Kirk-Othmer Encyclopedia of Chemical Technology.

ANALYTICAL METHODS, SURVEY

Analytical methods are utilized by all branches of the chemical industry. Sometimes the goal is the qualitative determination of elemental and molecular constituents of a selected specimen of matter; othertimes the goal is the quantitative measurement of the fractional distribution of those constituents; and sometimes it is to monitor a process stream or a static system. Information concerning the various individual analytical methods may be found in separate articles dispersed alphabetically throughout the *Encyclopedia.* The articles are introductions to topics each of which is the subject of numerous books and other publications.

Analytical chemistry is an extremely broad discipline encompassing analytical strategy and data interpretation as well as techniques and instrumentation. Thus the analytical methods topics within the *Encyclopedia* may be roughly divided into six categories: articles on techniques such as the various spectroscopies, involving material characterization; articles on separation techniques, including some unit operations; articles on types of instrumentation and instrumental components; articles on nonspectrometric measurements, often used for monitoring; articles on sampling and on data analysis; and special purpose articles describing analytical methodology for specialized systems such as surfaces or residues. Methods for the analysis of a particular substance or group of substances can be found in the individual articles eg, see the analysis section in Acetic acid; Herbicides; (Polyhydroxy)benzenes; and Tin and tin alloys).

Materials characterization techniques, ie, atomic and molecular identification and analysis, are discussed in articles the titles of which, for the most part, are descriptive of the analytical method. For example, both infrared (ir) and near infrared analysis (nira) are described in Infrared and raman spectroscopy. Nuclear magnetic resonance (nmr) and electron spin resonance (esr) are discussed in Magnetic spin resonance. Ultraviolet (uv) and visible (vis), absorption and emission, as well as Raman spectroscopy, circular dichroism (cd), etc are discussed in Spectroscopy (see also Chemiluminescence; Electro-analytical techniques; Immunoassay; Mass spectrometry; Microscopy; Microwave technology; Plasma technology; and X-ray technology).

Some separation techniques articles discuss methods that may be applicable to samples that contain quantities of materials that are in microgram concentrations, such as Electrophoresis or high performance liquid chromatography (hplc) (see Chromatography). Other articles describe techniques that can be used in the chemical process industry for the separation of metric ton-sized samples (see Distillation; Distillation, azeotropic and extractive; Diffusion separation methods; Extraction, liquid–liquid; Extraction, liquid–solid; Filtration; Ion exchange; Reverse osmosis; Separation, centrifugal; Separation, magnetic; Separation, size; and Separation systems synthesis). Many of the special purpose articles also involve mixtures of materials and discuss separation techniques specific to the specialized system (see Biopolymers, analytical techniques; Forensic testing).

Although instrumentation is discussed in many of the analytical articles, there are only a few places in the *Encyclopedia* where it is the primary emphasis (see Analytical methods, hyphenated instruments;). However, articles relating to materials used either in or as instrumental components such as energy sources (see Lasers), sampling devices (see Fiber optics), and detectors (see Biosensors; Photodetectors; Ssensors) abound.

Both spectrometric and nonspectrometric methods are useful for monitoring systems for process or quality control, for environmental impact, and for other studies. Articles describing nonspectrometric measurements

(see Flow measurement; Liquid-level measurement; Pressure measurement; Rheological measurements; and Temperature measurement), and articles describing the use of analytical monitoring for particular systems (see Groundwater monitoring; Materials reliability; Process control; Quality control) are to be found in the *Encyclopedia*.

The quality of an analytical result also depends on the validity of the sample utilized and the method chosen for data analysis. There are articles describing Sampling and automated sample preparation (see Automated instrumentation) as well as articles emphasizing data treatment (see Chemometrics; Computer technology), data interpretation (see Databases; Imaging technology), and the communication of data within the laboratory or process system (see Expert systems; Laboratory information management systems).

Special purpose articles describe analytical methodology for specialized systems such as art objects, surfaces, or residues (see Fine art examination and conservation; Nondestructive testing; Surface and interface analysis; and, Trace and residue analysis). Many of the techniques utilized for these systems are also discussed in materials characterization and separations articles. The methodology and some of the techniques are unique, however, and the emphasis in these special topics articles is on application to a particular system.

BIBLIOGRAPHY

"Analytical Methods" in *ECT* 3rd ed., Vol. 2, pp. 586–683, by E. Lifshin and E. A. Williams, General Electric Co.; in *ECT* Supplement, pp. 43–64, by C. W. Reimann and R. A. Velapoldi, National Bureau of Standards.

Related Articles

Infrared technology and Raman spectroscopy; Mass spectrometry; Electroanalytical techniques; Thermography; X-ray technology; Immunoassay; Chromatography; Electrophoresis; Microscopy; Spectroscopy; Analytical methods, hyphenated instruments; Analytical methods, trends; Surface and interface analysis; Biopolymers, analytical techniques