The Use of Fibrous Cellulose as a Mold Material in the Compensation of Large Losses in Ceramics

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Molds used in conservation should meet certain requirements. The material from which they are made cannot interfere with the artifact; the molds have to support their own weight and that of the cast. Ideally, the moldmaking and mold-casting processes should be fast, efficient, and low-tech, using inexpensive materials. Molds are typically made of Plasticine, wax, or a variety of silicone rubbers. However, as the size of the loss increases, the choices of mold materials become more limited.

Fibrous cellulose was used as a mold material for the compensation of a large loss in an Attic stamnos (WAM1953.92) by the Tyszkievicz Painter at the Worcester Art Museum. It was prepared by soaking Whatman 542 filter paper in deionized water and blending the mixture. The resulting pulp was applied to the outer surface of the vessel by pressing it through a perforated aluminum sheet (Larsen 1998). When it was dry, the mold was removed (Fig. 1) and sealed with Paraloid B-72 as the consolidant, 15% in solvents (Koob 1986). This light but strong mold was then placed over the loss, fastened to the object, and filled with plaster. When the plaster had cured, it was finished, as described by Sigel and Koob (1997).

Keywords: mold, cellulose, Worcester Art Museum, ceramics

References
Koob 1986

Larsen 1998

Sigel and Koob 1997

Figure 1
Dried cellulose mold is removed from vase.
Conservation of Plaster Casts

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The 2008 exhibition “Models of Beauty: Masterpieces in Plaster,” presented at the National Museum of Antiquities in Leiden, the Netherlands, featured beautiful 17th- to 19th-century plaster casts of some of the finest sculptures from the ancient world. Before the exhibition, a large-scale restoration project was undertaken to stabilize the plaster casts, which had been damaged principally by improper handling and storage. Recently, there has been renewed interest in plaster-cast sculptures in museums and academic collections. This has prompted an expanded interest in issues related to the conservation of objects made of plaster.

Plaster is vulnerable to moisture, very porous, and sensitive to mechanical damage, dirt, and changes in humidity. Tensions within the plaster objects often cause large cracks and structural problems. The original paint layers and finishes, which were applied to the casts to imitate the surface of the original marble or bronze sculptures, sometimes exfoliate, leading to large losses that affect the appearance of the sculptures.

Restoration materials were tested to assess their reversibility and aging properties. Ethical questions, including possible alterations to large areas with missing paint or old restorations, were discussed. In addition to stabilizing the casts, the project was intended to make them legible for visitors to the exhibition.

The work demonstrated the need for additional study of the application and effects of current conservation methods, for improvements in these methods, and for the development of new methods. This sparked the initiation in early 2010 of a research project at the Netherlands Institute for Cultural Heritage (ICN), in association with the National Museum of Antiquities in Leiden and the Allard Pierson Museum of the University of Amsterdam. This project will address technical conservation questions

Figure 1
and issues surrounding the valuation and future role of plaster-cast collections.

In the first phase of the new project, the material properties of plaster objects from different periods and workshops will be characterized. Published reports (Uhlenhuth 1912; Wager 1938; Ashurst 1983; Chevillot 2001) have shown that various additives were used in preparing the plaster so that its properties could be modified. Conservators have learned that different objects react to consolidation methods in different ways. The influence of the composition of the plaster on the consolidation, the effects of various methods of cleaning the surface of the plaster, and problems in the cleaning and consolidation of finishing layers will be studied in close connection with art-historical and museological questions concerning plaster-cast collections.

Keywords: plaster casts, sculptures, conservation

References
Ashurst 1983

Chevillot 2001

Uhlenhuth 1912

Wager 1938
Historical Restorations in the National Museum of Antiquities, Leiden, The Netherlands

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The National Museum of Antiquities (RMO) in Leiden, the Netherlands, was founded in 1818. Many objects in the collection were restored before or after they entered the museum in the early 19th century. Over time, various conservation techniques and materials were applied to the objects. Many of these treatments cannot be dated properly because of a lack of conservation reports. We are now trying to gain a better understanding of the conservation history of the RMO collection, including changes in the ethical views of the conservators who treated the objects.

Until recently, the identification of historical conservation materials was based on visual and mechanical characteristics. In collaboration with the Netherlands Institute for Cultural Heritage, a research project has been established to determine materials used on the RMO collection. Both inorganic and organic conservation materials will be analyzed using microscopic and analytical techniques, including X-ray diffraction, infrared spectroscopy, and chromatography. With this data, we will try to place the historical repairs into a time frame, recording the development of the use of glues, filling materials, and paint media. Our poster will present the first results of this project.

One old restoration material that has been analyzed is gypsum, which was generally painted. In many cases, the paint was lead white or zinc white and sometimes a combination of both, with pigments added for color. Zinc white pigment has been in use since the middle of the 19th century. Investigations of the binding media in the paints and organic additives to the gypsum are ongoing.

A sample was taken from an Attic black-figured kyathos dating to the fifth century B.C. The object, which was acquired by the museum in 1839, has been repaired. Figures 1 and 2 show the object with the old repairs clearly visible. The material used to fill in the missing parts of the object proved to be plaster, mixed with red ochre and sawdust, which was covered with paint. The red paint on the outside consists of lead white, zinc white, and red ochre, and the black paint on the inside is carbon black. Animal glue was used to join the fragments together.

The restorer made a quite modern ethical decision. The retouching was carried out in a color closely resembling that of the original ceramic material, and the missing parts of the figures were not completed.

Keywords: history, conservation, ethics, analysis

Figures 1 and 2
A Hellenistic Eshara and Its Repair

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In 2008, during the annual excavations at the Kabyle national archaeological reserve near Yambol, Bulgaria, an adobe eshara (altar) was uncovered. It is not the first such structure that has been found in this Hellenistic settlement, but it is the first one that has been shown to have been repaired when it was in use. The initial inspection revealed that almost one-third of the altar’s original surface is preserved and nearly half of the rest is a repair. The two surfaces were easy to distinguish because the original was smooth, with incised decoration, while the repair had a rough surface. The obvious differences between these two surfaces raised questions about the materials used in their manufacture.

Two samples were taken—one from the original and one from the repair—so that a comparison could be made. Macroscopic observations that the original and the repair had different structures were disproved by the cross sections: they appeared to be almost identical. While the original adobe consisted of clay and a mixture of sand grains and gravel, the repair also contained a certain amount of coal. This observation was confirmed by X-ray fluorescence (XRF) analysis, which demonstrated that the composition of the two samples was identical.

It is not possible to date the repair, which was obviously made to prolong the life of the altar. The material used in the repair does not contain ingredients different from those that were employed to build the eshara itself. The contrast between the surfaces indicates that they were made using different processes.

Keywords: eshara, adobe, ancient repairs

Figure 1  
The eshara following its discovery.
The microclimate in a showcase is governed by the complex interaction of several factors. Differences in inside and outside environments are usually determined by temperature (T) and relative humidity (RH). Local variations are caused mainly by heat sources. The thermovision camera has been applied as a complementary method to datalogger systems for monitoring T and RH values (Thomson 1986, pp. 43–48). These kinds of measurements allowed us to recognize even very small temperature differences and to determine a real value of body temperature for a chosen object. This parameter can induce different expansion in the materials and create tensions between the surface and the core structure. Temperature cycles cause a number of mechanical weathering mechanisms and accelerate deterioration, especially in materials with weak chemical durability (Scholze 1988; Greiner-Wronowa 2004).

Data were collected over two-day, one-week, and four-week periods of monitoring, and differences among the shelves in a single showcase were recorded. Coefficients of T and RH were calculated, as shown in Tables 1 and 2.

The closest correlation is between outside values and the highest shelf in the showcase, largely because of the sun and of lamps situated over the cabinet. The lack of ventilation in the cabinet leads to higher temperatures on the top shelf and to higher humidity values on the bottom of the case. This has very important consequences for inducing corrosion in glass objects. To predict potential changes in these objects, some corrosion processes were created on glass samples, according to what is known as the glass sensor method. The experiments were conducted in environments with fluctuating parameters, recorded by thermovision and the datalogger. Changes in the glass were detected by micro-Raman spectroscopy, optical interferometer, scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDS). The information obtained has been useful for proposing sustainable conservation strategies for the display and storage of objects in museums (Greiner-Wronowa 2004; Greiner-Wronowa and Pusoska 2006).

**Keywords:** glass corrosion, thermovision

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Coefficients of Temperature Correlation</th>
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1 = upper shelf; 2 = middle shelf; 3 = bottom shelf

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<th>TABLE 2</th>
<th>Coefficients of Relative Humidity Correlation</th>
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<td>Hum. 3</td>
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References

Greiner-Wronowa 2004

Greiner-Wronowa and Pusoska 2006

Scholze 1988

Thomson 1986
Glass Objects from Banbhore, Sindh

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Banbhore is located on the northern bank of the Gharo Creek near the Arabian Sea, about 40 miles east of Karachi. Its origin has not been firmly established, but the city is generally considered to have been continuously occupied from 100 B.C. to the 13th century A.D. This time frame has been divided into three major periods: Scytho-Parthian, Hindu-Buddhist, and Islamic.

The site has been known to scholars for a long time. Large-scale excavations began in 1958, and the work continued for eight years. The excavations revealed exciting architectural remains, as well as pottery from the earliest waterlogged levels of the Scytho-Parthian period. Metal objects, ivory, iron, coins, and glass objects were uncovered in other levels. The pottery shows links with Syria during the Umayyad period, with Iran, and with adjacent countries. Chinese stoneware and porcelain (including celadon) were also discovered.

Most of the glass objects found at Banbhore are broken and weathered. Only a small number of perfume bottles, candle stands, vases, and bottles were intact.

During the third and fourth centuries A.D., trading along the Silk Route was at its peak. Sources tell us that merchants and traders lived in the province of Fars on the Persian Gulf, along the coast of Kerman to Debul in Sindh, and on the coasts of India and China (Daryae 2003).

The Arabian Sea was a very important link in the sea trade. Strong ties were established with Egypt, Iran, Syria, Burma, and Sri Lanka. Ships from Banbhore took full advantage of monsoon winds, and they docked in Japan, China, Egypt, and Iraq. Banbhore, Siraf, and Mantai were totally dependent on trade and on such imported luxury items as the white and thin-glazed pottery of Iraq, porcelain and stoneware from China, white paste-decorated wares from Syria, and coarse storage jars and alkaline-glazed ware from the Gulf region. Banbhore also reported the receipt of lapis lazuli, musk (musk), indigo, madder, and other expensive items in the year 1200, as it did from 20 B.C. to A.D. 200 (Panhwar 2003).

Sindh’s trade with the rest of southern Asia was mostly by boat. It went through Banbhore until 1224, when the port of Debul was destroyed by fire (it was probably never reoccupied). Because of a change in the course of the Indus River, a new port was established at Lari Bunder in the 13th or 14th century.

Southern Asia played a prominent role in glassmaking in the early medieval period. The craft made significant advances between the 10th and 12th centuries, and interesting examples of its production have been excavated in Banbhore, which occupied a key position on the Arabian Sea. It is unfortunate that the excavations there, which were conducted quite unsystematically, do not tell us much about the great variety of recovered glass objects. This glass has not been studied or published, and information about glass production in southern Asia, and especially in Sindh, is practically nonexistent.

The glass objects found at Banbhore, dating from the ninth century on, include blown, mold-blown, and mosaic glasses, and some of them are decorated with tooling or relief cutting. Some examples are opaque dark red streaked with brown. Subjects for future research on these objects include their provenance and date, the materials from which they were fabricated, and the manner in which they were traded.

Keywords: Indus Delta, trade, glass objects

References
Daryae 2003

Panhwar 2003
Protecting Art and Other Objects of Cultural Value from Photochemical Damage: The Possibilities of UV Protection on Glass

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The risk posed by the exposure of art and cultural objects to light and radiation often remains underestimated. Unfortunately, the well-known 50 lux as the maximum tolerable intensity in museums for light-sensitive objects applies only to the radiation perceptible by the human eye as “light” (i.e., “visible light,” with a wavelength range of 395–750 nanometers [nm]). But art objects may also be materially altered by short-wavelength ultraviolet (UV) radiation and long-wavelength infrared (IR) radiation; in combination with other environmental factors, these often lead to irreversible damage.

The manifestations of light damage recognized in the course of conservation work include a change of color in retouchings or inpainted areas, the embrittlement of adhesives and coatings, and a discoloration/fading and/or evidence of material fatigue on objects made from a variety of materials (e.g., glass objects, wooden objects, wall paintings, and paintings on glass). Examples of light damage were analyzed in cooperation with conservators, engineers, physicists, and chemists, and the causes as well as the effects of this damage were investigated.

In the past, the goals of aesthetic presentation and maximal radiation protection were often in conflict. Protective films often displayed a basic yellow or gray color that significantly interfered with the viewing of an object. Today, the manufacture of highly effective radiation-protection panes with an absolute filter effect is feasible, providing only 1% transmission for wavelengths below 405 nm and a color-rendering value of 99.8%. These coated glass sheets can be utilized as individual panes, as architecturally bound windowpanes, and as components in the construction of display cases. Depending on the specific application, a pane can be selected with additional features, such as reflective response, antireflective coating, penetration shields, and modified surfaces. The panes can even be adapted to historical glazings. Radiation levels above 750 nm can be blocked with the addition of integrative infrared filters. This permits objects to be displayed safely and viewed optimally.

Keywords: sun filter, UV and IR radiation, photochemical damage, protective panes
The Preservation and Weathering of Second-Millennium B.C. Glass from the Hurrian City of Nuzi (Iraq)

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The project has involved the detailed characterization of the glasses and other materials in terms of their preservation and the formation of weathering crusts. The results indicate that there is a wide range of preservation states in all classes of vitreous materials, with both well-preserved and completely weathered, often unstable, examples. Evidence was found both of ion exchange and hydration at the glass surface, and of the breakdown and reprecipitation of the glass network into secondary weathering crusts. Many compositions and morphologies were noted in the weathering crusts of the glasses, suggesting that small variations in burial environment conditions may have a significant effect on the preservation of vitreous materials. In addition, the early stages of weathering that are seen on a few examples may have occurred after excavation, while the objects were stored in the museum. Comparisons of different materials showed that where glass had been present (e.g., in the glaze of ceramics), similar secondary phases were formed.

Keywords: glass, weathering, Late Bronze Age, vitreous materials

The preservation state of buried glasses is very important in understanding their composition, technology, burial environment, treatment since excavation, and future stability. As part of a major international project looking at the material assemblage from the Hurrian city of Nuzi and now stored in the Semitic Museum at Harvard University, the preservation of vitreous materials has been studied in considerable detail. The site of Yorgan Tepe, which contains the Late Bronze Age city of Nuzi, was excavated from 1925 to 1931. The city contains the largest known collection of vitreous materials from the Near East dating to the second millennium B.C. This assemblage includes polychrome glass vessels, beads, pendants, and other glass objects; faience and frit vessels and other objects; and glazed ceramic vessels, wall nails, and figurines.
William H. Grueby’s Pottery Techniques and Glaze Compositions: Analysis of Two Tile Panels from the Collection of the City of New York

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William H. Grueby (1867–1925), a prominent ceramist of the American Arts and Crafts movement, manufactured signature vessels and wall tiles from his factory in Boston, Massachusetts. Grueby’s ceramics were known for their simple forms and their olive green and mustard yellow opaque matte glazes. His decorative tiles are installed in New York City subway stations, the Bronx Zoo, the Cathedral Church of Saint John the Divine, the Heckscher Foundation for Children, and many other venues in New York City, Boston, and elsewhere in the United States and around the world. Grueby’s glaze colors, finish, and style influenced his contemporaries, who produced lines of pottery that attempted to replicate his work, beginning the American Arts and Crafts pottery type (Montgomery 1993). Grueby kept his glaze recipes and methods secret, and in the 1950s his notebooks disappeared.

In this study, we applied in situ hand-held X-ray fluorescence (XRF) spectroscopy to analyze the glazes from a group of 23 Grueby wall-tile panels that were installed in the original Heckscher Foundation lobby in 1923. The lobby tiles were chosen because they are glazed with a full range of colors, supplying a large palette for future comparisons (Fig. 1). The results of these analyses show that all of Grueby’s glazes contain high concentrations of lead. Different colors were achieved by adding various amounts of copper, cobalt, manganese, nickel, and iron compounds to the base glaze. Zinc was also identified, and it was probably used as an opacifier as well as a flux. Grueby altered the amount of colorant, the flux/opacifier, and selected firing conditions to create his intended colors and signature matte and crystalline surfaces. XRF analysis of the glazes will be presented in an attempt to identify Grueby’s production methods and recipes. Understanding the glaze compositions will help in future identification, conservation, and preservation of his works.

Keywords: X-ray fluorescence, pottery, Arts and Crafts movement

Reference
Montgomery 1993

Figure 1
Analyzed panel from the Heckscher Foundation for Children, Collection of the City of New York. H. 61 cm, W. 183 cm.
The Development of the Art of Stained Glass in Porto Alegre, Brazil

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The lack of documentation about the history of stained glass in southern Brazil prompted this study, which involved both historical research and technical investigation. The production of the Genta and Veit studios in Porto Alegre between 1920 and 1980 (Brandão 1994, p. 74) was the subject of this project. The research included religious and public panels of stained glass. Genta, the larger studio, was active from the 1940s to the 1980s. Most of its workers came from Europe, and its two most important painters were Francisco Huguet and Max Dobmeier. Veit, a family-operated studio, was started in the early 1920s, and it closed about the 1970s. Its founder, Albert Gottfried Veit, came to Brazil after working in Württemberg, Germany.

Analyses using scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS) were used to obtain information about the chemical composition and to observe fractures and processes and/or elements of deterioration (Jembrih-Simbürger and others 2002; Carmona, Villegas, and Navarro 2006). We found that both studios used glasses consisting of silica (SiO₂) and lead (Pb) as principal elements. Potassium and sodium were added as fluxing agents, with K₂O contents as low as 0.8%.¹ The percentages of sodium showed some variation between the studios and over the various decades of production. The highest amounts were observed in Casa Veit’s glasses (4%–9%). Very similar levels of calcium (Ca) and aluminum (Al), which act as modifying agents, were observed for both studios in glasses made in the 1940s. The main alterations found on the glass surface were crystalline particles, probably CaCO₃, formed from the reaction of CO₂ in the air with Ca ions leached from the glass or deposited from external sources. Changes observed in the paint layer were the detachment and deterioration of the grisaille on some panels. This can be associated with the size of the grains and the distribution and/or possible decomposition of the glass paint.

During our research, we obtained a small amount of the glass used by the two studios, and we analyzed its composition. The results provide a starting point for further historical and scientific research that will contribute to the investigation and preservation of historical stained glass in Brazil.

Keywords: stained glass, Genta, Veit, SEM-EDS analysis

References
Brandão 1994

Carmona, Villegas, and Navarro 2006

Jembrih-Simbürger and others 2002

¹. Percentages in this poster are mass percent.
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Hannelore Roemich, Editorial Coordinator
Cover Image:
*Cire perdue* figure made by Frederick Carder in the 1930s or 1940s, with a repair in which the epoxy is badly yellowed. The Corning Museum of Glass (59.4.426).