

A Sticky Situation: Conservation of Historical Waterlogged Rubber



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I. Introduction

The Mariners' Museum and Park is the repository for archaeological material recovered from USS *Monitor*, a Civil War iron-clad steam powered ship that sank off of Cape Hatteras in 1862. The builders used rubber gaskets throughout the steam plant to maintain water and steam-tight seals. Rubber, as an industrially manufactured material, was in its infancy at this time. As archaeological investigation moves into the late 19th and 20th centuries, modern materials like rubber are becoming common place on the archaeological conservator's bench. This poster presents suggested practices for waterlogged rubber conservation, as developed through experimentation and research at the Museum.

The gaskets were recovered between pipe fittings, valve attachments, and other connections. Condition varies widely; some are highly stable, others are degraded and delaminating. Many had iron and copper staining and corrosion on the surface. The gaskets appear to have been manufactured in a similar method. All gaskets have distinct layers of rubber and plain weave textile, in alternating layers. The number of layers of rubber and textile varies gasket to gasket.

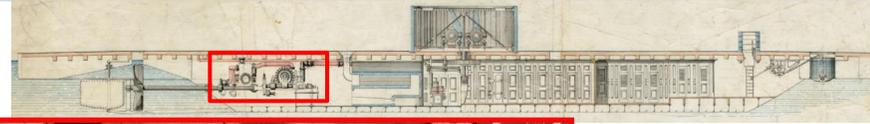
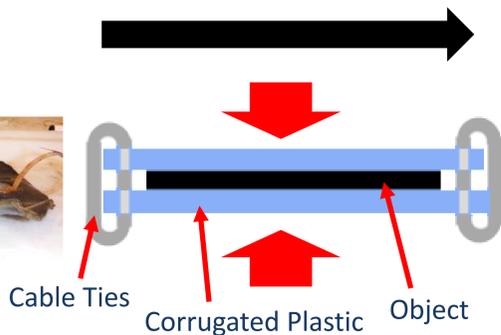


Figure 1
Above: Historical builder's drawing of USS *Monitor*, dated 1862. Red highlights the main steam engine in the ship.
Left: USS *Monitor*'s partially disassembled main steam engine has already yield seven gaskets, with more anticipated.

Condition



Storage

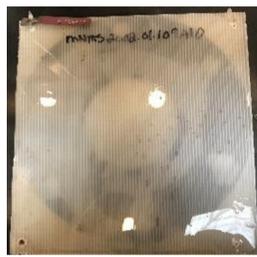


Figure 2. Storing rubber between plastic sheets prevents warping and curling

III. Cleaning and Treatment

Chemical Cleaning

- Iron and copper stain removal via a bath of 2% (w/v) dibasic ammonium citrate in DI H₂O
- Bath lasted 24 hours, followed by a 24-48 hour rinse in DI H₂O
- Multiple baths necessary for some objects, depending on severity of staining

Mechanical Cleaning

- Bamboo sticks and brushes
- Cleaning with Parkell Turbo SENSOR™ Ultrasonic Scaler; water pressure and ultrasonic power were altered based on the stability of the object to remove debris, staining, and corrosion
- Use of an ultrasonic bath is **not** recommended; delamination of layers and disintegration of some rubbers were observed when tested

II. Desalination Storage

Objects were stored in DI H₂O cold storage (6°C) until treatment began. However, in storage, the objects began to warp, curling on the edges or delaminating. To mitigate this damage, a structural support for the objects was created by sandwiching each gasket between two layers of corrugated plastic sheeting. The sheets were held tightly around the gasket using cable ties (zip-ties). Objects could still be stored and desalinated in batch-treatments, but with lower risk of warping.

Note: Several gaskets in the collection tested positive for lead due to the presence of a lead based sealant used between valves. Therefore, all gaskets were handled with the appropriate PPE for lead safety.



Figure 3.
Laurie King surface cleaning rubber gasket using with Parkell TurboSENSOR™ Ultrasonic Scaler. Image Credit: Jonathon Gruenke of Daily Press

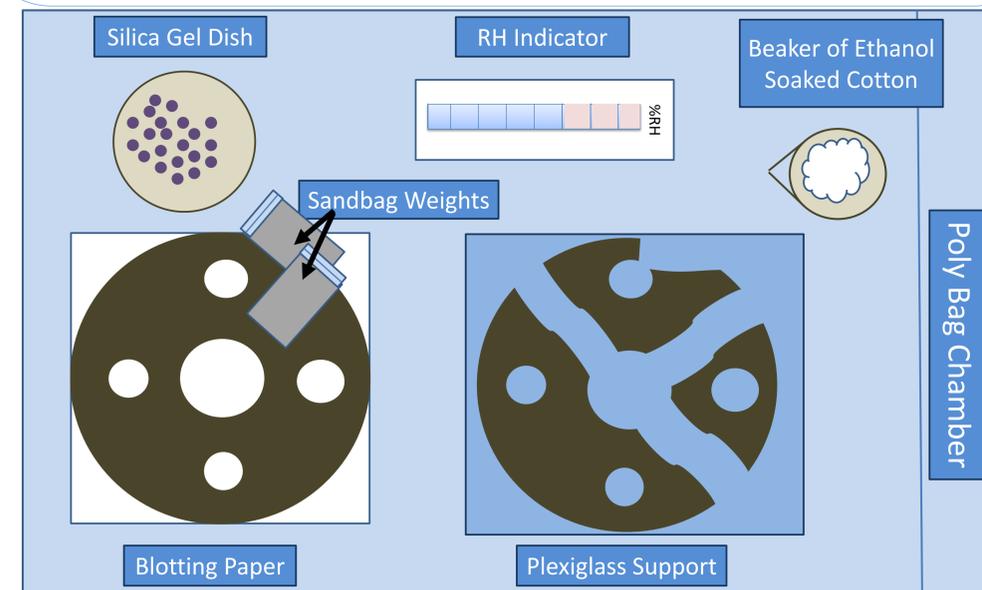


Figure 4. Diagram of the drying microenvironment. Note that the type of support is dependent on object condition

V. Storage

- Gaskets are stored on corrugated plastic trays lined with silicone release paper
- Each tray is encapsulated in an Escal® barrier bag with Mitsubishi RPK® oxygen scavenger packets, oxygen level indicators, and blue/pink humidity cards. Bags are heat sealed and the seams are covered in foil tape for secondary protection
- Multiple trays are stored in blue museum board boxes to eliminate light
- Boxes are stored in Delta Design Ltd. Series 700 cabinets with other organics at 50% RH, controlled by silica gel
- The system was designed over 10 years ago by conservator Susanne Grieves. Original bags have not been opened and the gaskets are stable. While the system restricts handling, visual inspections can occur. The packets cannot be reused, so when a bag is opened, it will need new packets before resealing.
- System Materials (All available from Mitsubishi Gas Chemical America Inc.):
 - ESCAL® barrier film - ceramic coated poly vinyl alcohol transparent film
 - RP-20K type Agent - neutral-moisture oxygen absorber packets, RP System®
 - NDE7 type oxygen Indicator - color changing oxygen indicators, RP System®

IV. Controlled Air Drying: Set Up

Microenvironment

- Gaskets removed from DI H₂O storage, blotted dry, weighed, placed inside microclimate bag
- Polyethylene bag creates microclimate (with ethafoam support underneath)
- Blotter paper under gasket, to absorb excess moisture
- Fragile objects placed on plexiglass—minimize object handling & increase object support (daily weights taken with plexiglass)
- Tacky objects placed on silicone release paper
- Warped, curling areas are flatted by poly bags filled with sand or lead shot
- Beaker with 20ml of ethanol and cotton placed in bag to prevent mold growth
- Watch glass with 0% RH conditioned silica gel to absorb excess moisture
- RH indicator card

Methodology

- Objects weighed twice a day and flipped daily for even drying
- Silica gel, ethanol, and blotter paper replaced daily to remove moisture
- Condensation removed from bag interior via Kimwipes® laboratory tissue
- Object weight and RH indicator used to track air drying progress
- Entire drying process may take 1-2 months – slow and steady method prevents warping



Figure 5.
Anoxic storage of rubber gaskets slows degradation and saves space.

References

- Grieve, S. 2006 *Archaeological Conservation of Modern Materials: A Case Study of Waterlogged Rubber Gaskets from the USS Monitor (1862)*. In: Journal of Middle Atlantic Archaeology. Vol 22 pp79-89
- Grieves, S. 2007 *The Conservation of mid-19th Century Waterlogged Rubber* In: Proceedings of the 10th ICOM-CC Group on Wet Organic Archaeological Materials Conference, Amsterdam, 2007.
- Grieves, S. 2008 *The Excavation, Conservation, Storage and Display of Rubber Artifacts Recovered from the USS Monitor (1862)*. In: Journal of the American Institute for Conservation. Vol 47, Issue 2, pp139-148.
- Mitsubishi Gas Chemical America, Corp. "RP System: Oxygen, moisture and corrosive gases absorber, oxygen barrier bags for industrial and cultural assets". Accessed April, 16 2020. <http://ageless.mgc-a.com/product/rp-system/>

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