CHAPTER 10:
SPECTROSCOPY AND CHROMATOGRAPHY

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WHAT IS ANALYTICAL INSTRUMENTATION?

Analytical instrumentation is one the important techniques to analyse the pollutants in environmental samples. This chapter describes various types of instrumentation that are extensively applied for the analysis of pollutants in environmental samples.

Spectroscopy is one of the most important and powerful analytical tools for the useful analysis of target compounds in complex environmental samples. There are various forms of technique depending on the detection system and the features of the analyte to be analysed, thus enabling different application fields [1]. Atomic absorption spectroscopy (AAS), Ultraviolet-visible (UV-Vis) spectroscopy, infrared spectroscopy (IR) and inductively coupled plasma-mass spectroscopy (ICP-MS) are the common spectroscopic technique used in environmental analysis.

Chromatography is an important and powerful analytical tool for the effective separation and purification of target compounds in complex environmental samples. Chromatographic techniques, such as gas chromatography (GC) and high-performance liquid chromatography (HPLC) are commonly used for the sensitive analysis of pollutants in environmental samples.

FLAME ATOMIC ABSORPTION SPECTROPHOTOMETRY (FAAS)

Basic Principle

This technique is widely used to analyse metals in environmental samples such as metals in soil, water, and air samples. The sample solution was aspirated into a flame and the sample was converted to atomic vapour which contains atoms of the element. The absorbance obtained is directly proportional to the concentration of atomic vapour in the flame. A calibration curve is used to determine the unknown concentration of metal in the solution. The standard solution of the metal will be used to plot the calibration curve. A major drawback of AAS is that different sources (lamps) are required for each element [3].

Methodology

The sample is diluted in distilled water, acids or organic solvent. For solid samples, the isolation of metal from the sample must be done with or without reagents. Examples of digestion methods are wet digestion or dry ashing. Before proceeding with the analysis, a calibration curve must be prepared using different concentrations of the standard.

Application: Determination of Cu Ions in Soil

Figure 10.1 shows the example AAS result for the determination of Cu ions in the soil. Soils were digested using the wet digestion method before analysis. From Figure 10.1, it was clearly shown that the concentration of Cu in soil was 0.678 ± 0.009 mg/L. This result can be compared to the standard limit of Cu in soil which is stated in the Environmental Quality Act 1974.