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Chapter 22

Conservation methods of Edo period Japanese paper garment 'Kamiko'

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Abstract
ATOPOS is a non-profit, contemporary culture organization in Athens, which has, worldwide, a unique collection of paper garments, including the Japanese paper garments which belong chronologically to the end of the Edo period. This research is about the qualitative and semi-quantitative elemental analysis of a Japanese paper garment ('Kamiko') and the conservation methods. This garment was presented at the exhibition of the New Benaki Museum, 'RRRIPP! Paper Fashion', (03-05/2007) and was first published in the exhibition's catalogue. Until today it has participated in many exhibitions all over the world. The uniqueness of the manufacturing technique of a paper made exclusively for garment use in combination with the three-dimensional structure of the object and the preservation condition that was found according to the quality of storage and handling, posed questions about the conservation method (practices, techniques and materials). The garment's exterior, which had a dark colour due to persimmon tannin, was decorated with orpiment yellow. Sodium carboxymethyl-cellulose helped increase the mechanical strength of the material. Starch-based glue gave the best adhesiveness.

Keywords: *Japanese paper garment, SEM-EDX, conservation methods*

Introduction

The conservation project of the Japanese paper garment 'Kamiko' (ATOPOS index code CVC 2006.08.032), which chronologically belongs to the Edo period (1600-1863 AD), was an interesting collaboration with ***ATOPOS*** Contemporary Visual Culture (a nonprofit cultural organization), which owns this garment and a rare collection of paper dresses worldwide. 'Kamiko' appeared in Japan around the 10th century (988 BC) (Leitner 2005; Lentzi and Facorellis 2007; Antziletou and Chatzipalamoutzi 2010; Antziletou *et al*. 2010). In the beginning, it was connected to sacramental and religious rituals, as its own name shows as a combination of 'kami' (a piece of paper but a deity too), and 'koromo' (monk's garment). Then, it served everyday practical needs of Japanese people as a cheap construction with great resistance to humidity, wind and heat. Later, it acquired glamour and timelessness, taking a very important position in the life and art of Japan (Kiyofusa 1980; Miller 1985; Fukai 2007). Today, it expresses both meanings: monks create and wear them at religious rituals as a symbol of austerity whereas, at the same time, beyond the religious rituals, it stands as a symbol of luxury. The invention of the paper garment by the people of the East shows the great difference in philosophy and meaning of that material - paper - in contrast to the western philosophy that used it mainly for writing (Sahlstrand and Koplos 1984). That difference marked the following evolution on both sides. This research concerns: (a) optical observation and microanalysis of Kamiko's samples with the Scanning Electron Microscope (SEM-EDX), which gave us precious information about its material structure (manufacturing technology) and (b) the appropriate conservation methods (techniques and materials) for a three-dimensional object (Fig. 5).

The preliminary and necessary process of collecting information related to the history and the manufacturing technology of the garment, included three steps: (a) bibliographical research, (b) observation and microanalysis of samples with the Scanning Electron Microscope (JEOL JSM-5310, EDX OXFORD LINK ISIS L310), and (c) laboratory tests for humidity resistance and oxidation grade.

The unique manufacturing technique of a paper made exclusively for garment use in combination with the three-dimensional structure of the object and the preservation condition, according to the quality of storage and handling, defined the appropriate conservation methodology based on the reversibility and compatibility of treatments and materials for the best and most long-lasting results. There were two phases of the conservation project: *1st phase* (i) photographic documentation before, during and after conservation treatments, (ii) detailed identification and damage recording, (iii) testing of the solubility of dyes and (iv) selection and organisation of

the methods, techniques and materials of the conservation treatments. *2nd phase* (i) water cleaning in a suction table (Figs. 1-5), (ii) levelling (flattening) creases and foldings methodology - a rather time-consuming procedure, (iii) sizing with a water diluted solution of sodium carboxymethyl-cellulose SCMC (1/15: SCMC/H_2O), (iv) fixings-fillings tears or holes with the appropriate Japanese papers and starch based glue (Figs. 6-8) and (v) aesthetic retouching with water colours (aquarelle) (Figs. 9 and 10).

Results and Discussion

According to bibliographical research, Kamiko's paper is purely of vegetable origin, from the inner bark of the mulberry family (*Broussonetia papyferia*, Moraceae family, known as kozo in Japanese), which grows in Japan (Tsai and van der Reyden 1997; Materials for Washi; RISI). The pulp of the inner bark is treated with a vegetable glue, named 'Konnyaku', and is soaked in persimmon tannin (Diospyros kaki) to make it water resistant. The following treatment of the sheet of paper included continuous creases and rubbing of the surface in order to soften and increase its resistance to humidity. The final result is a sense of leather (creases and hardness). In order to create the Kamiko garment in the ATOPOS' Collection, two pieces of paper are sewed together by a hidden seam, on the edges of the sheets, with a dark blue cotton thread. The same thread is used for the embroidery on the neck finish and in the front side where the garment closes.

Observations with SEM (Table 1) showed that the raw material is pure, natural, of vegetable origin, and soaked in persimmon tannin. On the outer surface the vegetable fibers are visible and have random orientation. They are round and their width ranges from 7 to 35 μm. The inner side of the same sample is smoother than the outer and no fibers are visible. This picture can be combined with the information that the raw material comes from treated vegetable bark. There are grains all over the surface and they are most probably foreign bodies and impurities.

The microanalysis (SEM-EDX) provided us with the elemental composition of the raw material but not the exact chemical compound (Stuart 2007). The presence of S and As suggests the use of the yellow dye orpiment (As_2S_3) (Eastaugh *et al*. 2004) for the yellow design of the three leaves on the back side of the garment (Fig. 9). This dye is well known in the East since the Roman period. Also Na, S, K, and O are basic elements of persimmon tannin, Si and Ca are detected at Kozo and especially Si is found in plant phytoliths.

Observations during the conservation project indicated that the main damage was due to bad storage conditions, since that garment was made from the beginning for hard environmental conditions. Oxidation of the paper was indicated by a bad smell in combination with the inflexibility and high level of brittleness of the material, the accretions of foreign bodies and other impurities (Figs. 1 and 2).

Given that the object was found folded (Figs. 2, 3 and 5), the unfolding, the flattening of the creases and the reinstatement of the garment to its original operational feature were possible only by humidification and pressing with Hollytex blotting paper and using weights for 2-3 days for each crease. Wet cleaning decreased brittleness for a short time.

The testing of the solubility of dyes in order to avoid any accident during the next phase of the conservation project showed that they were stable. That fact helped a lot the following water cleaning procedure which took place in the suction table (Figs. 1, 3 and 4). This method confirmed that the tears would not extend and the mediation (interleaving support) of Hollytex and Melinex sheets in between the garment would prevent any colour, oxidation and dye transfer from one side to the other.

Sodium carboxymethyl-cellulose SCMC (1/15: SCMC/H_2O), contributed a lot to the increasing of mechanical strength of the paper but did not have a satisfactory adhesiveness for the fixings of the tears and fillings of the losses. For that reason, another glue factor had to be found. According to the literature, starch-based glue was used for the manufacturing of Kamiko (Leitner 2005). Therefore, it was selected with satisfactory results. Besides, appropriate Japanese paper was chosen: a) for fixing the tears with adequate mechanical strength (*Locta*, 60-75 g per sheet) and b) for filling the holes that were finally retouched with water colors (*Argeli*, 50 g per sheet) (Figs. 9 and 10). *Locta* and *Argeli*, the trade names of handmade papers from Nepal, are of high resistance to tearing, humidity, insects and mildew. They are used for conservation purposes.The garment is kept in a plexiglass showcase coated with 100% cotton paper (*Somerset*, alkaline/lignin/acid free), specially designed with specific standards for exhibiting, transferring and storage in a place with controllable environmental conditions (humidity, heat, air, light).

The three-dimensional and double-sided structure of the garment indicated the need for special techniques at all stages of the conservation project. That thought guided: (a) the water cleaning in the suction table, where fortunately dyes were not soluble, (b) the fixings from the inner side of each leaf of paper, (c) the fillings of the holes from the outer side of each leaf (without turning the garment inside out because of the brittleness) and (d) the flattening of the creases which was one of the most difficult and time-consuming procedures. There is a clear difference between inner and outer side of the same sample. The outer side has visible and distinct fibres while the inner side has a more uniform appearance. Yellow orpiment and persimmon tannin were the likely dyes used.

The conservation project showed that the garment fulfilled its initial purpose making it water/heat/wind resistant. The most important factor that helped the most in all phases of the conservation project (unfolding the garment, flattening creases, fixing tears, filling holes) was humidity. Without humidity there was a high level of

brittleness. The dark colour of the outer side is due to persimmon tannin which has the property of darkening (blue-black) in sunlight while drying. The inner side, also soaked in persimmon tannin, dried in darkness, so it maintained its natural ochre-yellow colour. SCMC helped a lot by increasing the mechanical strength of the material but had no adhesiveness for fixings and fillings. The best adhesiveness was achieved with starch-based glue. Watercolours were used for aesthetic restoration, only on areas of new Japanese paper.

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References

Antziletou M. and Chatzipalamoutzi D., 2010, Study of the manufacturing technology of historical paper garments from the collection of the Atopos cultural organization and comparison of them with paper dresses of the 1960s, Graduate thesis, Department of Antiquities and Works of Art Conservation, Technological Educational Institute of Athens.

Antziletou M., Hatzipalamoutzi D. and Facorellis Y., 2010, Study of the manufacturing technology of historic Japanese paper dresses and comparison with paper dresses of the 60's, in N. Zacharias, K. Polikreti, M. Georgakopoulou, Th. Vakoulis and Y. Facorellis (eds.) *Proc. 5th Symp. Hellenic Society of Archaeometry* (Athens 2008), Athens, University of Peloponnese, Papazisis editions, 921-942.

Eastaugh N., Walsh V., Chaplin T. and Siddall, R., 2004, *The pigment Compendium: A dictionary of Historical Pigments*, Butterworth-Heinemann.

Fukai A., 2007, Paper tradition in Japan. Contemporary paper dress, *RRRIP!!! Paper Fashion*, Atopos, Athens, 262- 277.

Kiyofusa N., 1980, *A life of Ts'ai Lung and Japanese papermaking*, Paper Museum, Tokyo.

Leitner Ch., 2007, Paper Textiles, *RRRIP!!! Paper Fashion,* New Benaki Museum, 1 March - 29 April 2007, ATOPOS Cultural Organisation, Athens, 126-157.

Leitner C., 2005, *Paper Textiles*, A&C Black Publishers, London.

Lentzi K. and Facorellis Y., 2007, The Non-Woven Garments of the ATOPOS Collection: A Physical-Chemical Investigation, *RRRIP!!! Paper Fashion,* New Benaki Museum, 1 March - 29 April 2007, ATOPOS Cultural Organisation, Athens, 126-157.

Miller D., 1985, Shifu: A Handwoven Paper Textile of Japan, *ARS TEXTRINA*, Vol. 4, The Charles Babbage Research Centre, Canada, 43-66 http://ulita.leeds.ac.uk/docs/Ars_Textrina/Volume4/4.Shifu.pdf (visited May 21, 2015).

Sahlstrand M. and Koplos J., 1984, Paper clothing: East and West, *Fiberarts* 11(2), Interweave Press, Loveland, Colorado.

Stuart B. H., 2007, *Analytical Techniques in Materials Conservation*, Wiley.

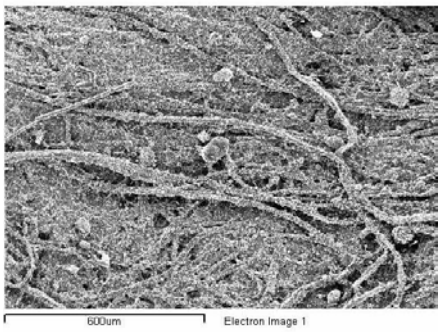
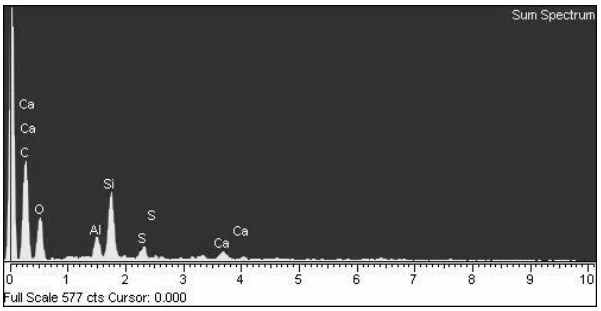
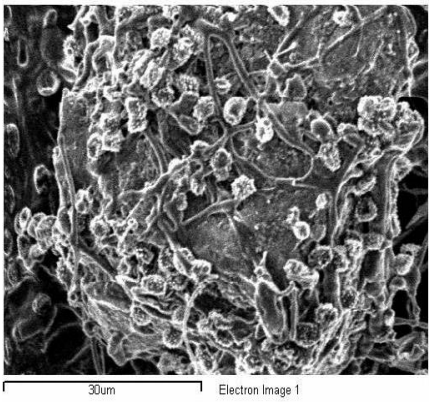
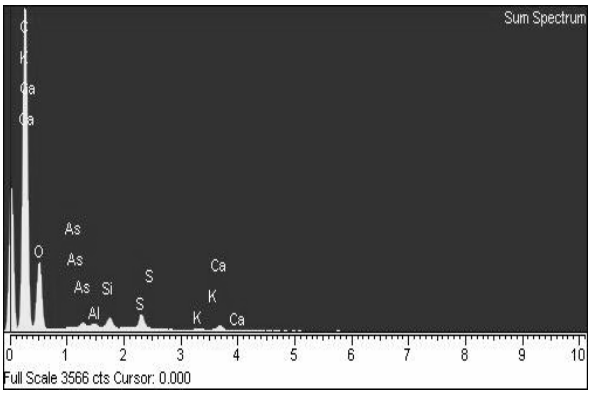
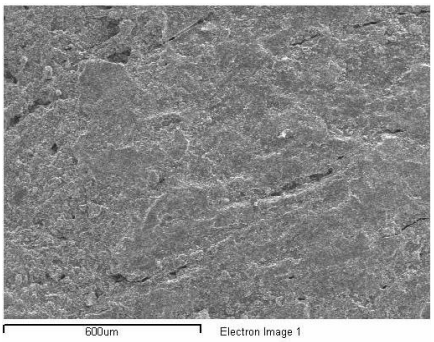
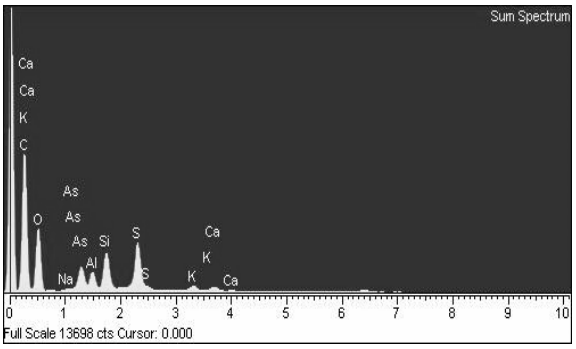
Tsai F.W. and van der Reyden D., 1997, Technology, treatment, and care of a Chinese wood block print, *The Paper Conservator*, 21(1), 48-62.

Websites

Materials for Washi, Awagami factory, (http://www.awagami.com/awawashi/materials.html) (visited 18/05/2015).

RISI, Toolkit, PaperHelp Encyclopedia, http://www.risiinfo.com/toolkit# (visited May 21, 2015).

Table 1. Summary of SEM-EDX results of the Japanese paper garment 'Kamiko' (ATOPOS index code CVC 2006.08.032).

Analysis position	*SEM photograph*	*EDX Spectrum with Semi-quantitative elemental analysis*
Front side, bulk analysis		 Si (26.3 ± 0.9); Al (21.1 ± 1.3); S (5.5 ± 0.6); Ca (6.3 ± 0.8); O (40.7 ± 1.2); C
Front side, grain		 S (16.4 ± 0.8); Si (10.9 ± 0,6); Ca (8.7 ± 0.8); Al (4.5 ± 0.5); As (9.1 ± 1.2); K (2.7 ± 0.6); O (47.8 ± 1.3); C
Back side, bulk analysis		 S (16.3 ± 0.2); Si (11.4 ± 0.1); As (14.8 ± 0.2); Al (4.6 ± 0.1); K (2.4 ± 0.1); Ca (2.3 ± 0.1); Na (0.4 ± 0.1); O (47.8 ± 0.3); C

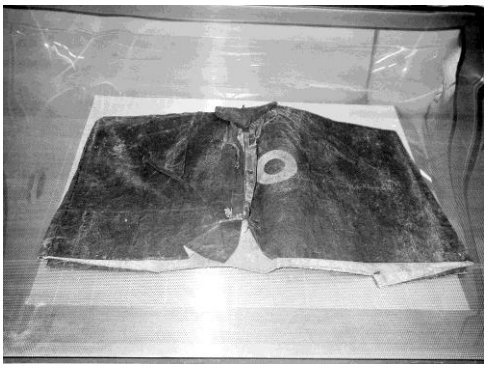


Fig. 1. Front side of the garment. Unfolding and cleaning on the suction table.

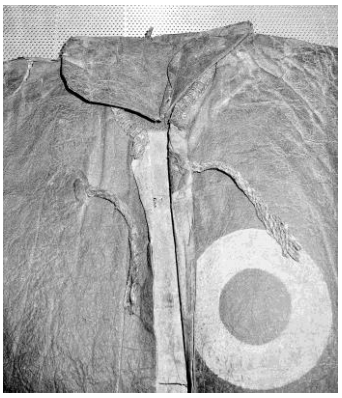


Fig. 2. Detail of the front side, neck.

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Fig. 3. Back side of the garment in the suction table.

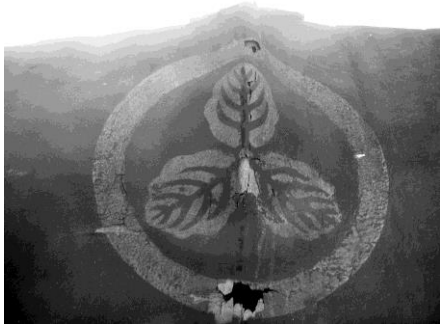
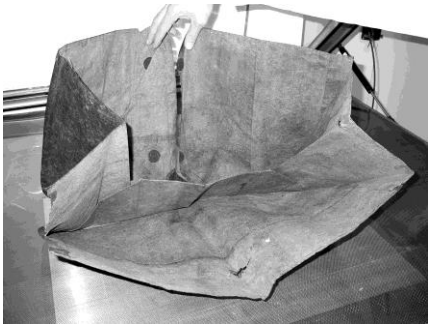


Fig. 4. Detail of the back side of the garment showing loss of material, tears and creases.



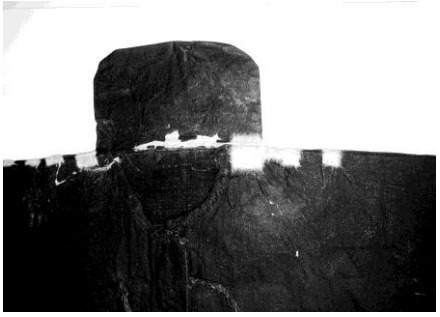
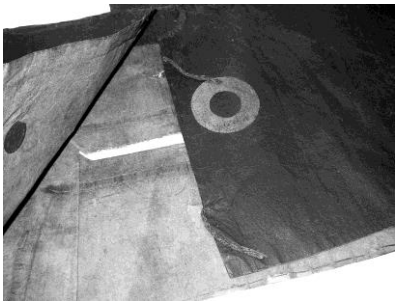


Fig. 5. (left) The three-dimensional structure, after humidification. Reduction of brittleness; Fig. 6. (middle) Back side. Filling in the holes; Fig. 7. (right) Back side. Unfolded neck, fixing of tears.



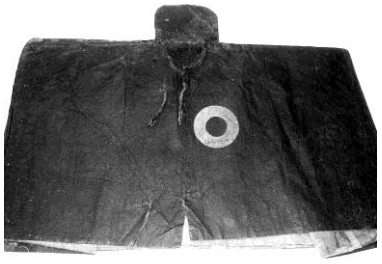


Fig. 8. (left) Inner side of the garment. Fixing of tears; Fig. 9 (middle) Back side of the garment, after aesthetic retouching; Fig. 10 (right) Front side of the garment, after aesthetic retouching.