

Program Description: Utilization of Sub-critical H₂O Solutions for the Removal of Corrosive Salts From Artifacts from Marine Sites: The Hunley Project



The classic techniques that have been employed for the stabilization (removal of chloride from) of cast and wrought iron artifacts from marine sites are long and slow processes requiring large amounts of chemical and producing large quantities of waste and yield unpredictable results.

A new technology has been investigated for removing chloride from large and complex maritime artifacts utilizing sub-critical H₂O solutions for the stabilization and conservation of marine artifacts. Prior to this work there were no reports in the literature on the utilization of either super or sub-critical fluids for the stabilization of metal artifacts. To date we have been able to demonstrate that this approach may completely change the way that marine artifacts are conserved in the future

Program Description: Supercritical Fluid Sterilization of Biomaterials

The current sterilization methods all have significant drawbacks with respect to the sterilization of sensitive polymeric biomaterials.

- Gamma-sterilization
 - Chain scission, decrease in molecular weight, x-linking.
 - Ethylene Oxide sterilization
 - Residual EtO toxicity and carcinogenicity issues
 - Steam sterilization
 - Destruction of heat-sensitive and hydrolytically unstable polymers.
- In our research we have been able to achieve complete deactivation of *B. Stearothermophilus* (autoclave standard) and *B. Subtilis* (ethylene oxide standard) spores in SC-CO₂ at 40° C in less than 2 hours using <100ppm H₂O₂ at pressures under 300 ATM. In addition we have not observed any significant effect on the physical and mechanical properties of different, clinically relevant polymers

Capabilities relevant to the research:

- Flow through 600 ml supercritical water reactor.
- Thar 250 ml, stirred with quartz windows supercritical CO₂ Reactor
- Analytical supercritical CO₂ extraction and capillary chromatography.
- Polymer analysis and characterization facilities.

Sponsors and selected recent publication:

- National Parks Service, NIH, FoTH
- M. J. Drews , P. de Viviés, N. G. González, P. Mardikian, "A Study of the Analysis and Removal of Chloride in Iron Samples from the Hunley," Metal 2004, Proceedings of the International Conference on Metals Conservation, Canberra, Australia, October 2004, J. Ashton and D. Hallum, (eds.), Published by National Museum of Australia, Canberra, 247(2004).