

## A SCIENTIFIC APPROACH OF PRESERVATION TREATMENT AND RESTORATION PROCEDURES ON HISTORICAL ROYAL SONGKET SARONG

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### **Abstract**

*The object under research represents a 19<sup>th</sup> century Songket sarong belonging to the Royal family preserved in the National Museum of Malaysia collection. Historical reviews with analyzed the motifs and weaving technique showed that sample represent the Indonesia art. There is a lack of awareness on the preserving of songket textiles towards identifying deterioration factors, preventive preservation and restoration of historical songket textiles. This study aims to establish a new procedure for the preservation of historical songket textiles. It became evident that by exposing fabrics to improper storage and display technique had caused considerable harm to the physical, chemical and mechanical parts of the sample. This project integrated in three phases: historical analysis, scientific analysis and experimental research. Scientific analysis is used to analyze the materials in Songket textile under investigation by examining the natural and metal fibers using chemical examinations, Field Emission Scanning Electron Microscopy (FESEM) and Energy Dispersive Spectroscopy (EDS) and Fourier transform infrared spectroscopy (FTIR). Finally, after accurate survey, examination and identification, the researcher developed the most reliable procedure of preservation and new approach of restoration that was adopted in the National Museum of Malaysia.*

**Keywords:** *Songket Sarong; Preservation; Restoration; FESEM-EDS; FTIR; Pathology; Display;*

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### **Introduction**

The name Songket is derived from its technique of production whereby “*menyongket*” in Malay means the art of embroidery or to adorn gold thread on silk weaving using floral patterns. Since sixteenth century, songket has played a major role in the ruling courts of this region [1-9]. Songket hailed as “*the cloth of gold*” and “*the Queen of fabrics*” songket remains one of the most popular Malay textiles [10-13]. Songket belongs to the brocade family of textiles and patterns are created beautifully by metallic gold and silver threads by using the supplementary weft method.

#### ***Nature of songket sarong***

*Kain* songket or sarong as defined by Siti Zainon Ismail in 1999 [14] is unique textile that has originated from the process of *sungkit* or the art of embroidering gold thread. Songket sarong is a board, tubular cloth, joined at the two width ends, which is wrapped round the waist and extends to the ankles. Formerly, men wore their songket sarong so that it's almost reached their ankles. The women wear their songket sarong in a variety of styles tied at the waist [10-13]. The traditional structure of songket sarong is divided into four basic compositions, which

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are body, head, border and supporting head. Each part of the songket sarong is design with different patterns consisting of several songket motifs arranged systematically.

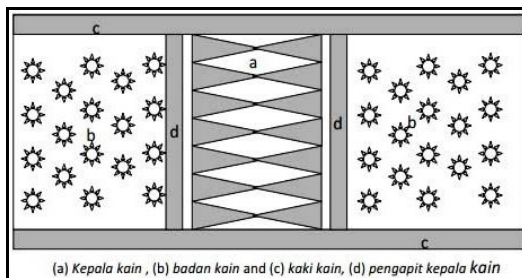


Fig. 1. Structure of songket sarong; a: head, b: body, c: foot, d: supporting head [3, 10, 11]

**Materials and Methods**

*Description of the Object under Study*

The studied object is full pattern songket sarong in green color with diagonal stripes design and red cotton fabric attached on it (registry number: E8573/7-1992 PA1(a)14) (Fig. 2). The width in songket part is 55cm and total width with cotton part is 85cm and the length is 79cm in one side and total around 158cm. In the length of songket part diagonal stripes pattern are repeated every seven centimeter. The songket sarong is damaged in different areas and lots of natural and metal threads are missed. Cotton part was very weak and suffered from aging, different stains and dirt. Furthermore, the songket body is greatly damaged by fading and many missing parts and corrosion layer are observed on the surface of the fabric.



Fig. 2. View of the one side of songket sarong

*Technical Study*

In this research the main consequences has been identification of the metal and natural fibers and their interaction in order to achieve proper maintenance and long-term preservation according to the objects characteristic and condition [15-21].

In this particular case, the following steps were taken to identify and technically study the material and the summary of result is presented in Table 1:

- Macro and micro photography of different parts of the fabric were produced;
- Samples from different parts were taken;

- Fibers were identified by using optical microscopy, burning test, chemical examination and FTIR.
- Metal fibers were identified by FESEM-EDX with using ZEISS AURIGA device;
- The woof and warp were similarly identified;
- The fabric density and texture design was reviewed; and
- The motifs used on the fabric were accurately analyzed.

**Identification of Natural Fibers and Metal Threads**

Fiber identification includes different processes such as prepare samples from the object, microscopic observation at 100 times or more magnification with the use of microscope (Olympus BX51M) and analysis to indicate the fiber morphology [16-19]. Therefore, a small part of each fiber was analyzed by burning test; chemical analysis and Fourier transform infrared spectroscopy (FTIR). In this study *Thermo Scientific Nicolet iS50 FT-IR Spectrometer* was used for analysis.

**Results and Discussions**

Scientific analysis was carried out to identify the materials present in sample under research. Analysis was undertaken using microscopic as well as chemical methods. The details of the analytical method and technical study are summarized in Table below.

Analysis shows that there are one group of warp and two groups of natural and metal weft threads in sample under study. Songket part contains four weft threads such as, olive-green silk, light green silk, maroon silk and gilt-silver metal thread with cotton yarn in the core as well as green and maroon silk weft threads. However, the cotton part is woven with a group of warp and weft in red color.

**Laboratory Examination and Microscopic Observation**

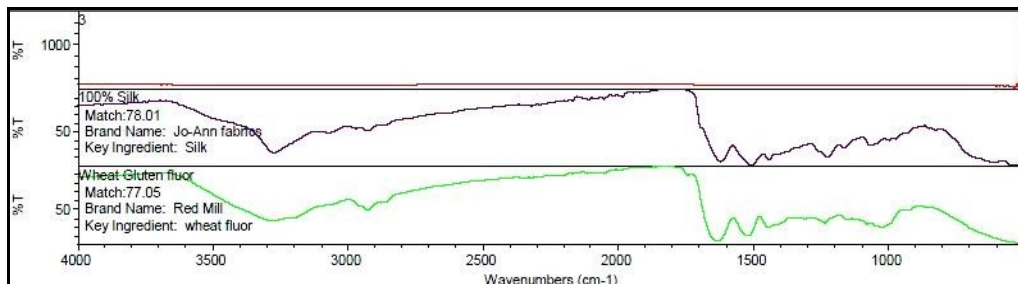
Laboratory examination was performed on both natural and metal threads. Table 1 is given the summary of process for identification of fibers and the result through burning test as well as chemical and microscopic analysis.

Table 1. Laboratory examination and microscopic observation

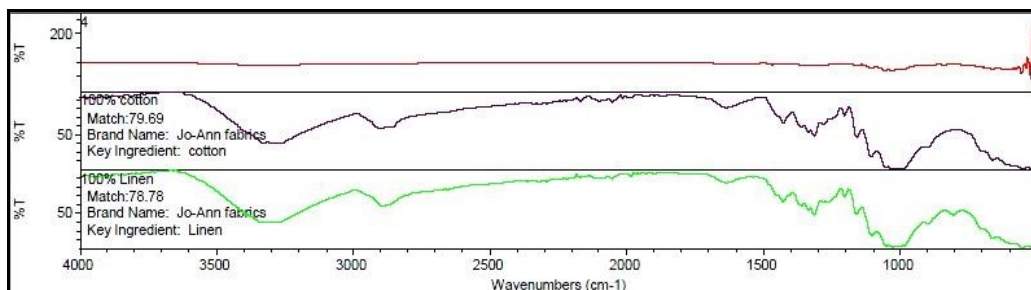
The method of fiber identification	Fibers	Result
Identification of Fibers by Burning Test	Burns with a steady flame, smells like burning paper and soft dark crumbled ash (cotton part)	Cotton
	Burns readily, not certainly with a steady flame, smells like burning hair and crumble black ash (songket part)	Silk
Identification of Fibers with Chemical Test	- 60% Sulfuric acid at environment temperature dissolve silk	Silk
	- Acetone + NaOH dissolve silk	
	- NaOH + boiling heat = dissolve silk	
	- 75% ZnCl <sub>2</sub> + heat = dissolve cotton	Cotton
	- Using H <sub>2</sub> SO <sub>4</sub> + Acetone + NaOH	
	Metal thread + HNO <sub>3</sub> + heat = some sample remain	Gilt silver
Identification of Fibers by Microscopic method	flat, spirally twisted ribbon like tube with rough granular surface	Cotton
	Elliptical shape, lustrous filaments and transparent rods with triangular shape	Silk

**Morphological Study**

For doing more reliable experiments on natural fibers, Fourier Transform Infrared (FTIR) examination was used to characterize two samples of natural fibers from songket and cotton parts of studied object. Experiments have been performed to gain further information about exact contents and purity of materials in songket sarong.



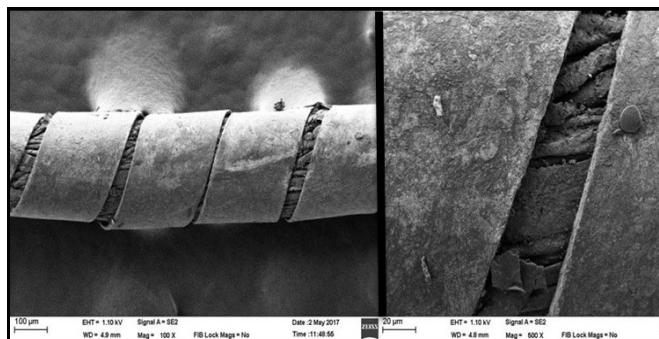
**Fig. 3.** FTIR result of songket warp fiber (Green: 100% Silk), IUM



**Fig. 4.** FTIR result of attached red fabric (Red: 100% cotton), IUM

**Field Emission Scanning Electron Microscopy (FESEM)**

The surface morphology of sample under study were done and recorded by FESEM with providing clear pictures of surface morphology and characteristics that are helpful to determine the surface structure of the studied sample, the quality of fibers and their vulnerabilities as well. FESEM was used for the micro-morphological study of the metal surfaces as well as of the edges of the solid metal strips.



**Fig. 5.** FESEM image of metal thread (100× and 500×, CAREF lab. UM)

**Energy-dispersive X-ray Spectroscopy Findings**

Identification of the materials composition of the metal fibers in investigated sample was carried out with the use of Energy Dispersive spectrometer (EDS) system attached with the Field Emission Scanning Electron Microscope. EDS analysis was used to determine the exact percentage of content and chemical composition as well as alloys and corrosion layers of metal threads in specific way. Here, the result of fiber analysis by EDS in metal thread and cotton yarn in core is reported in Figures 6 and 7.

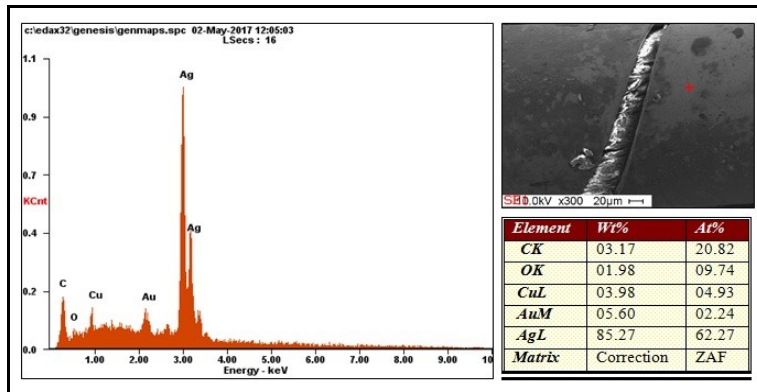


Fig. 6. Metal thread EDS analysis (CAREF lab. UM)

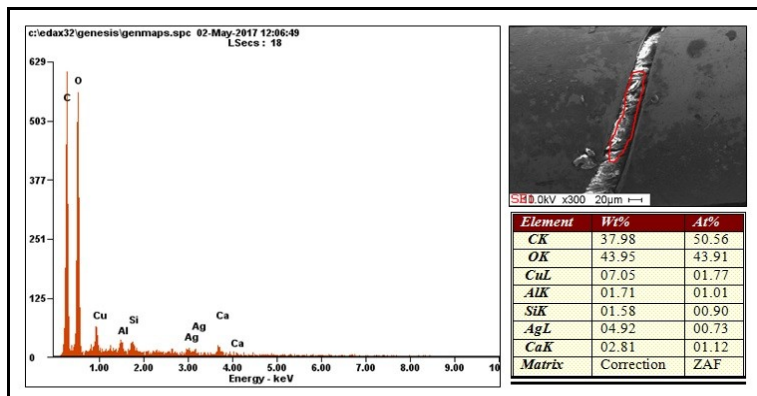


Fig. 7. Cotton yarns inside metal thread (EDS analysis CAREF lab. UM)

**Pathology Studies**











Songket is a valuable fabric decorated with metallic threads. These decorations are often heavy and places strain on fabric and Malaysia’s humid weather causes more damages on it. A scrutiny of the fabric material shows that some damages have been affected on the fabric. Some of the damages include, but not limited to, the following deteriorations:

- Traces (effects) of dust and grime
- Acidification of the fabric.
- Physical, chemical and biological rupture;
- Disruption of natural fibers;
- Stretching and opening of the metal threads;
- Fading of the metal fibers used on fabric;
- Separation of the natural fibers;
- Previous improper restoration; and

- Inappropriate display and storage.

The details of the analytical method and technical study are summarized in table 2.

**Table 2.** Summary of technical study and scientific analysis of songket sarong

TECHNICAL STUDY OF SONGKET SARONG	
SONGKET SARONG	
INVENTORY No.	E8573/7-1992 PA1(a)14
DIMENSION	79 × 85cm
SONGKET PART	
DIMENSION	79 × 55cm
TEXTURE DESIGN	
MOTIFS	 BAMBOO SHOOT, SHARK TEETH, HOOK&RHOMB, JASMINE, HONEYCOMB,CLOVE, MOUNTAIN, CLOUD
WARP COLOR WARP TWIST Z,S	SILK GREEN 
WEFT 1 COLOR WEFT TWIST Z,S	SILK LIGHT GREEN 
WEFT 2 COLOR TWIST	SILK MAROON 
METAL THREAD METAL THREAD TWIST	GILT-SILVER 
YARN INSIDE METAL THREAD COLOR	COTTON CREAM
COTTON PART	
DIMENSION	79×30 cm
TEXTURE: PLAIN WEAVE	
DYNASTY WARP COLOR TWIST	25/cm COTTON RED 
WEFT COLOR TWIST	COTTON RED 

**Damage Illustration**

The figure below illustrates the place and amount of damages that happened on songket sarong in both sides.

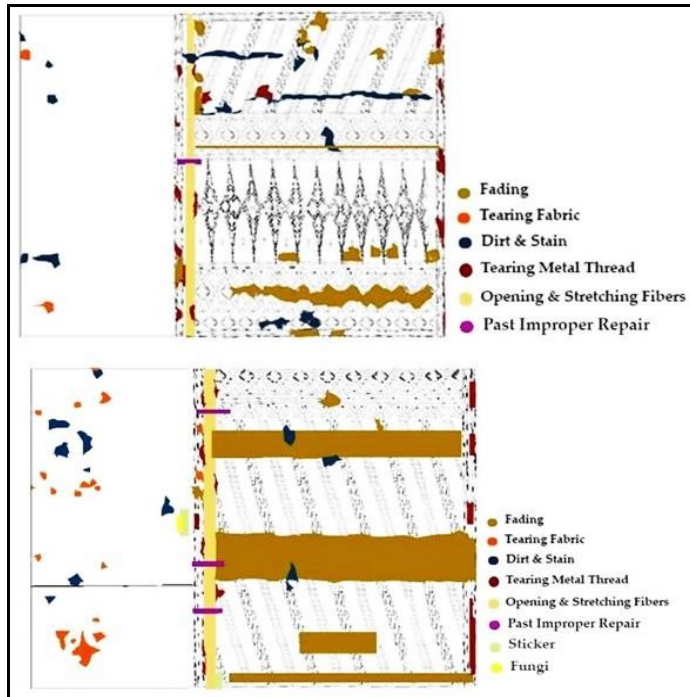


Fig. 8. Damage illustration of both sides of songket sarong

**Deteriorations of Songket Sarong**

The primary visual observation revealed that this part presented a very poor conservation condition. Some damages are shown by figures below. The cotton fabric was very weak and suffered from abrasive damage and tearing in many areas (Fig. 9). Due to the nature of the dirt, it induced degradation in short or long term. In addition, dirt causes abrasion, loss of flexibility, fading and irreversible color change, increased acidity and occasionally total structure of the fibers.

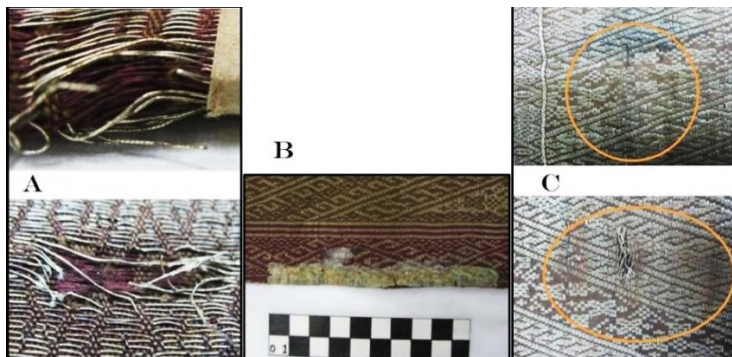
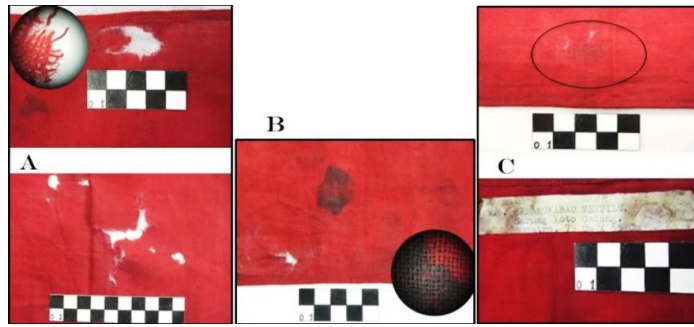
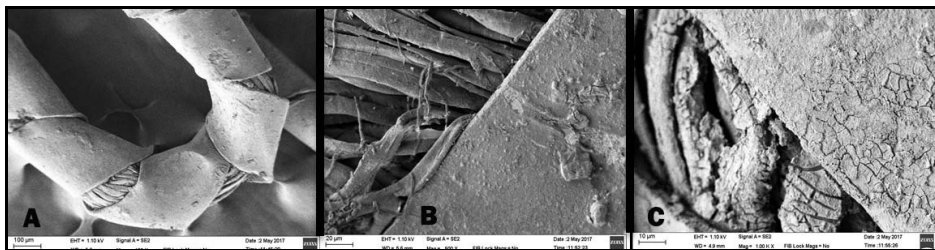


Fig. 9. A. Tearing metal threads, B. Sticker damage on songket, C. Corrosion Stain and fading



**Fig. 10.** A. Tearing and missing part in cotton fabric, B. Dark ink stain, C. Stains caused by paper sticker, Fungi pollution and dark



**Fig. 11.** A. Delamination of metal thread (100x), B. Corrosion and scratching of metal thread and natural yarn inside (500x), C. Cracking of metal thread and natural yarn in core (1.0Kx) CAREF lab. UM.

### Preservation and Restoration

The sample under study was assessed carefully and based on the condition preservation treatment carried out in the following steps [20, 21]:

1. The fabric surface was cleaned using vacuum cleaner.
2. PH was measured. The fabric pH in the cotton part was five and in the Songket was four and five; it was quite acidic.
3. The color fastness was also tested for all fibers.
4. The front and back of the fabric were washed using distilled water, ethanol and special detergent for delicate fabric (100:1:1).
5. The front and back of the fabric were dried using cold air dryer;
6. The solvent was employed to clean the stain on fabric.
7. The ruptured area was restored and the losses were filled with appropriate colored fabric. (This innovative method was chosen after considering the strength of the fabric)
8. The metallic yarn was restored and connected to the background through the sewing method.
9. The fabric was covered with a non-acidic paper to keep in storage.



**Fig. 12.** A. pH measurement, B. Color fastness test, C. Surface cleaning



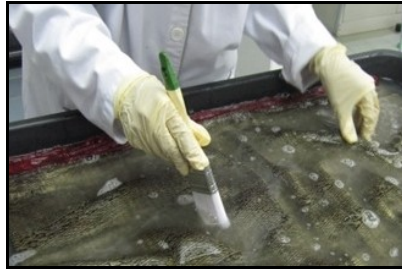


Fig. 13. wet cleaning of samples under study by using soft brush

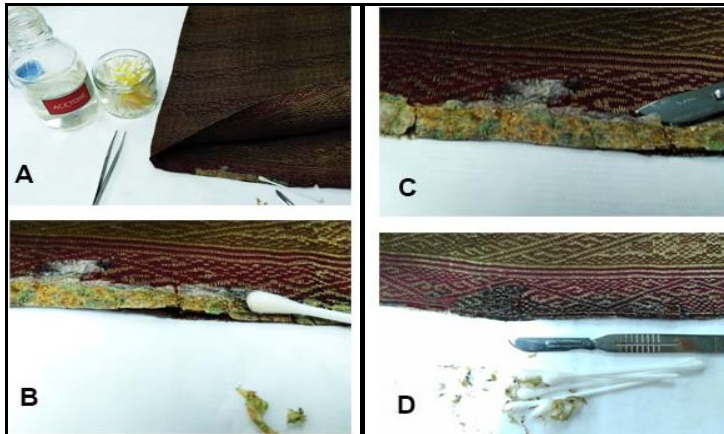


Fig. 14. Removal of stickers and adhesive with using solvent:  
 A. prepared Acetone and cotton swab; B. apply acetone to solve the adhesive;  
 C. remove the stain with using scalpel; D. View of the fabric after cleaning)

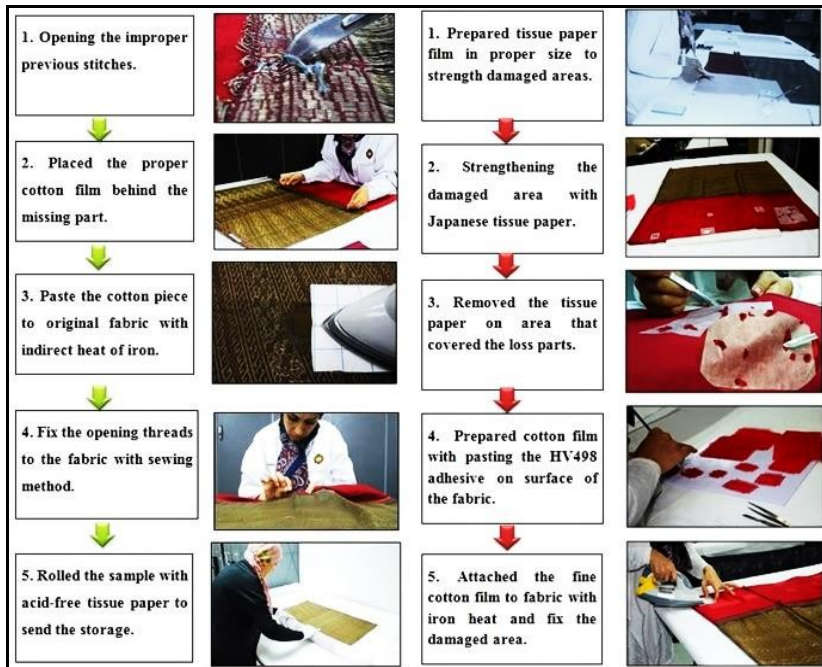


Fig. 15. Details of treatment and stabilizing the lost parts of songket sarong (songket and cotton part

The restoration process was a time-consuming due to the delicacy of sample and lots of damages on it; however, it had a good result at the end. The purpose of the restoration of the songket textiles is to improve the appearance of the woven, and increase the strength of the structure of the fabrics for long time. Summary of whole steps of restoration is shown in figure below.

The appearance of the objects under study after treatments show that there is an improvement in the solidarity of the objects (Fig. 16).



Fig. 16. View of songket and cotton part of sarong before and after treatment

### Songket Sarong Storage

For songket sarong which is a kind of skirt with the same width from top to bottom, a new design of storing method was introduced. In this technique a thin layer of cotton pad inserted between two layers of sarong and prevent abrasion and tension between metal threads in fabric structure. Another benefit of using this method is preventing biological damage due to the pad filled up with synthetic anti-insect fibers like mattress placed in internal part of sarong and it is not attractive for insects as well. For rolling the sarong a layer of acid-free tissue in bigger size should be located inside and outside the fabric. Tissue paper prepares a soft surface to roll the textile.

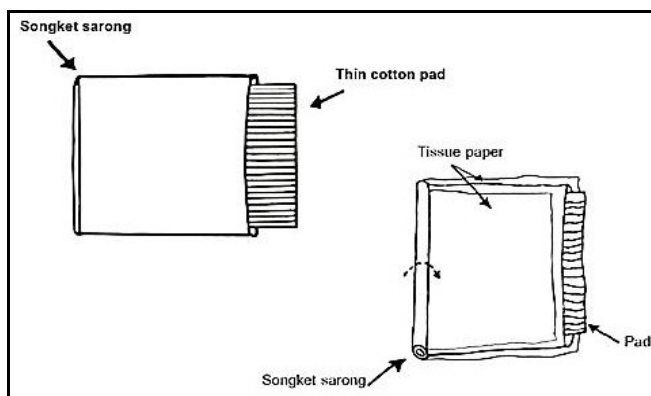


Fig. 17. Rolled storage of songket sarong with cotton pad inside

### Conclusions

The present article describes the intervention preservation on historical songket sarong which is fully decorated by metal thread dated around 19th century belonging to National Museum of Malaysia. Examination and motifs analysis showed that the sample was woven in Indonesia and send for royal family of Malaysia as a gift. FESEM-EDS and FTIR observations have shown that the object is made of silk decorated with gilt-silver metal threads attached by red cotton fabric to make it longer. The object's both songket and cotton parts affected by an intense deteriorations such as dust and dirt that exist stains on fabric, losing its mechanical

properties and tearing threads in all parts. In order to increase the stability of songket sarong preservation treatment was done properly and new design of storing prepared as a guideline for museums. Finally, it is recommended that sample covered by acid-free paper properly and keep at storage room.

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