Abstract

The Japanese lacquer bottles presented in the "Chinese Oval Cabinet" are a valuable example of Japanese art in Europe. This paper focuses on the conservation of these ten vessels, dating back to the 17th century. It was written as part of a research project about the "East Asian Cabinets" of the Schönbrunn Palace in Vienna. A study of East Asian lacquer techniques in general as well as a detailed investigation of the objects' construction and decoration techniques preceded the evaluation of the damage. The bottles have been partially stained with an adhesive. Furthermore, they have been damaged by UV-light, which results in increased vulnerability of the lacquer layers. Therefore, the choice of suitable methods for cleaning the bottles and removing the staining was limited. A series of tests helped in choosing an adhesive for the consolidation of the flaking lacquer and metal sheets. Lastly, a guideline for presenting and handling the bottles was established to ensure their long-lasting preservation.

Introduction

The ten lacquer bottles date back to the early 17th century and were produced in the so-called "Edo-period" between 1615 and 1686 AD. Japanese lacquer or urushi has a long history and has been used in Japan from 7000 BC up to this day.

The bottles have a square shape and round shoulders, with a round nozzle on top. The objects are similarly decorated, depicting landscapes and plants alternating on their four faces. One can find geometrical designs bordering these scenes and on the bottle's top. Their shape follows the tradition of a schnapps bottle. Nevertheless, it is believed that they have never been used in that way, due to being regarded as an art object.

There are two Asian cabinets in Schloss Schönbrunn, the so-called "Chinesische Kabinette". The research project about the "East Asian Cabinets" of the Schönbrunn Palace focuses on the conservation and historical investigation of the rooms and its interior. They host numerous pieces of Chinese, Japanese and European porcelain. The cabinets have wooden wall paneling. The Japanese lacquer bottles as well as the porcelain objects are placed on wooden consoles. These are fixed to the wall at a height of several meters. Next to them, visitors can see Chinese, Japanese and European lacquer panels, incorporated in gilded framing on different levels (figure 1). The bottles depict landscapes on two faces and ensembles of bushes, flowers and grasses on the other two faces (figure 2). These pictures, just as the repetitive patterns surrounding them, are created by applying metal powders through different techniques. The landscapes are generally composed of a scenic view of hills, pavilions and trees on a waterfront. Some of the bottles show distant mountains, or waterfalls in the background. The other two faces carry plants on them representing different seasons of the year.

As mentioned earlier, the bottles are shaped as hard-liquor bottles. This type of vessel has been designed specifically for export and was also realised in porcelain. Supply and demand between western countries and Japan led to a mutual influence. The bottles reached Europe presumably along maritime routes. After initially welcoming strangers, Japan soon closed its borders. For a long time the Netherlands was the only European country allowed to trade goods with the insular state. Lacquer became a highly valued and expensive item of goods. It came into fashion to establish lacquer cabinets in grand residences. Schönbrunn hosts three cabinets demonstrating lacquer objects. Due to limited trading and its elaborate production, lacquerware became more and more expensive. This led to attempts to imitate lacquerware in Europe with local materials and techniques, known as "Japanning".

Japonské lakované láhve z paláce Schönbrunn
Průzkum – Záchraňa – Prezentace

Abstrakt

Japonské lakované láhve vystavené v „Čínském oválném kabinetu“ patří k cenným příkladům japonského umění v Evropě. Tento článek, který se zaměřuje na restaurování deseti takových nádob pocházejících ze 17. století, byl napsán v rámci výzkumného projektu, věnujícího se východoasijským kabinetům Schönbrunnského paláce ve Vídni.

Dříve než byl vyhodnocen stav dochování a míra poškození láhví, byly prostudovány výchozí průzkum konstrukce a výzdoby objektů. Láhve byly znečištěny skvrnami od adheziv a nesly poškození způsobená UV zářením, které zvýšilo křehkost lakových vrstev. Z tohoto důvodu byl omezen výběr vhodných způsobů čištění a odstranění skvrn. Konsolidant vhodný ke zpevnění laku a kovových plátků byl vybrán na základě rozsáhých zkoušek. Na konci zásahu byly sestaveny pokyny pro bezpečné zacházení s láhvemi a podmínky pro jejich vystavování.
Material and investigation

Urushi

There are three different kinds of oriental lacquer, which all have different properties. Urushi, previously termed lacquer, is the sap of the urushi tree “Toxicodendron vernicifluum”, which is cultivated mainly in Japan, China and Korea. The raw sap is collected and filtered before it is ready for use. It can also be further refined for example by driving off excess water through heat and by adding pigments. Raw lacquer is toxic and can lead to severe allergic reactions. Once dried, it becomes harmless and is even extensively used on tableware. The lacquer can be applied on various substrates like wood, textile, porcelain, metal and many others.

The hardening of Urushi follows a two-step process. The sap cures through oxidation and auto-oxidation of its components (mainly urushiol-monomers, glycoproteins, polysaccharides, laccase and water), which leads to polymerisation and cross-linking of these monomers. It is therefore different from lacquer varnishes in Europe that dry through the evaporation of solvents. To fully enable the process of curing, the material needs thermal settings of 20°C and approximately 80% relative humidity for a period of 10 to 24 hours. The lacquer forms a strong and hard polishable surface and is initially resistant to humidity, acids and alcohols.

General construction

The bottles consist of a wooden substrate, covered with oriental lacquer. Figure 3 shows the construction of the bottle. Four side panels (yellow, transparent, orange and green), one at the bottom (grey) and another one to close the top of the vessel (blue) form the body of the bottle. Urushi is typically applied in many layers and follows a traditional scheme that starts by isolating the substrate. It is not possible to determine, if it was carried out on the bottles. To investigate the composition of the layers, three samples have been taken and prepared as cross-sections (figure 4).

The wooden body carries two foundation layers. Analysis performed by scanning electron microscopy showed a composition of feldspar, quartz and iron oxide particles, bound with a mix of animal glues and other binding media. Microscopy showed a composition of feldspar, quartz and iron oxide particles, bound with a mix of animal glues and other binding media. Two layers of lacquer follow the foundation.

Figure 3  Model of the bottles’ construction with four side panels (yellow, transparent, green and orange), a top panel (blue) and a bottom panel (grey).

Figure 4  Cross-section of the lacquer layer with two foundation layers (red and violet) and two lacquer layers (green and blue). © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Tanja Bayerova, Institut für Konservierung und Restauration; Sammlung Bundesmobilenverwaltung.

Figure 5  X-ray image of the bottle with outlet reaching into the vessel. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Agnes Szakron-Michl, Institut für Konservierung und Restauration; Sammlung Bundesmobilenverwaltung.

Figure 6  Example of the Hira-makie technique on leaves and flowers. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Stefan Olah, Institut für Konservierung und Restauration; Sammlung Bundesmobilenverwaltung.

Figure 7  Example of the Taka-makie (rock formation). Kirikane (framed red) and Togidashi (framed blue). © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Stefan Olah, Institut für Konservierung und Restauration; Sammlung Bundesmobilenverwaltung.

Decoration techniques

There are multiple possibilities to decorate lacquerware amongst which one can find different inlays, carvings, or the application of metal sheets. Most decoration techniques are carried out on the previously polished lacquer surface. “Makie” or “Maki-e” is the Japanese term for the decoration with sprinkled metal powders. These powders can be differentiated into fine and coarser grades, depending on the shape of the particles, and alloys. Considering its long-term stability, gold is the most commonly applied metal for this purpose. Other metals and alloys can create a contrast to the gold and are used for the decoration of the motives and for shingles on buildings and butterflies.

The vessel’s nozzle and its top consist mainly of copper, partially covered with silver. X-ray images show that the copper nozzle reaches inside the bottle (figure 5). Seven of the tops have been lost. The rest depicts a chrysanthemum, an ornamental flower, with multiple rows of petals.

Hira-makie

Hira-makie is the Japanese term for “flat sprinkled picture”. In this technique, the artist traces the outlines of a pattern with urushi. While it is still wet and tacky, he sprinkles metal powder on top, which adheres to the freshly painted lacquer. For this step, silver particles are used on the bottles. After curing, the area in between the outlines is filled with urushi and gold powder is applied. The gold particles of these Hira-makie designs are very fine and have a round shape. After finishing and drying the motifs, multiple layers of lacquer are applied on top to protect the underlying gold decoration. It can be found on the ornaments on the top and on the edges of the bottles, as well as in the pictorial motifs.

Taka-makie

This decoration is similar to Hira-makie, but forms a noticeable relief. There are several ways to build a raised surface, the easiest being a mixture of fine earthen powder and Urushi. More elaborate and more stable are the ones built up of multiple lacquer layers. This sort of decoration exists in the form of rock formations (see figure 7).

Tsukugaki

Tsukugaki describes fine lines often applied on top of Hira-makie or Taka-makie design to enable further explicitness of the motives. The process is the same as in Hira-makie. On the bottles, this technique is used in detailing flowers and bushes as well as for shingles on buildings and butterflies.

Krikane

Krikane can be found on top of the Taka-makie rock formations. The term refers to the square pieces of metal foil – gold and tin in this case - applied onto the relief (figure 7).
Togidashi

Similar to other Makie techniques, in case of Togidashi metal powders are applied onto wet urushi. The difference is that the particles are embedded in multiple layers of lacquer and are polished afterwards. It therefore resembles an inlay technique. The metal particles in use are slightly coarser so they do not get lost in the process of polishing. Their distribution is not as dense in the Hira-makie and Taka-makie technique which often achieves a smooth blending (compare figure 9 with figure 10). It is applied mostly on distant mountain peaks and on the riverside depictions.

Damage protocol

Considering their age and long journey to Schönbrunn Palace, the bottles’ condition seems to be rather good. Nevertheless, they carry a significant amount of minor and more serious damage, which should be taken care of to ensure a long-term preservation. Furthermore, we encounter typical damage that is due to the specific aging and deteriorating of lacquerware.

Photodegradation

Centuries and decades of exposure to sunlight have led to photo-oxidation of the lacquer surface. The short wave ultraviolet radiation causes the greatest harm. Newly fabricated and well-kept lacquerware has a deep gloss. It shows great stability and optical appearance, they prevent an even aging of the lacquer layers.

Adhesive staining

Besides dirt and dust accumulation on the objects’ surface, they also display widespread adhesive staining. Those spots are clearly visible in ultraviolet light (figure 14 and 15). They occur incoherently and mostly in the form of fingerprints and do not fulfill any purpose. Therefore, it is assumed, that someone working with adhesive touched the objects without intending to stain them (figure 16). Analysis by FTIR (fourier transform infrared spectroscopy) revealed a composition of resin and wax, which could be interpreted as beeswax or Japanese wax.

Not only do these stains tarnish the bottles optical appearance, they prevent an even aging of the surface. They may also damage the underlying lacquer as they might develop inner tension and become less soluble over time. Therefore, it was decided to remove the staining. In this process, stickers with inventory numbers on the bottom of the bottles were removed as well.

Figure 8 Example of Tsukegaki as lines on the butterfly’s wings. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Stefan Olah, Institut für Konservierung und Restaurierung, Sammlung Bundesmobilenverwaltung.

Figure 9 Close-up of dense gold distribution of a Hira-makie design. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Silvia Míklin-Kniefacz, Institut für Konservierung und Restaurierung, Sammlung Bundesmobilenverwaltung.

Figure 10 Close-up of loose gold distribution of a Togidashi design. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Silvia Míklin-Kniefacz, Institut für Konservierung und Restaurierung, Sammlung Bundesmobilenverwaltung.

Figure 11 Close-up of micro-cracks on the lacquer surface. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Stefan Olah, Institut für Konservierung und Restaurierung, Sammlung Bundesmobilenverwaltung.

Figure 12 Dull photodegraded lacquer surface. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Stefan Olah, Institut für Konservierung und Restaurierung, Sammlung Bundesmobilenverwaltung.

Figure 13 Close-up of photodegraded lacquer surface that is not photodegraded. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Stefan Olah, Institut für Konservierung und Restaurierung, Sammlung Bundesmobilenverwaltung.

Figure 14 Side-view in normal light. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Stefan Olah, Institut für Konservierung und Restaurierung, Sammlung Bundesmobilenverwaltung.

Figure 15 Side-view in ultraviolet light that clearly shows the adhesive staining. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Stefan Olah, Institut für Konservierung und Restaurierung, Sammlung Bundesmobilenverwaltung.

Figure 16 Detail of adhesive staining on the bottles’ surface. © Schloss Schönbrunn Kultur- und Betriebesges.m.b.H. / Amélie Bézard, Institut für Konservierung und Restaurierung, Sammlung Bundesmobilenverwaltung.
The main topic was the cleaning of the bottles. The objects should be freed from dust and dirt accumulations, as well as from the adhesive staining. To prevent dust falling into the bottles through the nozzles without bottle tops, seven replicas needed to be fabricated. The second issue concerned the damage of the lacquer surface, its flaking and the fragile gold decorations that were at risk of getting lost. Mainly some Kirikane sheets, whose borders started detaching from the lacquer layer, are endangered. Another point was the presentation of the bottles. The overall concept aims to show all the historical objects in the Schönbrunn palace in their initial position, that is to say, on wooden consoles mounted on the wall of the cabinets. These presentation elements have a platform that is more or less inclined. To ensure that the objects are stable once mounted, a solution for the compensation of this incline was required. Lastly, a guideline for the care and handling of the bottles needed to be worked out.

**Concept of the conservation**

The approach to the conservation and restoration of lacquerware in Japan and in western countries is different to some extent. The claim for reversibility is often secondary for Japanese restorers. It is important for them to use original lacquer techniques, which mostly include the use of urushi. This is both an irreversible process and a very delicate procedure that requires the necessary expertise and experience of working with lacquer. This report therefore tries to find a reversible approach without the use of Urushi.

**Cleaning**

Lacquer surfaces alter their properties during aging as has already been described above. One of the most crucial alterations is the heightened sensitivity to polar substances. It can vary from object to object and depends on the degree of photo-oxidation. It is imperative to carry out spot tests to define the specific reactions. Rash use of solvents can lead to discolouring, bleaching, swelling or even dissolution of lacquer.

Due to this fact, conservators start cleaning approaches by using non-polar solvents and slowly move to more polar ones. Hence, white spirit was chosen to start the experiments. Additionally, ten mixtures of a non-polar and polar solvent (iso-octane: ethanol, 10:1 to 2:1) lead to smearing effects. The mixture of 1:1 isooctane to ethanol, however, produced good results. So did water, acetone and ethanol, even though a slight dissolution of lacquer was the consequence.

According to the test results, 1:1 isooctane and ethanol were chosen for cleaning the bottles, but ultimately, mostly ethanol was used, as the mixture lead to bleaching (Figure 20).

The adhesive staining disrupts the optical appearance and prohibits even aging. It may create tensions on the surface and emit harming substances. Due to these facts, it was decided, not to retain it on the objects. The adhesive consists of resin (soluble in polar solvents) and wax (soluble in non-polar solvents). For removing the staining, the same procedure of testing solvents and solvent mixtures was applied. The different solvents were tested on the bottles edges contaminated with adhesive. Through optical inspection, photo-documentation and comparison under ultraviolet-light, the following results were achieved. Most of the mixtures (iso-octane: ethanol, 10:1 to 2:1) lead to smearing of the adhesive and had a rather low impact on removing it. The concentration of 1:1 iso-octane to ethanol, and ethanol alone however, lead to good results. Relatively good results were attained with white spirit and acetone. Therefore, 1:1 isooctane to ethanol and mere ethanol were chosen for removing the adhesive. As with the cleaning, the mixture lead to undesired results and mostly ethanol was used. Images with ultraviolet light, (Figure 21 and 22, before and after adhesive removal) show that it was possible to fully remove all of the staining.

**Consolidation**

Flaking lacquer layers as well as loose metal leafs (Kirikane) could be noticed. There are different types of separation, one in the zone between the lacquer layer and the foundation layer; another one between the foundation layer and the wooden structure and the last one between the Kirikane and lacquer. Hence, these three different types of flaking should be kept in mind when choosing a consolidation medium. To find a medium that can be applied for the different situations, desirable properties...
were formulated. They include good penetration, adhesion strength and, as lacquer layers are quite rigid, elasticity for being able to move with eventual expansions and contractions of the body, and good aging properties, as well as reversibility. As lacquer might react sensitively to polar substances, adhesives dissolved in non-polar solvents were included in the choice. Paraolid B 67 was chosen, as it dissolves in white spirit and has good aging characteristics.20 Other consolidation media that are in use for lacquer conservation are animal glues, Paraolid B72 and Lascaux Medium for Consolidation. They were also included in the series of experiments.

A traditionally used Japanese adhesive is a mixture of urushi with wheat starch or wheat flour, called Mugi-urushi.21 It has excellent bonding performance and the conservator uses the same materials in the object. For comparative reasons, it was tested as well.

A series of experiments should detect the most suitable consolidation medium amongst this selection. As the detachment of lacquer and Kirikane occurred in different three zones, three test boards had been produced: at first an isolation layer with urushi was applied on wood, followed by two foundation layers with Tonko (powdered clay) and urushi. Two boards were then again isolated with urushi, and on one of them, a black lacquer layer was applied on top. In addition, lacquer films were fabricated to imitate flaking lacquer and tin and gold sheets were cut to imitate Kirikane (figure 23).

The Schönbrunn Palace has taken measures to achieve favourable settings of relative humidity and temperature. As previously mentioned, the bottles will be placed on the consoles in the Oval Chinese Cabinet under ultraviolet light. The first one refers to the reduction of corrosion and formed bubbles. Amongst the best results were those with cold urea formaldehyde resins of different concentrations have been tested on each test board. After several days of weighting were formulated, the second topic is the replication of the missing bottle tops. They were cut in brass, using the centrifugal casting technique.

Exhibition parameters

As previously mentioned, the bottles will be placed on the consoles in the Oval Chinese Cabinet after conservation. They stand free, held only by the metal pin sticking out of the consoles’ platform. To compensate the platforms’ inclination, a wedge could fit in between the console and the objects (figure 24, green wedge). Plioglas would be a dissimilar material for this purpose. Turning towards climate conditions, one has to define the storage and exhibition parameters. Unfavourable settings of relative humidity and temperature can accelerate the lacquer decay and lead to the formation of cracks, micro-cracks and flaking of the lacquer layers.22 Optimal conditions for keeping lacquerware are set at 55–60 % relative humidity and 20 °Celsius.23

However, these demands are hard to implement in historical buildings. Therefore, experts working on lacquer have defined a relative humidity range of 45–60 % and a temperature of 18–25 °Celsius as acceptable for historical exhibition buildings.24 The Schönbrunn Palace has taken measures to achieve similar results. The cabinet is oriented towards the southwest. The window shutters are permanently closed, which prevents sunlight from shining onto the objects and increasing the room’s temperature. Moreover, a glass barrier has been built at the cabinet’s entrance to prevent tourists from entering and to stabilize the climate. Additionally the palace revived already existing ventilation systems that regulate air exchange.25

Schönbrunn has a cleaning initiative once a year, where restorers and custodial staff clean the palace’s inventory. It was determined, that the bottles should be carefully cleaned by brushing the dust off their surface with a soft brush.

Figure 21 A bottle before removing the adhesive staining under ultraviolet light. © Schönbrunn Kultur- und Betriebsges.m.b.H. / Stefan Olah, Institut für Konservierung und Restaurierung; Sammlung Bundesministeriumsverwaltung.

Figure 22 A bottle after removing the adhesive staining under ultraviolet light. © Schönbrunn Kultur- und Betriebsges.m.b.H. / Stefan Olah, Institut für Konservierung und Restaurierung; Sammlung Bundesministeriumsverwaltung.

Figure 23 Test boards for defining a suitable consolidation medium, with lacquer on foundation (right), lacquer on foundation with isolation of the foundation (middle) and Kirikane on a finished lacquer surface (left). © Schönbrunn Kultur- und Betriebsges.m.b.H. / Silvia Miktin-Kniefetz, Institut für Konservierung und Restaurierung; Sammlung Bundesministeriumsverwaltung.

Figure 24 Model of a wedge (green) compensating the platform’s inclination.

Footnotes

2 | Yamashita, Urushi-workshop at the University of Applied Arts Vienna, Vienna 2014.
10 | Yamashita, Urushi-workshop at the University of Applied Arts Vienna, Vienna 2014.
22 | Mag, Mihel-Kniefetz, S., Personal communication, Vienna November 2014.
23 | Yamashita, Urushi-workshop at the University of Applied Arts Vienna, Vienna 2014.