Desiccated corrosion control of the 324 feet long wrought iron hull of ss Great Britain: theory and operational realities 10 years on

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Brunel's ss Great Britain ocean going liner is an iconic historic ship located in Bristol (UK). At its launch in 1843 it embodied multiple steps forward in engineering and shipbuilding. It was the biggest ship in the world, built with an iron hull using an innovative box girder hull design that was the forerunner for all future ship design and was screw driven. After an eventful life as a liner, emigrant vessel, sailing ship and finally a floating warehouse in the Falkland Islands, it was returned to Bristol in 1970 to rest in the dry dock in which it was constructed, where it become a visitor attraction.

Traditional painting techniques failed to offer sufficient protection from corrosion for the corroded hull open to the elements. The ss Great Britain Trust explored ways to preserve the ship, finally settling on a procedure that involved glazing the dock at water level to provide an enclosed space for controlling corrosion of the lower hull by desiccation, leaving the less corroded upper hull exposed to the atmosphere and maintained by traditional painting methods. This addressed the problem of the instability of the salt infested lower hull area.

Research at Cardiff University determined the impact of relative humidity (RH) on the corrosion rate of iron to inform the design of the desiccation plant. Mass gain experiments examined the impact of ferrous chloride and the corrosion bearing ferric oxyhydroxide akaganéite, which were both identified on the hull, on corrosion rate of iron identifying corrosion would be negligible at a target RH of 20%. Plant was designed to maintain this value by desiccating and channelling air around the dock.

This paper reports the performance of the plant by looking at the spatial distribution of RH on the surface of the hull, inside it and within the roofed in dry dock area. Temperature control within the dock is a challenge during summer months due to solar gain through the glass roof and the welfare, safety and comfort of visitors entering this area has to be considered, as well as operation of the plant. Relationships between corrosion rate, plant performance, RH and temperature are discussed and set against the cost of maintaining the desiccation levels and the ethical constructs of preserving heritage.