Metallurgical & Corrosion Evaluation of the USS Arizona
Research Experience for Undergraduates 2009 (REU)
Research Undergraduates: Nathan Saunders & Elliot Hamilton
Faculty Advisor: Dr. Dana Medlin
Grant #: 0852057

Objectives
• Characterize steel taken from the U.S.S. Arizona.
• Present findings on experiments performed on selected pieces from U.S.S. Arizona’s hull.
• Experiments include microstructural, chemical, and corrosion susceptibility analysis.
• This information will provide understanding into the metallurgical practices of the time when the ship was built.
• May provide information leading to better preservation of the ship and others like it.

Metallurgical Analysis
• Three varieties of plate were analyzed as well as a rivet.
• A photograph showing the plate and rivet is shown in Figure 1.

In Figures 2, 3, 4, and 5, the respective micrographs of the plate and rivet taken with an optical microscope are shown.

Core samples recently taken from the U.S.S. Arizona’s hull were also analyzed with an optical microscope.

A photograph of the core samples is shown in Figure 6.

The core samples were compared to the other specimens.

If the core sample has similar microstructure, it can be assumed that it also has similar chemistry and corrosion-susceptibility given the same conditions.

A chemical analysis for the carbon content of the steel was performed on the selected samples of plate and rivet.

The results of the carbon content analysis are shown in Table 1.

Corrosion Rate Analysis
• Corrosion rate data was obtained using PAP (potentiodynamic anodic polarization) testing.
• The tests were done within specifications of ASTM, G-61.
• The results of the corrosion analysis are shown in Table 2, and the rates are given in mils (thousandth of an inch) per year.

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Corrosion Rate (mpy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate A-1</td>
<td>4</td>
</tr>
<tr>
<td>Plate A-2</td>
<td>2.3</td>
</tr>
<tr>
<td>Plate A-3</td>
<td>5.2</td>
</tr>
<tr>
<td>Rivet Head</td>
<td>5.3</td>
</tr>
<tr>
<td>Rivet Shaft</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Table 2: Corrosion rates of selected U.S.S. Arizona samples.

Broader Impact
• This information will allow the National Park Service to make better informed decisions in preserving the U.S.S. Arizona.
• Preserving the U.S.S. Arizona will ensure that the sailors that lost their lives on the ship will continue to be remembered and honored for their sacrifice for freedom.
• This information will also allow others to make better informed decisions in preserving other submerged ships as well.

Special Thanks to Dr. Michael West, Dr. Dana Medlin, Dr. Alfred Boysen, and the National Park Service.

National Science Foundation