

Introduction to ISE

Three Methods of Analysis

Potentiometric ion analyses with ISEs are performed by use of one of three methods, each entailing its own advantages: Direct Potentiometry, Incremental Methods, and Potentiometric Titration. HANNA offers a solution for each of these methods.

Direct Potentiometry

Direct Potentiometry is a widely used method of performing ion analysis with ISEs. This method is highly effective when the user must quickly measure large batches of samples at many concentrations. Our direct reading meters such as the HI 98184 and HI 98185 display concentration of the unknown sample by a direct reading after calibrating the instrument with 2 or more standards. Ionic strength adjustments are made to both samples and standards. In some applications quick and reliable measurements can be made on-site without taking samples back to the laboratory.

Incremental Methods

Incremental Methods are useful techniques used to determine ion concentration quickly in samples whose constituents are variable or concentrated. Incremental Methods have some inherent advantages over direct potentiometry. The techniques can reduce errors from variables such as temperature, viscosity, pH or ionic strength. The electrodes remain immersed throughout the process thus reducing sample carry over and possible liquid junction changes in the reference and analysis steps are reduced. Known addition, known subtraction, analyte addition, and analyte subtraction methods are four of these incremental techniques. All techniques involve adding a standard to the sample, or sample to the standard and the meter calculates the sample's ion concentration directly.

Potentiometric Titration

A Potentiometric Titration can increase the precision of ISE measurements and also the number of ionic species that can be determined. ISEs are commonly used as indicators for the titrant or sample species to follow the progress of a precipitation or complexometric titration. A small change in reactant addition corresponds to a large change in electrode potential at the stoichiometric endpoint. An example of a precipitation titration is the determination of chloride using silver nitrate. A silver ISE can be used to follow this titration. A complexometric titration is used for the determination of calcium. A calcium solution is titrated with the complexing reagent EDTA. During the titration there is a gradual decrease in the free Ca^{2+} ion concentration as more EDTA is added. The end point corresponds to the point when all the Ca^{2+} is complexed. The progress of this titration can be monitored using a calcium ISE.

HANNA offers a solution for each of these methods,

Ion Selective Electrode Types

HANNA's ion selective electrodes can be grouped into three general categories based upon construction.

Solid state electrodes are available as both single half cells or as combination electrodes complete with reference electrode. These electrodes incorporate a solid sensing surface made of compressed silver halides, or solid crystalline material. HANNA's offering includes sensors for the determination of bromide, cadmium, chloride, cupric, cyanide, fluoride, iodide, lead and silver ions. Rugged, solid body construction ensures a long life.

Theory: A solid state electrode develops a voltage due to ion-exchange occurring between the sample and the inorganic membrane. An equilibrium mechanism occurs due to the very limited solubility of the membrane material in the sample.



Ion Selective Electrodes

Liquid membrane electrodes are available as single half cells or as combination electrodes complete with reference electrode. The sensing surfaces of these electrodes are comprised of a homogeneous polymer matrix containing organic ion exchangers selective for the determined ion. These sensors incorporate easily replaceable membrane modules and are available for measurements of nitrate, potassium and calcium.

Theory: The potassium electrode was one of the earliest liquid membrane sensors developed of this type. The membrane is usually in the form of a thin disc of PVC impregnated with the antibiotic valinomycin. The exchanger, also known as an ionophore, is a ring structure that fits potassium ions inside like a lock and key. This type of membrane is not as rugged as the solid state type so they are designed for easy replacement of the sensing module.



Reference and Combination Electrodes

HANNA's reference electrode is used with our half cell ISE sensors to provide accurate and repeatable measurements. HANNA's combination electrodes incorporate the measuring electrode with the reference making them ideal for field measurements.

Reference electrodes are used to provide a stable voltage and electrolytic contact to permit a voltage gradient to be measured across a measurement membrane such as an ISE. HANNA has designed an easy to use, unbreakable plastic, double junction, quick fill, sleeve style reference electrode with a cone style junction to work with the ion selective electrode family of sensors. The design forms the liquid junction with the test solution at the tip of the junction cone and not further up the cone surface. The design produces a highly stable reference electrode with reasonable, low flow rates. The model HI 5315 is a silver/silver chloride electrode half cell with a permanent gel filled internal cell. The outer fill solution is easily replaceable and serves as a buffer zone between the internal chloride ion containing gel and the sample solution. HANNA offers a complete line of silver-free fill solutions to optimize your ion measurement. A fast responding liquid junction, excellent reproducibility, and ease of use will mark this reference as your "best" in the lab.



Gas sensors are combination electrodes that detect dissolved gases in a solution. No external reference is required for these electrodes. The sensing element is separated from the sample solution by a gas permeable membrane. HANNA's offering includes the HI 4101 Ammonia electrode and the HI 4105 Carbon Dioxide electrode.

Theory: A gas sensor works due to the partial pressure of the measured gas in solution. The dissolved gas in the sample diffuses into the membrane and changes the pH in a thin film of unbuffered electrolyte on the surface of the internal pH sensor. Diffusion continues until the partial pressure of the sample and the thin film is the same. The pH change is proportional to the dissolved gas in the sample.



Combination electrodes include a sensor and reference electrode in a single electrode body. Our combination ion selective electrodes provide the same selectivity and response as our ISE half cells, but include our superior double junction reference into the same electrode body. Combination solid state electrodes have a built in solid state sensor and quick refillable reference electrode. Our liquid membrane and fluoride combination electrodes have replaceable module construction and the HANNA double junction reference stability.

