Wesley Hileman

Predicting Rust: Modeling the Electrochemical Deterioration of Iron

The accurate prediction of corrosion could reduce costs associated with inefficient maintenance schedules and prevention techniques. This project's purpose is to develop a model for predicting the corrosion rate of iron based on the amount of dissolved salts in rust media (that is, the solutions in which iron rusts). A series of rust media of varying sodium chloride concentration (0, 0.01, 0.025, 0.05, 0.1, 0.2, and 0.3 mol/L at 20 C) were prepared, and three square iron samples were suspended in each medium in separate beakers. Stir bars were added to the media that were then placed on a magnetic stirrer. Samples (20 mL each) of the media were taken in intervals of 20 minutes for one hour; after being acidified with nitric acid, potassium thiocyanate was added to the samples to yield a certain amount of the iron(III) thiocyanate complex, which is red in color. A colorimeter was used to determine the amount of iron(II) present in the media at the start of each time interval. With this information, average iron(II) concentration was plotted as a function of time at each salt concentration. A linear regression was performed on each set of points, and the slope of the fit lines were used as the corrosion rate. Results show that, in general, the corrosion rate increases with increasing salt concentration. The corrosion rate also becomes increasingly unpredictable as rust time and dissolved salt concentration increases, as indicated by increasing standard deviations.