ORP

Oxidation-Reduction Potential (ORP): A More Complete Explanation

By MHI February 5, 2023

HALF-REACTIONS

As **explained previously**, ORP is measured in volts and informs us of a solution's oxidizing or reducing potential.[1] An **ORP probe** measures the voltage difference

between redox couples in accordance with their half reactions[2] (see table 17.1 below).

For example, the first redox couple fluorine (F_2) is a strong oxidizing agent. If you measured the voltage difference between F_2 and its reduced species fluoride (both at a 1 Molar concentration), you would get a voltage reading of 2.87 V.

Notice that the reduction potential of hydrogen: $2H^+ + 2e^- \Rightarrow H_2(g)$ is zero. This is because all redox values are based off of the standard reduction potential for hydrogen, which has been defined as zero.[3] Just as sea level is defined as zero elevation or water freezes at 0°C, the voltage produced by 1 M H^+ (pH 0) to H_2 (g) (pressure equals 1 bar) is defined as zero.[3]It's actually estimated to be 4.44 ± 0.02 V at 25 °C,[4] but we define it as zero at all temperatures.[3] This allows us to make comparisons; for example, the elevation of a mountain, the boiling point of alcohol, or the ORP of a redox couple. All redox reactions are compared to the **S**tandard **H**ydrogen **E**lectrode (**SHE**).[2]

This diagram shows how the standard potential $E^o$of a species (M) can be determined. The M electrode contains M ionic species in equilibrium with the non-ionic M species. The potential is referenced to the standard hydrogen electrode on the right.

ORP METERS

The **ORP meter** is generally a two-electrode system (some may have a third as a counter -electrode). One is the platinum electrode called the working electrode where the oxidation-reduction reactions occur. It either serves as an electron donor or an electron acceptor, depending upon the test solution. The other is a reference electrode (usually Ag/AgCl), which is calibrated back to the standard hydrogen electrode. The reference electrode is filled with a saturated solution (3 M) of KCl. This two electrode system makes a potentiometric measurement measured in volts.[2]

NERNST EQUATION

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