

Corrosion rates of marine archaeological cast iron as a function of relative humidity and treatment

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Objects from King Henry VIII flagship Mary Rose are displayed in a new museum within thematic mixed material displays. Cast iron cannon balls within a showcase representing the gun-deck of the ship were corroding within the 55% relative humidity (RH) that was maintained to prevent damage to wooden gun carriages and other organics in the mixed material display. Determining the corrosion rates of cannon balls, as a function of RH, provided guidance on how fast the cannon balls were corroding while on display and offered data to indicate how lowering the RH would reduce corrosion and prolong survival of the cannon balls.

Using oxygen consumption as a comparative proxy for corrosion rate, cannon balls treated by hydrogen reduction, alkaline sulphite desalination and Hostacor™ IT inhibitor were individually incrementally exposed to 20%, 30%, 40%, 50% and 60% RH. Cannon balls treated by hydrogen reduction exhibited negligible corrosion through the full RH range tested, while those treated by alkaline sulphite corroded faster at all humidity values. Hostacor™ IT returned a slow corrosion rate until 60% RH. Initial results reopen the debate about the use of hydrogen reduction as a treatment for cast iron. It was discredited due to the changes it produced in metallographic structure and the cost of its implementation.

Research outcomes provided data for producing guidelines for the safer display of cast iron at the Mary Rose Trust.