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THE IMPORTANCE OF THE SPECTROPHOTOMETRIC ANALYSIS METHOD IN THE STUDY OF THE COMPOSITION OF SUBSTANCES

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Abstract
This article discusses the importance of the spectrophotometric analysis method, one of the physico-chemical analyses, for studying the composition of substances.

Keywords. Physico-chemical methods of analysis, spectrophotometric analysis, optical methods, spectrum, absorption spectroscopy, infrared spectroscopy.

Introduction
Physicochemical methods of analysis are based on the measurement of the physical properties of a substance, which depend on its chemical nature and concentration. These methods include a variety of approaches that allow you to identify the composition and properties of samples.
At present, the importance of spectroscopic methods in conducting qualitative and quantitative analysis in various fields of chemistry is increasing. These methods are characterized by commonality, sensitivity, different spectra of individual substances, short analysis time and the possibility of automating certain stages of the measurement process.
Physicochemical methods of analysis make it possible to comprehensively approach the study of the relationships between the composition and properties of the systems under study. They are based on measuring the values of various changing physical properties of systems with the help of appropriate devices depending on the ongoing physical and chemical processes expressed in the appearance of a certain analytical signal [1].
Spectroscopic techniques can be applied to a wide range of substances, including organic and inorganic compounds, gases, liquids, and solids. This makes them versatile tools for analysis in various fields of science and industry.
Modern spectroscopic techniques have high sensitivity, which makes it possible to determine components at very low concentrations. This is important for trace amounts analysis and for applications that require high accuracy.

Each chemical element or compound has a unique spectrum that can be used to identify and quantify it. Spectra can be absorption, emission or scattering of light, and they serve as a "fingerprint" for substances.
Classification of physicochemical methods of analysis.
All physicochemical (instrumental) methods of analysis are divided according to the principle of use into five large groups, sections:
1. Spectral (optical) methods of analysis.
2. Electrochemical methods.
3. Chromatographic methods.
4. Radiometric and radiophysical methods.
5. Mass spectrometry methods.
Spectroscopic methods often allow for quick and efficient analyses. For example, many methods can provide results in minutes, making them useful for operational quality control and monitoring [2].
Modern spectroscopic instruments and systems can automate many stages of analysis, including sample preparation, measurements, and data processing. This reduces the possibility of errors, increases reproducibility, and simplifies the use of methods.

Basic Spectroscopic Methods
1. Absorption spectroscopy:
Ultraviolet Visible (UV-Vis) Spectroscopy: Determines the concentration of a substance based on the absorption of light in the ultraviolet and visible range. It is widely used for the analysis of solutions and chemical reactions.
Absorption Index: Measures how strongly a substance absorbs light at a specific wavelength.
Ultraviolet (UV) and visible (Vis) absorption spectroscopy is a powerful analytical technique that allows the concentration of a substance in solution to be determined by measuring the absorption of light at different wavelengths. This method uses laws that relate the absorption of light to the concentration of the substance in the solution. The most famous of these laws is the Behr-Lambert Law [3].
Examples of spectroscopy applications:
Substance Concentration Analysis, Pharmaceuticals: Determination of the concentration of active pharmaceutical ingredients (APIs) in formulations. For example, measuring the absorption of a certain wavelength allows you to estimate the concentration of paracetamol in tablets.
Chemical Reaction Analysis: Determination of the concentration of intermediates or end products of chemical reactions. For example, during the synthesis of a particular organic compound, it is possible to track the change in the concentration of reactants or products by measuring the change in absorption at the appropriate wavelengths.
Water Quality: Determination of Contaminant Content: Measurement of absorption in the UV range can help in assessing the content of organic matter such as phenols or other contaminants in water.
Food Analysis: Determination of Pigment Concentration: Determination of the concentration of anthocyanins and carotenoids in foods such as fruits and vegetables. This is important for assessing the quality and freshness of products.

2. Emission spectroscopy:
Atomic Emission Spectroscopy (AES): Measures the light emitted by atoms that are excited by a high-frequency current or flame. Suitable for the analysis of metals and inorganic compounds.

Fluorescence spectroscopy: Measures the light emitted by molecules after absorbing light. It is often used for the analysis of organic matter and biomolecules.

3. Nuclear magnetic resonance (NMR) spectroscopy:
Measures the interaction of nuclei with a magnetic field. It allows you to study the molecular structure and dynamics of organic and inorganic compounds.

4. Mass spectrometry: measures the mass and composition of molecules, which allows you to determine the molecular structure and mass of substances. It is most often used in combination with spectroscopy to obtain more complete information about a substance.

5.Infrared Spectroscopy (IR): Measures the absorption of infrared light, which can identify functional groups and molecular bonds in a sample.

6. Raman spectroscopy: Measures the scattering of light from molecules, which provides information about molecular vibrations and the structure of matter. Useful for the study of solids and solutions.
Example of analysis**:** analysis of the concentration of paracetamol in a solution:
1.Sample preparation: Dissolve the paracetamol sample in a suitable solvent (e.g., distilled water or buffer solution).
2.Calibration: Prepare standard solutions of paracetamol with known concentrations. Measure their absorption at a specific wavelength where paracetamol has maximum absorption (e.g., 243 nm in the UV range).
3.Measurement: Measure the absorption of the sample in the same wavelength range.
4.Calibration curve: Plot a calibration curve relating absorption to concentration for standard solutions.
5. Concentration calculation: Use a calibration curve to determine the concentration of paracetamol in the sample based on the measured absorption.
UV-Vis spectroscopy provides accurate and reliable results, and due to its versatility, it is widely used in analytical chemistry for a variety of applications [4].
In the synthesis of amidonicotinate coordination compounds of metals, their composition is analyzed in different ways. The composition, individuality and physicochemical properties of the synthesized compounds are determined. Vibration spectroscopy, electron diffusion reflection spectra, thermal and quantum-chemical methods of analysis have proven ways to coordinate the reactivity of acid amides, nicotinate fragment, central ionic medium, thermal behavior, electronic structures, and synthesized complexes [5].
Spectroscopic techniques are a powerful tool in analytical chemistry due to their versatility, sensitivity, and ability to analyze substances quickly and accurately. They find applications in a variety of fields, including pharmaceuticals, biology, materials science, ecology, and many others. Automation and modern technologies greatly expand the possibilities of these methods, making them indispensable in scientific and industrial laboratories.

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