Summary

PHySICAL

Profound study of Hydrous and Solvent Interactions in Cleaning Asian Lacquer

Context

Asian lacquer, derived from specific endemic trees in the Anacardiaceae family, holds a rich historical legacy across Southeast Asia, Japan, and China. Employed as a versatile coating material, it embellishes diverse substrates, ranging from bamboo to ceramics, valued for its durability and aesthetic appeal. The Royal Museums of Art and History (RMAH) in Brussels house a significant collection of lacquered artifacts, posing challenges in preservation. With age, these inert lacquers become highly sensitive to water and solvents, introducing risks in cleaning and conserving these precious objects, often necessary for displaying them in a museum environment. The cleaning methods for these lacquer objects, lack a robust scientific foundation, prompting a comprehensive assessment for effective conservation.

Objectives

The main aim of the project was to develop enhanced cleaning strategies for common Asian lacquer formulations by investigating solvent and water interactions with aged lacquer surfaces from both conservation and chemical perspectives. The study also sought to improve the analytical analysis methods for the characterisation of Asian lacquers, primarily pyrolysis gas chromatography mass spectrometry (Py-GC-MS), aiming for a deeper insight into the composition of aged Asian lacquers. A final objective was to inventory and evaluate the current condition of lacquer objects in the collection of the RMAH, systematically document them, and relocate them to suitable conservation environments.

Methodology

In the initial phase, the RMAH collection underwent comprehensive documentation and examination to gain a deeper understanding of the quantity of lacquered objects within the museum and their conservation status. Concurrently, during the inventory creation and the transition to more suitable storage spaces, a subset of lacquered objects was identified for in-depth analysis. From this subset, a final selection of four objects emerged for thorough cleaning and conservation.

To assess the impact of solvent and water cleaning on aged lacquer surfaces, numerous tests were conducted on artificially aged mock-up samples designed to replicate real-life Asian lacquers. To bridge the gap between mock-ups and authentic artifacts, a deteriorated and depreciated object from the

RMAH collection—an early 20th-century shelf exhibiting all the characteristics under investigation—was utilised.

Supporting the cleaning, it was imperative to characterise the composition of the Asian lacquers. Due to the lacquers forming polymer networks that are challenging to dissolve before analysis, Py-GC-MS was employed, enabling the analysis of solid samples. A meticulous optimisation of the analytical methodology was undertaken to delve into the intricate details of the various compounds present in aged Asian lacquers, including degradation products.

The selection of solvents for evaluation was informed by the outcomes of an extensive international survey. Four solvents, along with demineralised water, underwent rigorous testing as potential cleaning agents. The impact of these cleaning agents on critical physical parameters—such as gloss, colour, and lacquer acidity—was methodically assessed in tandem with chemical analyses of the solvent and water extracts and of the lacquer surface before and after cleaning.

Recognising the pivotal role of lacquer acidity in formulating an effective cleaning strategy, significant attention was directed towards developing a precise method for measuring the pH of the lacquer surface. This research phase was initially conducted on mock-ups to ensure a comprehensive and accurate evaluation. Subsequently, a portion of these tests was replicated on the deteriorated object.

In the final phase, the methodology for chemical characterisation of the lacquers, coupled with a general cleaning protocol tailored to each specific object, was applied to the four selected items.

Scientific Results

The inventory of lacquered objects in the museum yielded a remarkable and successful outcome, describing a staggering 750 lacquered items. Comprehensive condition reports were meticulously compiled for each object, and leveraging a specialised thesaurus, they were systematically incorporated into the MuseumPlus Ria collection management system. Simultaneously, the objects in the reserves underwent a strategic relocation to safer and more adapted storage rooms, ensuring enhanced preservation conditions for the entire lacquered collection.

The evaluation of four selected solvents comprised two apolar solvents (cyclomethicone D5 and Shellsol D40) and two polar solvents (acetone and ethanol), along with demineralised water. The application of apolar solvents demonstrated minimal impact on the colour and gloss of mock-up samples and proved ineffective in removing degradation products, as indicated by GC-MS analysis of the extracts. Similarly, their efficacy in cleaning the soiled, deteriorated object was limited. In contrast, the polar solvents exhibited more pronounced effects on the mock-ups, resulting in significant changes in gloss and colour. GC-MS extracts revealed the extraction of numerous compounds, including both degradation products and lacquer components, posing a potential risk to the long-term stability of the lacquer. This was further confirmed by reaging the cleaned mock-up samples, showing drastic reduction in gloss when polar solvents were used during cleaning, possibly indicating accelerated aging post-cleaning. Demineralised water, positioned between polar and apolar solvents in terms of efficacy and risk, exhibited a moderate impact on the aged lacquer surface when assessed on mock-up samples.

On the soiled, depreciated object, the impact of organic solvents was relatively limited, with both polar and apolar solvents causing bleaching of the lacquer surface. Water, however, emerged as the most effective solvent for removing dirt deposits, resulting in the highest gain in gloss and best visual

homogeneity of the lacquer surface. Tests at different pH values of the water did not yield significant differences on this test object.

Various methods were assessed for determining the acidity of the lacquer surface. All methods left visible marks on the lacquer surface, but the use of hydrogels appeared to have the least impact on the formation of craquelures. Instead of measuring pH directly on real objects, the use of a safe pH range is recommended to limit potential damage to the lacquered object when measuring the pH.

For cleaning the selected objects from the RMAH collection, water emerged as the most suitable compromise. Adjusting the pH to the surface pH of the lacquer was further evaluated and proved effective in the cleaning process for the selected objects.

Chemical analyses are imperative to augment the cleaning process and gain insights into lacquer composition and layer structure. The optimisation of Py-GC-MS and LC-(orbitrap)HRMS facilitated a nuanced study of the macromolecular structure of aged lacquers, shedding light on degradation products present or formed during object cleaning. GC-MS analysis of solvent and water extracts from aged mock-up samples further contributed to this understanding.

Notably, one of the Py-GC-MS methods developed exhibited improved sensitivity in analysing polysaccharides in lacquers, offering a unique opportunity to unravel the polysaccharide metabolism in Asian lacquers—a hitherto unreported achievement based on the analysis of cured Asian lacquers.

Conclusion

The PHySICAL project stands as a cornerstone in providing invaluable guidelines for best practices in cleaning aged Asian lacquer surfaces, offering insightful solutions to the challenges surrounding the identification, preservation, and cleaning of lacquer objects. The findings emphasize that the use of water (with adjusted pH), proves to be the most effective method for cleaning aged lacquer surfaces. The optimisation of analytical methods, coupled with the development of the cleaning procedure, presents a comprehensive and meticulously crafted approach to ensure the conservation and optimal display of these culturally significant artifacts within a museum environment.

Beyond the confines of the RMAH collection, the project's impact resonates globally, contributing significantly to a broader comprehension of Asian lacquer cleaning practices and, in turn, benefiting future generations of scholars, conservators, and enthusiasts. The results obtained from this project not only bolster the continued appreciation of these valuable objects but also play a pivotal role in securing their enduring place within the rich tapestry of cultural heritage.

Key-word: Asian lacquer, cleaning, best practices, water and solvent, chemical analyses