoke sponge (vulcanised rubber or synthetic), dry cleaning putty (Groom Stick®) and polyurethane cosmetic sponges.

3.3 Conservation literature with reference to wet cleaning

Much of the early conservation literature can be divided into two key groups: Texts originating from a major three-phase tapa conservation project. This was undertaken between 1978-1985 at the Bernice Pauahi Bishop Museum, Honolulu, in conjunction with research and analysis by staff at the Anthropology Conservation Laboratory (ACL, formerly Pacific Regional Conservation Center), Natural History Museum, Smithsonian Institute, Washington D.C. The second group of papers originate from a large conservation survey and subsequent treatment undertaken between the Fiji Museum, Suva and the Texas Memorial Museum (TMM), University of Texas, Austin.

Two key authors of these project are the objects conservator, Natalie Firnhaber, working first at the Bishop Museum, and later, at the ACL, and Sara Wolf Green, who was then senior conservator of the Materials Conservation Laboratory, TMM and also previously conservation officer for the Fiji Museum, since 1979.

One paper jointly authored by Firnhaber and David Erhardt (research chemist at ACL) focuses on investigations into the manufacture, deterioration and conservation of Hawai'ian oiled and mamaki tapa cloth from the Bishop Museum collection,[58] whilst a second paper is concerned with the identification of oils and their long-term effects on Hawai'ian oiled tapa. A third paper by several conservators of the Bishop Museum, details the complete 7 year project.[59] The 1986 Firnhaber and Erhardt paper has a

[58] David Erhardt and Natalie Firnhaber, "Analysis and Identification of Oils in Hawaiian Oiled Tapa". *Recent Advances in the Conservation and Analysis of Artifacts.* Compiled by James Black. London: University of London Institute of Archaeology Summer School Press. 1987, 223-227.
Natalie Firnhaber and David Erhardt, "Hawaiian Oiled and Mamaki Tapa: Characterisation and Conservation". *Symposium 86*: *The Care and Preservation of Ethnological Materials, Ottawa, September 1986.* Edited by R. Barclay, M. Gilberg, J. C McCawley and T. Stone. Ottawa: Canadian Conservation Institute,1986, 178-185.
[59] Roger G. Rose; Carol Turchan; Natalie Firnhaber and Linnea O. Brown, "The Bishop Museum Tapa Collection Conservation and Research into Special Problems."

stronger emphasis on the implications for conservation and treatment methods and most important for this research is the wet cleaning treatment of mamaki tapa. Samples were washed by immersion in warm tap water in order to raise the pH. [60] During this treatment, dye run was observed, however, the authors concluded that there was no visible difference to the pattern on drying and the beater marks appeared to be unaltered.[61] The authors point out that due to the large size of many mamaki tapas, wet cleaning may not often be a feasible option.
Washing test were also undertaken on an oiled tapa samples, but only summarised in the paper. The sample, which had a pH range of 4.0, was were immersed in lukewarm tap water for 30 mins. The authors noted an increase in flexibility and a rise in pH to 6, whilsts stating that no colour run was observed, but describe a slight raise to the beater marks.[62]

The authors concluded that the best way for reducing acidity and increasing flexibility in oiled and mamaki tapa is with a washing treatment, but that further investigation was needed to find a more appropriate solution for oiled tapa, and suggest new better storage conditions to slow the rate of deterioration.[63]

The 1987 paper by Erhardt and Firnhaber, has a greater emphasis on the chemical analysis of the oils used on Hawai'ian tapa, but does make some recommendations for conservation, concluding that aqueous cleaning and deacidification was not suitable for oiled tapa because of the nature of the binding of oils to the tapa matrix.[64] The authors also state that paper conservation techniques which have been applied to tapa would not be appropriate in the case of oiled tapa.[65]

The paper from the Bishop Museum, as well as giving an overview of the complete project, provides some interesting insight into the complex nature of tapa. The authors

Bishop Museum Occasional Papers 28, (February 1988): 1-34.
[60] Firnhaber, "Hawaiian Oiled and Mamaki Tapa," 183.
[61] Firnhaber, "Hawaiian Oiled and Mamaki Tapa," 183.
[62] Firnhaber, "Hawaiian Oiled and Mamaki Tapa," 181.
[63] Firnhaber, "Hawaiian Oiled and Mamaki Tapa," 184.
[64] Erhardt, "Analysis and Identification," 227.
[65] Erhardt, "Analysis and Identification," 223.

describe how each object responded in a unique way to moisture absorption. Whilst the two case studies on wet cleaning oiled tapa samples (detailed by Firnhaber and Erhardt 1986), demonstrated how a difference between the use of lukewarm and warm water as well as immersion time had a considerable affect on the pigments. The authors, evaluating the treatment of the second oiled tapa, which was washed in warm tapa water and immersed for over twice the length of time of the previous sample, concluded that the treatment "proved to be excessive and damaging",[66] as there was as significant yellow colour loss observed during each wash.

Texts by Wolf Green detail the survey and treatment of 30 plus Fijian and Samoan tapa cloths which included the testing of all dyes for wash-fastness, only 4 (which were commemorative issues of newspapers printed with ink on tapa) had completely stable dyes.[67] Following the survey, two papers by Wolf Green provide details of the proposals and conservation treatment using aqueous methods. The treatment of a commemorative copy of the *Samoa Weekly Herald* on tapa from the collection of the Fiji Museum, which had stable dyes and a painted Samoan tapa from TMM, involved wet cleaning, deacidification and support, which is summarised in the appendix of the 1986 Wolf Green paper. Wet cleaning was carried out using methods familiar in paper conservation. The tapa was supported on a screen while it underwent three washes in deionized water, and further treatment with magnesium bicarbonate to raise the pH to 6.5 and then weighted to dry. The painted Samoan tapa from TMM was float-washed after pre-humidification using an ultrasonic humidifier to flatten in order to ensure the tapa would evenly wet out. [68]

In a second article, Green (1987) details a method of crease removal for tapa with very unstable pigments which combined the use of a vacuum suction table and ultrasonic humidifier. The aim of this technique was to saturate the object with moisture, without completely soaking, whilst using suction to ease out creasing.[69] The author also details a

[66] Rose, "The Bishop Museum Tapa Collection Conservation and Research into Special Problems," 23.
[67] Wolf Green, "Conservation of Tapa Cloth from the Pacific," 21.
[68] Wolf Green, "Conservation of Tapa Cloth from the Pacific," 30.
[69] Sara, Wolf Green, "The Treatment of a Tapa Cloth with Special Reference to the Use of the Vacuum Suction Table," *Historic Textile and Paper Materials II: Conservation and Characterization*. ACS Symposium Series 410 ed. S. Haig Zeronian; Howard L. Needles. (Washington, DC: American Chemical Society, 1987): 177.

proposed methods for cleaning whilst managing fugitive dyes, by swabbing with the aid of vacuum suction table to draw the by-product out of the cloth and transferring it to blotting paper underneath.[70] It was hoped that this method of almost saturating the cloth could also having application for reducing acidity, to dissolve and release the cellulosic degradation product, however, Green reports having little success with the tests, and at the time of writing, was not able to pinpoint the reasons for this, but that the technique could have application after more thorough testing.[71] Whilst having success with vacuum suction for crease removal and infills, Green also acknowledges that, for practical reasons the technique could only be suitable for small objects due the limited size of the suction table.[72] The author also highlights (at the time of publication) that wet cleaning techniques common to paper and textile conservation which had been applied to tapa, had not received enough thorough testing and investigation in practice. [73] The paper also raises the questions of the implications for conservation that the wide range of colouring agents, plants and manufacturing processes that have been applied to tapa may have. [74]

Another interesting detail of the case study by Wolf Green is details of the use of silicone release paper as an alternative to blotting paper for drying tapa, as it would discourage the wicking of water soluble pigments.[75]

Much of the wet cleaning methods described by Firnhaber and Green have a lot in common with paper conservation treatments. Whilst a method taken by Bakken and Aarmo (1981) used a combination of paper and textile conservation methods. The author's rationale for cleaning was to remove "grime" and "harmful pollutants" but concerns of dissolving adhesives pastes meant that initial trial washes using plain pasted tapa samples were undertaken using Lissapol N (Synperonic N) in a first bath and gentle sponging in a second bath of plain water. The results of these tests are not fully described, but instead summarised as numbered points. The main points being that

[70] Wolf Green, "The Treatment of a Tapa Cloth with Special Reference to the Use of the Vacuum Suction Table," 176.
[71] Wolf Green, "The Treatment of a Tapa Cloth," 177.
[72] Wolf Green, "The Treatment of a Tapa Cloth," 177.
[73] Wolf Green, "The Treatment of a Tapa Cloth," 173.
[74] Wolf Green, "The Treatment of a Tapa Cloth" 179.
[75] Wolf Green, "The Treatment of a Tapa Cloth," 182.

the treatment was considered to be safe so long as the cloth was handled correctly, whilst the loss of adhesive was thought to be minimal.

A full treatment of a painted tapa cloth, followed the test phase. The vulnerable torn edges were sandwiched in “gauze” material which was stitched to the cloth. And the whole thing was supported on a sheet of perspex during treatment in a bath of warm “filtered” water and 1% Lissapol N.

Some of this work was presented at two important early conferences, both held in Ottawa, the *International Council of Museums (ICOM) 6th Triennial Meeting* (1981) (Ethnographic Materials Working Group) and *Symposium 86: The Care and Preservation of Ethnographic Materials.* Whilst both conferences included further contributions to tapa conservation and research literature, with texts by Susan Nash Munro and Arne Bakken and Kirsten Aarmo (Conservators, Ethnographic Museum, University of Oslo, now Museum of Cultural History), which were written independently of the previous projects mentioned.

A number of authors have contributed papers which provide a broad overview of Pacific tapa conservation and many have described the theory of using wet cleaning treatments. Two key publications have included reviews on wet cleaning treatments, Norton and Kronkright (1990) have covered the literature from roughly 1979-1990, whilst a later publication by Barton and Weik (1994), adds literatures up to 1994.

Another key author is Roswitha Zobl, conservator of textiles and paper at the World Museum, Vienna (WeltMuseum Wien, Formerly Museum of Ethnology).[76] Zobl’s writings have included tapa wet cleaning treatments, however, at present, the author of this dissertation is unaware of any English translations of articles by Zobl before 2014.

[76] Wilhelm Bauer and Roswitha Zobl, "Rindenbaststoffe aus der Wiener Cook-Sammlung. Technologie - Konservierung – Restaurierung (Bark Objects in the Vienna Cook Collection)," *Conservation-restoration of leather and wood; Training of restorers; Sixth International Restorer Seminar*, *1987 Veszprém* (Hungary. Budapest: National Centre of Museums, 1998): 45-54.
Roswitha Zobl, “Die Restaurierung eines Tapa-Stoffes aus der Wiener Cook-Sammlung (Restoration of a Tapa Cloth from the Cook Collection in Vienna),” *Restauratorenblatter* 8 (1985-1986): 121-126.

Barton and Weik (1994) have included some details of an aqueous cleaning and deacidification treatment undertaken by Zobl. The review, details the use of 0.04% non-ionic detergent (TinovetinJU) and 0.005% carboxymethyl cellulose, in 22°C distilled water, and a rinse in calcium hydroxide to keep a neutral pH during treatment. The authors do not report the complete outcome of the treatment, but mention the rise in pH, from 4.9 - 5.5 and note of the dimensional change after drying.[77]

The 1997 workshop and seminar, *Barkcloth: Aspects of Preparation, Use, Deterioration, Conservation and Display*, held in the United Kingdom and Organised by the Conservators of Ethnographic Artefacts (published in 2001), was unique in its dedication to the UK's contribution to tapa conservation and research. As the title suggests, the seminar covered a broad range of treatments and research subjects, but particularly relevant here, is a paper which details the use of aqueous deacidification methods for a Samoan tapa cloth in the collection of Manchester Museum, with a trial treatment based on previous work undertaken by Zobl.[78]

The Samoan tapa in the case study was extremely acidic and brittle, with a pH of 2-3, and although surface cleaning with latex sponge helped to reduce the visible soiling, the author explains the rationale for further treatment in order to slow the rate of deterioration.[79] The choice of treatment is further justified by the authors detailed assessment of the object, as many of the condition features which are commonly problematic for wet cleaning, such as would be found in smoked cloth which often disintegrates or layers which can delaminate, were not found to be a feature of the tapa in the Manchester Museum. Whilst it is also pointed out that any pre acquisitional soiling would have become intermixed with city pollution, meaning that there was little justification for retaining this as evidence as it would have been difficult to distinguish at this stage.[80]

[77] Barton,"The Conservation of Tapa," 32.
[78]Johnson, "The Deacidification and Conservation of a Samoan Tapa at the Manchester Museum," 76.
[79] Johnson, "The Deacidification and Conservation of a Samoan Tapa at the Manchester Museum, "73.
[80] Johnson, "The Deacidification and Conservation of a Samoan Tapa at the Manchester Museum," 76.

What is also interesting, is that at the time, Manchester Museum did not have a set procedure in place for treating acidic tapa, and so the author's includes her review of a broad range of literature, as it was felt important to weigh up the different approaches to treatment, including those which have been adapted from textile and paper conservation. Furthermore, after preliminary test, the author notes of the consultation with several conservators, including paper conservation and a keeper of ethnography, in order to firm up a treatment procedure.
The final treatment method is explained in detail, and the decision to use a combination of carboxymethylcellulose (CMC) and Synperonic N, due to the embedded nature of the soiling,[81] as well as an additional treatment with a buffering agent. In a similar way to some of the earlier treatments in the literature, this combined the use of detergents familiar to textile conservators, and buffering agents and pre humidification procedures common to paper conservation.

In 2014, the symposium, *Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa* was held at Rautenstrauch-Joest-Museum of World Cultures and the Institute of Conservation Sciences, in Cologne. Coinciding with the exhibition of the same name, the symposium brought together an international group of researchers and conservators working with tapa collections. The proceedings, published in 2015 contributes some of the most recent literature on the conservation and research of tapa.

Included in the publication, is a chapter by Monique Pullan (2015), senior conservator of textiles and organic materials at the British Museum. The paper gives an overview of treatment and display of barkcloth at the British Museum and includes a detailed discussion of examples of aqueous cleaning methods, one full treatment, which applied paper conservation techniques and one localised spot cleaning method.

The paper includes details of the consultation and collaboration with members of the Vanuatu cultural centre involvement in the decision making process to wet clean of a

[81] Johnson, "The Deacidification and Conservation of a Samoan Tapa at the Manchester Museum," 76.

barkcloth from Erromango. The barkcloth in the case study had significant water staining, and while not causing damage, its disfigured state, meant a loss to the intended meaning of the object. Pullan includes a full characterisation of the staining and describes the likely cause and origin. As it was not considered to been acquired pre acquisition, this gave further rationale for undertaking a wet cleaning treatment.
The paper also covers the risk involved in using aqueous cleaning methods, such as the fugitive nature of decorative media and soluble adhesives leading to separation of layers. The final choice of a blotter wash method is described and the principles of the technique and their benefits in application to barkcloth. The blotter technique is also specifically mentioned by the author as being adapted from paper conservation.
The method of using a blotter wash was very successful as it meant that the staining, which was likely to be cellulose degradation could be drawn out into the blotting paper. This resulted in a reduction in acidic content evidenced in the neutral pH, a significant reduction in staining and a brighter appearance. The author also notes that the colours and beater marks were unaltered by the treatment.

Pullan also includes an example of a case where, in the end, a full wet cleaning treatment was not undertaken to make the point that it will not always be appropriate. The case study, another barkcloth from Erromango, which had similar water stained damage, was spot cleaned, as treatment risked colour alterations in one of the pigments. It is stated that a localised cleaning method was a less successful technique.

The paper also raises concerns as to the potential for microscopic damage due to the stress of swelling and shrinkage caused by saturation of water during cleaning, but it was felt that in this case, there were considerable benefits to removing the acidity, as it would ensure the long term preservation of the object. Whilst, the appropriateness of treatment in balancing the needs of the object and that of stakeholders is highlighted. Pullan also stresses the importance of interdisciplinary and inclusive dialogue between the many stakeholders in the process of conservation and display of barkcloth.

Chapter 4: Review of cleaning treatments for paper and textiles

4.1 Introduction

Aqueous cleaning will generally be familiar and often routine to both textile and paper conservators. However, the type of soiling and staining to be removed, and the material properties differ greatly between paper and textile objects. Whilst there are similarities between washing techniques, the two disciplines have developed quite distinct wet cleaning methods.

4.2 Comparing characteristics

On a basic level, barkcloth and paper are similar in that they are both produced from a sheet of cellulosic fibres.[82] Similarly, paper and textiles, share the characteristic of having a large surface area.[83]

However, there are important difference in processing of the raw material.[84] In the manufacture of paper, the fibres are separated and made into a pulp, which are suspended in water and then pressed to form a sheet. In cellulosic woven textiles, staple fibres are spun and twisted together to form a yarn. The fibres in woven textile are ordered, whereas in paper sheets, individual short fibres are irregularly placed.[85] In tapa making, the bast fibres are left intact, [86] but become intermixed during the beating process.[87]

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[82] Anne-Claire de Poulpiquet, "Starch Pastes on Barkcloth: A Comparison Study Using Mechanical Tests of Three Starches". *Journal of paper conservation: IADA* 13, no. 4 (2012): 8.

[83] Mary-Lou E. Florian, *Fungal Facts: Solving Fungal Problems in Heritage Collections.*

[84] Sara J. Wolf, "Repair and Display of Fijian Tapa Cloth".*Conservation Notes: An Occasional Periodical of the Materials Conservation Laboratory Texas Memorial Museum* 5. Austin: The University of Texas at Austin, (1983): 2.

[85] Anthony W. Smith, "Cellulose: In Paper and Textiles". In *Paper and Textiles: The Common Ground* ed. Fiona Butterfield and Linda Eaton, (Glasgow: Scottish Society for Conservation and Restoration, 1991): 9.

[86] Arne Bakken and Kirsten Aarmo, "A Report on the Treatment of Barkcloth," in *ICOM Committee for Conservation: 6th Triennial Meeting, Ottawa, 21-25 September 1981; Preprints, Volume 4*. (Paris: International Council of Museums, 1981): 2.

[87] V. Daniels, "The Characteristics of Modern and Old Barkcloth (tapa)". *The Conservator* 29, no. 1 (2005): 95.

Several conservators working with tapa collections, have noted the crossover of tapa, paper and textile conservation disciplines.[88] The rationale explain by Firnhaber (1979) for using both methods from paper and textiles for lining and support treatments was due the similar properties paper shares with tapa.[89] However, in another treatment, Wolf Green (1983) felt that due the differences in the processing of materials, applying paper conservation methods to tapa would not necessarily be suitable,[90] particularly when it came to wet cleaning, as tapa commonly contain unstable dyes. [91]

4.3 Types of Soiling and staining

Greasy and oily soiling are more frequently encountered on textile objects than on paper. The prevalence of this type of soiling in textiles is owing to their functional aspect, either through use or wear. This is a key reason why dry cleaning (cleaning by mechanical means only) and detergents are more frequently called upon for textiles, whilst in paper conservation, the method is less commonly used.[92]

4.4 Aqueous cleaning of paper

Paper washing treatments are mainly used for the purpose of removing the (often water soluble) yellow discolouration and acidic compounds which are associated with cellulose degradation,[93] in order to stabilise and slow down the rate of deterioration, reduce brittleness and to improve the appearance.

The theory of washing paper is that the porous matrix swells, freeing up space for water to access and in turn, facilitating the water to dissolved and to transport away the water-soluble degradation by-product. This process happens through diffusion, which is why it is necessary to do this in changes of fresh water as diffusion will continue until an

[88] Nash Munro, “The Conservation of a Hawaiian Sleeping Tapa,” 1.
[89] Natalie Firnhaber, “The Conservation of Bark Cloth,” *Newsletter (Museum Ethnographers Group)* No. 8, (September 1979): 20.
[90] Wolf, “Repair and Display of Fijian Tapa Cloth,” 2.
[91] Wolf, “Repair and Display of Fijian Tapa Cloth,” 2.
[92] Vincent Daniels and Yvonne Shashoua, “Wet Cleaning of Paper and Textiles: Similarities and Differences,” *in Paper and Textiles: The Common Ground* ed. Fiona Butterfield and Linda Eaton, 19-27 (Glasgow: Scottish Society for Conservation and Restoration, 1991): 21.
[93] Vincent Daniels; and Joanna Kosek, “The Rate of Washing Paper,” *Studies in Conservation* 47, sup 3 (2002): 47.

equilibrium is reached between the soiled object and the water containing the released soiling. [94]

The risk, however is that media may also be removed at the same time,[95] surface applied pigments can be bonded in a similar way to soiling, meaning they are vulnerable to being dislodge when undertaking dry or wet cleaning treatment. (reference)

4.5 Wet strength

It is well known that paper decreases in tensile strength when wet, whilst natural cellulosic textiles become significant stronger.[96] The increase in wet strength of textiles such as cotton is partly due to the radially swelling of fibres resulting in increased frictional forces as a consequence of the denser packing of fibres.[97]

Whilst it also reported that the tensile strength in paper can be permanently reduced after drying, [98] a initial hypothesis, for the loss of tensile strength in paper while wet may be due to the plasticizing effects of the added moisture, whilst the permanency may be due to the retention of some moisture after drying. However, research undertaken by Moropoulou and Zervos (2003) suggested that it was due to damage sustained by the paper.[99]

Chapter 5 Questionnaire

5.1 Survey Design

The questionnaire was designed to be completed online using the survey building website, *Zoho.eu*, in order for it to be straightforward and convenient to fill out. Whilst,

[94] Joanna M. Kosek, "Washing Paper in Conservation," in *Paper and Water: A Guide for Conservators* ed. Gerhard Banik and Irene Brückle (Oxford: Butterworth-Heinemann, 2011): 318.
[95] Kosek, "Washing Paper in Conservation," 317.
[96] Smith. "Cellulose", 9.
[97] Smith, "Cellulose", 9.
[98] A. Moropoulou; S. Zervos. "The Immediate Impact of Aqueous Treatments on the Strength of Paper". *Restaurator* (2003): 170.
[99] A. Moropoulou; S. Zervos, "The Immediate Impact of Aqueous Treatments on the Strength of Paper," 171.

using an online survey meant results could be collected instantaneously. Participation for the survey was encouraged from people working across the globe by posting the survey on the Conservation DistList (ConsDistList).[100] The survey was also sent directly to several conservators who were known to have specialist knowledge or had previously worked on tapa conservation projects. The majority of questions were formatted as multiple choice, several of which enabled participants to choose one answer whilst having the option to make multiple selections. For example, Question 4. "What types of post acquisition soiling or staining have you observed on barkcloth?" Other questions were built as free text boxes, which allowed respondents to provide more developed and specific answers, such as, when asked about their wet cleaning treatment methods.

5.2 Results introduction

The survey brought together the experiences of conservators from a diverse range of disciplines and specialisms including textiles, paper, organics, ethnography and objects and in total, 18 participants, working in the USA and Pacific territory, UK, Germany, Austria, India, Australia and New Zealand responded to the questionnaire and over half (8/18) were very familiar with working on barkcloth.

Ethnography was most frequently stated, as at least one area of expertise (12/18). The majority of the conservators were not specialists in any one discipline but had expertise spread across two or more areas of conservation (12 out of 18 participants). Most commonly this was ethnography and textile conservation (7/12).

5.3 Results: Types of soiling and staining observed

The most commonly encountered types of post acquisition soiling or staining listed were loose and ingrained particulate, water staining and cellulosic degradation product. Whilst, the most frequently noted types of pre-acquisition soiling or staining

[100] The conservation Distlist is an online forum and mailing list for anyone involved in the preservation of cultural property, such as conservators, conservation scientists and curators.
Australian Institute for the Conservation of Cultural Material, "Conservation Distlist," https://aiccm.org.au/conservation-distlist. (Last accessed 7 Sep 2017).

or evidential soiling observed was of unknown origin (13 of the 17 responses) and water staining (11/17). 11 of the 13 participants choosing these had observed both water staining and soiling/staining of unknown origin which was considered to be pre acquisition/evidential. 10 respondents listed more post-acquisition soiling and staining, while 5 listed more of the pre-acquisition or evidential type.

Of the 11 respondents who had never wet cleaned, almost all (8/11) had observed pre acquisition/evidential soiling/staining of unknown origin. Of the 7 (7/18) that had undertaken at least one wet cleaning treatment, all but 1 had also observed soiling or staining of unknown origin. This result could therefore indicate that unidentifiable soiling which is suspected to evidential is not on its own an overriding factor preventing wet cleaning. However, 5 of those 7 that had wet cleaned, had listed identifying more post acquisition soiling.

Of the 3 participants that selected paper conservation as one area of expertise, in combination with either textiles, ethnography or organics (or in the case of one participant, textiles, paper and ethnography), all had undertaken a barkcloth wet cleaning treatment.

5.4 Treatment context

A significant result from participants was in the case for the source communities input into the decision making process and as a motivator for treatment. A high number of the respondents (9/17) listed “as advised by the source community” as a potential context for wet cleaning. The second most frequent context selected was for exhibition and display requirements

5 out of the 7 conservators who had wet cleaned, stated advisement of the source community as a hypothetical context for undertaking an aqueous treatment and 4 of those 5 also listed exhibition or display requirements as a context for wet cleaning. Whilst one other conservator had listed both the source communities and the need for repatriation or restitution as context for wet cleaning.

There was a higher proportion of conservators that had never wet cleaned to those that had. Of the 10, 6 did not list any of the proposed contexts as a situation or a circumstance for wet cleaning barkcloth. A view may be taken then, that a high number of participants do not feel there is any appropriate circumstance for wet cleaning or were not able to find from the options listed in the questionnaire an acceptable context. Of the 4 that did state at least one context for wet cleaning, all had listed as advised by members of a source community.
This result clearly demonstrates that the needs of the indigenous stakeholder and their input and consultation is a high priority for conservators.

5.5 Prohibiting factors

All participants listed risking loss of surface paints; decoration; finishes or dye bleed as a prohibiting factor. Also a high number people listed risking separation/loss of layers/parts; if the soiling/staining was pre-acquisition or suspected to be evidential; as well as other ethical considerations; and also if the soiling/staining was not actively degrading the object. A much less frequent issue prohibiting treatment was limited time; limited or no experience of wet cleaning; and limited resources or personnel.

For the purpose of displaying the results, the participants are referred to as participant 1, 2, 3 and so on.

Table 1: Respondents specialist areas, familiarity and level of experience of conservation and wet cleaning Pacific barkcloth.

Participant	**Area of expertise**	**Familiarity working with barkcloth**	**How frequently have you wet cleaned barkcloth?**
1	Textiles, paper, ethnography	Some experience/familiarity	Just once.
2	Ethnography, objects, organics	Very familiar	Never

3	Objects	Fairly familiar	Never
4	Textiles	No experience	Never
5	Textiles, ethnography, organics	Very familiar	Infrequently
6	Textiles, ethnography, related materials	Some experience/familiarity	Never
7	Textiles, ethnography	Very familiar	Never
8	Textiles, ethnography	Some experience/familiarity	Never
9	Objects	Very familiar	Infrequently
10	Paper, ethnography	Some experience/familiarity	Several times
11	Paper, organics	Fairly familiar	Infrequently
12	Textiles	Very familiar	Never
13	Ethnography	Some experience/familiarity	Never
14	Textiles, ethnography	Very familiar	Frequently
15	Textiles, ethnography	Fairly familiar	Never
16	Ethnography, objects	Fairly familiar	Never
17	Ethnography	Very familiar	Just once
18	Objects, textiles	Very familiar	Never

Table 2: Post-acquisition and pre-acquisition soiling/staining observed.

Post-acquisition soiling/staining	**Participant**	**Count**
Loose particulate	1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 17, 18	14
Ingrained particulate	2, 5, 6, 8, 9, 11, 12, 13, 14, 15, 17, 18	12

Ingrained oily/greasy	2, 5, 11, 17	4
Staining: water	1, 2, 5, 6, 8, 9, 11, 12, 13, 15, 16, 17, 18	13
Staining: rust	1, 2, 5, 6, 8, 9, 11, 16, 17	9
Cellulosic degradation product	2, 3, 5, 6, 9, 10, 11, 12, 13, 14, 15, 16, 18	13
Mould	2, 5, 9, 12, 13, 14, 16, 17, 18	9
None of the above		0
Other (Please specify)	1, 2, 3	3
Pre-acquisition soiling/staining	**Participant**	**Total**
Loose particulate	3, 6, 7, 8, 9, 10, 11,	7
Ingrained particulate	5, 6, 7, 8, 9, 11, 12, 13	8
Ingrained oily/greasy	6, 7, 9, 11, 13, 17	6
Staining: water	1, 2, 6, 7, 8, 9, 11, 12, 14, 16, 17	11
Staining: rust	6, 7, 8, 9, 16	5
Cellulosic degradation product	3	1
Mould	7, 8, 9, 16	4
Soiling of unknown origin	1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 14, 16, 17, 18	14
None of the above	15	1
Other (Please specify)	1, 2, 18	3

Table 3: The context for wet cleaning treatments.

Treatment context	Participant	Total
Improved storage	11	1
Exhibition or display requirements	2, 5, 9, 10, 11, 14, 15	7
Research visits	10, 12	2
Repatriation/restitution	11, 17	2
As advised by members of a source community	2, 5, 9, 10, 11, 12, 13, 15, 17	9
Request of private client	2, 10, 12	3
None of the above	6, 7, 8, 16, 18	5
Other (Please Specify)	1, 2, 3, 5, 14, 15, 18	7

Table 4: Issues and concerns prohibiting the respondents from considering wet cleaning treatments.

Prohibiting condition features, ethical concerns, resource/time constraints	Participant	Total
Soiling/staining is insoluble in water	1, 2, 3, 5, 7, 9, 10, 12, 13, 15, 17, 18	12
Soiling/staining not actively degrading the object	1, 2, 3, 5, 7, 8, 9, 11, 12, 13, 15, 16, 17, 18	14
Risk separation/loss of layers/parts	2, 3, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18	15
Risk loss of surface paint, decoration, finishes, dye bleed.	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18	17
Soiling/staining is pre-acquisition or suspected to be evidential	1, 2, 5, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18	14
Other ethical considerations	1, 3, 5, 7, 8, 10, 11, 13, 15, 17, 18	11

Limited time	1, 2, 5, 10, 11, 17	6
Limited information	1, 2, 5, 7, 9, 10, 12, 15, 17	9
Limited/or no experience of wet cleaning in conservation context	2, 8, 10, 13, 16, 17	6
Limited resources or personnel	2, 10, 11, 17	4
Other (Please Specify)	1, 6	2

5.6 Wet cleaning treatment methods

The types of wet cleaning treatments used included, soaking in a wash bath; sponging; float wash; tilt wash; blotter washing, either on one side or a closed system (sandwich blotter). Whilst, localised spot cleaning treatments involved either, swabbing with moistened cotton wool, blotting, in some cases, with the aid of vacuum suction to draw out soiling. Respondent 14 who had frequently washed barkcloth, using float wash, spot cleaning with vacuum suction and blotter washing methods also described carrying out a full immersion once. They stated however, that they would not attempt a similar treatment again and would not recommend this as it "is nearly impossible to maintain the contours of the original if the cloth is completely soaked". Participant 17, also had reservations, after investigating spot cleaning a "test piece of barkcloth" on a suction table to "see if the treatment had any effect on the structural integrity of the barkcloth". Stating that they were not sure if they would ever immerse a whole barkcloth. However, they did evaluate the spot cleaning test as being fairly effective.

The majority of responses were for treatments using only water as the cleaning agent. However water was used in combination with a detergent or other cleaning or deacidification agents in 2 cases: Participant 1, used Tinovetin JU 0,04 % (a non-ionic

detergent) and carboxymethylcellulose 0,005 %, and rinsing in tap water and a calcium hydroxide solution. Participant 10 used a "mild dish detergent" in water with sponging action, as they explain, "mild dish detergents are gentle, non-reactive and non-staining and do not react with traditional organic dyes or affect the quality of undyed areas". The respondent did not specify the type or brand of this detergent.

5.7 Rationale for treatment choice

One respondent's rationale for treatment included the need to remove "heavy soiling from storage" and the "need for smoothing torn areas." Whilst another explained the "need to increase flexibility to allow pieces to be studied, stored and exhibited". Another participant felt that the object benefitted from wet cleaning, "particularly if being displayed and the original design is too obscured". Whilst they also mention the use of blotter and tilted bath washing as being "very effective without disturbing the item too much". Another participant found the use of a "mild dish detergent" and sponging "generally suitable for light to heavy weight Samoan, Tongan and Fijian barkcloths experiencing surface particulates" and that "it might also be applicable to treatment to other barkcloth types that have ingrained stains of organic or inorganic origin."

5.8 Consultation and collaboration

5 out of 7 of those that had wet cleaned barkcloth sought advice or support from a colleague or conservator from their own discipline or another. Collaboration between textile and paper conservators was the only to be specifically stated, but the majority did not specify the partnership.

5.9 Discussion

The results have shown that resources and time constraints are not significant factors prohibiting conservators from considering wet cleaning. The more significant factors leading conservators to rule out wet cleaning as an option were to do with the material condition and ethical concerns. The greatest concerns were for the potential risk of dye

bleed, separation of layers or parts, and loss of surface decoration and other media. Another major concerns was for the risk in removing evidential or pre acquisition soiling, as well as other unspecified concerns relating to ethical issues. The high priority with these concern directly corresponds with those voiced in the literature.
A high motivation for considering wet cleaning treatments was in response to the viewpoints and requests of source communities. Also important, was meeting exhibition or display requirements.

Chapter 6 Experimental investigation: wet cleaning tests

6.1 Sample material

Two types of barkcloth, a new plain cloth and a painted "historic" type were available for the project which meant there could be two avenues of investigation. Using the painted tapa to look into the wash-fastness of dyes and paint media, and the plain cloth for investigating the practicalities involved with handling wet barkcloth and the possible ways of drying the material.

A plain, uncoloured tapa cloth was sourced from the Hawai'ian based Black Pearl Designs, a company specialising in Polynesian inspired products. The material is a creamy white colour, with irregular patches which are a darker cream to beige- grey colour. Fragments of other plant material and a few very small flecks of brightly textile fibre were also noted. It is likely that these fibres transferred from a person's cloths either during manufacture or during packing.

The material is fairly thick and has a stiff handle, similar to starched linen. The sheets of tapa have been pasted together with a natural starch paste to form a longer length, approximately 3.5 metres which was folded several times for shipping. The exact ingredients of the adhesive paste are unknown, however the Black Pearl website

mentions the use of tapioca and also states the material has been "made with traditional tools and the inner bark of the mulberry tree".[101]

In contemporary Tongan tapa making, sometimes other materials have been incorporated into cloth. A mixture of flour, water and kerosene has been known to be applied to tapa as form of insect repellent and made-made material such as interfacing have sometimes substituted a few of the layers in tapa cloth. This is whats known as *ngatu loi* (lie barkcloth). [102] Whilst a mechanised beating machine has been used at one time or another. These are important factors to consider when working with contemporary tapa.

"Historic" Painted Tapa Cloth: a fairly thin patterned tapa cloth of an unknown age was purchased by the author from a private collector. The decoration consists of a repeat pattern of diamond and oval shapes in an orange brown colour which has been over painted with a dark brownish black colour to enhance the design. The tapa had been altered into a machine-stitched women's upper body garment, like a halter top, and synthetic material has been added. As the tapa had no provenance and owned by the author, it was seen as acceptable for it to be used for the purpose of this research.

Fig. 1 Painted barkcloth garment (as purchased by the author). Fig. 2 Detail of painted barkcloth

[101] Black Pearl Designs, "Products," https://www.blackpearldesigns.com/products/fijian-tapa-cloth (last accessed 7/09/2017).

[102] Fanny Wonu Veys, "A Feast For the Senses: Barkcloth During Royal Ceremonies in Tonga," in *Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014,* ed. Peter Mesenhöller and Annemarie Stauffer (Newcastle upon-Tyne: Cambridge Scholars Publishing, 2015): 48.

The tapa was visually examined using a Dino-lite digital microscope at a 430x magnification and it appeared that the orange-brown and black-brown colours had been applied using two different methods (see appendix). The orange-brown colourant had absorbed and penetrated through to the reverse. It was unclear whether the colour had been applied free-hand or by rubbing the dye using a design board (*kupesi)*. The dark brown colour appeared to have been applied free-hand as the media was visible as a layer on the surface of the cloth. These sections, also had a glossy finish which could indicate the use of an oil binder or coating.

FTIR test were conducted to determine the plant fibre and when the data was compared with a Paper Mulberry example, it showed a very similar spectra, which could confirm the use of Paper Mulberry bark.

The material was fairly creased and thin in places but structurally whole. There was no obvious particulate or ingrained soiling, however there were several areas of orange brown staining which were likely to be rust stains. Four metal hook and eye fastening which had been sewn to the tapa since it had been constructed into a garment had badly corroded, and it was probable that the staining was from this source.
The layer of dark brown glossy paint on the surface of the substrate showed extensive cracking but was not flaking or peeling away.

6.2 Test procedures and parameters

- A first step was to carry out a visual examination of samples to look for any significant dimensional changes or distortions after washing. The dimensions of each sample was measured with a standard ruler before treatment and after washing.

- A Dino-lite digital microscope was used to get a detailed look at the surface paint and pattern on the “historic” samples.

- Wash-fastness of the colours in the painted samples was investigated. A sample of the cloth was placed under the stereomicroscope and drops of tap water from a pipette were placed onto the surface to absorb. No colour run was observed. A cotton wool swab moistened with tap water was then gently rolled over the painted surface of the sample. After inspecting the swab it appeared that there was no transfer of colour onto the cotton wool.

6.3 Colour measurement

To determine any colour change, loss or alterations to dyes or pigments after wet cleaning, the reflectance value of samples was measured before and after treatment, using a portable spectrophotometer, model CM-2600d, made by Konica-Minolta brand. The data was generated on the SpectraMagic™ colour data software and using the CIELAB (International Commission on Illumination L* a* b) system for measuring colour. Colour is expressed using the three co-ordinates, L*a*b* which can give a quantifiable measurement of colour changes. The three colour coordinate values express the differences in lightness-darkness (L*), redness-greenness (a*), and yellowness-blueness (b*). The results can also be expressed as ΔE, which is the calculated total colour difference of the L*a*b* values, using the equation:

$AE = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]$.[103]

- Before measuring the samples, the instrument was first calibrated by taking a zero calibration and white calibration measurement.
- All measurements were taken with samples laid on a flat white surface (i.e table top) to ensure that transmitted light through the object was not interfering with the results.[104]
- To take measurements of patterned or textured objects such as the painted tapa samples, the handbook recommends taking several measurements in different locations, if a large measurement area is not available, to deal with the measurement value fluctuating depending on the location of a small area.[105]

[103] Bruce L. Ford, "Monitoring Colour Change in Textiles on Display". *Studies in Conservation* 37, No. 1 (1992), 2.
[104] Precise Color Communication, Konica Minolta, Inc. (2007-2013).
[105] Precise Color Communication, Konica Minolta, Inc. (2007-2013).

- For the painted barkcloth, an average measurement of three different coloured areas on each sample was taken before and after treatment by placing the instrument on the surface over the selected area and readings taken on 4 points of a compass. The instrument was lifted and repositioned on the surface for each of the four readings in order to test the statistical significance difference in all readings before and after treatment.[106]
- To ensure that the second set of readings were taken in the same position as the average measurements, template of individual sample were drawn out on melinex and the 3 measurement points were plotted on the template.
- For the purpose of this project, the three measurements were named: Light brown, dark brown and plain area.

Fig. 3 Samples with melinex templates

6.4 Test conditions

To keep the variables of the experiments to a minimum, only tap water (at approx. 22°C temp) without any detergent, was used for washing throughout the course of the experiments. Tap water was felt to be acceptable as all wet cleaning tests were to be conducted in Scotland (at the Centre for Textile Conservation and Technical Art History,

[106] Ford, "Monitoring Colour Change in Textiles on Display," 3.

University of Glasgow), where the water is known to be "soft".[107] Furthermore, in reference to the wet cleaning of textiles, de-ionised water is considered a very aggressive solvent, and in some cases can be damaging.[108]

The temperature and relative humidity within the lab was not controlled but monitored, and noted during each day of tests, with fluctuations in room temperature of 20 - 22.5 °C and a 48.5 - 54% RH.

Initial tests used samples measuring 100m x 50mm and all preliminary test samples were cut to this size using a standard template for uniformity. After completing preliminary tests it was decided to increase the size of sample to be a more realistic representation of a tapa cloth which may be found in practice. This was particularly relevant when considering the logistics of wet cleaning and safe handling of tapa cloth.

6.5 Preliminary tests

An initial set of wet cleaning tests were carried out using 8 samples of the plain barkcloth cut to 100mm x 50mm size, to look at the speed of water uptake and how much liquid a sample was able to hold. The method used here arose from similar experiments carried out by Poulpiquet on new Hawai'ian tapa samples.[109]

[107] Scottish Water, "Scottish Water Hardness Data Sheet, 2016," http://www.scottishwater.co.uk/-/media/Domestic/Files/You-and-Your-Home/Water-Quality/Scottish-Water-Hardness-Data.pdf?la=en (last accessed 07/09/2017).
[108] Ágnes, Tímár-Balázsy, "Wet cleaning of historical textiles: surfactants and other wash bath additives," *Studies in Conservation* 45, sup 3 (2000): 47.

[109] Poulpiquet, "Starch Pastes on Barkcloth, 12.

Figure 4: New barkcloth samples prepared for preliminary wash tests.

Samples were weighed dry before treatment and then immersed in water for a specified length of time (refer to table). Samples were then removed from the wash bath and held with tweezer for a few seconds to allow the excess water to drip off and then the samples were weighed again whilst wet. The samples were weighed for a third time after drying.

Table 4: Preliminary tests

sample size: 50x50mm	dry weight (g)	immersion time	wet weight (g)	weight after drying
1	0.445	15 sec	2.120	0.445
2	0.460	15 sec	2.155	0.453
3	0.392	30 sec	1.953	0.382
4	0.472	1 min	2.30	0.463
5	0.468	2 mins	2.286	0.464
6	0.475	30 sec	2.186	0.472
7	0.422	5 mins	2.028	0.415

8	0.430	30 mins	2.150	0.422

6.6 Results and discussion

The samples were able to hold a maximum of approximately 5x the dry weight, demonstrating that the material was able to rapidly absorb and retain a high volume of water. After drying, the samples returned to their original weight.

Chapter 7 Main body of tests

7.1 Introduction to blotter (capillary) washing

Blotting washing, also known as capillary washing is an aqueous cleaning method by the action of capillary diffusion.[110] The process involves dissolving or suspending foreign matter (soiling/staining), which is then picked up by an absorbent material in close contact with the object. The absorbent material, such as blotting paper, can be applied to one side (open blotter) or both side of the object (sandwich blotter).[111]
It is used as an alternative to immersion cleaning for paper, the theory being that soiling can be transported away before complete soaking an object.

This technique is suggested by Norton (1990) as a method for cleaning barkcloth, when the action of rubbing may be too abrasive on the fibrous surface or other attached media. [112] The open blotter method is described by Norton as "flow-through",[113] where

[110] The forces responsible are: 1. Moisture saturation gradient with water flowing from wet object to less wet blotter; 2. Concentration gradient with discolouration diffusing onto blotter with less discoloured material; and 3. Pressure gradient resulting from gravity or mechanical pressure. Kosek, "Blotter Washing," 329.
[111] Norton, "Conservation of Artifacts Made From Plant Material," 224.
[112] Norton, "Conservation," 224.

moisture is applied to one side of the object and the soiling is transported through to a blotter underneath. It is thought that by making the object wetter than the absorbent material, the "capillary draw" of the blotter will be more effective.[114] Whilst, Norton suggest the application of closed blotter washing for thin material which can be accessed from both the front and back.[115]

The decision to test the closed blotter wash was prompted by a response received from the survey and the method used here closely follows the details provided by the respondent who had used it in practice. A concern for Norton (1990) with this method is the risk of driving the soiling further into the material before it can be picked up.[116] However, as the samples to be tested were of a fairly thin type of tapa, it was predicted that this would not be a major concern. With this is in mind, it was also felt that the open blotter or "Flow-through" would be a suitable method for testing and to compare this with the closed method. The open blotter wash was adapted from a method described by Kosek.[117]

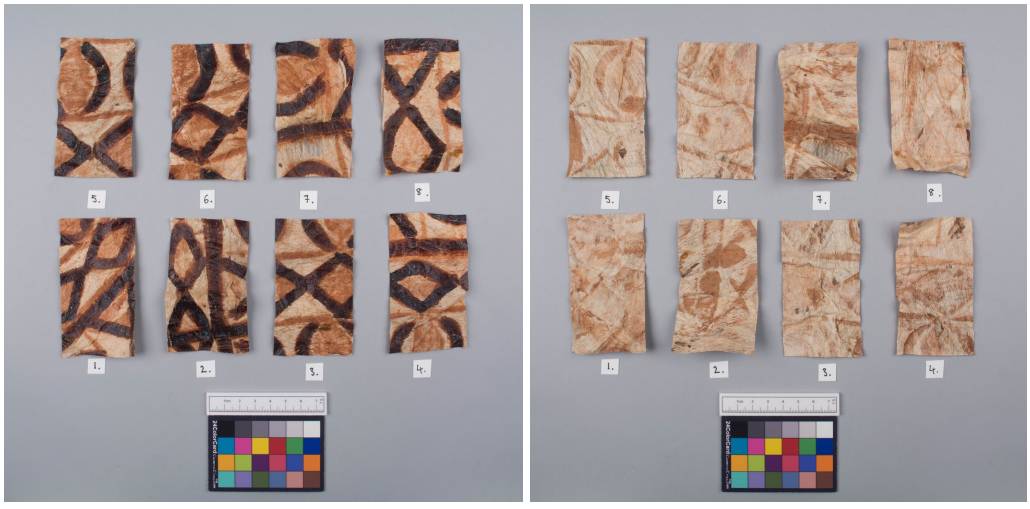


Fig. 5 Painted tapa samples before washing (front view). Fig. 6 Reverse side after washing.

[113] Norton, "Conservation," 224.
[114] Marc W Harnly, Cecile Mear and Janet E. Ruggles, "Washing," in *Paper Conservation Catalog: Seventh Edition* (Washington D.C.: American Institute for Conservation Book and Paper Group, 1990), 33. (last accessed: 07/09/2017) http://cool.conservation-us.org/coolaic/sg/bpg/pcc/16_washing.pdf.
[115] Norton. "Conservation," 224.
[116] Norton also highlights that this method may risk driving the soiling further into the material before it can be picked up.
[117] Kosek, "Washing Paper in Conservation," 329.

Using 16 painted samples measuring 100mm x 50mm, the samples were divided into two sets. 8 sandwich blotter and 8 open.

Instead of placing the top side of the sample (painted side) face down on the blotter, it was decided to place them face up. It was thought this way the painted surface could be monitored more easiy for any potential disruptions to the colours or pattern.

Table 6: Order of materials applied and method: sandwich and open blotter.

Sample	**Order of Materials**	**Washing/Drying Method**
1 2 3 4	1. work surface 2. damp blotting paper (1 layers) 3. dry cotton blotting cloth (1 layer) 4. sample (face up) 5. dry cotton blotting cloth (1 layer) 6. damp blotting paper (1 layers) 7. reemay 8. glass weight	Sandwich blotter: 1. Blotting paper misted to dampen. 2. Stack assembled and covered for 15 mins. 3. All material replaced and covered again for 15 mins. 4. Blotting paper and cotton replaced with dry. 5. Stack reassembled and covered for 15 mins. 6. Blotting paper and cotton removed. 7. Sample covered with reemay and weighted to dry.
5 6 7	1. work surface 2. damp blotting paper (1 layers) 3. sample (face up, misted with water) 4. reemay 5. glass weight	Open blotter: 1. Blotting paper misted with water to dampen. 2. Sample placed on top and misted with water. 3. Sample covered and weighted for 45 mins. 4. Sample misted a 2nd time.

8		5. Weighted again for 15 mins 6. Blotter removed and sample sandwiched in two cotton blotting cloths 7. Weighted to dry
9 10 11 12	1. work surface 2. damp blotting paper (2 layers) 3. dry cotton blotting cloth (1 layer) 4. sample (face up) 5. dry cotton blotting cloth (1 layer) 6. damp blotting paper (2 layers) 7. reemay 8. glass weight	Sandwich blotter: 1. Blotting paper misted to dampen. 2. Stack assembled and covered for 15 mins. 3. All material replaced and covered again for 15 mins. 4. Blotting paper and cotton replaced with dry. 5. Stack reassembled and covered for 15 mins. 6. Blotting paper and cotton removed. 7. Sample covered with reemay and weighted to dry.
13 14 15 16	1. work surface 2. damp blotting paper (1 layers) 3. sample (face up) 4. reemay 5. glass weight	Open blotter: 1. Blotting paper misted with water to dampen. 2. Sample placed on top and misted with water. 3. Sample weighted for ?45 mins 4. Sample misted a 2nd time. 5. Weighted again for 15 mins 6. Blotter removed and sample sandwiched in two cotton blotting cloths 7. Weighted to dry

7.2 Sandwich blotter wash

Pieces of blotting paper and cotton cloths were cut to a size slightly larger than the samples. The blotter strips were sprayed with water to make damp and placed on the work surface. Dry cotton cloth was then placed on top of this and the samples layered on top, painted side up. Another dry cloth was placed above and a further damp blotter placed on top. The whole pile was covered with a sheet of polythene and weight with a glass weight. This was left for 15 mins and then the damp blotter and dry cotton cloth was replaced to begin a second blotter wash. This was left for a further 15 mins and afterwards, the blotter and cotton cloths replaced with new dry material for 15 mins. The stack was then uncovered and weighted again with glass weights (without polythene) and left to dry.

7.3 Open blotter wash

The blotting paper was misted using a Japanese dahlia water sprayer, manufactured by Kuramata.

The samples required manipulation as described by Kosek,[118] as the samples tended to curl meaning that full contact was not achieved without smoothing out after misting. This issue was also raised by a survey respondent who suggested "creating contours to increase contact with irregular surfaces", when applying a damp blotter to the reverse.

7.4 Alterations to method

It was decided to undertake a first round of test, one of each method on two sets of four samples (samples 1-4, 4-8), and then reviewing both methods and making adjustments before moving on. During the first open blotter wash it was felt that the samples were still not making good contact with the blotter due to the slightly wavy nature of the tapa, and so it was decided to add pressure by applying glass weights to increase contact. If pre-humidified, the samples may have reduced their waviness, allowing more surface area contact. However, this was not investigated further during this project.

[118] Kosek, "Washing Paper in Conservation," 329.

For the second closed blotter test, samples 9-12 were sandwiched between 4, instead of two pieces of dampened blotting paper and samples 13-16 were misted more liberally and the sets were compared after completion.

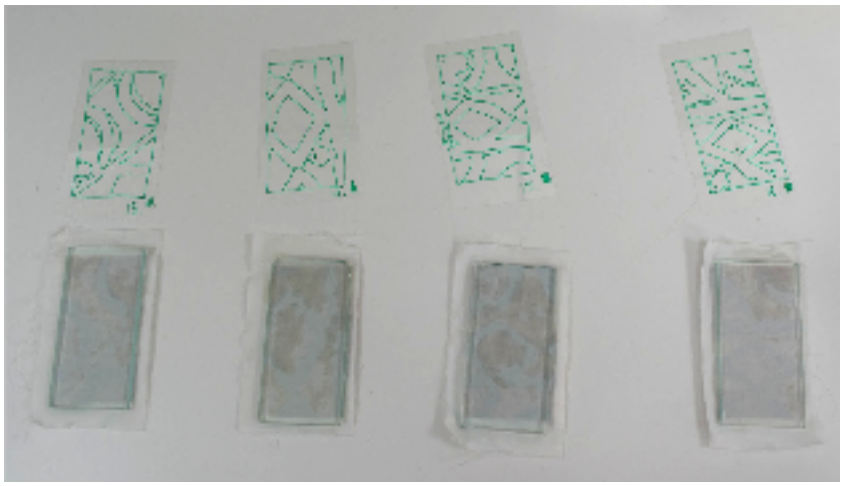


Fig. 7 Open blotter samples covered with glass weights.

7.5 Results and Discussion

Within the group 5-8, samples 6 and 7 showed significantly more brown staining on the blotting paper than samples 5 and 8. Very little staining present on the blotting paper from group 9-12, whilst a yellow-brown staining was more visible on the cotton drying cloths. Sample 10 drying cloths had the most staining and also 11 to a lesser extent.

The blotting paper on all four samples in group 13-16 were uniformly stained brown and compared with group 5-8, significantly more yellow staining had transferred onto the cotton cloths. The blotting paper from sample 7 was the most soiled of the two sets of open blotter wash samples.

The sandwich blotter wash, compared to the open blotter technique appeared to be a gentler and controlled technique. The saturation of the barkcloth was a slower process, which could be controlled by using more or less sheets of dampened blotter. Whereas, misting water directly onto the barkcloth was much less controlled and seemed extreme as the samples became saturated rapidly. The open blotter samples, even after

saturation did not make even contact with the blotting paper below, which required the samples to be weighted to rectify this.

The open blotter method appeared to have driven out more soiling (or potentially colourants) from the samples, evidenced in the staining transferred on to the blotting paper. However, similar values are seen across all samples in the colour measurement results (see tables below).

Fig. 8 Painted tapa samples (front view) after washing. Fig. 9 Reverse after washing (reverse)

Fig. 10 Staining on blotting paper (samples 5-8). Fig. 11 Staining on blotting paper (samples 13-16).

7.6 Colour measurements results

The largest changes were seen in lightness/darkness value (L*), which was negative in almost every measurement which show a darkening in colour after wet cleaning. The biggest overall colour change was seen in the light brown and dark brown coloured areas, the largest values being 3.31, 3.66, 3.80, 3.87, 4.30 and 4.87. This is seens as a significant change when considering that an ΔE value (total colour difference) of approximately 1.5 corresponds to a change which is visually perceptible to the human eye.[119],[120].

Table 7: Measured colour change after treatment: light brown colour

	dL*	da*	db	dC*	dH*
1	0.15 lighter	-0.26 less red	0.14 yellower	-0.04 less saturated	0.30 yellower
2	0.79 darker	0.88 redder	1.08 yellower	1.38 more saturated	-0.14 redder
3	-3.51 darker	1.52 redder	0.54 yellower	1.29 more saturated	-0.97 redder
4	-1.37 darker	-0.03 less red	-0.06 less yellow	-0.07 less saturated	-0.01 redder
5	-1.66 darker	0.93 redder	0.72 yellower	1.12 more saturated	-0.37 redder
6	-1.62 darker	0.87 redder	0.78 yellower	1.13 more saturated	-0.29 redder

[119] Helen Wilson; Chris Carr and Marei Hacke, "Production and Validation of Model Iron-tannate Dyed Textiles for Use as Historic Textile Substitutes in Stabilisation Treatment Studies," *Chemistry Central Journal* 6, no. 44, (2012): 8.
[120] Johnson, "The Deacidification and Conservation of a Samoan Tapa at the Manchester Museum," 78.

7	-0.62 darker	0.24 redder	0.42 yellower	0.48 more saturated	0.03 yellower
8	1.13 lighter	-1.66 less red	-0.25 less yellow	-1.04 less saturated	1.31 yellower
9	-3.26 darker	-0.01 less red	-0.58 less yellow	-0.47 less saturated	-0.35 redder
10	-1.02 darker	-0.24 redder	-0.71 yellower	0.72 more saturated	0.20 yellower
11	-2.07 darker	-0.05 less red	-0.10 less yellow	-0.11 less saturated	-0.02 redder
12	0.77 darker	-0.22 less red	-0.00 less yellow	-0.12 less saturated	0.18 yellower
13	-1.15 darker	0.28 redder	0.75 yellower	0.77 more saturated	0.22 yellower
14	-1.80 darker	-0.08 less red	0.59 less yellow	-0.55 less saturated	-0.23 redder
15	-2.30 darker	0.27 redder	0.07 yellower	0.20 more saturated	-0.19 redder
16	?	?	?	?	?

Table 8: Measured colour change after treatment: dark brown colour

	dL*	da*	db*	dC*	dh*
1	-0.29 darker	-0.18 less red	-0.74 less yellow	-0.51 less saturated	0.56 redder
2	-2.09 darker	-0.13 less red	-0.80 less yellow	-0.47 less saturate	-0.66 redder

3	-1.84 darker	-0.29 less red	-0.34 less yellow	-0.43 less saturated	-0.14 redder
4	-3.33 darker	1.41 redder	0.55 less blue	1.46 more saturated	0.42 redder
5	1.60 darker	-0.02 less red	-0.19 less yellow	-0.10 less saturated	-0.16 redder
6	-3.60 darker	-0.29 less red	-1.18 less yellow	0.73 more saturated	-0.98 redder
7	-3.84 darker	1.57 redder	1.16 yellower	1.91 more saturated	0.37 yellower
8	-2.07 darker	-0.23 less red	-0.66 less yellow	-0.61 less saturated	-0.34 redder
9	-1.18 darker	4.25 redder	2.06 yellower	4.72 more saturated	0.02 yellower
10	-0.18 darker	-0.32 less red	-0.65 less yellow	-0.45 less saturated	-0.56 redder
11	-2.11 darker	-0.04 less red	-0.15 less yellow	-0.12 less saturated	-0.09 redder
12	0.27 lighter	0.67 redder	1.14 yellower	1.23 more saturated	0.47 yellower
13	-2.66 darker	0.23 redder	0.06 yellower	0.23 more saturated	-0.06 redder
14	0.14 lighter	0.52 redder	0.03 yellower	0.47 more saturated	-0.22 redder
15	-2.62 darker	0.25 redder	0.35 yellower	0.34 more saturated	0.26 yellower

16	-1.28 darker	0.01 redder	-0.36 less yellow	-0.16 less saturated	-0.32 redder

Table 9: Measured colour change after treatment: plain area

	dL*	da*	db*	dC*	dH*
1	-0.55 darker	-0.20 less red	-0.52 less yellow	-0.55 less saturated	0.01 yellower
2	-1.39 darker	0.03 redder	-0.27 less yellow	-0.26 less saturated	-0.01 redder
3	-1.22 darker	0.00 redder	-0.24 less yellow	-0.23 less saturated	-0.09 redder
4	-2.47 darker	0.80 redder	-0.89 less yellow	-0.60 less saturated	-1.04 redder
5	0.86 lighter	-0.40 less red	-1.94 less yellow	-1.98 less saturated	-0.08 redder
6	0.20 lighter	-0.47 less red	-1.69 less yellow	-1.75 less saturated	-0.09 redder
7	-1.07 darker	-0.29 less red	-1.54 less yellow	-1.56 less saturated	-0.17 redder
8	-0.41 darker	-0.25 less red	-1.12 less yellow	-1.14 less saturated	-0.11 redder
9	-0.45 darker	-0.25 less red	-1.51 less yellow	-1.52 less saturated	-0.12 redder
10	-2.53 darker	0.50 redder	0.66 yellower	0.78 more saturated	-0.27 redder
11	0.77 lighter	-0.16 less red	-1.72 less yellow	-1.67 less saturated	-0.43 redder

12	-0.92 darker	1.52 redder	0.50 yellower	1.00 more saturated	-1.24 redder
13	-0.96 darker	0.05 redder	-0.22 less yellow	-0.19 less saturated	-0.12 redder
14	0.50 lighter	-0.14 less red	-1.01 less yellow	-1.01 less saturated	-0.14 redder
15	-1.12 darker	-0.25 less red	-0.99 less yellow	-1.02 less saturated	-0.11 redder
16	-0.13 darker	-0.21 less red	-1.10 less yellow	-1.10 less saturated	-0.21 redder

Table 10: Calculated total colour difference

Sample	ΔE* Light brown	ΔE* Dark brown	ΔE* Plain
1	0.33	0.82	0.33
2	1.60	2.24	1.42
3	3.87	1.89	1.24
4	1.37	3.66	2.74
5	2.04	1.61	2.16
6	2.00	3.80	1.76
7	0.79	4.30	1.90
8	2.02	2.19	1.22
9	3.31	4.87	1.59
10	1.26	0.74	2.66
11	2.08	2.12	1.89

12	0.80	1.35	1.84
13	1.40	2.67	0.99
14	1.90	0.54	1.14
15	2.31	2.66	1.52
16	?	1.33	1.12

The darkening of the colours is interesting as a loss of pigments would normally equate to a lightening in colour, expressed as a positive L* value,[121] however, these results would suggest an alteration instead of a loss.

It is well known that certain colourants such as turmeric can be affected or altered by changes in pH.[122] Johnson (2001) noted a darkening in the red-brown colour on a Samoan tapa cloth, corresponding to a rise in pH,[123] whilst, Ford (1992) noted a darkening of turmeric dyed textile after light fading. [124]

It is possible that cleaning altered the pH of the pigments causing this darkening effect, instead of a colour loss, however, the use of turmeric cannot be confirmed in theses test samples.

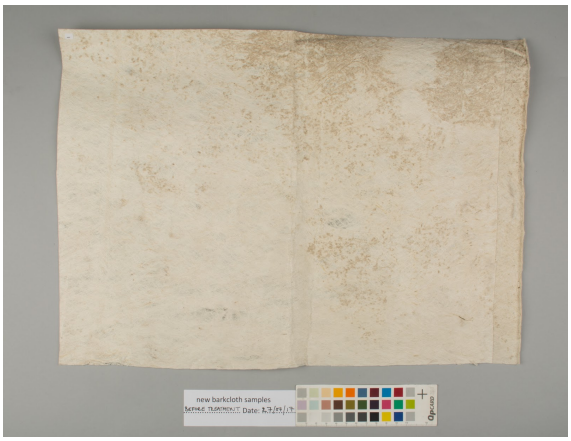
The preliminary tests for colour stability using pipette and cotton swab under the microscope, did not cause a visible colour run, whilst a visual examination and comparison of before and after images, did not appear to show a colour bleeding in the pattern. However, the blotting paper and cotton cloths showed used for wet cleaning showed a significant amount of colour transfer and in some cases looked similar to an imprint of the patterned design. It is unclear whether this was pigment or cellulose

[121] Johnson, "The Deacidification and Conservation of a Samoan Tapa," 78.
[122] David J.Lee; Louise Bacon; and Vincent Daniels, "Some Conservation Problems Encountered with Turmeric on Ethnographic Objects," *Studies in Conservation* 30, 4 (1985): 185.
[123] Johnson, "The Deacidification and Conservation of a Samoan Tapa," 79.
[124] Ford, "Monitoring Colour Change in Textiles on Display," 9.

degradation by-product, but the results from the spectrophotometer appear to show a darkening in colour.

7.7 New barkcloth samples: test 1

Three samples of new barkcloth were cut to an approximate size 460mm x 320mm size. Two of the samples (1 and 2) were cut from a section of the barkcloth at the point where two sheets overlapped slightly and pasted together with an adhesive (likely starch-based paste). On both of these samples the join point was towards the edge of the piece.



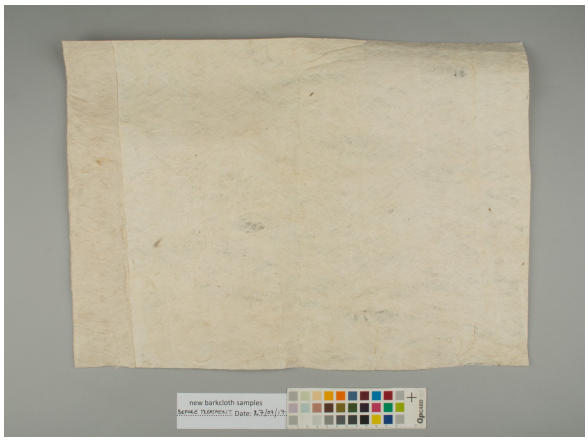
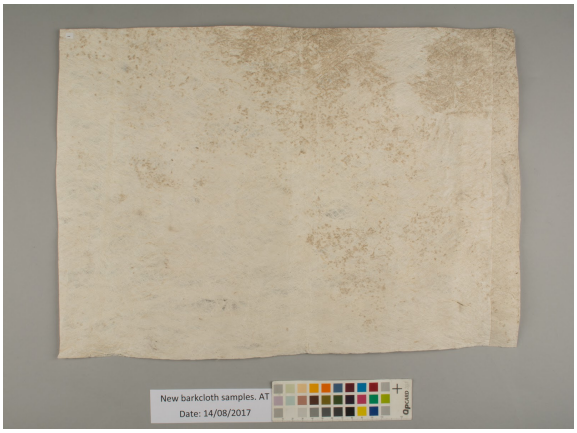


Fig. 12 New large barkcloth before treatment (front). Fig. 13 New large barkcloth before treatment (reverse).



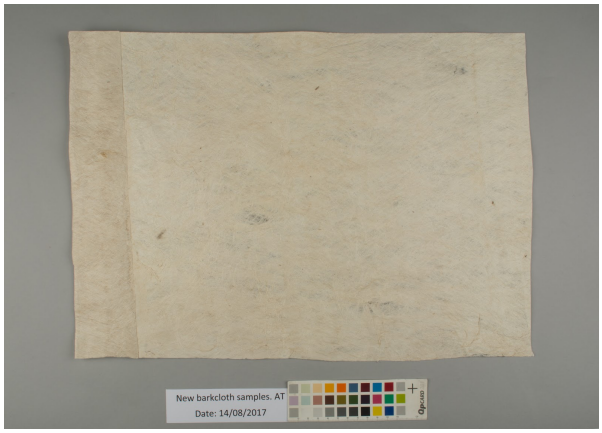


Fig. 14 New large barkcloth after treatment (front). Fig. 15 New large barkcloth after treatment (reverse).

All samples were float washed for 15 minutes in a wash bath of room temp tap water. The samples were floated on pre-wetted sheets of Reemay® (100% acid-free random spun-bonded polyester)

Float washing has application in cases where an object is unable to sustain a full immersion treatment.[125] The treatment differs from immersion in that the object sits on the surface of the water and relies on surface tension to keep it afloat. [126] The object to be washed can also be placed on top of a rigid support such as Reemay®, mesh or silk screen, which prevents it from sinking and helps to ensure the object does not sustain mechanical damage during wet cleaning treatment.[127]

In paper conservation, a common procedure prior to float washing is to pre-humidify the object. The principle of this is that it opens up the pores in the paper to allow water to flow in more easily. Pre humidification has specific application in float washing as the process smoothes any wrinkles prior to washing, allowing for more surface area to be in contact with the water.[128]

After washing, the samples were lifted out on the reemay and the excess water allowed to drip off. All barkcloth samples were then transferred onto a dry sheet of reemay and blotted dry with clean cotton cloths and then dried.

The treatment procedure of each sample is detailed below:

Sample 1: Due to the waviness of the sample, the full surface area did not lie in contact with the reemay sheet and as a result, experienced uneven wetting. After 8 minutes, the sample had still only partially wetted out. Uneven wetting was an issue raised by Wolf Green (1986), comparing the method to immersion treatments, the author had had limited success with float washing.[129] At this stage it was decided to spray to the surface of the sample with water to speed up the process to ensure. Still afterwards, there were

[125] Harnly, "Washing" http://cool.conservation-us.org/coolaic/sg/bpg/pcc/16_washing.pdf.
[126] Kosek, "Washing Paper in Conservation," 324.
[127] Moropoulou, "The Immediate Impact of Aqueous Treatments on the Strength of Paper," 160.
[128] V Daniels and J. Kosek, "Studies on the Washing of Paper. Part 1: The Influence of Wetting on the Washing Rate." *Restaurator* (2004): 82.
[129] Wolf Green, "Conservation of Tapa Cloth from the Pacific," 27.

small unwetted patches (had not darkened like the wetted parts) which appeared to be repelling the water. It was thought that this could be a contemporary product used in the manufacturing process which had not been specified by the manufacturer.

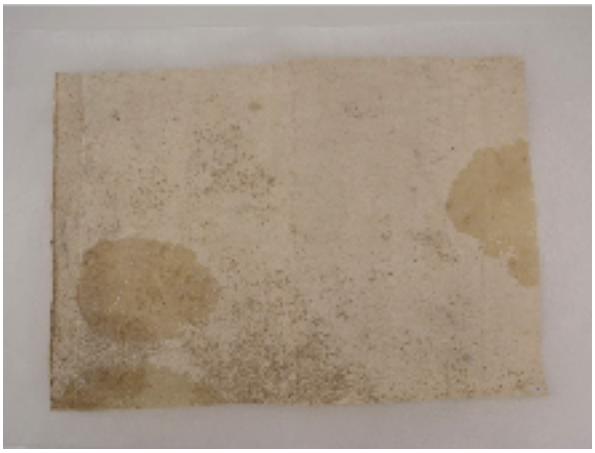


Fig. 16 Float washing new barkcloth sample showing uneven wetting. Fig. 17 Detail of white patches on new barkcloth (showing where the water has not penetrated)

During the tests it became evident that the starch-based adhesive was water soluble. Within 15 mins, the paste had solubilised and the two sheets, slightly separated and could be easily lifted, using little force. However, if the sheets were not physically separated, the two layers remained together.

Fig. 18 Detail of separated sheets (showing the adhesive paste used to join two sheets of new barkcloth).

Drying: weighted with glass plates around the all four edges and allowed to air dry overnight. The following morning, the sample was still slightly damp, particularly where the glass weights had been left overnight.

Once dry, the two pasted sheets, which been separated slightly in the wash bath had re-adhered together firmly.

Sample 2: The sample was float washed similarly to the previous. This time, once placed on the reemay, it was immediately sprayed with the water, to ensure even and faster wetting, by making good contact with the reemay.
As before, the adhesive at the join between two sheets began to solubilise rapidly. This time, the two sheet were intentionally separated by gently lifting the smaller piece off. This was done, in order to make a closer inspection of the paste. The paste was lifted off by scraping lightly with a small spatula. The paste appeared similar in look and texture to semi-dry PVA glue and malleable.

Drying: Fan assisted. The drying time was reduced to 2 ½ hours with the use of a fan. The sample was weighted around the edges and across the middle section with sandbag weights and the weight were moved around every 5-10 mins.

Sample 3: was washed in the same way as sample 2.

Drying: Fan assisted. The sample was first covered with a layer of dry cotton cloth, then a piece of correx board (dimensions slightly larger than the sample) and weighted with sandbag weights. The fan was directed onto the sample and the weights and correx board were periodically removed to allow the air to reach the surface, and then replaced to help the sample to stay smooth.

After several hours with fan assistance the sample was still damp as it was unable to dry out under the correx board. At the end of the day, the test was abandoned and the sample left in this same state to investigate what would happen to the barkcloth after a prolonged time in a damp environment. Not unexpected, after 10 days, the sample had developed widespread fungal growth.

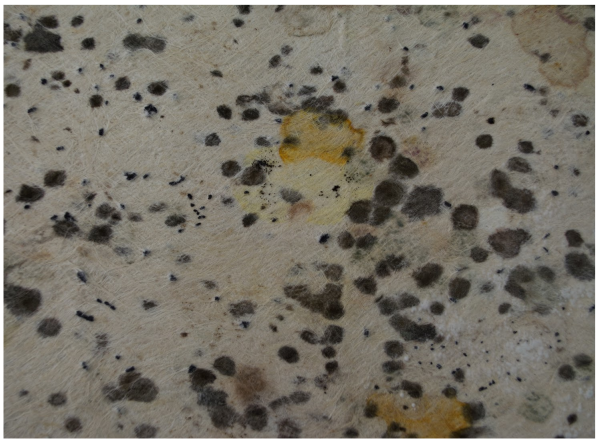



Fig. 19 Mould growth on new barkcloth after wet cleaning. Fig. 20 Detail of mould growth.

7.8 New barkcloth samples: Test 2

Evaluation of the new barkcloth test 1 concluded that the drying methods had not been completely successful. A new set of drying tests were devised, using a method known in paper conservation as a "blotter stacks" and the methods were followed as applied to drying paper,[130] which could then be compared with the previous set. Two new materials were introduced: Gore-Tex® (Polytetrafluoroethylene, barrier polyester felt laminate) and Sympatex® (moisture permeable synthetic material).
All four samples (measuring 320x230mm) were first immersed in water until completely wetted out. The samples were removed from the water and the excess water was blotted off with cotton cloths. The four samples were then dried as follows:

Sample 1: On the work surface: A layer of reemay, followed by a layer of dry blotting paper, sympatex, the sample, another layer of sympatex, a second sheet of dry blotting paper, followed by another sheet of reemay and four glass weights on top.

Sample 2: The sample was prepared using the sample 1 method. For this sample, gore-tex was used instead of sympatex.

[130] Irene Brückle and Gerhard Banik, "Drying Paper in Conservation Practice," in *Paper and Water: A Guide for Conservators,* ed. Gerhard Banik and Irene Brückle *(*Oxford: Butterworth-Heinemann, 2011): 409.

After 15 mins there was no change evident. It appeared there had been little evapouration of water from the samples through the semipermeable material as the blotting paper in the both stacks was still quite dry, only feeling slightly cold (damp) to the touch. The material was placed back in the stack and covered for a further 15 mins. After this period, the material was checked again and the blotting paper had absorbed more moisture from the sample as it felt slightly damp to the touch.
The sympatex and gore-text from both remained in contact with the barkcloth, whilst the blotting paper was replaced with new dry pieces and the stack was covered again with the reemay and glass weights. The stacks were then left for a further 30 mins and at this point, the blotting paper was replaced again with dry sheets and the stack was put together again and left weighted overnight.

Sample 3: On the work surface: Layer of reemay, followed by one sheet of dry blotting paper, the sample, another sheet of dry blotter. The whole stack was covered with a sheet of reemay and four glass weights.
After 15 minutes, the blotting paper was damp compared to the sheets in samples 1 and 2. The blotting paper was replaced with new dry sheets and the stack was left weighted for a further 15 minutes.

Sample 4: The sample was placed on a sheet of reemay on the work surface and weighted around the four edges with glass weights over small strips of blotting paper. A cool hairdryer on a low power setting was used to speed up the drying time and the glass weights were moved around periodically to ensure even drying.
This was tested for application in barkcloth drying as the method is frequently used in textile conservation after wet cleaning. For example, when there are unstable dyes and rapid drying is required to minimise the risk of colour run.

After 15 minutes, the sample was turned over, although the front side was at this stage close to completely dry, the back side was still damp. Drying with the hairdryer continued for a further 15 mins on the reverse. Afterwards the sample was turned over again, face side up to dry the last few small patches of damp.

Table 11: Drying method and material: 4 new barkcloth samples.

Sample	Order of materials	Drying method
1	1. work surface 2. reemay 3. dry blotter paper 4. sympatex (shiny side down) 5. wet sample 6. sympatex (shiny side up) 7. dry blotting paper 8. reemay 9. 4 x glass weights	1. stack covered for 30 mins. 2. replaced with new dry blotter. 3. covered again for 30 mins. 4. replaced with new dry blotter. 5. left overnight.
2	1. work surface 2. reemay 3. dry blotting paper 4. gore-tex (shiny side down) 5. wet sample 6. gore-tex (shiny side up) 7. dry blotting paper 8. reemay 9. 4 x glass weights	1. stack covered for 30 mins. 2. replaced with new dry blotter. 3. covered again for 30 mins. 4. replaced with new dry blotter. 5. left overnight.
3	1. work surface 2. reemay 3. dry blotting paper 4. wet sample 5. dry blotting paper 6. reemay 7. 4 x glass weights	1. stack covered for 15 mins. 2. replaced with new dry blotter. 3. covered again for 15 mins. 4. replaced with new dry blotter. 5. covered again for 15 mins. 6. replaced with new dry blotter 7. left overnight.

4	1. work surface 2. reemay 3. wet sample 4. 4 x glass weights	1. sample face up and edges weighted with glass weights over strips of blotting paper. 2. dried with hair dryer for 15 mins and weights moved periodically. 3. sample turned over dried with hair dryer for 15 mins. 4. sample turned back to face up and weighted around the edges and left overnight.

7.9 Results and discussion for new barkcloth test 1 and 2:

Float washing the samples on a rigid support such as Reemay® made handling the cloth safer, as not having to handle the edges meant the risk of lifting or separating layers was minimised. This is particularly significant when considering the edges of tapa sheets are often the thinnest part the cloth and so also the most vulnerable, as this would have been the area which sustained the most beating during manufacture.[131]
After using larger samples than that of the preliminary tests, it became evident that the drying process was complex and the barkcloth was slow to dry and attempting to keep the barkcloth completely smooth, inhibited the full drying of the cloth.
Without good airflow to the sample, there was an ability to dry properly, which was noticeably most dramatically in the growth of mould on sample 3. In addition to this, starchy substance such as adhesives or sizing materials would also encourage the biodeterioration.

A survey of historical literature revealed that several practices during manufacture, storage and use of tapa, either serendipitously were mold inhibiting or were intentionally performed to help minimise the risk of biodeterioration.

[131] Hill. "Traditional barkcloth from Papua New Guinea," 44.

For example, heat and cooking smoke from the open kitchen fire would have naturally kept tapa sheets or bundles dry, whilst the aldehydes in the wood smoke would have had a preservative effect.[132]

7.10 Slant washing

Slant washing is a technique used in paper conservation for rinsing and removing any cleaning agents.[133] It involves placing the pre-wetted object on a moisture permeable material such a synthetic fleece,[134] on an angled solid support made from perspex or similar material. Running water flows down from the top of the slope through the fleece, [135] dissolving soiling and transporting it out at the bottom.

The rationale for selecting this technique for testing was due to the mention of a tilted bath as a method used by two of the survey respondents. Respondent 11, stated that the use of *"damp capillary matting and tilted bath can be very effective without disturbing the item too much"* and a slant wash on perspex was also used by Bakken and Aarmo (1981). [136] Whist, there is a similarities to wet cleaning methods used in textile conservation, when the wash bath is raised at an angle during the rinsing stage of treatment to aid in the removal and drainage of dirty water and detergent.

The experiment was set up in the wash table (the table itself was too large for the sample, which meant a smaller slope needed to be constructed. An upturned plastic tray was used to make a slant of 30-40 degree angle which sat in a wash tray for the water to collect at the bottom. The slope was covered with a length of pre-wetted reemay. Two samples (labelled as 17 and 18) of the painted barkcloth with approximate dimensions of 150x170mm were prepared for the tests.

Using the spectrophotometer, average measurements were taken for both samples using the same method as previously mentioned. For this experiment as the samples were

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[132] Hill. "Traditional barkcloth from Papua New Guinea," 35.
[133] Harnly et al, "Washing," 37.
[134] Kosek, "Washing Paper in Conservation," 327.
[135] Kosek, "Washing Paper in Conservation," 327.
The upper edge of the fleece is dipped in a reservoir of water, making it wet, whilst water drains out of the lower edge into a tray at the end of the slope.
[136] Bakken, "A Report on the Treatment of Barkcloth," 2.

significantly larger than those from the early experiment, it was decided to take two measurements from separate locations for 3 colours.
The samples were individually soaked in a wash bath for 10 mins, and afterwards, removed and the excess water allowed to drip off. The sample was then placed on the pre-wetted reemay on the slope and a hose placed at the top of the slope for 1 minute to allow a slow steady stream of water to flow (similar to a running rinse) down away from the sample. After 1 minute the sample was removed, and again soaked in a fresh bath for a further 10 minutes. After this period, the sample was placed as before on the slant, and the running rinse was performed again for a further 1 minute.
Afterwards, the excess water was removed by sandwiching the sample in cotton botting cloths and gently applying pressure.

7.15 pH of samples

pH indicator strips were used to test the acidity of the samples before and after wet cleaning.
After wetting out, the samples were measured at pH 6 and after 10 minutes of soaking, the samples measured between pH 6.5 and 7. By the 2nd rinse, the pH was raised to 7-7.5.

Fig. 21 Slant wash set-up. Fig. 22 Beakers of wash bath water

7.16 Drying

Once blotted dry, the cotton cloths were removed and the samples placed on dry reemay sheet. The samples were weight around the edges with glass weights and the sample was dried using a cool hairdryer. Over a period of 20mins, the glass weights were periodically moved around to ensure all parts were evenly dried and the sample was kept smooth.

7.17 Results and discussion

During the first soak, the bath water developed a pale yellow colour and during the first slant wash (running rinse), further yellow discolouration was observed to flow out of the sample and into the fresh bath. This was not observed again during the 2nd wash or 2nd slant, and the pH had already raised to 7. This appears to show that washing was very effective during the first round of soak and slant washes. However, as the samplers were not obviously soiled to begin with, a series of washes may be more appropriate for more soiled material.

The method did not allow for control over how wet the sample became and the theory that the water would flow through the absorbent material under the sample in practice. Once the sample had become saturated, the water began to flow over the painted side of the sample.
There was also very little control over the handling of theobject using this method, as due to the height of the slant, there was a tendency for the sample to slip down from it position. This could have been solved by reducing the height of the slant and sandwiching the object between a sheet of transparent polyester film (melinex). It was not possible to pursue further slant wash experiments during this project, however small alterations to the method and practice may lead to better results.

7.18 Overall results and conclusion

Opting for cotton cloths over paper to dry samples. Blotting paper tended to wrinkle quickly when wet, prohibiting the samples from staying flat. Cotton blotting cloths were

more successful. Reemay was a sturdy support for the wet barkcloth. Whilst it also proved an effective material for laying out the sample to dry on as it stayed smooth/flat. The adhesive paste proved to be highly water sensitive, dissolving rapidly, and once solubilised, the layers could be physically peeled apart with little effort.
however supporting the sample on the reemay and without agitation in the wash bath meant that the layers stayed together and once dry had returned to being firmly secure. Prolonged soaking was not experimented with and so it is not possible to say whether the adhesive would have completely dissolved and led to voluntary/spontaneous separation of layers.

Chapter 8 Conclusion

8.1 Conservation literature and survey

The vast majority of conservators working with barkcloth have a diverse range of expertise and skillsets and there appears to be a common practice for adapting paper and textile conservation washing methods for the conservation of tapa, seen in the conservation literature and from the response to the questionnaire. The American Institute of Conservation (AIC) has a long established Objects Speciality Group, for the purpose of creating dialogue across disciplines by bringing together conservators from ethnography, archaeology, sculpture, decorative arts, historic collections and contemporary art specialisms. Whilst the recently formed *Icon Networks,* will promote a similar interdisciplinary collaboration.[137]

It can be assumed from the questionnaire that wet cleaning remains an infrequent method of treatment for barkcloth, as less than half of the respondents had undertaken any wet cleaning treatments. Similarly to the concerns raised in the literature, a major factor for the infrequency of wet cleaning were ethical considerations including the potential loss of pre-acquistion or soiling of evidential value and the risks of damage to

[137] Emily M. Williams. “Cross-disciplinary Conservation – is this the way forward?” *Journal of the Institute of Conservation* May, (2017): 1-11

the object incurred by the process, including separation of layers or parts, loss colourants and other decorative media.
The high number of respondents noting pre-acquistional soiling and staining of unknown origin could demonstrate that characterising or determining the source of soiling on ethnographic object can be a complex process, and is a major ethical consideration determining the course of treatment.
The high number of respondents to the questionnaire stating "as advised by the source community" as a context for treatment, demonstrates that this a strong motivation and an openess to input and meeting the needs of many stakeholders. Whilst another major factor was for exhibition and display demands.
Looking at the literature review and the questionnaire together helps to piece together how the conservation of tapa has progressed. It may well have been helpful however, to ask respondents at what stage they had carried out wet cleaning treatments and whether the work had been published, in order to put together a more complete timeline.

8.2 Practical aspects of wet cleaning

During the practical tests it was evident that even wetting was essential in order to avoid causing pools of water which could potential cause damage or water staining. Pre humidification may have helped to prevent this, to ensure full contact between the material and water surface tension. However, tapa may be impacted in the same way that, mould, foxing stains, oils, sizing material and residues will all affect the ability for paper to wet out evenly. [138]
The use of a rigid support, such as reemay was very effective, as it minimised the need for handling and reduce the risk of damage to vulnerable edges. This is also gave overall support for the material which appeared to be significantly weaker when wet.
Drying tapa can be as equally a complex operation as the washing process. Weighting the cloth clearly helped to prevent noticeable shrinkage and warping. However, completing covering the sample during the drying process in some cases, prevented air flow, which lead to mould growth, in one example. An essential step to this method of

[138] Kosek, 2011.

drying is to replace blotting paper or cloths with fresh dry sheets until the object is completely dry. This ensures that the damp tapa does not stay in equlilibrium with the damp blotter.

8.3 Further research

As there is huge diversity in the manufacturing, use of colourants, and methods of decoration that testing just two types of tapa during this project, can only result in tentative prediction for the affects of wet cleaning treatment and as phrased by Wolf Green, there is"the potential for individual eccentricities".[139] The potential for alterations to or loss of pigments or dyes is clearly a major concerns.

During this investigation, experiments were carried out on making beater marks on new barkcloth, with some success. It may be possible to produce samples to test the impact of water treatment on beater marks. Further investigation into this would be called for, as the results from previous treatments have showed varying results, from unaffected to slightly raised after wetting.[140]
Furthermore, a recommendation, relating to paper conservation made by Kosek (2011) was to avoid placing pressure on embossed or textured paper.[141] This may be a potential concern to consider for tapa that has decorative watermarks.

[139] Wolf Green, "Conservation of Tapa Cloth from the Pacific," 132.
[140] Firnhaber, "Hawaiian Oiled and Mamaki Tapa: Characterisation and Conservation," 181.
[141] Kosek, 2011.

Bibliography

Austin-Dennehy, Michele; Greta Hansen; Natalie Firnhaber; and Bob Muens. “The US Exploring Expedition (Wilkes) Tapa Project.” ICOM International Committee for Conservation Ethnographic Conservation Newsletter 35, (October 2013), 5-11.

Babdzan, Alain. “The Gods Stripped Bare”. In Clothing the Pacific. Edited by Chloë Colchester, 25–49. Oxford: Berg, 2003.

Bakken, Arne and Kirsten Aarmo. A Report on the Treatment of Barkcloth. ICOM Committee for Conservation: 6th Triennial Meeting, Ottawa, 21-25 September 1981; Preprints, Volume 4. Paris: International Council of Museums, 1981, 1-4.

Barton, Gerry and Sabine Weik. “The Conservation of Tapa”. The Conservator 18, no.1 (1994): 28-40.

Bastian, Robin; Stephanie Luerssen; and Regina Klee. “Before the Opening: Aspects of Conservation and Installation.” In Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014. Edited by Peter Mesenhöller and Annemarie Stauffer. Newcastle upon Tyne: Cambridge Scholars Publishing, 2015, pp.107-116.

Bauer, Wilhelm; Zobl, Roswitha. "Rindenbaststoffe aus der Wiener Cook-Sammlung. Technologie - Konservierung – Restaurierung (Bark Objects in the Vienna Cook Collection". Conservation-restoration of leather and wood; Training of restorers; Sixth International Restorer Seminar, 1987 Veszprém. Hungary. Budapest: National Centre of Museums, 1998, 45-54.

Brückle, Irene and Gerhard Banik. “Drying Paper in Conservation Practice”. In Paper and Water: A Guide for Conservators, edited by Gerhard Banik and Irene Brückle Oxford: Butterworth-Heinemann, 2011, 389-418.

Cruickshank, Pippa; and Helen Morgan. “Lining a Banana Fibre Belt: A Cool Vacuum Table Technique (1993)”. Changing Views of Textile Conservation. Edited by Mary M. Brooks and Dinah D. Eastop. Los Angeles, Calif. Getty Conservation Institute 2011, 501-511.

Colchester, Chloë. “Objects of Conversion: Concerning the Transfer of Sulu to Fiji”. The Art of Clothing: A Pacific Experience. Edited by Susan Kuchler and Graeme Were. London: UCL Press, 2005.

Colchester, Chloë. Clothing the Pacific. Oxford: Berg, 2003.

D’ Alleva, Anne. “Change and Continuity in Decorated Tahitian Barkcloth from Bligh’s Second Breadfruit Voyage, 1791-1793.” Pacific Arts 11, no. 12 (July 1995), 29-42.
Daniels, V. “The Characteristics of Modern and Old Barkcloth (tapa)”. The Conservator 29, no. 1 (2005): 95-104.

Daniels, V; J. Kosek. “Studies on the Washing of Paper. Part 1: The Influence of Wetting on the Washing Rate.” Restaurator (2004): 81-93.

Daniels, Vincent; and Joanna Kosek. “The Rate of Washing Paper”. Studies in Conservation 47, sup 3, (2002): 47-51.

Daniels, V. “An Investigation into the Reasons for the Deterioration of Barkcloth.” British Museum Conservation Research Group Report, no. 3, (London: British Museum, 2001): 1-13.

Daniels, Vincent and Yvonne Shashoua. “Wet Cleaning of Paper and Textiles: Similarities and Differences”. In Paper and Textiles: The Common Ground. Compiled by Fiona Butterfield and Linda Eaton, 19-27. Glasgow: Scottish Society for Conservation and Restoration, 1991.

Douglas, Bronwen. “Pre-European Societies in the Pacific Islands”. In Culture Contact in the Pacific: Essays on Contact, Encounter and Response. Edited by Max Quanchi; Ron Adams, 15-30. Cambridge: Cambridge University Press, 1993.

Dupont, A. L. “Degradation of Cellulose at the Wet/Dry Interface. 1. The Effect of Some Conservation Treatment on the Formation of Brown Lines”. Restaurator 17, (1997):1-21.
Erhardt, David; and Natalie Firnhaber. “Analysis and Identification of Oils in Hawaiian Oiled Tapa”. Recent Advances in the Conservation and Analysis of Artifacts. Compiled by James Black. London: University of London Institute of Archaeology Summer School Press. 1987, 223-227.

Eves, Richard. “Colonialism, Corporeality and Character Methodist missions and the refashioning of bodies in the Pacific.” Journal of History and Anthropology 10, no. 1 (1996): 85-138.

Firnhaber, Natalie; and David Erhardt. “Hawaiian Oiled and Mamaki Tapa: Characterisation and Conservation”. Symposium 86: The Care and Preservation of Ethnological Materials, Ottawa, September 1986. Edited by R. Barclay, M. Gilberg, J. C McCawley and T. Stone. Ottawa: Canadian Conservation Institute,1986, 178-185.
Firnhaber, Natalie. “The Conservation of Bark Cloth”. Newsletter (Museum Ethnographers Group) No. 8, (September 1979): 19-21.

Ford, Bruce. L. “Monitoring Colour Change in Textiles on Display”. Studies in Conservation 37, No. 1 (1992), 1-11.

Hakari, Anna. “The Conservation of a Bark Cloth Using Tapioca Starch”. In Starch and Other Carbohydrate Adhesives for Use in Textile Conservation. Edited by Pippa Cruickshank and Zenzie Tinker, 14-19. London: United Kingdom Institute for Conservation, 1996.

Hill, Rowena. “Traditional barkcloth from Papua New Guinea: materials, production and conservation”. Barkcloth: Aspects of Preparation, Use, Deterioration, Conservation and Display: Seminar Organised by the Conservators of Ethnographic Artefacts at Torquay Museum on 4 December 1997. Edited by Margot M. Wright, 24-55. London: Archetype Publications, 2001.

Hillyer, Linda. Zenzie Tinker; and Poppy Singer. “Evaluating the use of Adhesives in Textile Conservation (1997)”. Changing Views of Textile Conservation. Edited by Mary M. Brooks and Dinah D. Eastop. Los Angeles, Calif. Getty Conservation Institute 2011, 472-491.

Hooper, Simon. In Pacific Encounters: Art & Divinity in Polynesia, 1760-1860, London: The British Museum Press, 2006. Hooper, Simon. Gatu Vakaviti. The Great Barkcloths of Southern Lau, Fiji. Pacific Material Culture: Essays in honour of Dr. Simon Kooijman on the occasion of his 80th birthday. Edited by Dirk Smidt; Pieter ter Keurs; and Albert Trouwborst, ??-??. Leiden: Rijksmuseum voor Volkenkunde, 1995.

Huhsmann, Enke; Ulrike Hahner. “Application of the Non-Woven Viscose Fabric Para print OL 60 for Float Screen Washing of Documents by Iron Gall Ink Corrosion”. Restaurator, 28, (2007): 140-151.

Hulkenberg, Jara. “Masi: House and Cloth of the Vanua”. Journal of Material Culture. 21, no.2, (2016): 187-204.

Hutchins, J. K. “Water-Stained Cellulosics: A Literature Review”. Journal of the American Institute for Conservation 22, no. 2 (Spring 1983): 57-61.

Johansen, Katia. “Perfumed Textiles”. Textile Society of America. 11th Biennial Symposium Proceedings. Honolulu, Hawaii (2008): 1-11. Accessed Sep 7, 2017. http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1217&context=tsaconf.

Johnson, Emily. “The Deacidification and Conservation of a Samoan Tapa at the Manchester Museum”. Barkcloth: Aspects of Preparation, Use, Deterioration,

Conservation and Display: Seminar Organised by the Conservators of Ethnographic Artefacts at Torquay Museum on 4 December 1997. Edited by Margot M. Wright, 71-95. London: Archetype Publications, 2001.

Kaeppler, Adrienne L. “Culture, Conservation and Creativity: Two Centuries of Polynesian Barkcloth”. In Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014. Edited by Peter Mesenhöller and Annemarie Stauffer. Newcastle upon-Tyne: Cambridge Scholars Publishing, 2015, pp. 2-14.

Kaeppler, Adrienne L. The Pacific Arts of Polynesia and Micronesia. Oxford: Oxford University Press, 2008.

Kaeppler, Adrienne L. “Poetics and Politics of Tongan Barkcloth”. In Pacific Material Culture: Essays in honour of Dr. Simon Kooijman on the occasion of his 80th birthday. Edited by Dirk Smidt; Pieter ter Keurs; and Albert Trouwborst. Leiden: Rijksmuseum voor Volkenkunde, 1995.

Kooijman, Simon. Tapa in Polynesia. Honolulu: Bishop Museum Press, 1972.
Kosek, Joanna M. “Washing Paper in Conservation”. In Paper and Water: A Guide for Conservators. Edited by Gerhard Banik and Irene Brückle Oxford: Butterworth-Heinemann, 2011, 313-339.

Konica Minolta, Inc. “Precise Color Communication.” (Konica Minolta, Inc. 2007-2013).

Kronkright, Dale Paul. “Deterioration of Artifacts Made From Plant Material.” in The Conservation of Artifacts Made from Plant Materials. Edited by Mary-Lou E. Florian, Dale Paul Kronkright, Ruth E. Norton, 168-?. Los Angeles: Getty Conservation Institute, 1990, 139-193

Lawson, Barbara. “Clothed and in their Right Mind’: Women’s Dress on Erromango, Vanuatu”. Pacific Arts, no. 23/24 (2001): 69-86.

Lee, David J.; Louise Bacon; and Vincent Daniels. “Some Conservation Problems Encountered with Turmeric on Ethnographic Objects”. Studies in Conservation 30, 4 (1985): 184-188.

Lever, R. J. A. W. “Whales and Whaling in the Western Pacific”. South Pacific Bulletin, (April 1964): 33-36.

Lythberg, Billie; and Phyllis Herda. “Ngatu’uli: Exhibiting the Fine Art of Contemporary Tongan Black Barkcloth in New Zealand”. Journal of Museum Ethnography, no. 29 (March 2016): 131-151.

Moropoulou, A. and S. Zervos. “The Immediate Impact of Aqueous Treatments on the Strength of Paper”. Restaurator (2003): 160-177.

Nash Munro, Susan. “The Conservation of a Hawaiian Sleeping Tapa”. ICOM Committee for Conservation: 6th Triennial Meeting, Ottawa, 21-25 September 1981; Preprints, Volume 4. Paris: International Council of Museums, 1981.

Neich, Roger; and Mike Pendergrast. Traditional Tapa Textiles of the Pacific. London: Thames and Hudson, 1997.

Newell, Jenny. “Exotic possessions: Polynesians and their eighteenth-century collecting”. Journal of Museum Ethnography 17. Pacific Ethnography, Politics and Museums, (2005): 75-88.

Norton, Ruth E. “Technology of Plant Materials Used in Artifacts”. in The Conservation of Artifacts Made from Plant Materials. Edited by Mary-Lou E. Florian, Dale Paul Kronkright, Ruth E. Norton, 83-138. Los Angeles, Calif: Getty Conservation Institute, 1990, 83-138.

Norton, Ruth E. “Conservation of Artifacts Made From Plant Material”. in The Conservation of Artifacts Made from Plant Materials. Edited by Mary-Lou E. Florian, Dale

Paul Kronkright, Ruth E. Norton, 83-138. Los Angeles, Calif: Getty Conservation Institute, 1990, 195-285.

Peranteau, Anne. “Gellan Gum as Material for Local Stain Reduction”. In Conserving Modernity: The Articulation of Innovation; Preprints of the 9th North American Textile Conservation Conference (NATCC), San Francisco, November 12-15. San Francisco: NATCC, 2013, 72-85. [CD-ROM].

Poulpiquet, Anne-Claire de. “Identification of Oil on Hawaiian Barkcloths and their Treatment: Looking for the Suitable Adhesive”. In Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014. Edited by Peter Mesenhöller and Annemarie Stauffer, Newcastle upon-Tyne: Cambridge Scholars Publishing, 2015, 144-156.
Poulpiquet, Anne-Claire de. Starch Pastes on Barkcloth: A Comparison Study Using Mechanical Tests of Three Starches. Journal of paper conservation: IADA. Vol. 13, no. 4 (2012): 8-14.

Poulpiquet, Anne-Claire de. “Conservation of a Hawaiian Kapa: use of size-exclusion chromatography (SEC) for the evaluation of cellulose degradation caused by oil and sodium chloride.” Journal of the Institute of Conservation. Vol. 35, no.1 (March 2012): 50-61.

Pullan, Monique. “An Introduction to the Conservation of Barkcloth at the British Museum”. In Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014. Edited by Peter Mesenhöller and Annemarie Stauffer, Newcastle upon-Tyne: Cambridge Scholars Publishing, 2015, 129-143.

Reynolds, Pauline. “Tapa Cloths and Beaters: Tradition, Innovation and the Agency of the Bounty Women in Shaping a New Cult”. Journal of Textile History 47, no. 2, (2016): 190-207

Rose, Roger G; Carol Turchan; Natalie Firnhaber and Linnea O. Brown. “The Bishop Museum Tapa Collection Conservation and Research into Special Problems.” Bishop Museum Occasional Papers 28, (February 1988): 1-34.

Salmond, Anne. “Their Body is Different, Our Body is Different: European and Tahitian Navigators in the 18th Century”. Journal of History and Anthropology 16, no. 2 (2005): 167-186.

Sharrad, Paul. “‘Tapa’ and Text: Hybrid Technologies and Pacific (Re) Possession., University of Wollongong”. Journal of Pacific Arts 3-5, (2007): 128-138.

Smith, Anthony W. “Cellulose: In Paper and Textiles”. In Paper and Textiles: The Common Ground. Compiled by Fiona Butterfield and Linda Eaton. Glasgow: Scottish Society for Conservation and Restoration, 1991.

Souguir, Zied; Anne-Laurence Dupont; E. Rene de la Rie. “Formation of Brown Lines in Paper: Characterization of Cellulose Degradation at the Wet-Dry Interface”. Biomacromolecules 9, (2008): 2546-2552.

Tcherkezoff, Serge. “On Cloth, Gifts and Nudity”. In Clothing the Pacific. Edited by Chloë Colchester, 51-75. Oxford: Berg, 2003.

Thomas, Nicholas. “Savage Island’ Hiapo”. In Hiapo: Past and Present in Niuean Barkcloth. By John Pule; and Nicholas Thomas. Dunedin, N. Z: Otago University Press, 2005.

Thomas, Nicholas. “The Case of the Misplaced Poncho: Speculations Concerning the History of Cloth in Polynesia”. Journal of Material Culture 4, no. 1 (1999): 5-20.

Tímár-Balázsy, Ágnes. “Wet Cleaning of Historical Textiles: Surfactants and Other Wash Bath Additives”. Studies in Conservation 45, sup 3, (2000): 46-64.

Ward Gallery, Christine. Kinship to Kinship: Gender Hierarchy and State Formation in the Tongan Islands. Austin: University of Texas Press, 1987.

Williams, Emily M. “Cross-disciplinary Conservation – is this the way forward?” Journal of the Institute of Conservation May, (2017): 1-11.

Wilson, Helen; Chris Carr and Marei Hacke. “Production and Validation of Model Iron-tannate Dyed Textiles for Use as Historic Textile Substitutes in Stabilisation Treatment Studies.” Chemistry Central Journal 6, no. 44, (2012): 1-13.

Winner, Calvin. “Pacific Encounters: A Conservation Perspective”. Journal of Museum Ethnography 21, Encounters with Polynesia: Exhibiting the Past in the Present (March 2009): 57-68.

Wonu Veys, Fanny. “A Feast For the Senses: Barkcloth During Royal Ceremonies in Tonga.” In Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014. Edited by Peter Mesenhöller and Annemarie Stauffer, 42-57. Newcastle upon-Tyne: Cambridge Scholars Publishing, 2015.

Wonu Veys, Fanny. “Barkcloth in Tonga, 1773-1900: Presenting the Past in the Present”. Journal of Museum Ethnography, No. 17, Pacific Ethnography, Politics and Museums (2005): 101-117.

Wolf Green, Sara. “Conservation of Tapa Cloth: Filling Voids”. The Paper Conservator 11, 1, (1987): 58-62.

Wolf Green, Sara. “The Treatment of a Tapa Cloth with Special Reference to the Use of the Vacuum Suction Table”. Historic Textile and Paper Materials II: Conservation and Characterization. ACS Symposium Series 410. Edited by S. Haig Zeronian; Howard L. Needles. Washington, DC: American Chemical Society, 1987, 168-186.

Wolf Green, Sarah. “Conservation of Tapa Cloth from the Pacific”. The American Institute for Conservation of Historic and Artistic Works Preprints of Papers Presented at the Fourteenth Annual Meeting, Chicago, Illinois, 21-25 May 1986. Washington, D.C.: American Institute for Conservation of Historic and Artistic Works, 1986, 168-186.

Wolf, Sara J. “Repair and Display of Fijian Tapa Cloth”. Conservation Notes: An Occasional Periodical of the Materials Conservation Laboratory Texas Memorial Museum, No. 5. Austin: The University of Texas at Austin, 1983, 1-4.

Wolf, S; and G. Fullman. “A Report on the Treatment of Barkcloth”. ICOM Committee for Conservation: 6th Triennial Meeting, Ottawa, 21-25 September 1981; Preprints, Volume 4. Paris: International Council of Museums, 1981.

Wolf, Sara J.; and Gladys Fullman. “Notes on the Treatment of Fijian Tapa Cloths.” AICCM Bulletin 6, no. 3-4 (1980): 58-64.

Young, Rosalind Amelia. Mutiny of the Bounty and story of Pitcairn Island, 1790-1894. Mountain View, Calif.: Pacific Press Publishing Assoc., 1894.

Zobl, Roswitha. “Barkcloth in the WorldMuseum Vienna”. In Made in Oceania: Proceedings of the International Symposium on Social and Cultural Meanings and Presentation of Oceanic Tapa, Cologne, 16-17 January 2014. Edited by Peter Mesenhöller and Annemarie Stauffer. Newcastle upon Tyne: Cambridge Scholars Publishing, 2015, 117-128.

Zobl, Roswitha. “Die Restaurierung eines Tapa-Stoffes aus der Wiener Cook-Sammlung (Restoration of a Tapa Cloth from the Cook Collection in Vienna).” Restauratorenblatter 8 (1985-1986), 121-126.

Web sources

Australian Institute for the Conservation of Cultural Material, "Conservation Distlist," (Last accessed: 7/09/ 2017) https://aiccm.org.au/conservation-distlist.
Bishop Museum. "The Care of Tapa". Art Conservation Handout. Honolulu, Hawai'i: Bishop Museum, 1996.

Harnly, Marc W, Cecile Mear and Janet E. Ruggles, "Washing" in Paper Conservation Catalog: Seventh Edition. (Washington D.C.: American Institute for Conservation Book and Paper Group, 1990), 16.1-16.49. (last accessed: 07/09/2017) http://cool.conservation-us.org/coolaic/sg/bpg/pcc/16_washing.pdf.

Scottish Water. "Scottish Water Hardness Data Sheet, 2016." (last accessed 07/09/2017) http://www.scottishwater.co.uk/-/media/Domestic/Files/You-and-Your-Home/Water-Quality/Scottish-Water-Hardness-Data.pdf?la=en.

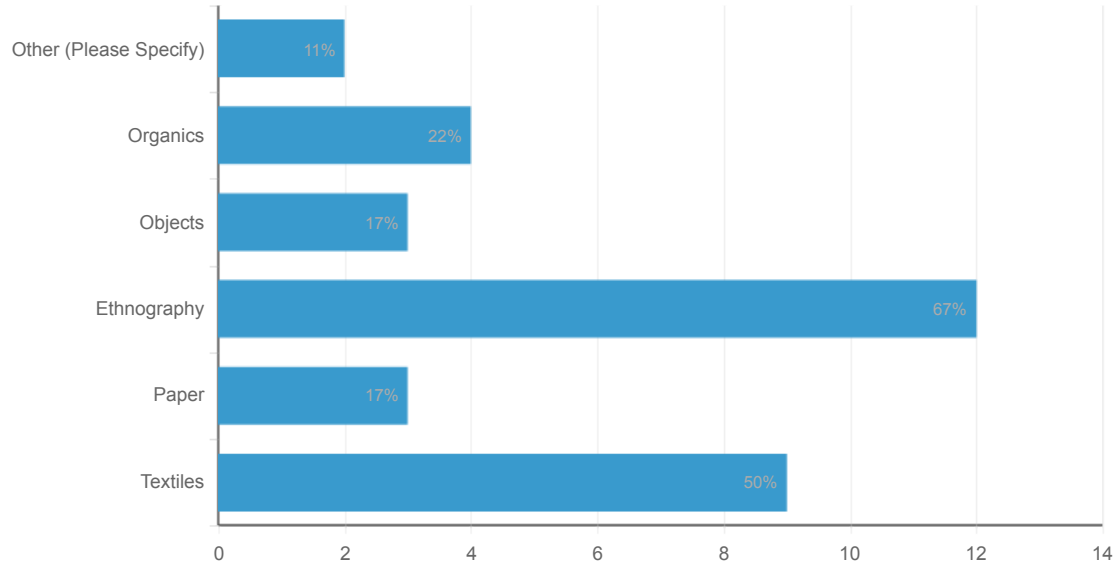
Tapa: Situating Pacific Barkcloth in Time and Place. "The Project" (last accessed: 07/09/2017. http://tapa.gla.ac.uk/project/.

Questionnaire on Pacific barkcloth wet cleaning treatments

Q1

Which would best describe your area of expertise.

Answered: 18 Skipped: 0



	Response Percent	Response Count
Textiles	50.0%	9
Paper	16.67%	3
Ethnography	66.67%	12
Objects	16.67%	3
Organics	22.22%	4
Other (Please Specify)	11.11%	2

1. related materials
2. objects and textiles

Q2

In which country do you work in?

Answered: 18 Skipped: 0

1 . Austria

2 . Scotland - UK

3 . United States

4 . India

5 . UK

6 . Germany

7 . New Zealand

8 . Australia

9 . New Zealand

10 . American Samoa

11 . UK

12 . USA

13 . Germany

14 . US

15 . UK

16 . Austria

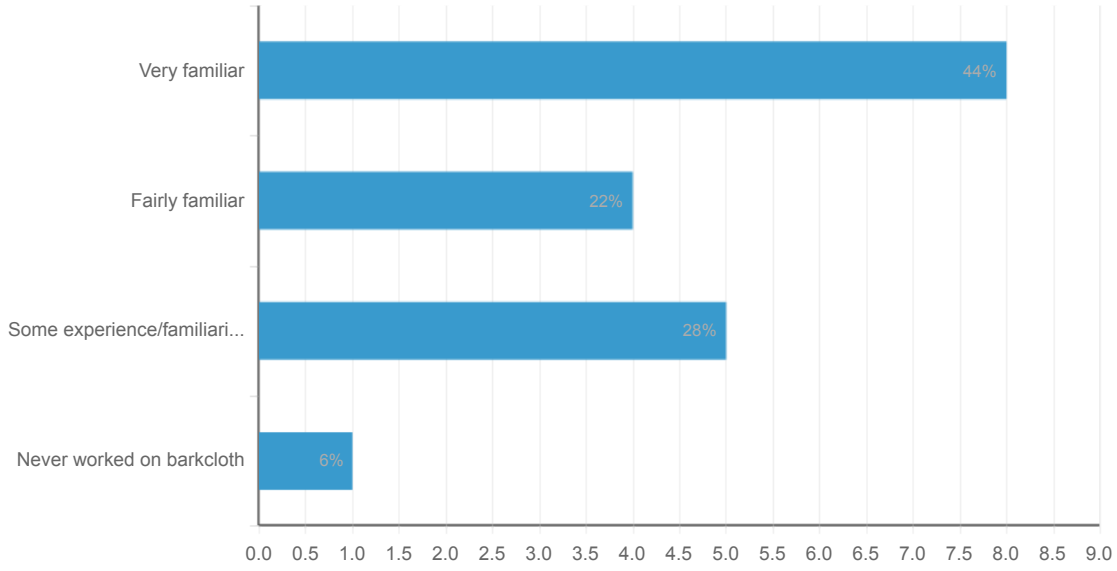
17 . UK

18 . USA

Q3

How familiar are you with working on barkcloth?

Answered: 18 Skipped: 0

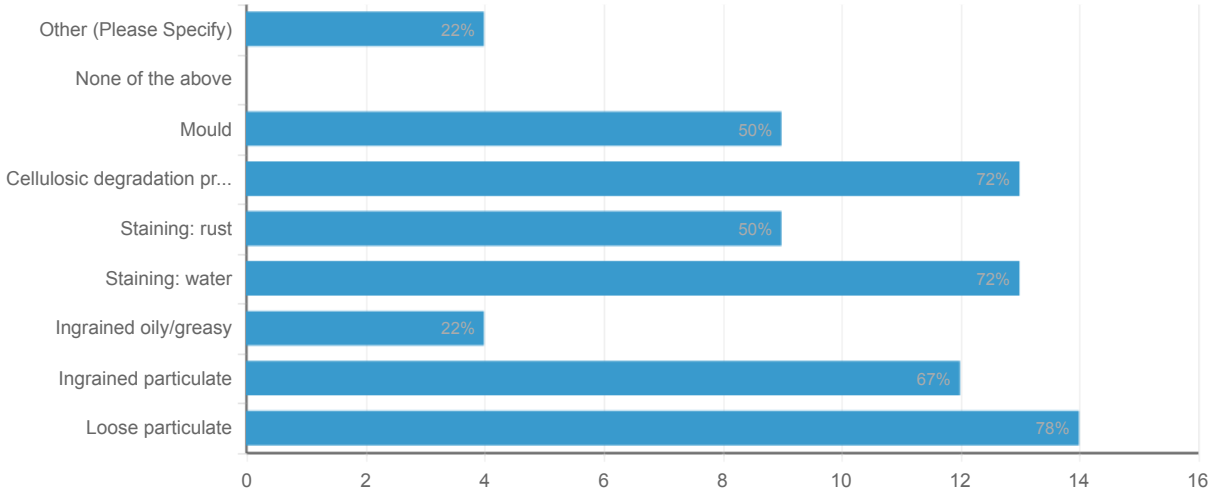


	Response Percent	Response Count
Never worked on barkcloth	5.56%	1
Some experience/familiarity	27.78%	5
Fairly familiar	22.22%	4
Very familiar	44.44%	8

Q4

What types of post acquisition soiling or staining have you observed on barkcloth?

Answered: 18 Skipped: 0



	Response Percent	Response Count
Loose particulate	77.78%	14
Ingrained particulate	66.67%	12
Ingrained oily/greasy	22.22%	4
Staining: water	72.22%	13
Staining: rust	50.0%	9
Cellulosic degradation product	72.22%	13
Mould	50.0%	9
None of the above	0.0%	0
Other (Please Specify)	22.22%	4

1. stains of adhesive / varnish (labels, repairs,..)

2. post-acquisition evidence of use - the evidence of the object used as table cloth

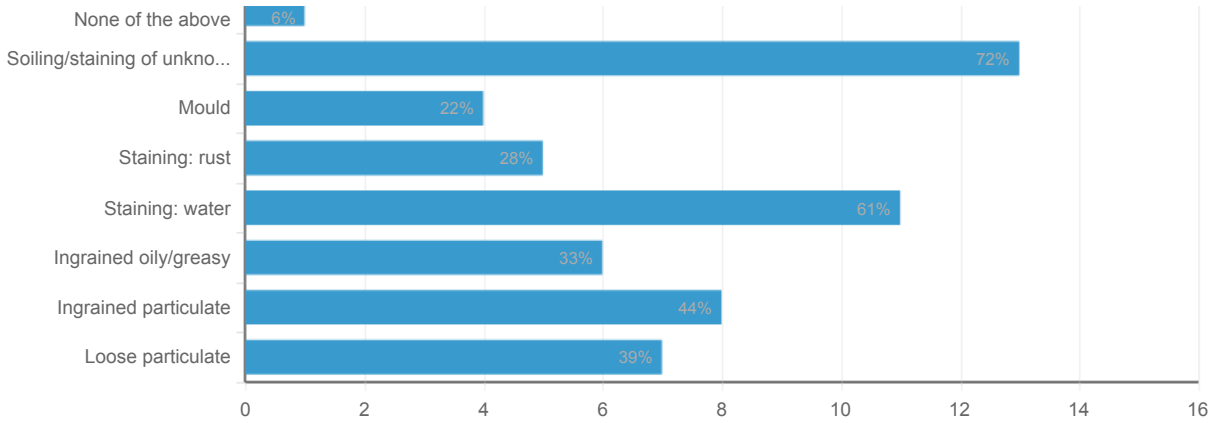
3. the condition of the bark cloth upon acquisition was unknown, so it was impossible to say whether soiling/staining had occurred before or after acquisition

4. No experience

Q5

What types of pre acquisition/evidential soiling or staining have you observed on barkcloth?

Answered: 18 Skipped: 0



	Response Percent	Response Count
Loose particulate	38.89%	7
Ingrained particulate	44.44%	8
Ingrained oily/greasy	33.33%	6
Staining: water	61.11%	11
Staining: rust	27.78%	5
Mould	22.22%	4
Soiling/staining of unknown origin	72.22%	13
None of the above	5.56%	1
Other (Please Specify)	27.78%	5

1. yellow-brownish stains accompanying painted patterns

2. accretion (sand), feathers (poss. from other artefacts), animal hair?, Humdan hair (beaten in)))

3. cellulosic degradation product

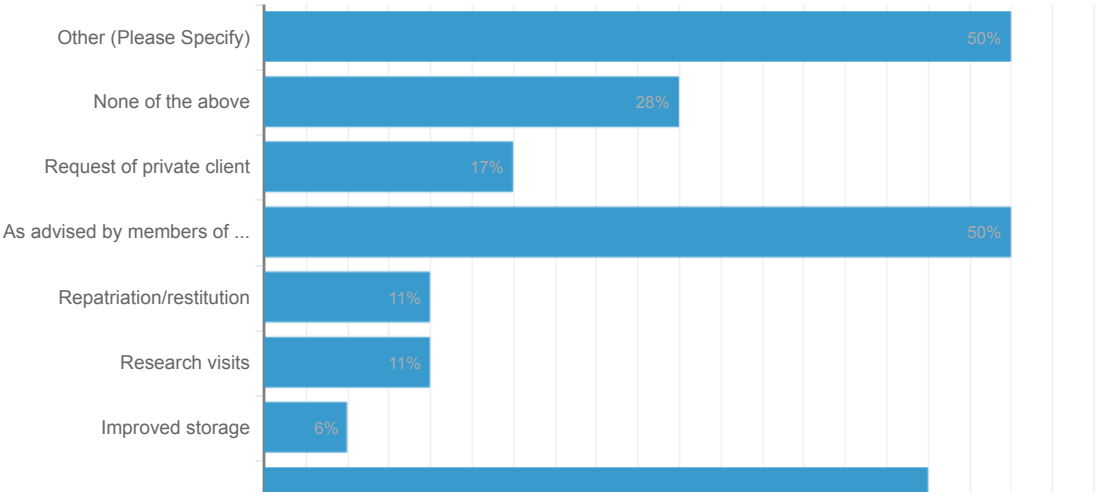
4. no experience

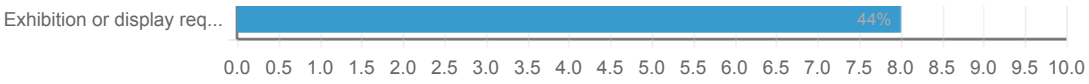
5. ingrained particulate and oily that could be from either indigenous use or subsequent to collecting

Q6

In what treatment context would you wet clean barkcloth?

Answered: 18 Skipped: 0





	Response Percent	Response Count
Exhibition or display requirements	44.44%	8
Improved storage	5.56%	1
Research visits	11.11%	2
Repatriation/restitution	11.11%	2
As advised by members of a source community	50.0%	9
Request of private client	16.67%	3
None of the above	27.78%	5
Other (Please Specify)	50.0%	9

1. not regularly, exceptionally when there is urgent conservation nee; would avoid to apply with pieces from pre-European contact

2. I ticked three contexts above but I would still discuss with interested parties (curators etc.) to examine if the wet cleaning is really necessary and having exhausted all other possible cleaning options.

3. This is very difficult to say, as each bark cloth is so unique and has its own risks.

4. (Empty)

5. For long term stability of barkcloth, eg as means of deacidification

6. (Empty)

7. certain older examples have very brittle components resulting from acid degradation. Limited wet cleaning can improve flexibility as well as appearance

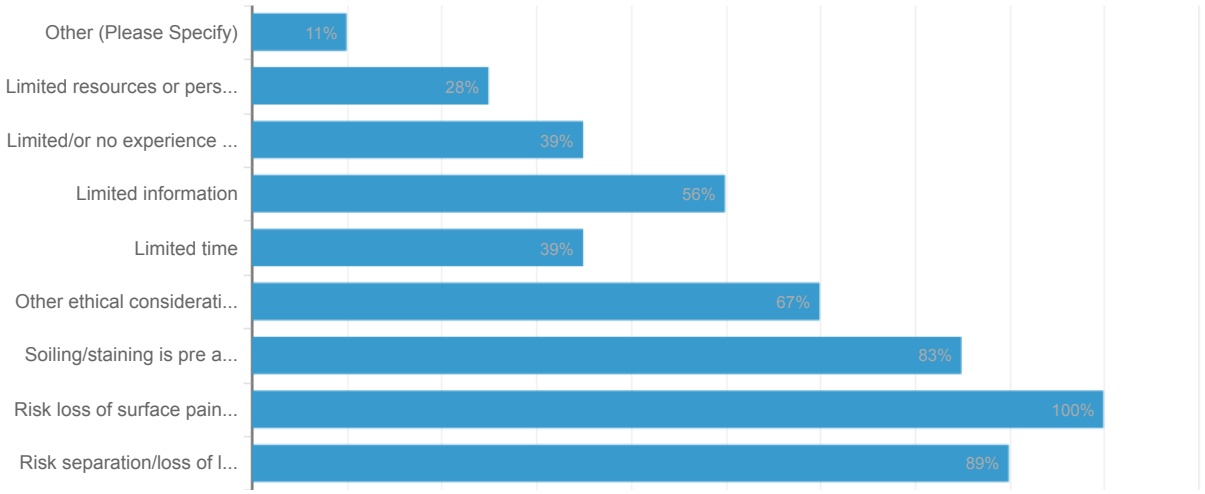
8. Only in very specific circumstances

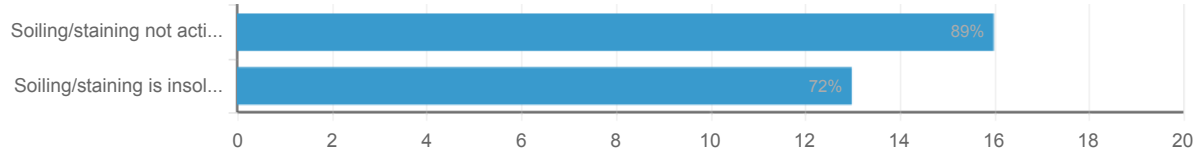
9. no member of a source community has ever recommended that any cloth be wet-cleaned

Q7

What condition features, ethical concerns, resource/time constraints would prohibit you from considering wet cleaning as an option?

Answered: 18 Skipped: 0



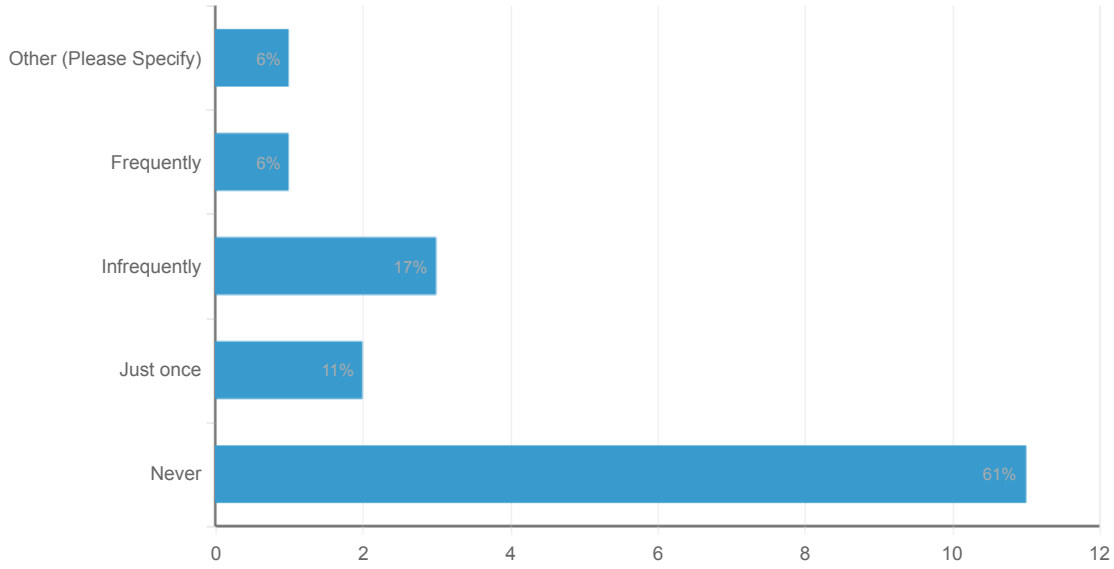


	Response Percent	Response Count
Soiling/staining is insoluble in water	72.22%	13
Soiling/staining not actively degrading the object	88.89%	16
Risk separation/loss of layers/parts	88.89%	16
Risk loss of surface paint, decoration, finishes, dye bleed.	100.0%	18
Soiling/staining is pre acquisition or suspected to be evidential	83.33%	15
Other ethical considerations	66.67%	12
Limited time	38.89%	7
Limited information	55.56%	10
Limited/or no experience of wet cleaning in conservation context	38.89%	7
Limited resources or personnel	27.78%	5
Other (Please Specify)	11.11%	2
1. changes of appearance - dimensional change, loss of loose texture probable		
2. shrinkage		

Q8

How frequently have you wet cleaned barkcloth?

Answered: 18 Skipped: 0



	Response Percent	Response Count
Never	61.11%	11
Just once	11.11%	2
Infrequently	16.67%	3

	Response Percent	Response Count
Frequently	5.56%	1
Other (Please Specify)	5.56%	1

1. Several times.

Q9

What methods have you used to wet clean barkcloth?

Answered: 9 Skipped: 9

1 . washing in sink, first on grid, later on Mylar sheet,
detergent Tinovetin JU 0,04 % and Carboxymethylcellulose 0,005 %,
first distilled water, for rinsing (4 x) tap water with Calciumhydroxide solution (pH about 7),
temperature 22° Celcius,
washing and rinsing lasting for an hour,

2 . Not applicable

3 . 1. Alternating soaking in wash bath and gentle flow in soft water on tilted wash table (no detergent) over period of 1 hour, supporting b/c on sheet of Reemay. This was a very thin Hawaiian b/c with stamped design in two colours, red and black.

2. Contact washing using blotter papers and cotton cloths. The b/c was sandwiched as follows:
work surface: blotting paper saturated with deionised water: dry cotton cloth: b/c: dry cotton cloth: blotting paper saturated with deionised water: polythene: sandbag weights providing overall even pressure. Leaving for period of c30mins (but checking constantly), then removing and replacing all layers with the same, for second 'wash'. Finally removing all layers and replacing with dry materials, reweighting and leaving for c30mins. To dry, removing top cloth and blotting paper layers to air dry. This was quite a thick coarse b/c from Erromango, with painted black and pinky red pigments. The thicker black pigment (carbon) was pre-consolidated using isinglass.

4 . none

5 . Swabbing with dampened cotton wool swabs
blotting with damp blotting paper, on occasion with vacuum to draw and control moisture in a localised area

6 . Applied mild dish detergent and water with a sponge. Sponge dried afterwards or dried in sunlight of apprx. 70-80 degrees farenheit for about an hour or until dry.

7 . Blotter was and tilted bath, cleaning through capillary action

8 . float wash (if carefully done, can "pull" soiling and degradation products into water by laying barkcloth on surface of water, allowing water to act only on the back side of the item)
spot cleaning on vacuum table
damp blotters applied to the back side (can include creating contours to increase contact with irregular surfaces)

Only did an immersion cleaning once -- is nearly impossible to maintain the contours of the original if the cloth is completely soaked. Not recommended.

9 . I have spot cleaned a test piece of barkcloth using a small suction table to draw water through.

Q10

What was the reason for your choice(s)?

Answered: 10 Skipped: 8

1 . heavy soiling from storage, need for smoothing torn areas, danger of water stains with local cleaning, washing mentioned in literature as a method of the source community, proposal of my mentor (diploma project) and last lack of practical experience in textile conservation methods

2 . The adhesives and pigments present in the bark cloths were soluble in water. All treatment conducted on the bark cloth (surface cleaning, adhesive tape removal, lining) was done with non-aqueous methods.

3 . Not applicable

4 . 1. The b/c was being prepared for display. It was very discoloured and yellowed with cellulose degradation products; it was acidic pH4.5. A section of this cloth had been cut out of the main body in late 19th/early 20th c soon after acquisition. It was intended to re-unite these two pieces for the exhibition. The smaller piece was much 'whiter' in appearance and less discoloured (either it had been 'washed' when it was cut off and mounted, or just due to the different storage and light exposure of the two parts). The primary aim of the washing treatment was to make the two pieces more similar in appearance, but also to reduce acidity and cellulose degradation products. All pigments were tested and found to be fast. The pH of the b/c was greatly improved due to the washing. There were no issues re delamination. The main issue was on drying, as the b/c had very frilly edges and was not flat; it was also very vulnerable when wet and it was important to support it fully on the Reemay for any handling when wet. During washing, copious yellow brown staining was removed, and the cloth was much fresher looking on drying - matching the other piece.

2. Again in preparation for display. The barkcloth was heavily water stained. Again, the piece had been cut in two in late 19th early 20th soon after acquisition. One half was badly water stained. The other half was not. It is thought that the staining was likely result of pipe leakage in the museum, although could not be confirmed and there is possibility that it was water damage occurring during voyage back to England (if the other half had been 'washed' at the time of removal). Discussions between curatorial team and community representatives from Vanuatu had raised possibility of cleaning, and it seemed that removal of the staining was desired, as it was quite visually distracting from the narrative pattern. The b/c was also very acidic. Initially there were concerns that the thicker pigment on black outlines was quite friable, but tests showed that pre-consolidation using isinglass was effective. Tests also showed that the wet treatment had no deleterious effect on the zigzag beater impressions - if anything, made them stronger. Treatment very successful in removing water staining and ring marks; also successfully reduced the acidity. Did not want to go for full immersion or soak washing due to the potential friability of the pigments and swelling of the beater marks. Worth noting that another Erromango cloth was tested for similar treatment, and it was found that the pinky red pigment changed colour on the blotter washing. It is though this might have been due to shift in pH before and after washing - and may well have been an acceptable change - nevertheless, it was decided not to wash.

5 . see no. 7

6 . Water or solvent can cause swelling, extraction or dissolution of components (ink, starch, resins etc) so minimal intervention is necessary.

7 . Mild dish detergents are gentle, non-reactive and non-staining and do not react with traditional organic dyes or affect the quality of undyed areas.

8 . Item benefited from wet clean despite interventive nature of treatment, particularly if being displayed and the original design is too obscured. Gentle methods such as use of damp blotters, damp capillary matting and tilted baths can be very effective without disturbing the item too much.

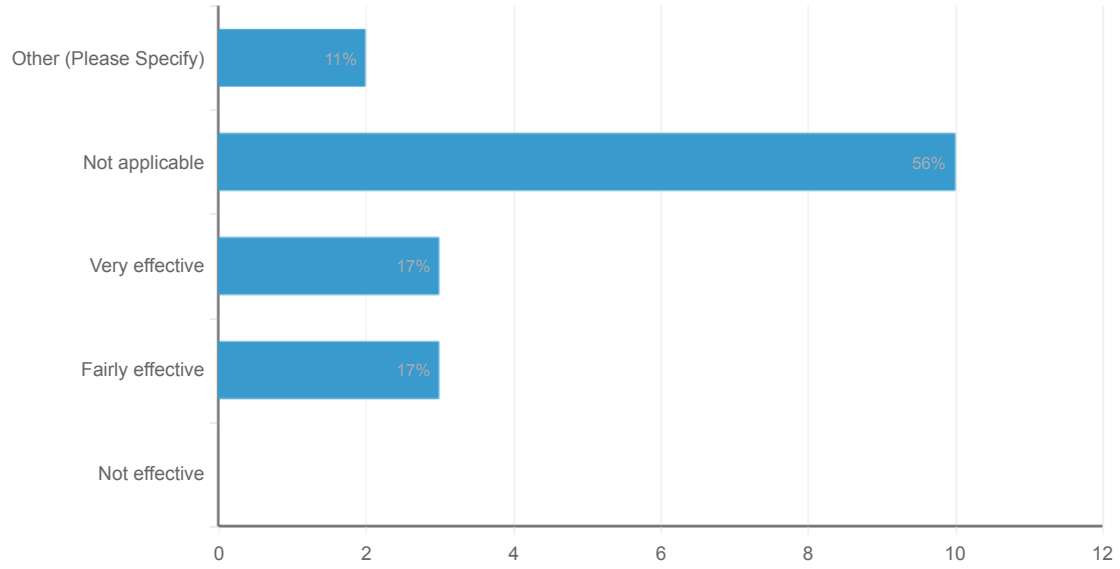
9 . desire to limit the amount of intervention
focus on maintaining the contours and shape of the original
need to increase flexibility to allow pieces to be studied, stored and exhibited
aesthetic considerations (less important than others)

10 . Testing to see if the treatment had any effect on the structural integrity of the barkcloth - not sure I would ever immerse a whole barkcloth

Q11

How effective was your treatment?

Answered: 18 Skipped: 0



	Response Percent	Response Count
Not effective	0.0%	0
Fairly effective	16.67%	3
Very effective	16.67%	3
Not applicable	55.56%	10
Other (Please Specify)	11.11%	2

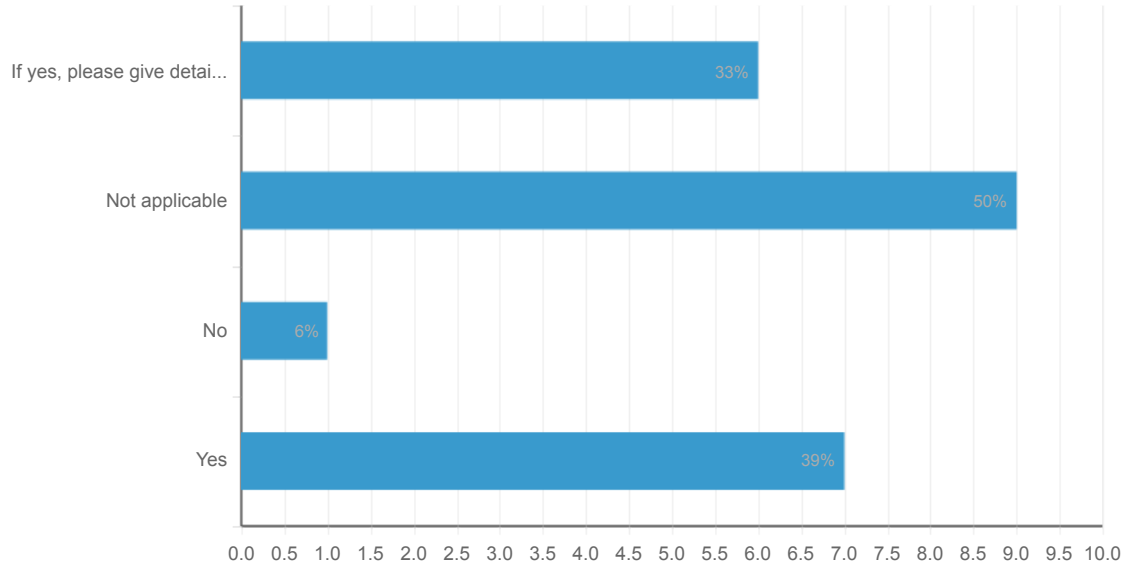
1. very effective in reference to better appearance, bright colours, smoothing of torn / expanded areas, increase of hold / grip,

2. Dry cleaning methods are fairly effective although it would not remove a certain types of ingrained/stained matter.

Q12

Did you consult or collaborate with any conservator(s) from your discipline or another before/during treatment?

Answered: 18 Skipped: 0



	Response Percent	Response Count
Yes	38.89%	7
No	5.56%	1
Not applicable	50.0%	9
If yes, please give details	33.33%	6

1. consulted paper and textile restorers about different washing methods and practical application

2. I've consulted paper conservators and textile conservators but I am yet to experiment with wet cleaning because of the time constraint, lack of resource and experience.

3. We consulted with conservators from U-Penn as well as the Smithsonian's National Museum of Natural History

4. Thorough discussed with textile conservation colleagues within my studio. Also sought advice and worked with paper conservators at BM

5. always use collegial support

6. I was one of the early pioneers in the treatment of barkcloth; most of the conservators I worked with were paper conservators

Q13

Any other comments?

Answered: 6 Skipped: 12

1 . Today the possible loss of original information is a point that would probably prevent me to repeat such an operation for pre-European barkcloths.

2 . It would be very interesting to know exactly what we are removing? Am I right in thinking mainly cellulose degradation products?
What is likelihood of evidential soiling - are people finding lots of this? - I find it difficult to tell sometimes, as everything so covered in black sooty pollution from UK cities, but is this ever evidence of indigenous storage above fireplaces? Very difficult to know what is pre-acquisition!
I would be interested for you to look at the use Paraprint capillary washing as used in paper conservation - this might have good application here, as often is used for washing works of art on paper where media may be vulnerable.
Watch out for scented or perfumed b/c.
Many pigments seem waterfast, but some of the yellow definitely not - yellow Tahitian tiputa with leaf prints we had was extremely 'unfast'.

I have only really washed to remove water staining, or overall discolouration and acidity due to cellulose degradation products...We did have one fine plain white b/c which was really grubby with grey black ingrained dirt - didn't wet clean as not required for display in the end, but I would really have liked to know how effective washing would have been as restoring this white b/c back to its former glory - with this fine white tapa, the whiteness was mark of status, and really was completely undisplayable in its current soiled state (Misa will remember this one, as she had to smoke sponge it instead!). Also would be interesting to follow up stain removal - I have little success in stain removal on textiles even, and so probably would not attempt on b/c.
Good luck with your research and looking forward to hearing your results.

3 . I was recently recommended by Prof. Wolbers to use (Hexa- or Octa-) Dimethylsiloxane for solvent cleaning of bark cloth but have not yet had the opportunity to use this method.

4 . We have a large barkcloth in our care and wet cleaning hasn't been undertaken - to date we haven't had an occasion where this would be appropriate. In most instances the loss of evidential soiling - from wear(oil applied to the body / fragrance), manufacture) The risks seem to outweigh any long term benefits.

5 . I have found this technique generally suitable for light to heavy weight Samoan, Tongan and Fijian barkcloths experiencing surface particulates. It might also be applicable to treatment to other barkcloth types that have ingrained stains of organic or inorganic origin.

6 . In what condition might a wet-cleaning be warranted? if the cloth was heavily affected with an active mould infestation however there might be less invasive solutions to reduce biological growth.

Questionnaire: Pacific barkcloth wet cleaning treatment

Dissertation title: An Investigation in the use of wet cleaning in the conservation of Pacific region barkcloth.

Researcher Details: Ruby Antonowicz-Behnan, MPhil Textile Conservation. Centre for Textile Conservation, School of Culture and Creative Arts, University of Glasgow.
2163872a@student.gla.ac.uk.

The purpose of this questionnaire is to understand the current practices in wet cleaning treatments for conserving Pacific barkcloth. I am interested to learn about the methods and skills being utilized for this type of treatment. The results of the questionnaire will help to inform the research for a master's degree dissertation on wet cleaning barkcloth.

Your participation in this project is entirely voluntary. If you decide to take part you are still free to withdraw at any time and without giving a reason. It should take around 15-20 minutes to complete the questionnaire.

All information which is collected about you during the course of the research will be kept strictly confidential.

- Collected data will be kept secure in locked room/facility/cabinet and access to computer files will be available by password only.
- Data will only be accessed by named researcher(s) and, where applicable, supervisor(s), examiner(s), research assistants, transcribers.
- Personal data and research data will be destroyed at the end of the research project.
- any information/results obtained from the research will not be published without the

participant's approval.

- Individual participants or institutions will not be name without prior formal consent.
- Results will be made available to participants as a written summary if requested.

Thank you for taking the time to read this information. Your participation in this questionnaire is greatly appreciated.

Questionnaire on Pacific barkcloth wet cleaning treatments

Researcher Details: Ruby Antonowicz-Behnan, MPhil Textile Conservation. Centre for Textile Conservation, School of Culture and Creative Arts, University of Glasgow. Email: 2163872a@student.gla.ac.uk.

Dissertation working title: An investigation into the use of wet cleaning in the conservation of Pacific region barkcloth.

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Any information/results obtained from the research will not be published without the participant's approval.
Individual participants or institutions will not be name without prior formal consent.
Results will be made available to all participants.

Questions are a mixture of multiple choice and free text boxes. For questions 1, 4, 5, 6 and 7 you may choose one or make multiple selections. Questions 9 and 10 may be left blank if not applicable.

It should take approximately 10-15 minutes to complete.

Completed questionnaires will be collected up until Friday 7th July 2017.

Thank you for taking the time to read this document. Your participation in this questionnaire is greatly appreciated.

NEXT

ZOHO Survey

Questionnaire on Pacific barkcloth wet cleaning treatments

1. Which would best describe your area of expertise.*

- [ ] Textiles
- [ ] Paper
- [ ] Ethnography
- [ ] Objects
- [ ] Organics
- [ ] Other (Please Specify)

2. In which country do you work in?

3. How familiar are you with working on barkcloth?*

- ○ Never worked on barkcloth
- ○ Some experience/familiarity
- ○ Fairly familiar
- ○ Very familiar

4. What types of post acquisition soiling or staining have you observed on barkcloth?

- [ ] Loose particulate
- [ ] Ingrained particulate
- [ ] Ingrained oily/greasy
- [ ] Staining: water
- [ ] Staining: rust
- [ ] Cellulosic degradation product
- [ ] Mould

- [ ] None of the above
- [ ] Other (Please Specify)

5. What types of pre acquisition/evidential soiling or staining have you observed on barkc

- [ ] Loose particulate
- [ ] Ingrained particulate
- [ ] Ingrained oily/greasy
- [ ] Staining: water
- [ ] Staining: rust
- [ ] Mould
- [ ] Soiling/staining of unknown origin
- [ ] None of the above
- [ ] Other (Please Specify)

6. In what treatment context would you wet clean barkcloth?*

- [ ] Exhibition or display requirements
- [ ] Improved storage
- [ ] Research visits
- [ ] Repatriation/restitution
- [ ] As advised by members of a source community
- [ ] Request of private client
- [ ] None of the above
- [ ] Other (Please Specify)

7. What condition features, ethical concerns, resource/time constraints would prohibit yo considering wet cleaning as an option?*

- [ ] Soiling/staining is insoluble in water
- [ ] Soiling/staining not actively degrading the object
- [ ] Risk separation/loss of layers/parts
- [ ] Risk loss of surface paint, decoration, finishes, dye bleed.
- [ ] Soiling/staining is pre acquisition or suspected to be evidential
- [ ] Other ethical considerations
- [ ] Limited time

- [ ] Limited information
- [ ] Limited/or no experience of wet cleaning in conservation context
- [ ] Limited resources or personnel
- [ ] Other (Please Specify)

8. How frequently have you wet cleaned barkcloth?*

- ( ) Never
- ( ) Just once
- ( ) Infrequently
- ( ) Frequently
- ( ) Other (Please Specify)

9. What methods have you used to wet clean barkcloth?

10. What was the reason for your choice(s)?

11. How effective was your treatment?*

- ( ) Not effective
- ( ) Fairly effective
- ( ) Very effective
- ( ) Not applicable
- ( ) Other (Please Specify)

12. Did you consult or collaborate with any conservator(s) from your discipline or another treatment?*

- [ ] Yes
- [ ] No
- [ ] Not applicable
- [ ] If yes, please give details

13. Any other comments?

PREVIOUS SUBMIT

7 Jun 2017

Dear Ruby

Ethics Application 100160155: Ethics Approval

Ethical approval is given for your research. Please note that an end of project report is required by the Ethics Committee. A brief report should be provided within one month of the completion of the research, giving details of any ethical issues which have arisen (a copy of the report to the funder, or a paragraph or two will usually be sufficient). This is a condition of approval and in line with the committee's need to monitor research. Further, it is your responsibility to inform, as appropriate, your supervisor, advisor or funding body of the outcome of your Ethics application. You should also indicate successful receipt of ethics clearance on the acknowledgements page of the approved project.

In addition, any unforeseen events which might affect the ethical conduct of the research, or which might provide grounds for discontinuing the study, must be reported immediately in writing to the Ethics Committee. The Committee will examine the circumstances and advise you of its decision, which may include referral of the matter to the central University Ethics Committee or a requirement that the research be terminated.

Information on the College of Arts Ethics policy and procedures is at http://www.gla.ac.uk/colleges/arts/research/ethics.

Yours sincerely

Iain

Dr Iain Banks

College of Arts Ethics Officer
School of Humanities/An Sgoil Daonnachdan
10 University Gdns
University of Glasgow
Glasgow
G12 8QQ
0141 330 2420

Samples: “Historic” Decorated Tapa Cloth

Decorated tapa cloth as purchased (garment top).

Dark brown (design outline) paint layer and lighter coloured pigment under magnification.

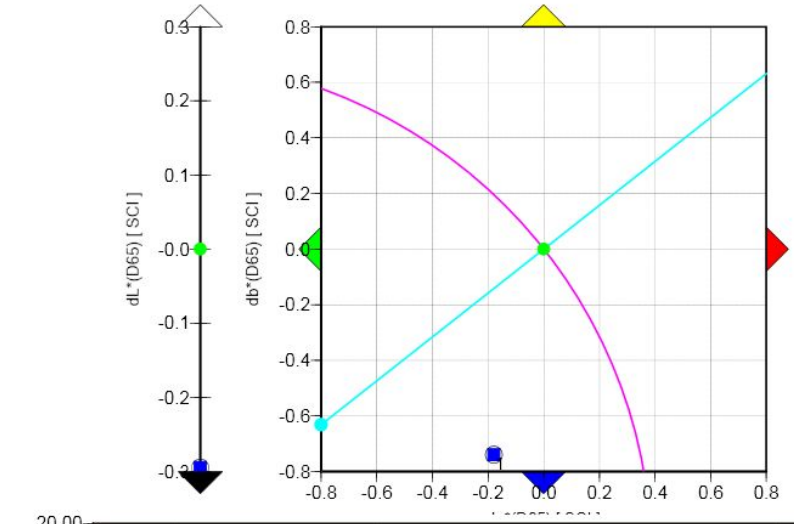
Samples: Plain Tapa Cloth

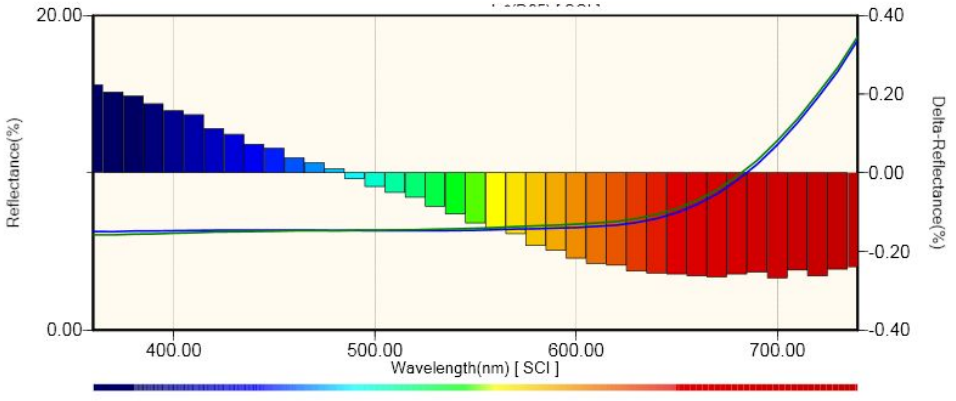
Centre for Textile Conservation

Target colour:	[Mean]Paint 2: dark brown (07/07/2017 15:						07/07/2017 15:04:31				
L*	30.77	**a***	1.41	**b***	1.12	**C***	1.80	**h***	38.30	**Gloss**	5
Sample colour:	[Mean]Paint 2 (1): dark brown (26/07/2017						26/07/2017 12:15:33				
L*	30.47	**a***	1.23	**b***	0.38	**C***	1.29	**h***	16.93	**Gloss**	6

Colour Difference

dL*	-0.29	darker	**da***	-0.18	less red	**db***	-0.74	less yellow	
dC*	-0.51	less saturated	**dH***	-0.56	redder	**dE00***	0.82		





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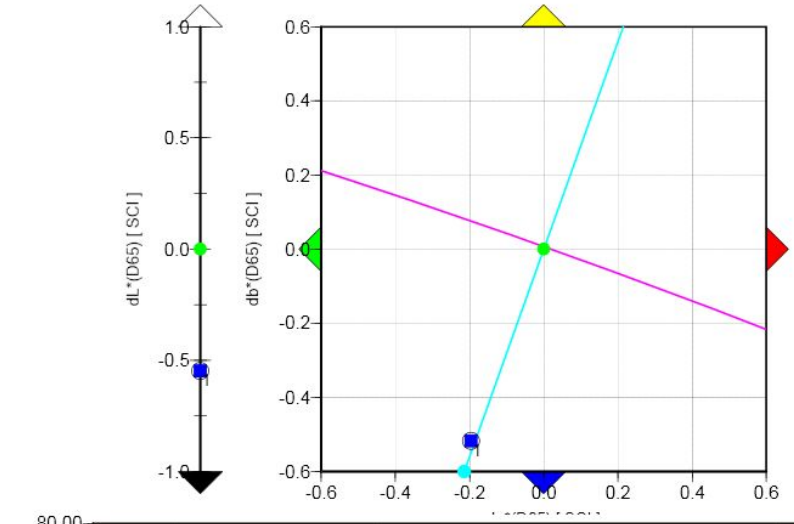
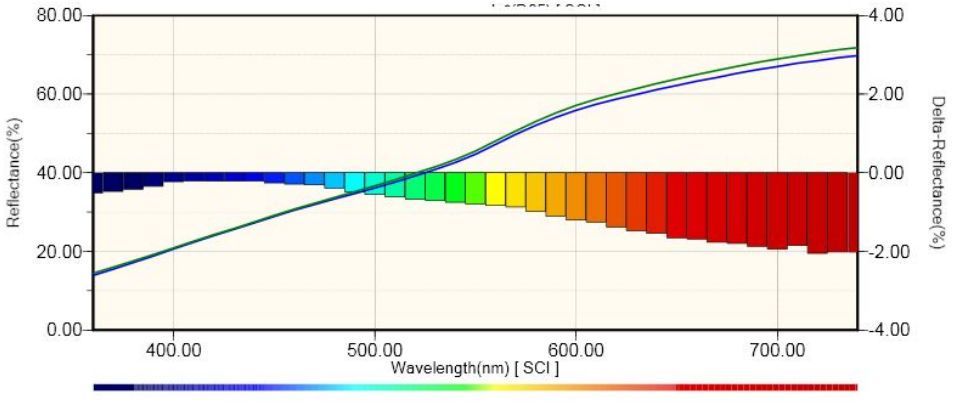
Target colour:	[Mean]Painted 1: plain area (07/07/2017 15						07/07/2017 15:10:50				
L*	73.90	**a***	7.84	**b***	21.97	**C***	23.32	**h***	70.36	**Gloss**	6
Sample colour:	[Mean]Painted 1: plain area (26/07/2017 12						26/07/2017 12:17:28				
L*	73.35	**a***	7.64	**b***	21.45	**C***	22.77	**h***	70.39	**Gloss**	6

Colour Difference

dL*	-0.55	darker	**da***	-0.20	less red	**db***	-0.52	less yellow	
dC*	-0.55	less saturated	**dH***	0.01	yellower	**dE00***	0.78		





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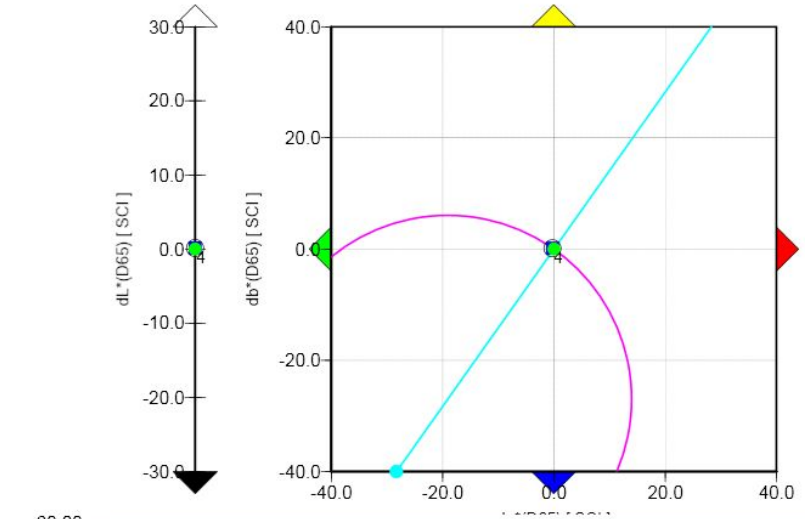
Target colour:	[Mean]|Painted 1: light brown (07/07/2017							07/07/2017 14:58:46
L*	54.42	a*	19.10	b*	27.00	C*	33.07	h*	54.73	Gloss	3

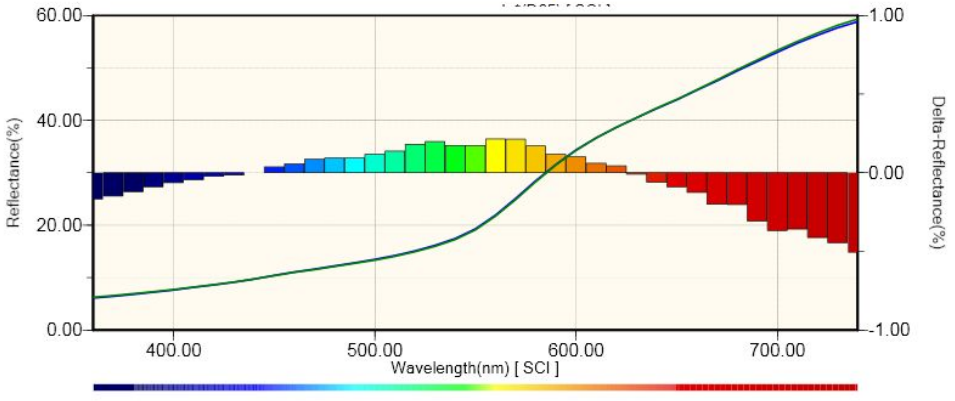
Sample colour:	[Mean]Painted 1: light brown (26/07/2017							26/07/2017 12:12:55
L*	54.57	a*	18.83	b*	27.14	C*	33.03	h*	55.24	Gloss	3

Colour Difference

dL*	0.15	lighter	da*	-0.26	less red	db*	0.14	yellower

dC*	-0.04	less saturated	dH*	0.30	yellower	dE00*	0.33





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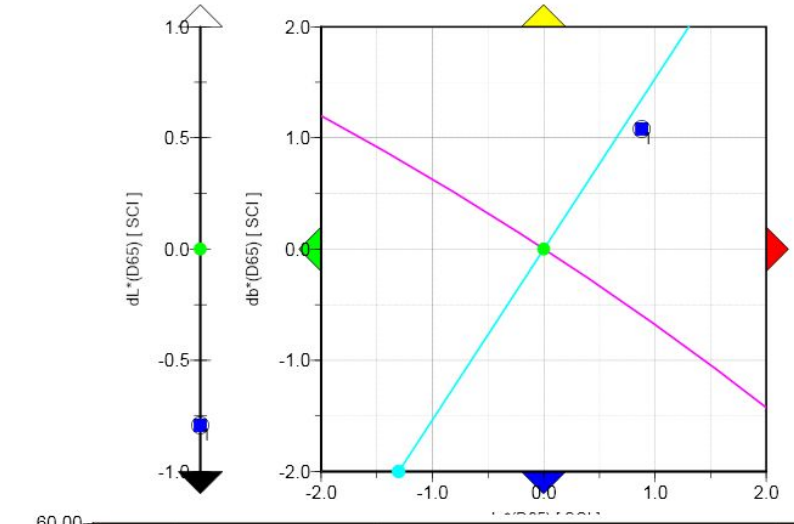
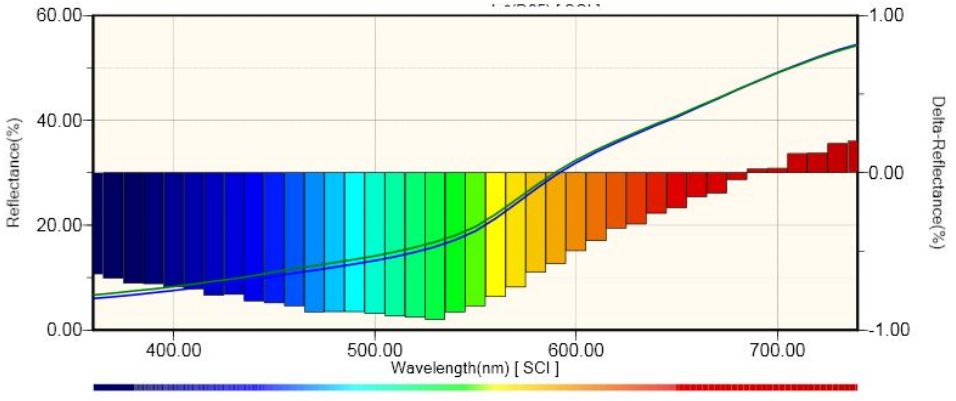
Target colour:	[Mean]Painted 2: light brown (07/07/2017									07/07/2017 15:33:31
L*	54.30	a*	16.14	b*	24.77	C*	29.56	h*	56.91	Gloss 4
Sample colour:	**[Mean]Painted 2: light brown (26/07/2017**									**26/07/2017 12:20:00**
L*	53.51	a*	17.02	b*	25.85	C*	30.95	h*	56.64	Gloss 3

Colour Difference

dL*	-0.79	darker	da*	0.88	redder	db*	1.08	yellower
dC*	1.38	more saturated	dH*	-0.14	redder	dE00*	1.60	





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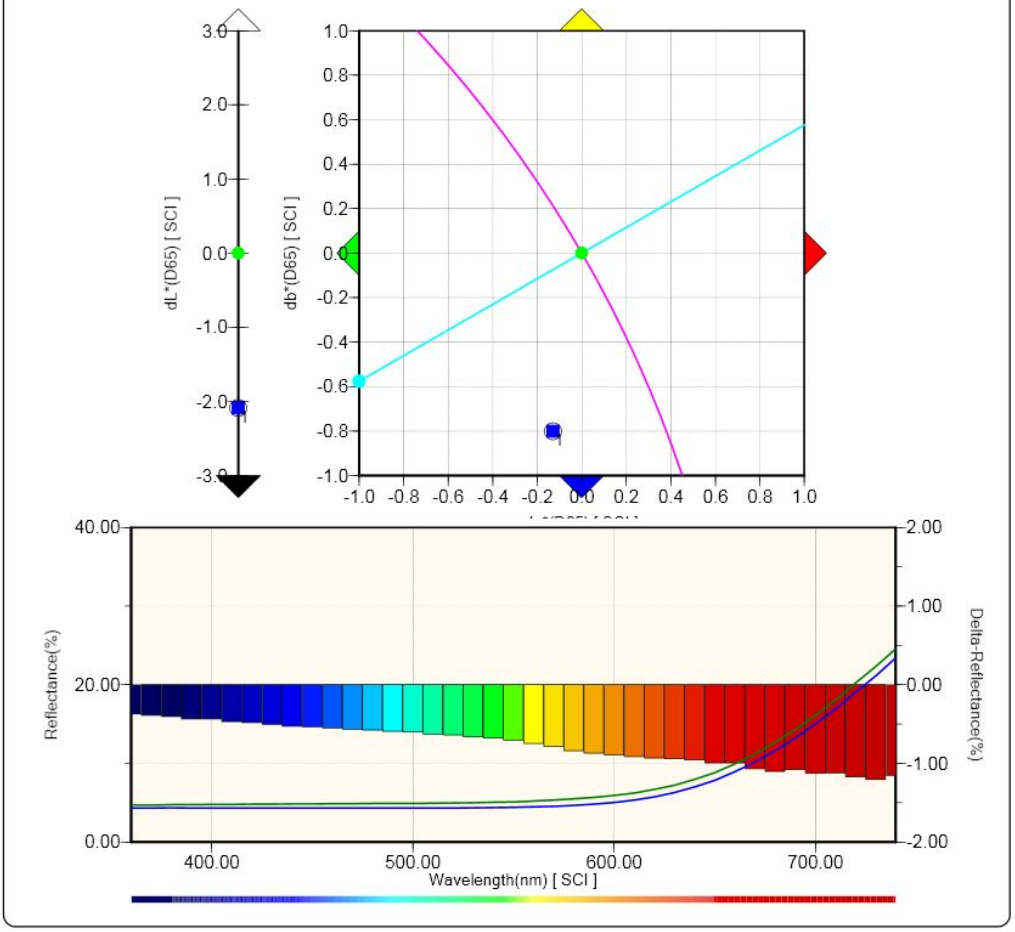
Target colour:	[Mean]Painted 2: dark brown (07/07/2017									07/07/2017 15:36:24
L*	27.92	a*	4.78	b*	2.76	C*	5.52	h*	29.97	Gloss 6
Sample colour:	**[Mean]Painted 2: dark brown (26/07/2017**									**26/07/2017 12:22:31**
L*	25.83	a*	4.66	b*	1.96	C*	5.05	h*	22.81	Gloss 7

Colour Difference

dL*	-2.09	darker	da*	-0.13	less red	db*	-0.80	less yellow
dC*	-0.47	less saturated	dH*	-0.66	redder	dE00*	2.24	



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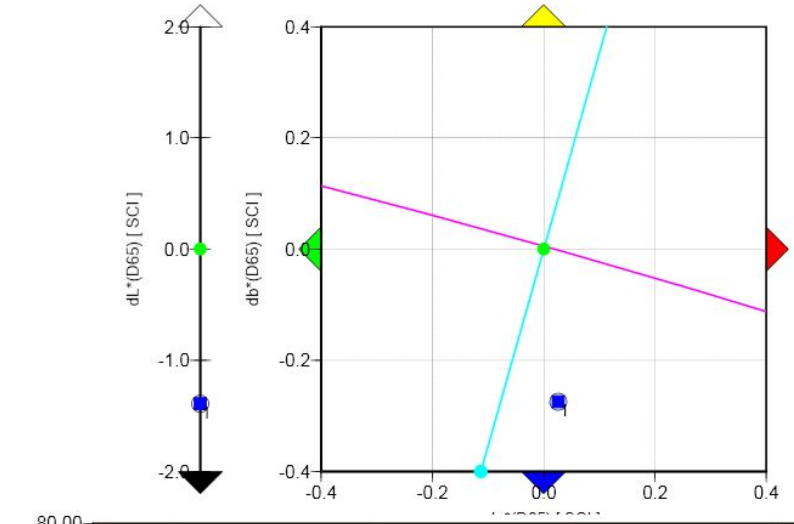
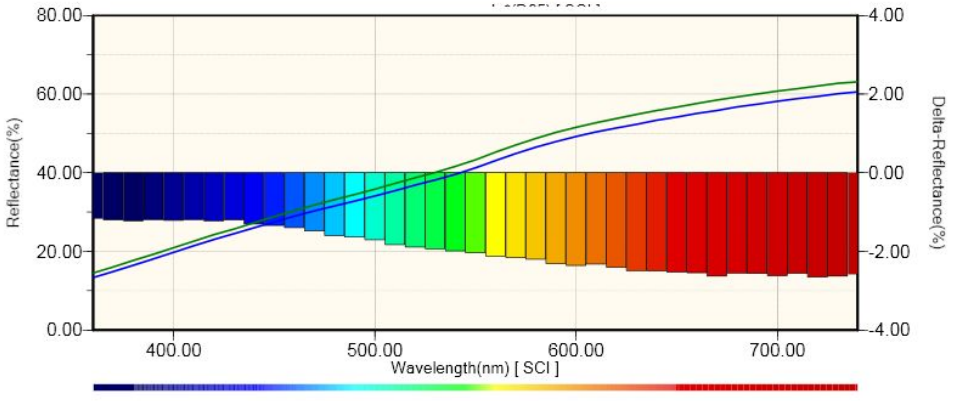
Target colour:	[Mean]Painted 2: plain(07/07/2017 15:39:5						07/07/2017 15:40:08				
L*	72.01	**a***	5.43	**b***	19.19	**C***	19.95	**h***	74.19	**Gloss**	5
Sample colour:	[Mean]Painted 2: plain (26/07/2017 12:24:3						26/07/2017 12:25:04				
L*	70.62	**a***	5.46	**b***	18.92	**C***	19.69	**h***	73.90	**Gloss**	5

Colour Difference

dL*	-1.39	darker	**da***	0.03	redder	**db***	-0.27	less yellow
dC*	-0.26	less saturated	**dH***	-0.10	redder	**dE00***	1.42	



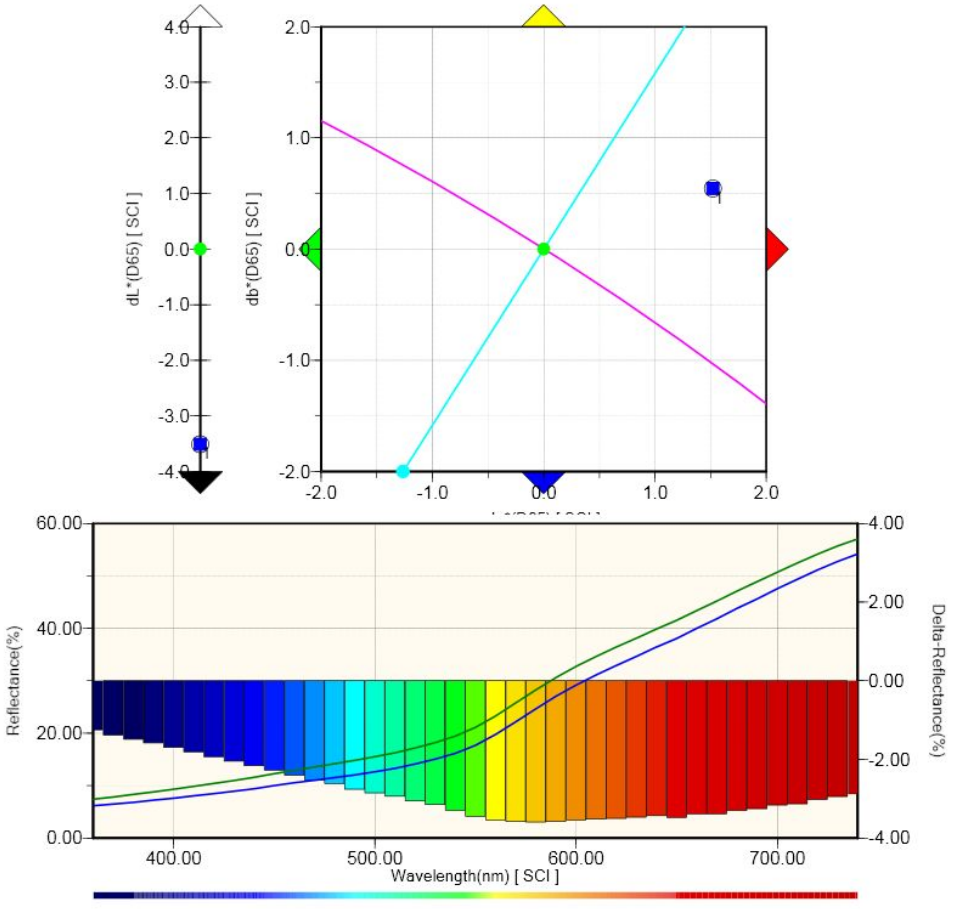


Centre for Textile Conservation

Target colour:	[Mean]Painted 3: light brown (11/07/2017						11/07/2017 12:23:14				
L*	55.39	**a***	14.70	**b***	23.27	**C***	27.53	**h***	57.71	**Gloss**	3
Sample colour:	[Mean]Painted 3: light brown (26/07/2017						26/07/2017 12:27:19				
L*	51.88	**a***	16.22	**b***	23.82	**C***	28.82	**h***	55.74	**Gloss**	2

Colour Difference

dL*	-3.51	darker	**da***	1.52	redder	**db***	0.54	yellower
dC*	1.29	more saturated	**dH***	-0.97	redder	**dE00***	3.87	



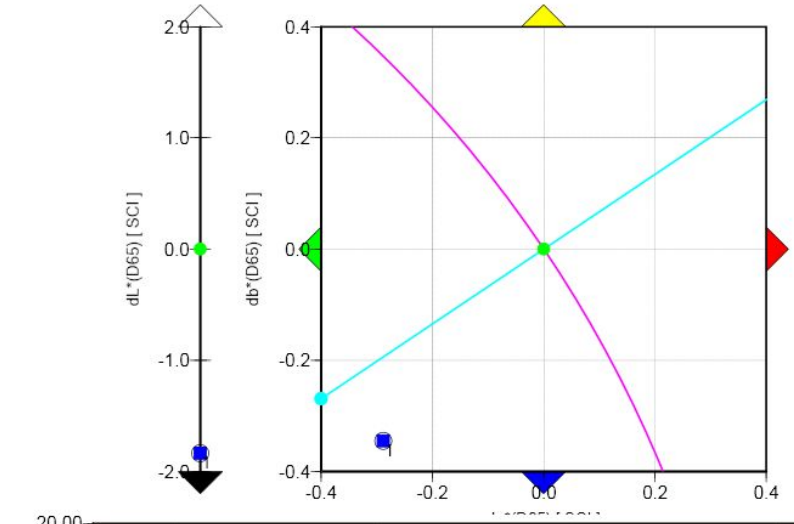
Centre for Textile Conservation

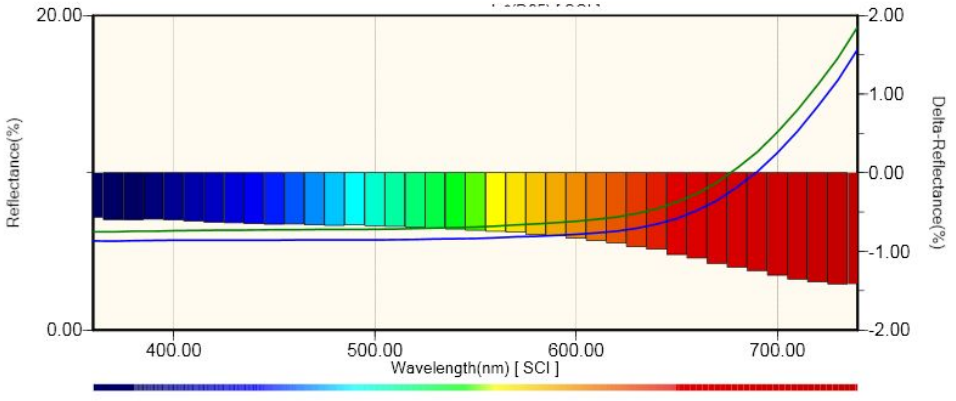
Target colour:	[Mean]Painted 3: Dark brown (11/07/2017								11/07/2017 12:26:10	
L*	31.05	a*	1.86	b*	1.25	C*	2.24	h*	33.94	Gloss 3

Sample colour:	[Mean]Painted 3: Dark brown (26/07/2017								26/07/2017 12:29:57	
L*	29.21	a*	1.57	b*	0.90	C*	1.81	h*	29.97	Gloss 3

Colour Difference

dL*	-1.84	darker	da*	-0.29	less red	db*	-0.34	less yellow
dC*	-0.43	less saturated	dH*	-0.14	redder	dE00*	1.89	



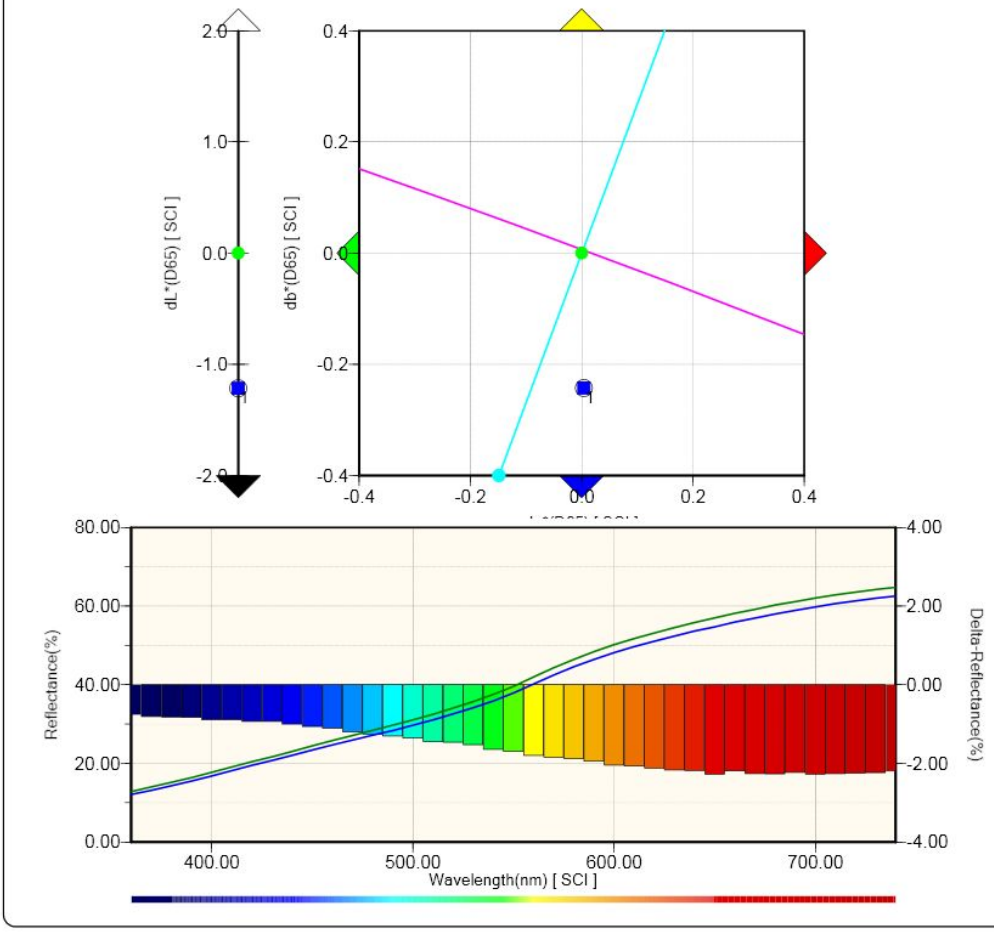


Centre for Textile Conservation

Target colour:	[Mean]Painted 3: Plain (11/07/2017 12:28:(						11/07/2017 12:28:43				
L*	69.78	**a***	8.32	**b***	22.34	**C***	23.84	**h***	69.59	**Gloss**	6
Sample colour:	[Mean]Painted 3: Plain (26/07/2017 12:31:2						26/07/2017 12:31:45				
L*	68.57	**a***	8.32	**b***	22.10	**C***	23.62	**h***	69.37	**Gloss**	5

Colour Difference

dL*	-1.22	darker	**da***	0.00	redder	**db***	-0.24	less yellow
dC*	-0.23	less saturated	**dH***	-0.09	redder	**dE00***	1.24	

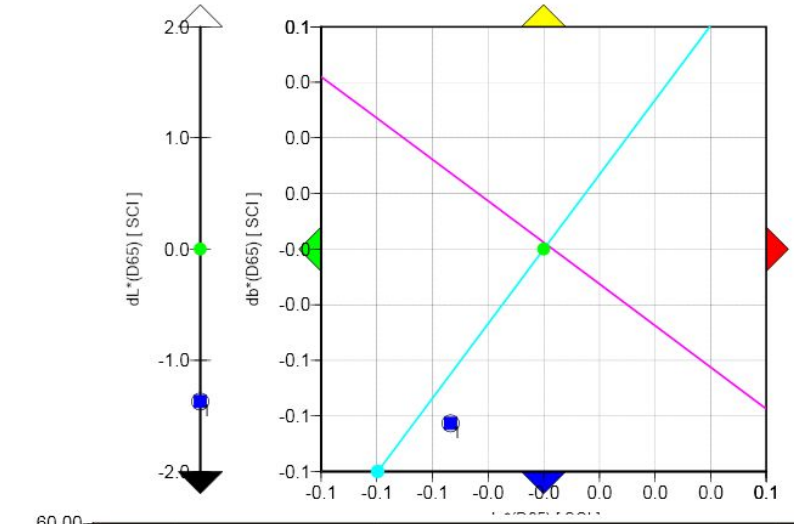


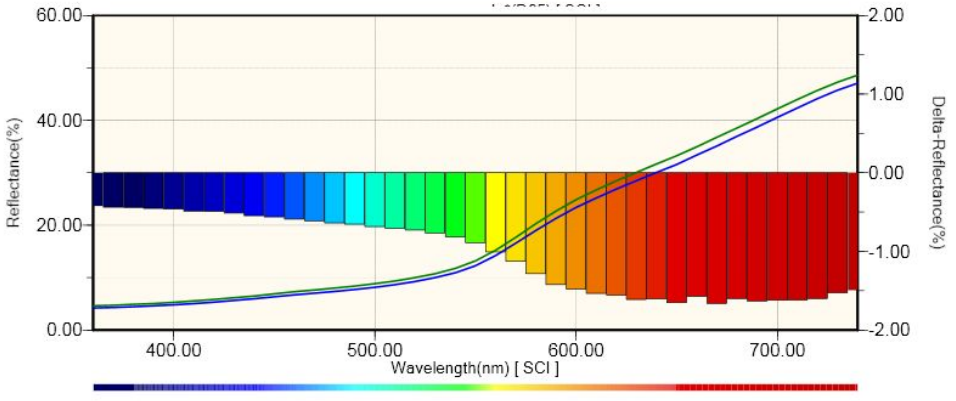
Centre for Textile Conservation

Target colour:	[Mean]Painted 4: light brown (11/07/2017								11/07/2017 12:07:38		
L*	46.69	a*	19.08	b*	25.59	C*	31.92	h*	53.29	Gloss	1
Sample colour:	**[Mean]Painted 4: light brown (26/07/2017**								**26/07/2017 12:34:04**		
L*	45.32	a*	19.05	b*	25.53	C*	31.85	h*	53.27	Gloss	1

Colour Difference

dL*	-1.37	darker	da*	-0.03	less red	db*	-0.06	less yellow
dC*	-0.07	less saturated	dH*	-0.01	redder	dE00*	1.37	



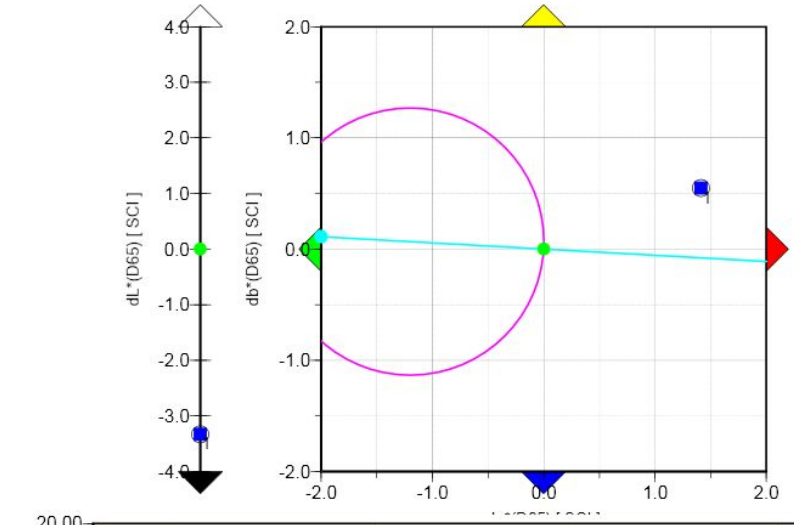


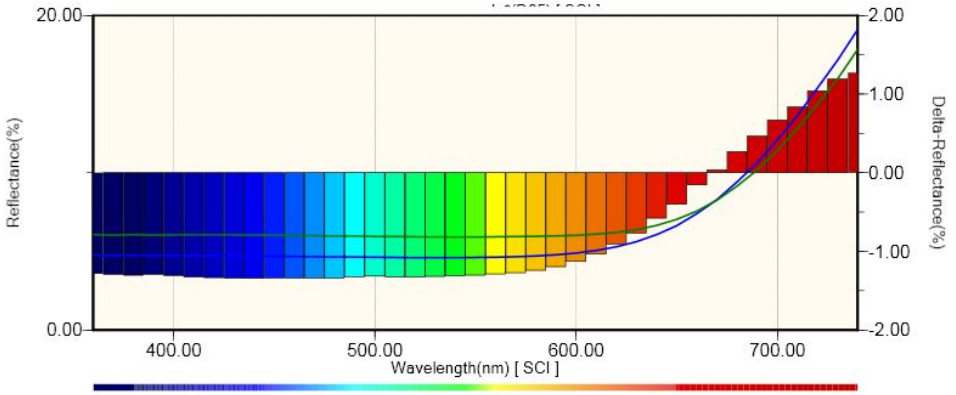
Centre for Textile Conservation

Target colour:	[Mean]Painted 4: Dark brown (11/07/2017								11/07/2017 12:13:29		
L*	29.42	a*	1.20	b*	-0.07	C*	1.20	h*	356.80	Gloss	3
Sample colour:	**[Mean]Painted 4: Dark brown (26/07/2017**								**26/07/2017 12:36:48**		
L*	26.09	a*	2.61	b*	0.48	C*	2.66	h*	10.44	Gloss	5

Colour Difference

dL*	-3.33	darker	da*	1.41	redder	db*	0.55	less blue
dC*	1.46	more saturated	dH*	0.42	redder	dE00*	3.66	





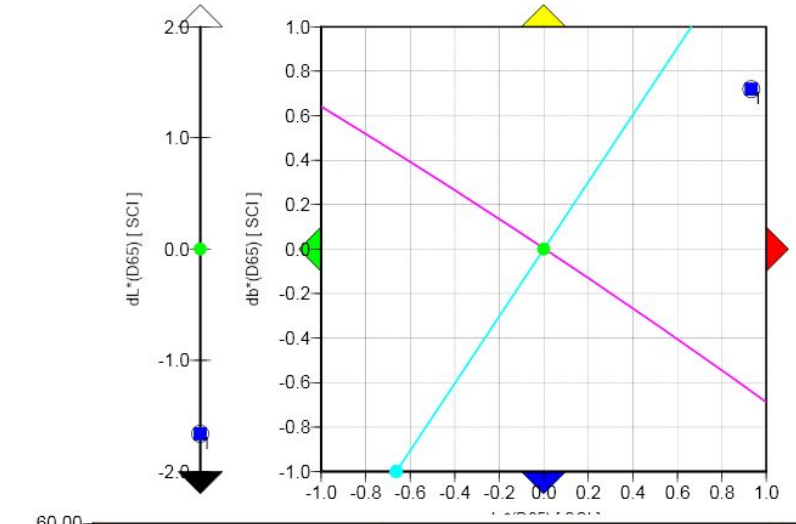
Centre for Textile Conservation

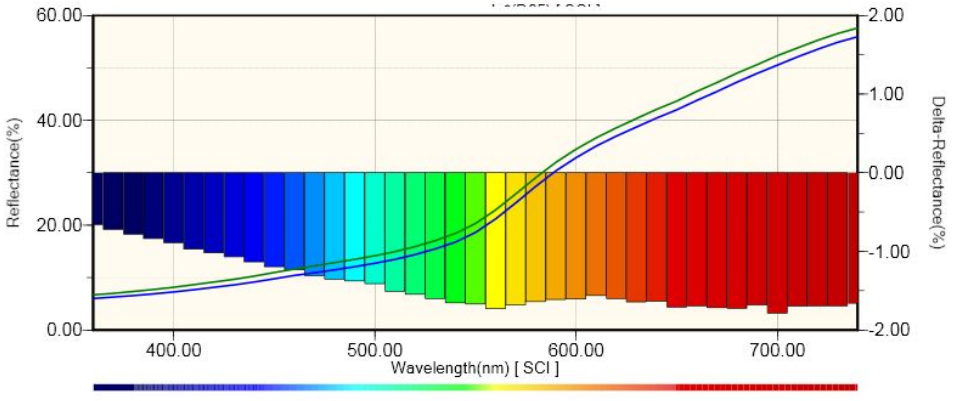
Target colour:	[Mean]Painted 5: light brown (07/07/2017									07/07/2017 15:47:39
L*	55.24	a*	17.61	b*	26.57	C*	31.88	h*	56.47	Gloss 4

Sample colour:	[Mean]Painted 5: light brown (26/07/2017									26/07/2017 12:43:39
L*	53.58	a*	18.54	b*	27.29	C*	32.99	h*	55.81	Gloss 4

Colour Difference

dL*	-1.66	darker	da*	0.93	redder	db*	0.72	yellower
dC*	1.12	more saturated	dH*	-0.37	redder	dE00*	2.04	



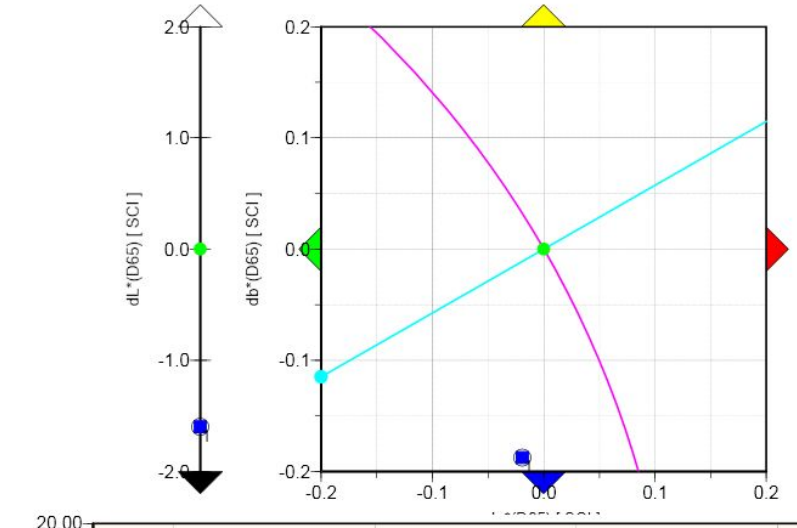


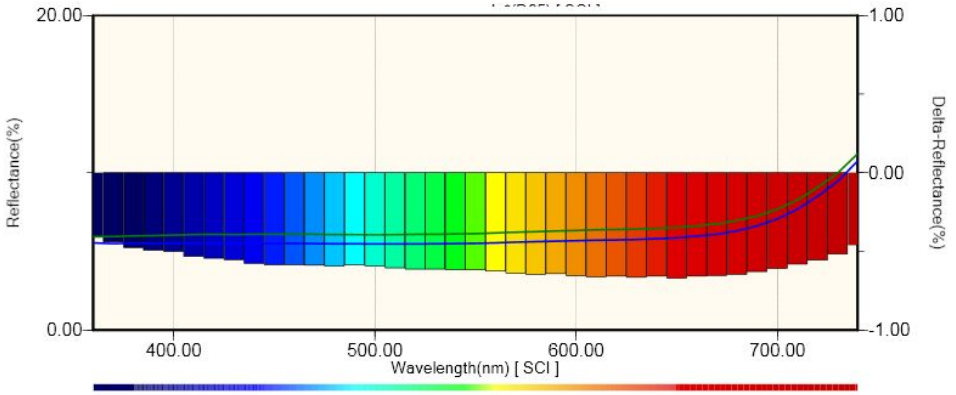
Centre for Textile Conservation

Target colour:	[Mean]Painted 5: dark brown (07/07/2017						07/07/2017 15:51:08				
L*	29.87	**a***	0.79	**b***	0.45	**C***	0.91	**h***	29.89	**Gloss**	4
Sample colour:	[Mean]Painted 5: dark brown (26/07/2017						26/07/2017 12:46:39				
L*	28.27	**a***	0.77	**b***	0.26	**C***	0.81	**h***	19.03	**Gloss**	4

Colour Difference

dL*	-1.60	darker	**da***	-0.02	less red	**db***	-0.19	less yellow	
dC*	-0.10	less saturated	**dH***	-0.16	redder	**dE00***	1.61		





Centre for Textile Conservation

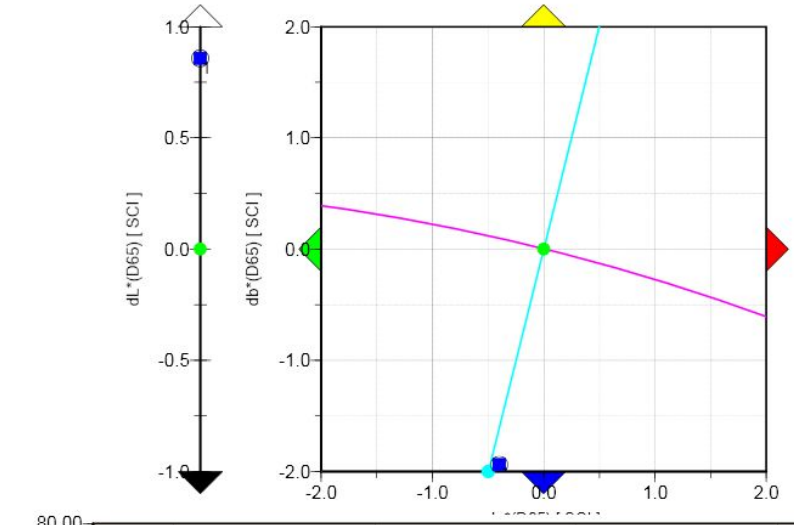
Target colour:	[Mean]Painted 5: plain (07/07/2017 15:53:1							07/07/2017 15:54:00	
L*	72.28	a*	4.79	b*	19.24	C*	19.83	h*	76.01	Gloss	5

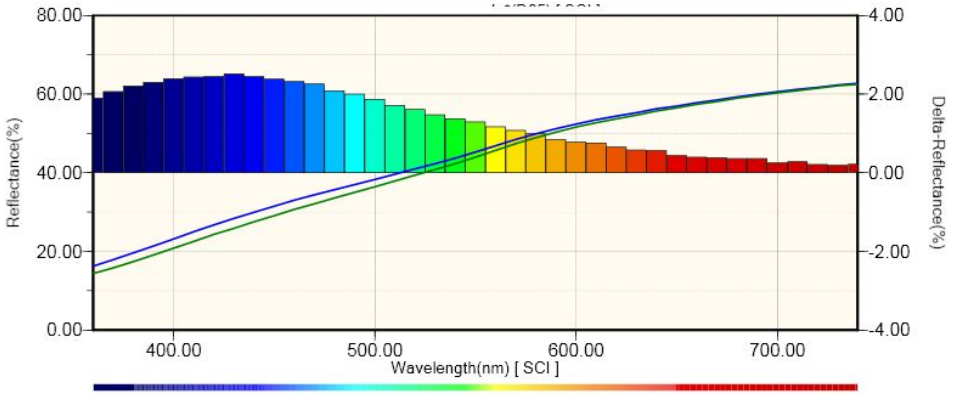
Sample colour:	[Mean]Painted 5: plain (26/07/2017 12:48:1							26/07/2017 12:48:36	
L*	73.14	a*	4.39	b*	17.30	C*	17.85	h*	75.75	Gloss	5

Colour Difference

dL*	0.86	lighter	da*	-0.40	less red	db*	-1.94	less yellow

dC*	-1.98	less saturated	dH*	-0.08	redder	dE00*	2.16



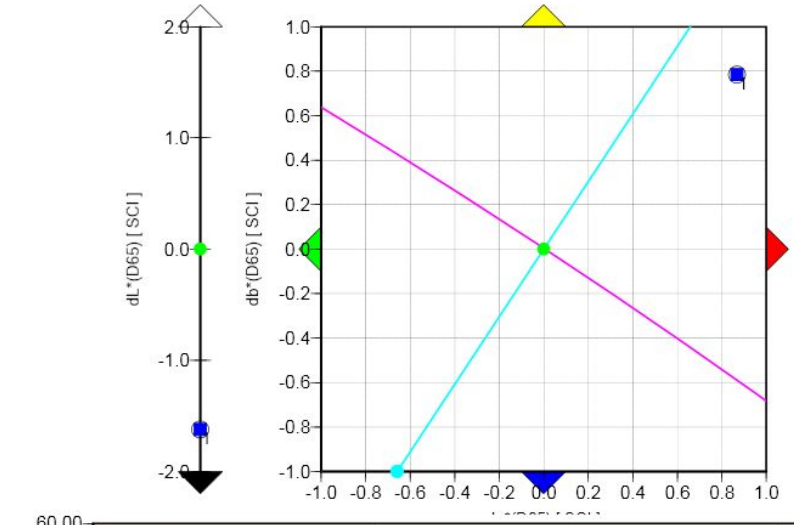


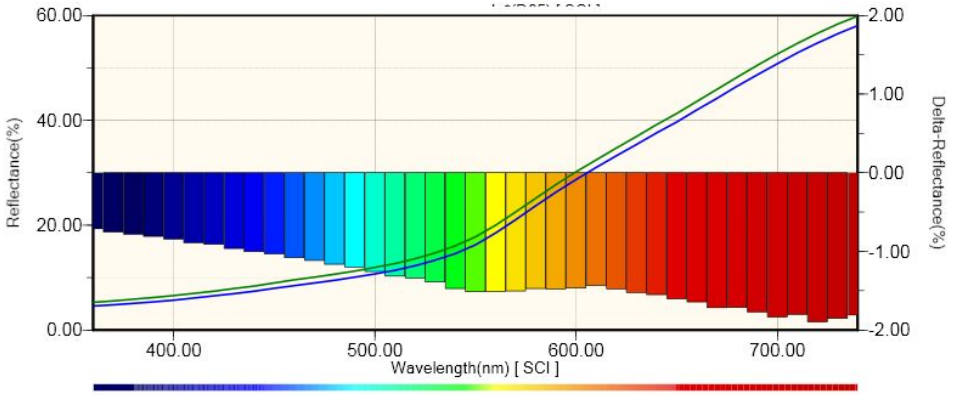
Centre for Textile Conservation

Target colour:	[Mean]Painted 6: light brown (07/07/2017						07/07/2017 15:58:58				
L*	52.11	**a***	17.96	**b***	27.28	**C***	32.66	**h***	56.64	**Gloss**	3
Sample colour:	[Mean]Painted 6: light brown (26/07/2017						26/07/2017 12:54:32				
L*	50.49	**a***	18.83	**b***	28.06	**C***	33.79	**h***	56.14	**Gloss**	2

Colour Difference

dL*	-1.62	darker	**da***	0.87	redder	**db***	0.78	yellower
dC*	1.13	more saturated	**dH***	-0.29	redder	**dE00***	2.00	



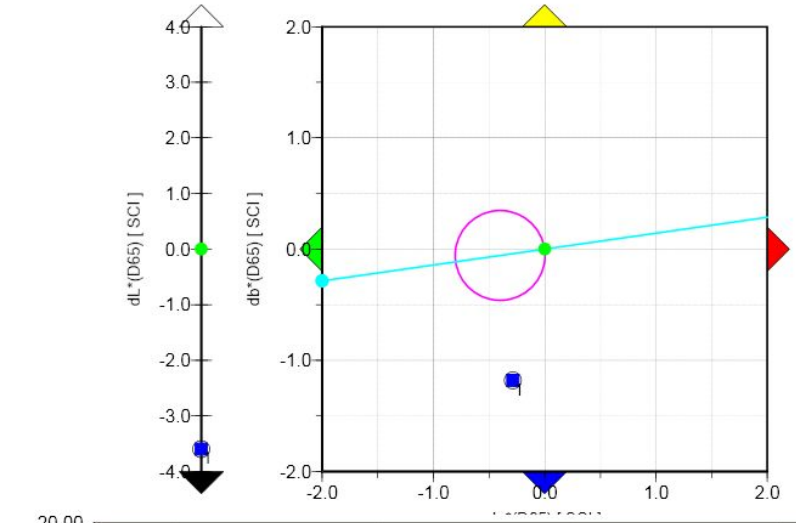


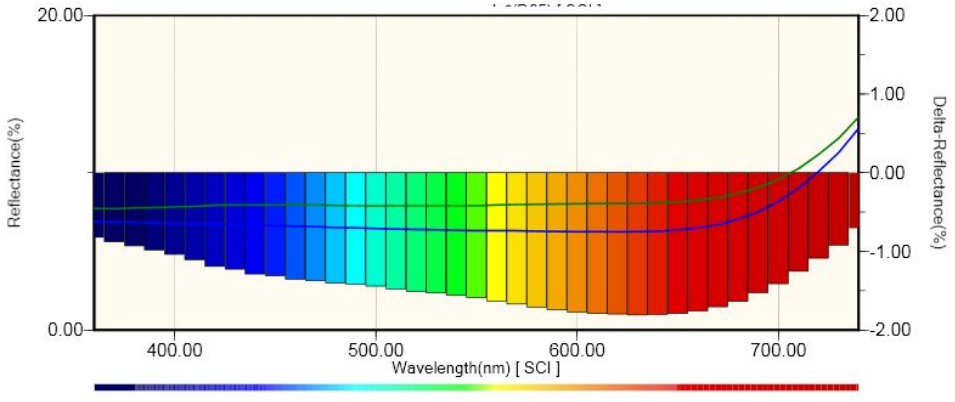
Centre for Textile Conservation

Target colour:	[Mean]Painted 6: dark brown (07/07/2017							07/07/2017 16:05:24		
L*	33.89	a*	0.40	b*	0.06	C*	0.41	h*	8.13	Gloss	2
Sample colour:	**[Mean]Painted 6: dark brown (26/07/2017**							**26/07/2017 12:56:42**		
L*	30.29	a*	0.11	b*	-1.12	C*	1.13	h*	275.82	Gloss	3

Colour Difference

dL*	-3.60	darker	da*	-0.29	less red	db*	-1.18	less yellow
dC*	0.73	more saturated	dH*	-0.98	redder	dE00*	3.80	



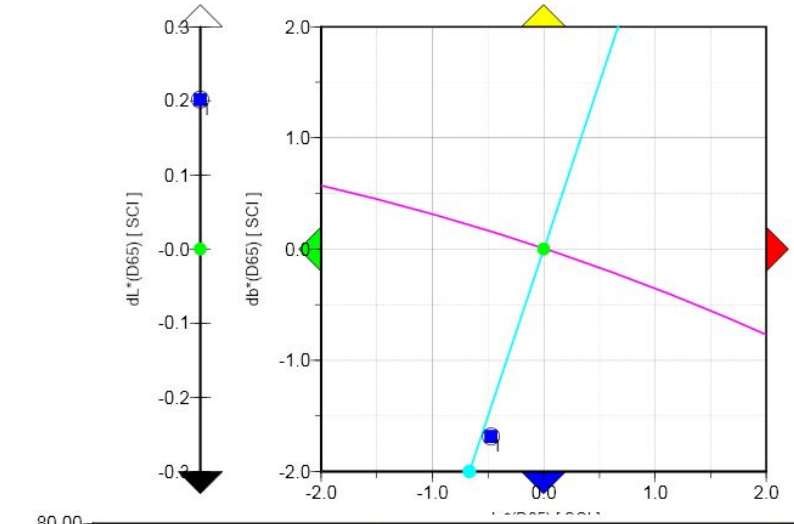


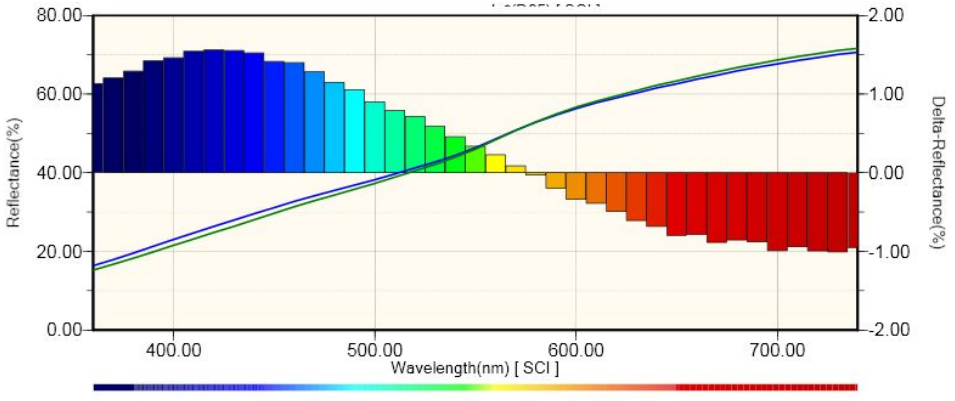
Centre for Textile Conservation

Target colour:	[Mean]Painted 6: plain (07/07/2017 16:08:2						07/07/2017 16:09:25				
L*	74.05	**a***	7.13	**b***	21.35	**C***	22.51	**h***	71.53	**Gloss**	6
Sample colour:	[Mean]Painted 6: plain (original target unk						26/07/2017 12:59:07				
L*	74.26	**a***	6.65	**b***	19.66	**C***	20.76	**h***	71.30	**Gloss**	7

Colour Difference

dL*	0.20	lighter	**da***	-0.47	less red	**db***	-1.69	less yellow	
dC*	-1.75	less saturated	**dH***	-0.09	redder	**dE00***	1.76		



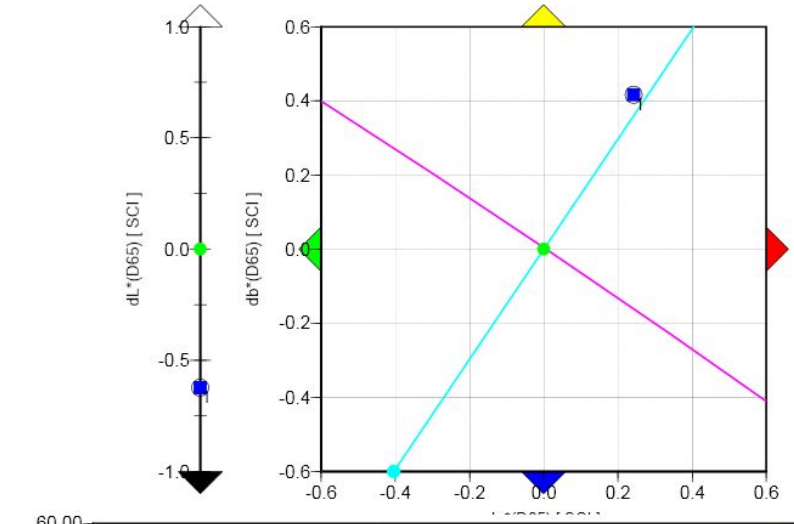


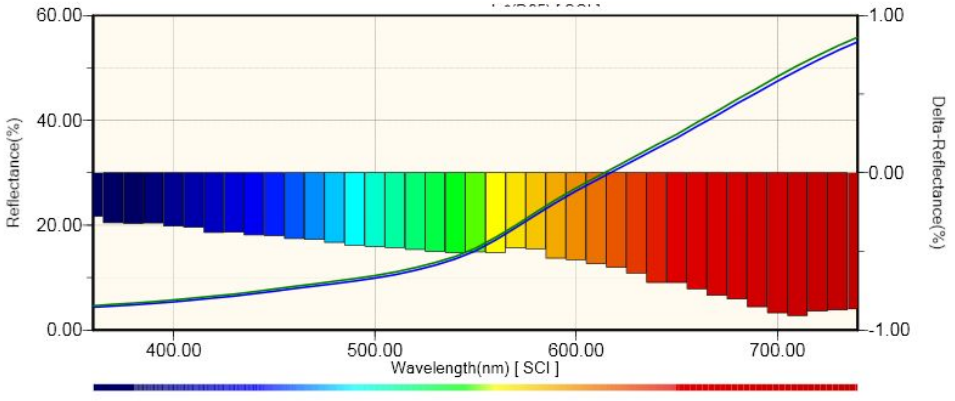
Centre for Textile Conservation

Target colour:	[Mean]Painted 7: light brown (11/07/2017						11/07/2017 12:33:03				
L*	49.43	**a***	17.98	**b***	26.70	**C***	32.19	**h***	56.05	**Gloss**	2
Sample colour:	[Mean]Painted 7: light brown (26/07/2017						26/07/2017 13:01:37				
L*	48.81	**a***	18.22	**b***	27.12	**C***	32.67	**h***	56.10	**Gloss**	2

Colour Difference

dL*	-0.62	darker	**da***	0.24	redder	**db***	0.42	yellower
dC*	0.48	more saturated	**dH***	0.03	yellower	**dE00***	0.79	



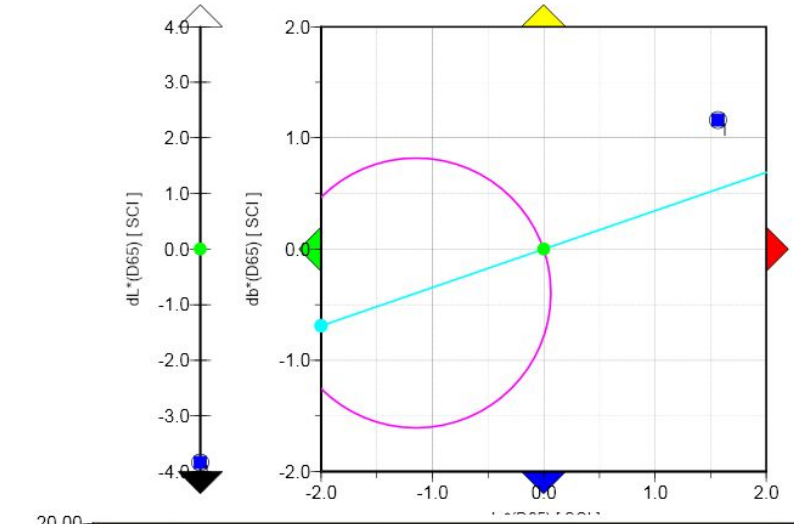


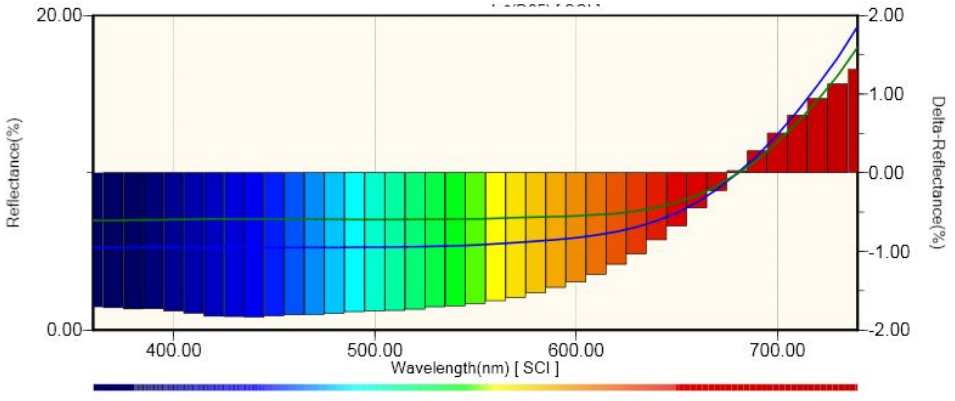
Centre for Textile Conservation

Target colour:	[Mean]Painted 7: Dark brown (11/07/2017								11/07/2017 12:35:34		
L*	32.15	a*	1.15	b*	0.40	C*	1.21	h*	19.02	Gloss	3
Sample colour:	**[Mean]Painted 7: Dark brown (26/07/2017**								**26/07/2017 13:06:59**		
L*	28.31	a*	2.71	b*	1.55	C*	3.13	h*	29.82	Gloss	5

Colour Difference

dL*	-3.84	darker	da*	1.57	redder	db*	1.16	yellower
dC*	1.91	more saturated	dH*	0.37	yellower	dE00*	4.30	



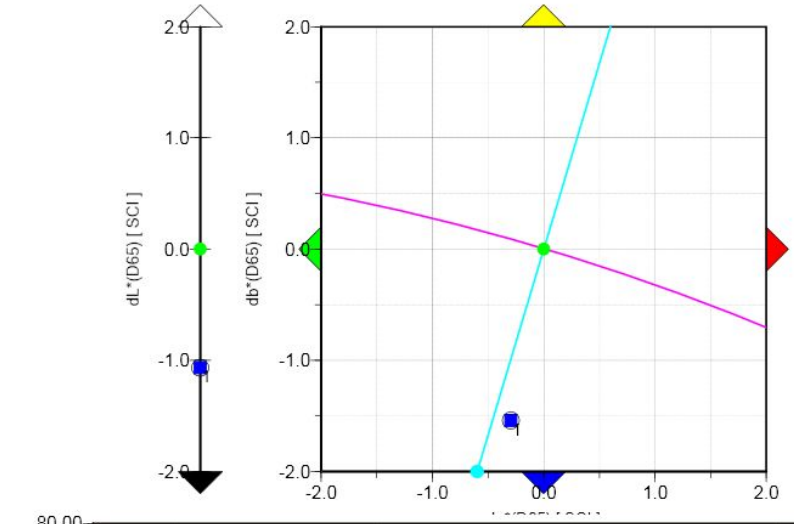


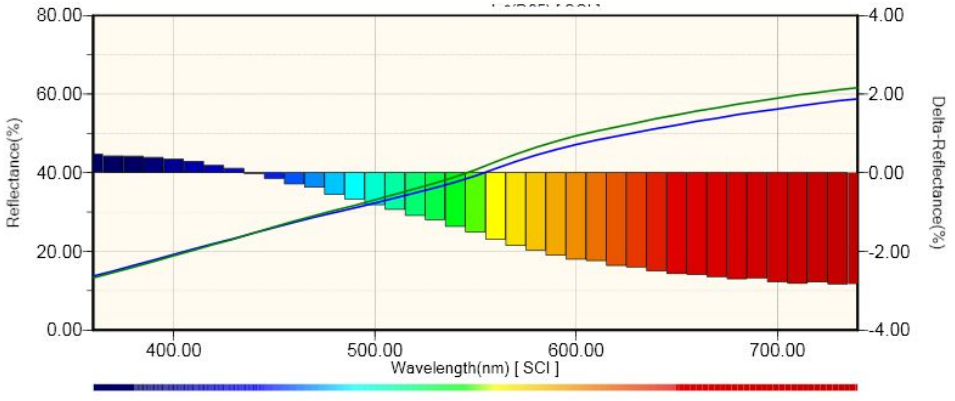
Centre for Textile Conservation

Target colour:	[Mean]Painted 7: Plain (11/07/2017 12:37:1						11/07/2017 12:38:10				
L*	70.30	**a***	6.09	**b***	20.34	**C***	21.23	**h***	73.34	**Gloss**	5
Sample colour:	[Mean]Painted 7: Plain (26/07/2017 13:08:2						26/07/2017 13:08:46				
L*	69.23	**a***	5.79	**b***	18.79	**C***	19.67	**h***	72.87	**Gloss**	5

Colour Difference

dL*	-1.07	darker	**da***	-0.29	less red	**db***	-1.54	less yellow
dC*	-1.56	less saturated	**dH***	-0.17	redder	**dE00***	1.90	





Centre for Textile Conservation

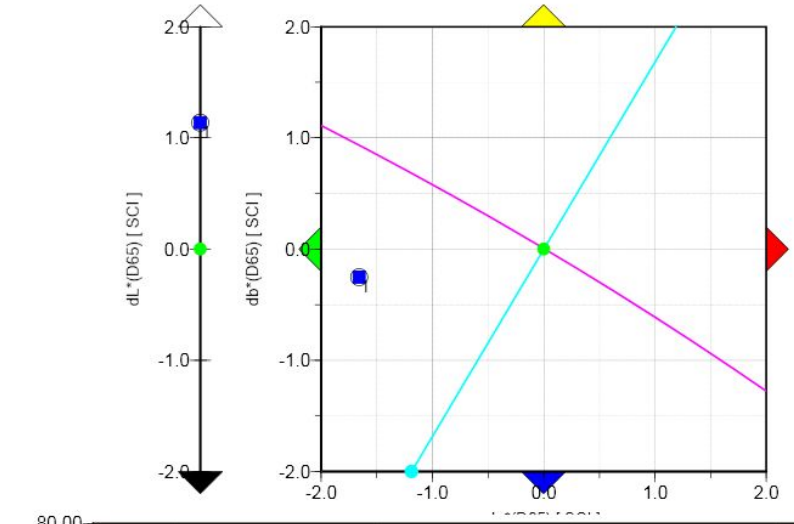
Target colour:	[Mean]Painted 8: Light brown (11/07/2017							11/07/2017 12:43:13	
L*	60.29	a*	18.11	b*	30.47	C*	35.45	h*	59.27	Gloss	4

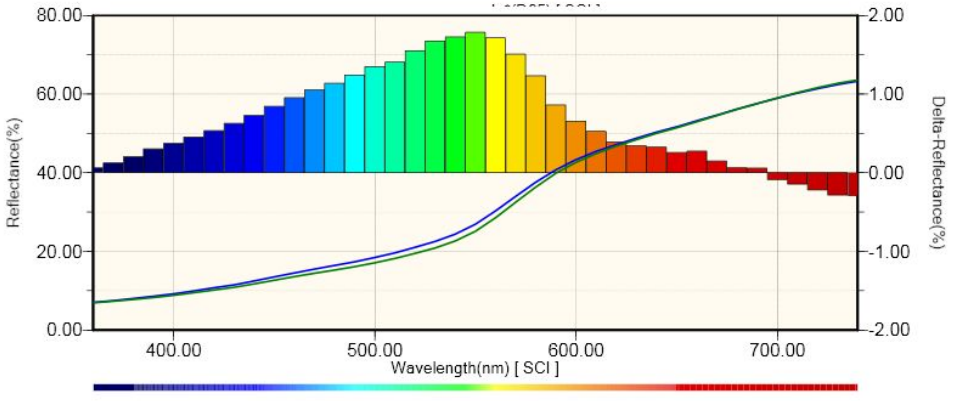
Sample colour:	[Mean]Painted 8: Light brown (26/07/2017							26/07/2017 13:11:20	
L*	61.42	a*	16.46	b*	30.22	C*	34.41	h*	61.43	Gloss	4

Colour Difference

dL*	1.13	lighter	da*	-1.66	less red	db*	-0.25	less yellow

dC*	-1.04	less saturated	dH*	1.31	yellower	dE00*	2.02





Centre for Textile Conservation

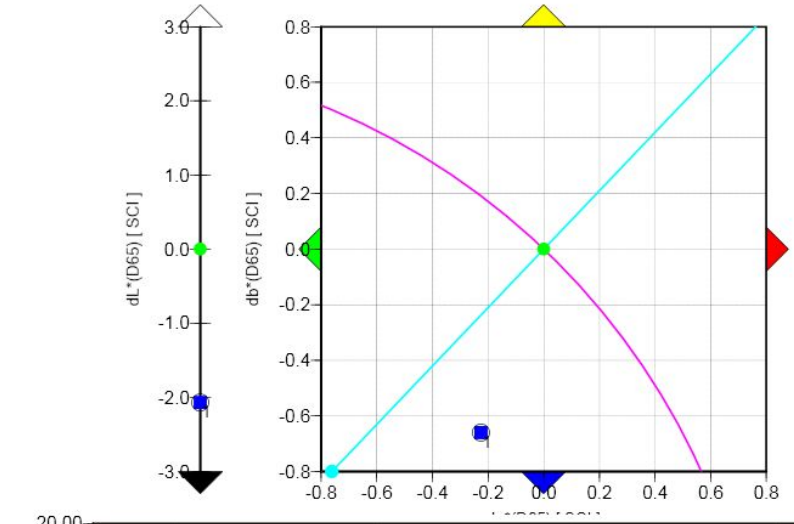
Target colour:	[Mean]Painted 8: Dark brown (11/07/2017							11/07/2017 12:46:26	
L*	32.59	a*	1.76	b*	1.84	C*	2.55	h*	46.40	Gloss	3

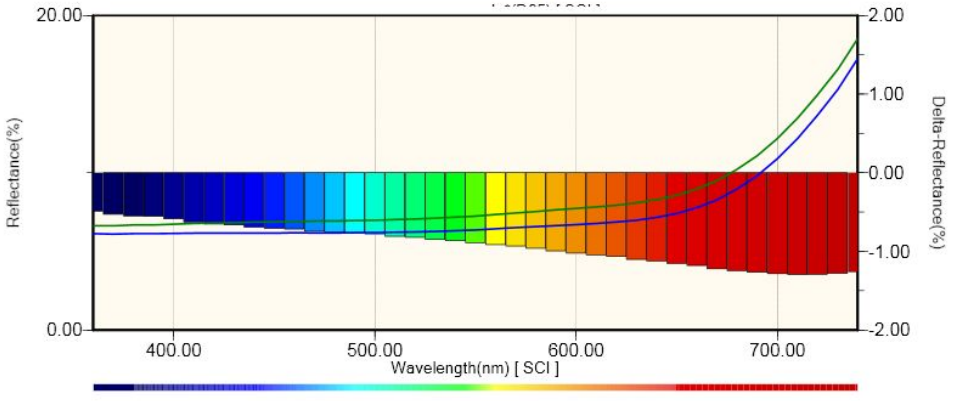
Sample colour:	[Mean]Painted 8: Dark brown (26/07/2017							26/07/2017 13:13:13	
L*	30.52	a*	1.53	b*	1.18	C*	1.94	h*	37.71	Gloss	4

Colour Difference

dL*	-2.07	darker	da*	-0.23	less red	db*	-0.66	less yellow

dC*	-0.61	less saturated	dH*	-0.34	redder	dE00*	2.19





Centre for Textile Conservation

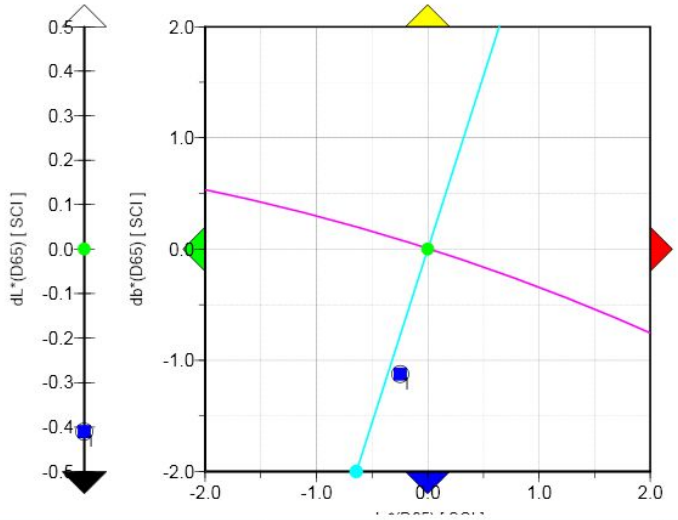
Target colour:	[Mean]Painted 8: plain (11/07/2017 12:48:2							11/07/2017 12:49:17
L*	74.23	a*	6.17	b*	19.25	C*	20.21	h*	72.23	Gloss	7

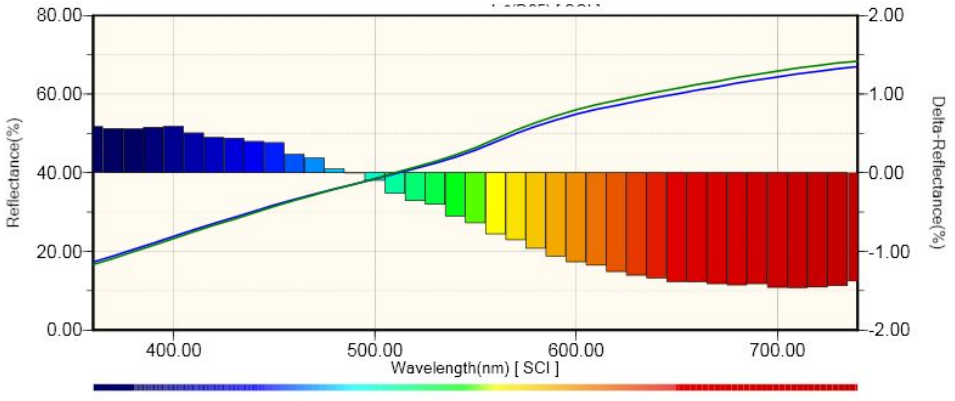
Sample colour:	[Mean]Painted 8: plain (26/07/2017 13:15:0							26/07/2017 13:15:51
L*	73.82	a*	5.92	b*	18.12	C*	19.07	h*	71.90	Gloss	6

Colour Difference

dL*	-0.41	darker	da*	-0.25	less red	db*	-1.12	less yellow

dC*	-1.14	less saturated	dH*	-0.11	redder	dE00*	1.22



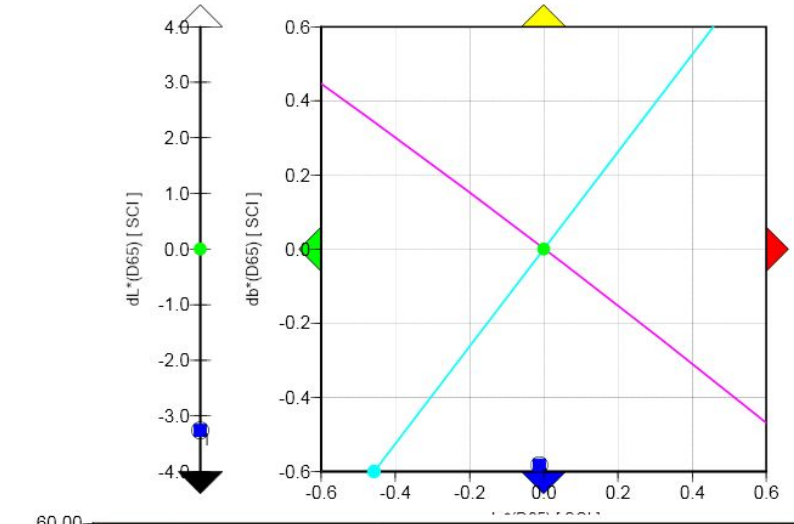


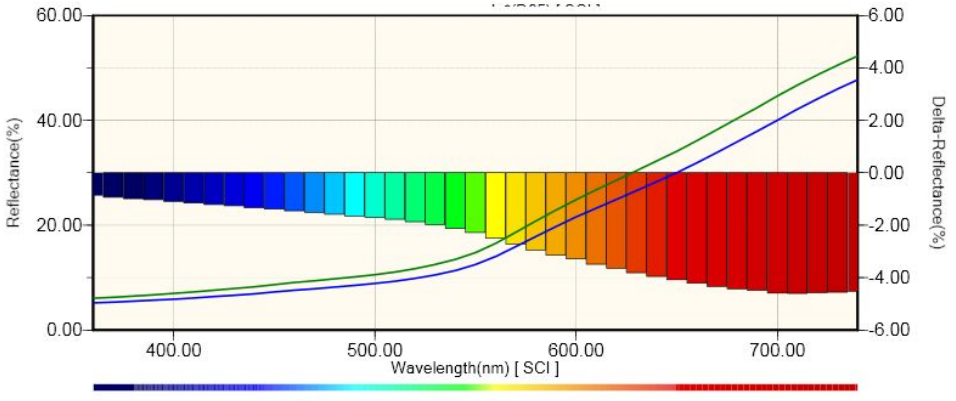
Centre for Textile Conservation

Target colour:	[Mean]Painted 9 NEW: light brown (14/07/									14/07/2017 11:39:48
L*	48.22	a*	16.66	b*	21.88	C*	27.50	h*	52.71	Gloss 3
Sample colour:	[Mean]Painted 9: light brown (26/07/2017									26/07/2017 13:20:19
L*	44.96	a*	16.65	b*	21.30	C*	27.04	h*	51.98	Gloss 3

Colour Difference

dL*	-3.26	darker	da*	-0.01	less red	db*	-0.58	less yellow
dC*	-0.47	less saturated	dH*	-0.35	redder	dE00*	3.31	





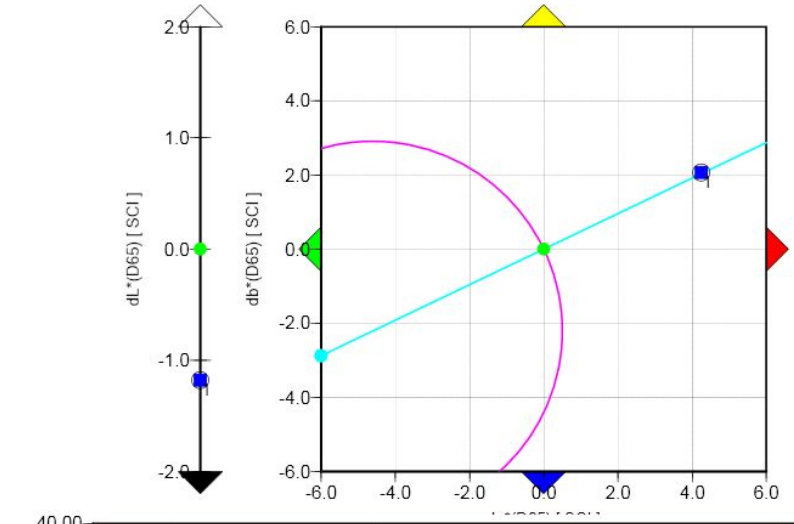
Centre for Textile Conservation

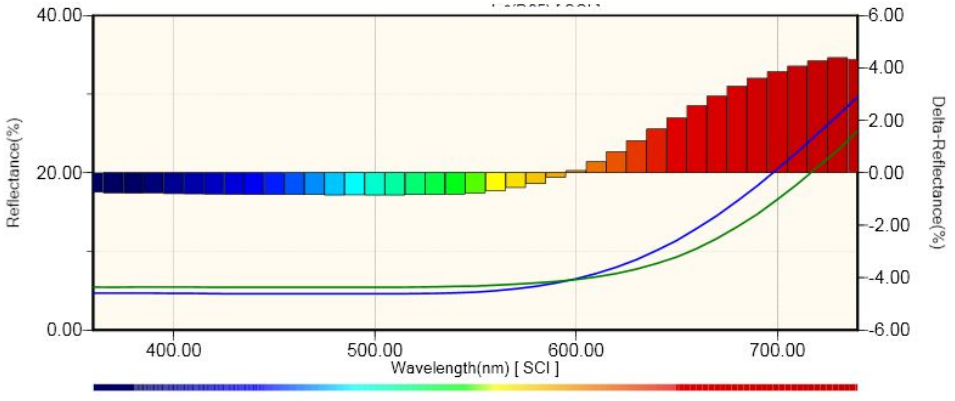
Target colour:	[Mean]Painted 9: dark brown (14/07/2017								14/07/2017 11:41:47
L*	29.23	a*	4.62	b*	2.21	C*	5.12	h*	25.61	Gloss	4

Sample colour:	[Mean]Painted 9: dark brown (26/07/2017								26/07/2017 13:22:39
L*	28.05	a*	8.86	b*	4.27	C*	9.84	h*	25.74	Gloss	5

Colour Difference

dL*	-1.18	darker	da*	4.25	redder	db*	2.06	yellower
dC*	4.72	more saturated	dH*	0.02	yellower	dE00*	4.87	



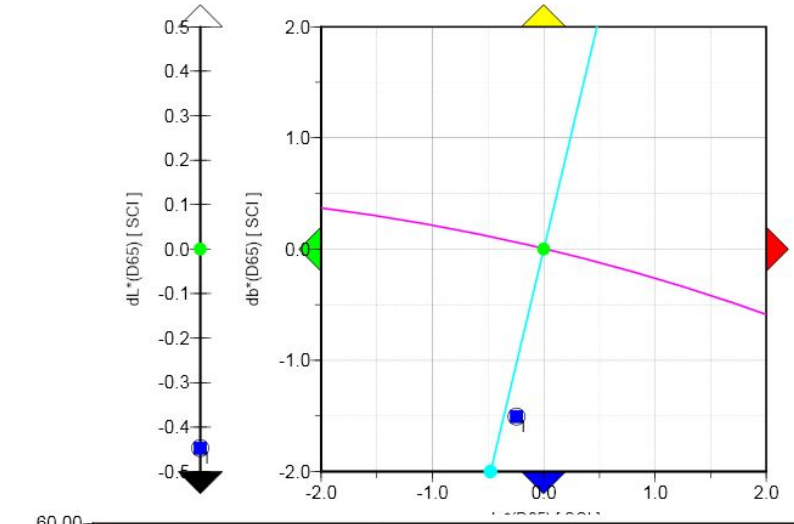


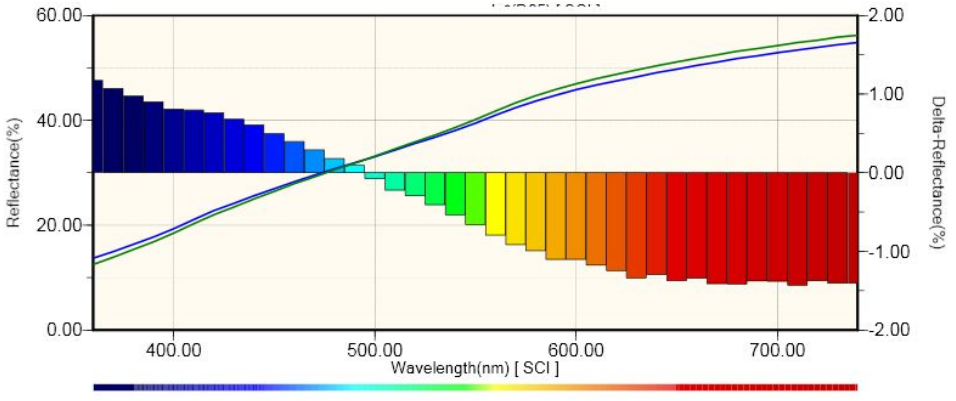
Centre for Textile Conservation

Target colour:	[Mean]Painted 9: plain (14/07/2017 11:43:2						14/07/2017 11:44:50				
L*	69.59	**a***	4.48	**b***	18.77	**C***	19.30	**h***	76.57	**Gloss**	5
Sample colour:	[Mean]Painted 9: plain (26/07/2017 13:24:3						26/07/2017 13:25:03				
L*	69.14	**a***	4.24	**b***	17.27	**C***	17.78	**h***	76.21	**Gloss**	5

Colour Difference

dL*	-0.45	darker	**da***	-0.25	less red	**db***	-1.51	less yellow
dC*	-1.52	less saturated	**dH***	-0.12	redder	**dE00***	1.59	





Centre for Textile Conservation

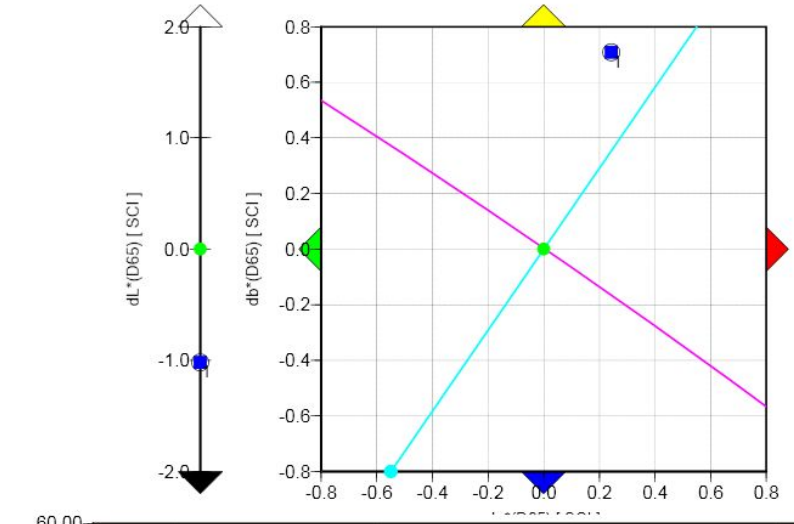
Target colour:	[Mean]Painted 10: light brown (14/07/2017								14/07/2017 11:47:11
L*	47.73	a*	16.74	b*	24.40	C*	29.59	h*	55.54	Gloss	3

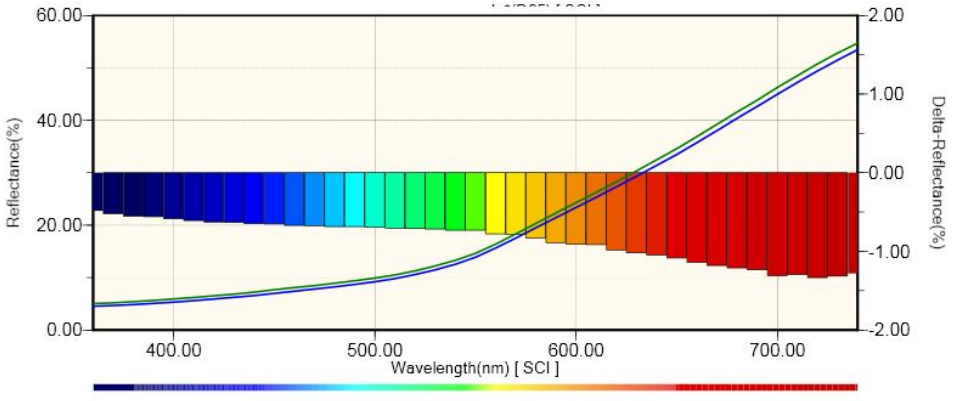
Sample colour:	[Mean]Painted 10: light brown (26/07/2017								26/07/2017 13:27:57
L*	46.71	a*	16.99	b*	25.10	C*	30.31	h*	55.91	Gloss	3

Colour Difference

dL*	-1.02	darker	da*	0.24	redder	db*	0.71	yellower

dC*	0.72	more saturated	dH*	0.20	yellower	dE00*	1.26





Centre for Textile Conservation

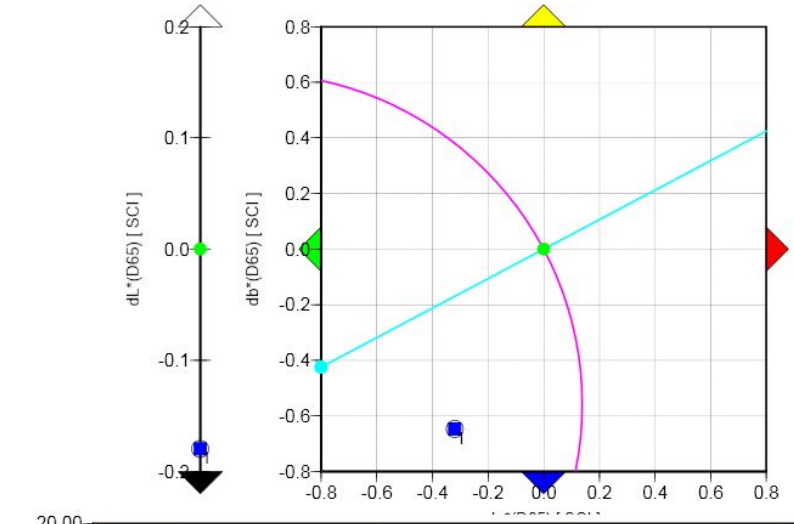
Target colour:	[Mean]Painted 10: dark brown (14/07/2017								14/07/2017 11:49:27
L*	31.67	a*	1.05	b*	0.56	C*	1.19	h*	27.96	Gloss	1

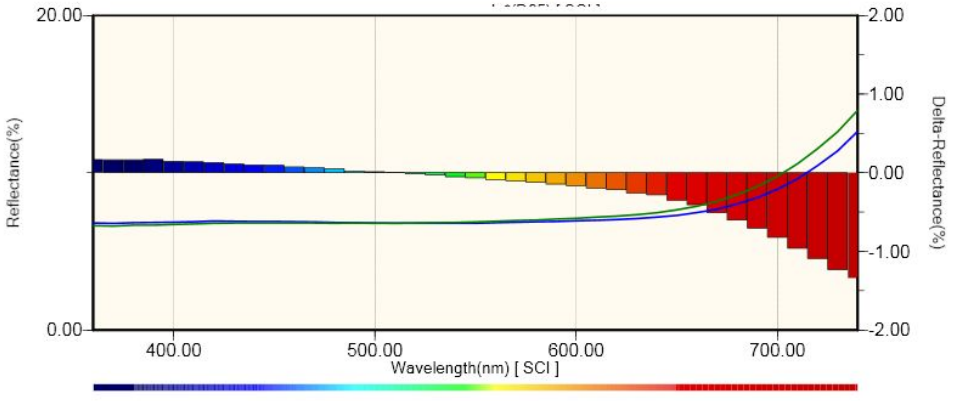
Sample colour:	[Mean]Painted 10: dark brown (26/07/2017								26/07/2017 13:32:03
L*	31.49	a*	0.73	b*	-0.09	C*	0.74	h*	353.21	Gloss	1

Colour Difference

dL*	-0.18	darker	da*	-0.32	less red	db*	-0.65	less yellow

dC*	-0.45	less saturated	dH*	-0.56	redder	dE00*	0.74





Centre for Textile Conservation

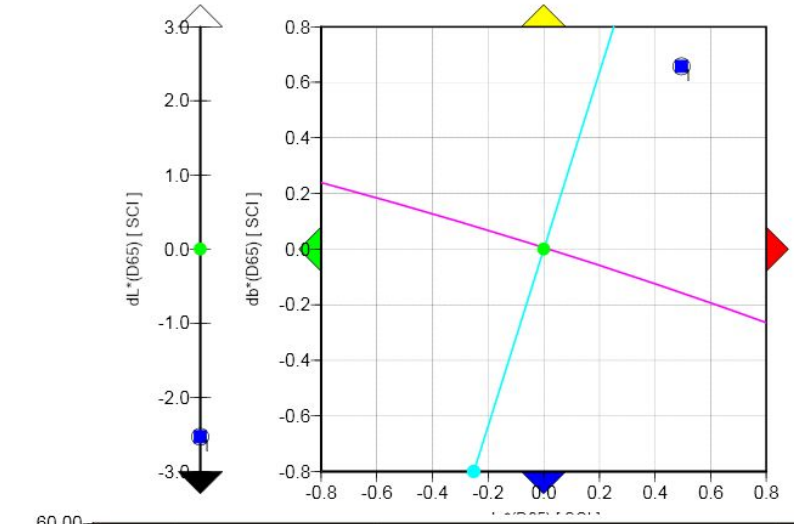
Target colour:	[Mean]Painted 10: plain (14/07/2017 11:50								14/07/2017 11:51:16
L*	65.25	a*	6.11	b*	19.40	C*	20.34	h*	72.52	Gloss	4

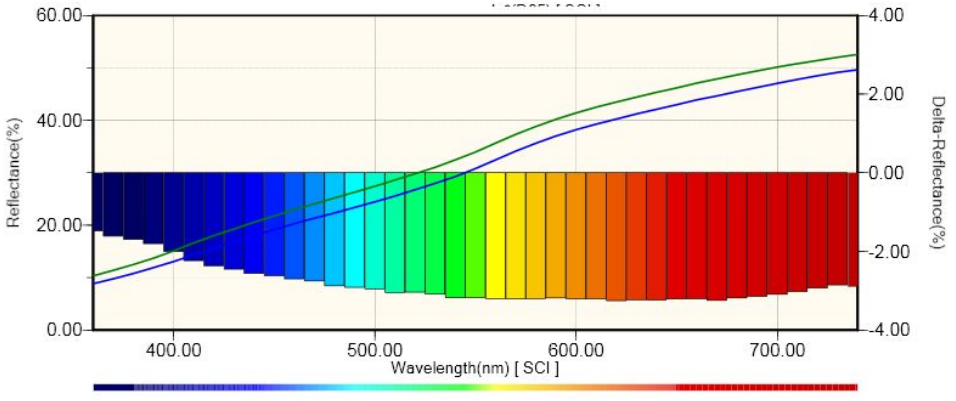
Sample colour:	[Mean]Painted 10: plain (26/07/2017 13:33								26/07/2017 13:33:58
L*	62.72	a*	6.60	b*	20.06	C*	21.11	h*	71.78	Gloss	2

Colour Difference

dL*	-2.53	darker	da*	0.50	redder	db*	0.66	yellower

dC*	0.78	more saturated	dH*	-0.27	redder	dE00*	2.66





List of Suppliers

New paper mulberry barkcloth (Fijian tapa cloth)

Black Pearl Designs
Catalog Department
PO Box 1955
Kamuela, Hawaii 96743

Painted barkcloth (purchased from collector)

Robert Rummage
68 High Street,
HASTINGS,
East Sussex,
TN34 3EW

Reemay® 34gsm, acid free, random-spunbonded 100% polyester
Sympatex, 50gsm
Blotting paper, 300gsm
Kuramata Dahlia Sprayer

ALL
Preservation Equipment Ltd
Vinces Rd
Diss
Norfolk
IP22 4QH
UK