

The Chemical Laboratory provides analyses of various organic and inorganic constituents in construction materials by common chemical techniques such as wet chemical (gravimetric) analysis, atomic absorption spectroscopy (AAS), x-ray fluorescence spectroscopy (XRF), UV-Visible spectroscopy, Fourier Transform Infrared Spectroscopy (FT-IR), inductively-coupled plasma spectroscopy (ICP), and thermal analysis (differential thermal analysis, thermogravimetric analysis, and differential scanning calorimetric analysis):

- Elemental and oxide analysis in various types of construction materials
- Chemical analysis of portland cements for conformance to ASTM C 150
- Chemical analysis of fly ash, slag, silica fume and other pozzolanic and cementitious materials
- Acid and water-soluble chloride content in mortar, concrete, and other materials
- Chloride permeability analysis
- Alkalinity and pH analyses
- Sulfate analyses in cement and concrete
- Detection of organic constituents and various property-enhancing chemical admixtures in concrete, masonry, and mortar
- Paint, coating, pigment, and sealer analyses



**Cement Composition and Cement Content in Hardened Concrete** - Using an inductive-coupled plasma atomic emission spectrometer (ICP-AES) or an energy-dispersive x-ray fluorescence spectrometer (XRF), various major element oxide compositions of construction materials are routinely determined in the Chemical Laboratory. Major element oxide analysis is a common procedure used for determination of chemical composition of cement, concrete, mortar, stucco, lime and gypsum based products, pozzolanic and cementitious materials, proprietary grouts, and various other products. The calcium oxide and silicon dioxide contents in hardened concrete are often used for determination of cement content in the concrete; these oxide contents in the hardened mortar are often used for the determination of the mortar type (e.g., ASTM C 270 Type M, S, or N).

**Chloride Content Analysis** - Routine analysis of acid or water-soluble chloride contents in concrete and mortar samples are done by using the automated Metrohm Titrino potentiometric titrators, manufactured by Brinkmann Instruments. The 716 DMS and 751 GPD Titrino models equipped with metrohm chloride probe, 731 sample changer for continuous analyses of 12 samples, 728 magnetic stirrers, 5 and 20 ml burets, and 685 Dosimat are used. Both models are connected to a PC for automated chloride analysis and data download. The Titrino Models seek the endpoint by adapting the volume increment and potential measurement acquisition time - dynamic titrant addition to the slope of the titration curve. Accurate determinations are made over a large dynamic range, in minimal time. Brinkmann Workcell 5.0 Titration Software is used for end point calculation and chloride analysis. To evaluate consistency in

results, chloride analysis is also done, sometimes with the manual method by using a Fisher Scientifics' pH/ion electrode.

**Rapid Chloride Permeability Test** - Rapid chloride permeability analysis of hardened concrete cylinders and cores is done by using "Prove It" manufactured by Germann Instruments. Up to eight samples can be tested simultaneously. The results of chloride permeability are expressed in terms of coulombs passed through the samples, which are recorded in a PC connected to the instrument.



**Organic Analysis** - The presence of various organic chemical admixtures and property-enhancing chemicals are determined in concrete, masonry, mortar and other materials. Such a determination often requires a sample of the material to be searched and preparation of concrete or mortar mixtures with various dosages of such chemical (for calibration purposes). Examples of some organic analysis include: (a) analysis of set controlling and air entraining chemicals in concrete, (b) analysis of water-reducing and superplasticizing admixtures in concrete, (c) analysis of a water repellent in a masonry block and/or jointing mortar, (d) analysis of an organic pigment in a material, (e) detection of the presence of a polymer in a grout or stucco, etc. UV-VIS spectroscopy and fourier transform infra red spectroscopy (FTIR), after various sample extraction procedures are commonly employed in the organic analysis.