

Flags and pigments:

the conservation treatment and the analysis of two flags from Costa Rica, 1921.

Mariela Agüero Barrantes¹, Mavis L. Montero²³⁴, Juan Morice Montoya⁶³⁴, Roberto Urcuyo²⁵, Carlos Pacheco Ureña⁷.

¹Museums of the Central Bank of Costa Rica ²Chemistry School, University of Costa Rica ³LabCultura, University of Costa Rica ⁴Materials Science and Engineering Research Center (CICIMA) ⁵Electrochemistry and Chemical Energy Research Center (CELEQ) ⁶Chemical Engineering School, University of Costa Rica ⁷National Archive of Costa Rica *Corresponding author, email: mari.aguerob@gmail.com

Introduction:

This project studied two flags and their colored components when wet cleaning was considered as part of the conservation treatments. These flags tell the story of borderline disputes between Costa Rica and Panamá during the first half of the 20th century. Even though the flags are 100+ years old, both the red and blue stripes are still quite vibrant – leading to questions regarding whether the dyes used were natural or synthetic and where they came from. Two parallel processes were applied to these objects: first, complete conservation treatment included cleaning, vacuuming,

testing, and wet cleaning; second, scientific analysis included Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy-energy dispersive X-ray spectroscopy (SEM-EDS), and RAMAN spectroscopy. The preliminary results of these tests are presented here while further research and analysis is still in process. This analysis helped to identify the fibers and informed the approach to wet cleaning. It also guided dye identification and how they may react over time.

Methodology:

- The flags were removed and separated from their historic wooden boxes and all surface dust was removed by vacuuming.
- The blue and red parts were tested for colorfastness using blotting and chromatography paper.
- Acidity was assessed via pH testing of the textiles before and after wet cleaning.
- Before wet cleaning, sample threads were taken from both flags to confirm fiber composition and analyze dyes.
- Fiber identification and composition were analyzed by FTIR spectroscopy, RAMAN spectroscopy, and scanning electron microscopy-energy dispersive X-ray spectroscopy (SEM-EDS)
- Dye identification was tested by RAMAN spectroscopy to discover possible color spectrums and FTIR to determine composition.
- Possible mordants and metals were identified by scanning electron microscopy-energy dispersive X-ray spectroscopy (SEM-EDS).





Figl. Flags 1 and 2.



Results:

Conservation treatment

Both objects were vacuumed to reduce surface soil and dust. Colorfastness was tested with deionized water on blotting paper and with deionized water and the washing solution (non-ionic) on chromatography paper, resulting in no dye movement of either the blue or red.

Wet cleaning was completed in 3 different baths, spanning 1h 30 mins. As a result of wet cleaning, the fibers were rehydrated and creases were reduced. The pH measured 7 by the final bath. Yellowness and stains, which were mostly visible in the white stripes, were significantly reduced.

The treatment was successful – the objects are now clean and stable.

Original storage



Vacuuming



Air drying



Final result



Fibers

FTIR and RAMAN spectroscopy- showed a spectrum that matches cellulose (either cotton or linen). Cotton was confirmed with SEM images that provided data on morphology.





Dyes

RAMAN spectroscopy and FTIR results were inconclusive but guided some initial considerations:

White: fibers could be raw and therefore no dye is present.

Blue: could be compared with indigo.

Red: preliminary spectrums are similar to dyes such as *bleu lanaset B* and *sandalwood*.







Fig2. SEM from blue Fiber and FTIR cellulose spectrum

Mordants

SEM-EDS did not show any metals or possible mordant compositions.

Conclusions:

The conservation treatment and testing were successful and the flags are stable and in good condition.

Fiber identification informed the approach to the wet cleaning process. Continued research is needed on the dyes, pigments, and mordants as preliminary results were inconclusive.

Future Research:

Further instrumental analysis will explore new methodologies such as pigment extraction for more accurate results.

Acknowledgements:

Thanks to APOYOnline, the Foundation of the American Institute for Conservation (FAIC), and The Getty Foundation for the opportunity.









