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Spectrophotometry: Timeless Workhorse of Analytical Chemistry

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Spectrophotometry, as the name advocates, is the study of the change in the intensity of light upon its interaction with matter.[1] This change can be correlated to the analyte concentration. Therefore, it is an useful analytical technique. Spectrophotometry is one of the ancient yet modern technique that finds extensive applications. The most important aspect of the technique is the need for continuous calibration and validation of both the method as well as the detector. Apart from using it as an analytical technique, spectrophotometry can be used to gain insight regarding different systems that are being investigated. The ongoing research generates new approaches to make the technique more efficient. The first approach is the derivative spectrophotometry which is used to obtain qualitative and quantitative information from unresolved peaks by distinguishing very small variations between the spectra. This also leads to enhancement of spectral resolution. Another approach is the use of mean centring of the spectra. Both these approaches can be used without any prior separation of the sample mixture.
A substantial number of divergent studies have been carried out. Prior to the analysis, we can see how the technique is used to gain interesting aspects of a particular study. During the sorption of methylene blue onto nanocomposite, the interesting changes of the dye structure occurring could be easily evaluated.[2] Determination of various species has been studied. Spectrophotometric determination of lead using Inorganic–organic Ag-Rhodamine 6G hybrid Nano rods “Turn on” sensors was developed.[3] Determination of important constituents like salt in iodate and EDTA in detergent have been carried out with a high degree of selectivity and sensitivity[4] The use of spectrophotometer as flow detectors makes liquid chromatography (LC) and flow injection analysis (FIA) system useful. The applications of FIA have been highlighted in earlier paper.[5] The studies of alpha nitroso beta naphthol complexes

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of transition metal ions using FIA and LC has been reported.[6] FIA could be used to determine very low concentrations of cobalt while LC studies revealed the presence of isomeric forms of cobalt chelate. The kinetics and stability of metal complexation has been studied under stop flow conditions using FIAS system.[7] It is revealed that the pH played a vital role in sensitivity of determination and there is a possible existence of cation-cation complexes in solution. FIAS has been used for determining trace level iron without[8] and with uranium matrix separation.[9]

Apart from studies in aqueous samples, UV-VIS spectrophotometer can be used to measure transmittance & reflectance of solid samples. This technique is known as reflectance spectrophotometry and it gives various interesting results. From UV-Visible spectra, the water clusters present in Nafion ionomer membrane could be identified.[10] Further the effect of different experimental conditions on the membrane structure was also clearly shown. Spectrophotometric evaluation could also be used to understand the nature of interaction between the nanosorbent and dye during the sorption of dye on nanoparticles.[11] Another important application of spectrophotometry is its use in characterization of solid-state nuclear track detectors (SSNTDs). SSNTDs are extensively used in nuclear fuel characterization. These samples were evaluated to understand the various changes in the sample structure.[12]

Thus, it is seen that spectrophotometry is very simple yet a powerful technique for analysis of various kinds of systems. It also helps in revealing interesting aspects of the studies being carried out.

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