

Scientific Paper:

Corrosion Engineering, Science and Technology (2010) Vol. 45, No.5, 350 - 356

***In situ* measurement of oxygen consumption to estimate corrosion rates**

H. Matthiesen¹ and K. Wonsyld²

¹Department of Conservation, National Museum of Denmark, Lyngby, Denmark

²Topsoe Fuel Cell, Lyngby, Denmark

Abstract:

This paper presents a novel non-destructive method to measure the actual corrosion rate of precorroded metal objects, such as historical and archaeological artefacts. The corrosion rate is estimated from the oxygen consumption of the objects, which is measured in a small volume of air encapsulated directly on the surface of the object. An optical method is used for the oxygen measurements, making it possible to measure through transparent materials such as glass. The method is tested on iron and copper samples in different environments using both new uncorroded metal and historical artefacts, which have thick corrosion scales from more than 50 years outdoors. The results show the following: the method has a good reproducibility; there is a good correspondence between oxygen consumption and weight loss; the corrosion rates of precorroded cast iron are significantly lower than the rates found for new steel samples, whereas corrosion rates for precorroded copper are equal to or higher than rates for new copper samples; and corrosion rates as low as $0 \cdot 1 \mu\text{m}/\text{year}$ can be measured by the method.

Keywords: atmospheric corrosion, oxygen consumption, corrosion rate, *in situ* measurement, non-destructive