

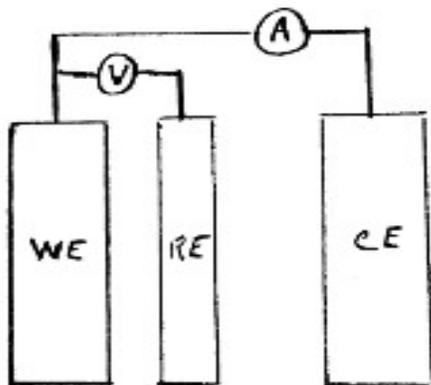
Commentary About Electrochemical Testing

Corrosion, or any chemical reaction, involves the transfer of electrons. Thus, there is a flow of electrical current. Electrochemical test methods for corrosion measure the small electrical currents due to the chemical reactions that cause the corrosion. The current density is proportional to the rate of the reaction, and when the measurement conditions are representative of long term behavior, this rate of reaction can be used to predict corrosion regardless of when and where the rate was measured. Of course there are uncertainties due to the variation of the materials and the experimental errors.

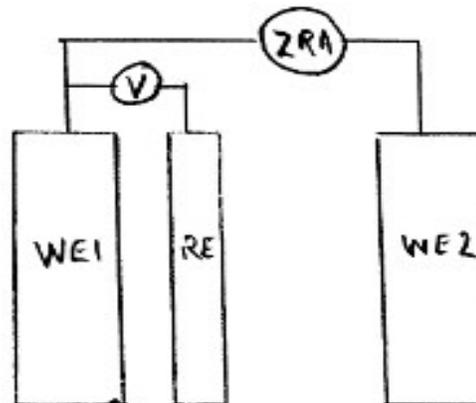
Evaluating corrosion by appearance changes or weight changes usually takes a long period of time and there is no certainty of using that information to make successful predictions of how the material will perform beyond the test period or how it will perform under slightly different conditions.

Electrochemical test methods cannot be used for every type of corrosion and additional information is usually needed to properly interpret the results. Measuring the corrosion current works well when the surface reaction is thermodynamically driven by the oxidizer, usually air, in the electrolyte or galvanically driven by the potential difference between two conductive materials. There is no practical way to measure corrosion currents in localized corrosion cells, pits and crevices, or when the corrosion is driven by externally impressed currents. Electrochemical tests can be configured to separate the contributions from general corrosion and galvanic corrosion.

General Corrosion Measurements



Galvanic Corrosion Measurements



There are also four "wild cards" that effect corrosion that are difficult and sometimes impossible to determine their exact influence on the corrosion process by any method. Only common sense helps. First, mechanical stress in the material that can be the result of forming, heating, machining, abrasion, etc. Both tensile and compressive stress aggravate corrosion. Second, contaminants within the metal alloy – tramp elements and non-metallic inclusions; slag, oxides, sulfides, nitrides, carbides. The more homogenous and the finer the distribution, the less the effect on corrosion. Third, surface contamination – dirty surfaces create localized cells which initiate pitting. Microbial slimes often cause pitting but in some environments reduce corrosion by being a barrier coating. Fourth, flow significantly reduces any tendencies to initiate localized corrosion, and usually reduces the general corrosion rate. However, high flow rates can aggravate corrosion by erosion and increasing the active surface area.