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Editorial

Chemical analysis

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EDITORIAL NOTE

In failure analysis and remediation, chemical analysis for substance detection and verification is important. These approaches are used in conjunction with more conventional methods such as microscopy and physical analysis. Popular instrumental techniques for chemical analysis were discussed in part one of this book, particularly in terms of principles of operation and how they could be applied to failure analyses. Several examples of how these methods were used to achieve effective failure analysis are mentioned in this chapter. The importance of remediation is also emphasised. Examples are provided in which a multi-technique method was used, resulting in a higher level of confidence in the data produced. Fourier transform infrared spectroscopy, Raman spectroscopy, mass spectrometry (MS), chromatography, atomic emission spectroscopy, energy dispersive spectroscopy, wavelength dispersive spectroscopy, and others are among the techniques discussed.

Chemical research is carried out by a group of specialists who each have thorough knowledge of their own specialist methodology, such as infrared absorption, emission spectrography, electrochemistry, or gas chromatography, as well as a good understanding of the capabilities of the techniques used by the other team members. As a result, the analytical chemist has evolved into something more than a chemist who measures the chemical composition of a substance; he is now a problem solver with two additional steps in the analytical process —one at the start (problem definition) and one at the end (solution) (solution to the problem). This means that an analytical chemist can calculate things other than chemical composition in a narrow sense—for example, pH measurements may be preferable to final product analysis for process control, or details on the valency states of compounds on a metal's surface may be more valuable than determining its composition.

Chemical analysis of textile damage is a broad topic that necessitates a thorough understanding of chemical testing methods. Chemical identification of the fibres may also clarify technological errors caused by the use of incorrect material or by foreign fibres. Physical methods are sometimes combined with chemical analysis in functional damage analysis, such as microscopic staining, swelling and dissolution reactions, or colour reactions and derivatization in chromatography. For the identification of fibres, textile auxiliaries, and stains, IR spectroscopy, a physical process, involves chemical knowledge.

Chemical analysis can be used to determine the composition of hardened concrete and mortar, as well as provide insight into the causes of degradation. There are simple British Standard procedures available. Analytical chemistry skills, basic laboratory equipment, and a working knowledge of concrete technology are all necessary. It's ideal to have a precise understanding of the chemical composition of the concrete or mortar's constituents, but it's rarely possible. As a result, conclusions must be based on the analyst's knowledge and judgement. When it comes to turning empirical findings into concrete knowledge with a reasonable degree of precision, interpretation based on sound assumptions is often the most important skill.

The technique of measuring the intensities of different gamma energies emanating from a radioactive source is known as gamma ray spectroscopy. (For more information, see Chapter 30.) It can be used to identify the components of radionuclide mixtures qualitatively and quantify their relative abundance quantitatively. In neutron activation analysis, a situation like this can occur.

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