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BASICS OF TITRIMETRIC METHODS OF ANALYSIS

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Analytical chemistry is of great practical importance in the life of modern society, since it creates tools for chemical analysis and ensures its implementation. Chemical analysis is an important means of monitoring production and assessing product quality in a number of industrial sectors, such as ferrous and non-ferrous metallurgy, mechanical engineering, production of pure and ultra-pure materials for the electronics industry, mining, chemical oil refining, petrochemical, pharmaceutical and food industries, geological service, etc. The purpose of the article is to master the basic principles of qualitative and quantitative analysis. The goal is achieved by solving a specific task for the analysis of an unknown substance, carrying out calculations using the titrimetric method of analysis and constructing the corresponding titration curve.

Keywords: release of gas, solution, precipitation, dissolution, formation, characteristic shape, cases, reaction progress, crystals, microscope.

Introduction

The scientific basis of chemical analysis is analytical chemistry, which develops the theoretical foundations of analytical methods or borrows them from related areas of chemical and physical science and adapts them to its purposes. Analytical chemistry determines the limits of applicability of methods, evaluates their metrological characteristics, and develops methods for analyzing various objects [1].

Qualitative analysis is a section of analytical chemistry devoted to establishing the qualitative composition of substances, that is, the detection of elements and the ions they form that are part of both simple and complex substances. This is done using chemical reactions characteristic of a given cation or anion, making it possible to detect them both in individual substances and in mixtures.

Chemical reactions suitable for qualitative analysis must be accompanied by a noticeable external effect. This may be: release of gas, change in the color of the solution, precipitation, dissolution of the precipitate, formation of crystals of a characteristic shape. In the first four cases, the reaction progress is observed visually, and the crystals are examined under a microscope [5].

To obtain correct results, reactions are required that are not interfered with by other ions present. This requires specific (interacting only with the ion being determined) or at least

selective (selective) reagents. Unfortunately, there are very few selective, let alone specific, reagents, so when analyzing a complex mixture one has to resort to masking interfering ions, converting them into a reaction-inert form, or, more often, to separating a mixture of cations or anions into component parts called analytical groups. This is done using special (group) reagents, which react with a number of ions under the same conditions to form compounds with similar properties

poorly soluble precipitates or stable soluble complexes. This allows you to divide a complex mixture into simpler components. Qualitative analysis consists of the following stages:

- preliminary observations;
- preliminary tests;
- the effect of acids on a dry sample;
- transfer of the analyzed sample into solution;
- systematic (or fractional) qualitative analysis of cations and
- anions [2].

When carrying out analytical reactions, certain conditions must be adhered to. These include the concentration of reacting substances, the reaction of the medium, and temperature [1].

Preparing a substance for analysis

When starting to study the chemical composition of a given substance, you must first carefully examine it, determining its appearance, color, smell, degree of grinding (powder, coarse-grained or fine-grained mixture, solid mass, etc.), the presence of crystalline or amorphous phases and prepare accordingly way to analysis and only after that begin to establish its chemical composition [6].

Preparing the test substance for analysis is a very, very important part of the entire study.

Based on the color of the analyzed sample, one can make assumptions about the presence or absence of certain cations in it. If, for example, the analyzed object is a colorless transparent or white mass, then this indicates the absence of significant amounts of colored cations in it - chromium(III) Cr 3+ (blue-violet color), manganese(II) Mn2+ (light pink), iron(III) Fe3+ (yellow-brown), cobalt(II) Co2+ (pink), nickel(II) Ni2+ (green), copper(II) Cu2+ (blue). If the sample is colored, then it can be assumed that it contains one or more of the above cations. For a complete analysis of the test substance, it is necessary to take a small amount of it, measured in milligrams. Qualitative analysis is performed in two stages. First, preliminary tests are carried out, a, then proceed to a systematic analysis of cations and anions [4].

Preliminary tests

Preliminary tests make it possible to establish the presence of certain elements, the detection of which is difficult during systematic analysis. To test for flame coloring, take a wire 60 mm long and 2-3 mm in diameter. One end of it is bent into a loop, the other end is soldered into a glass rod, which serves as a handle. The wire must be well cleaned by repeated calcination in the hottest, non-luminous burner flame. The wire is dipped in hydrochloric acid and calcined in a burner flame, then cooled to room temperature. Several crystals of the analyte are placed on the wire prepared in this way and introduced into the burner flame. Different ions give the flame the following colors:

Carmine red Sr2+,Li2+
Brick red Ca2+
Yellow Na+
Yellow-green Ba2+
Blue-green Te
Light blue As, Sb, Pb2+
Bright blue Cu2+, Se
Violet K+, Rb+ or Cs+

Wetting the wire with hydrochloric acid is carried out in order to obtain in the flame volatile chlorides of cations present in the sample (if it contains a non-volatile or difficult-to-volatile component) [3].

Test for thermal decomposition products.

By the nature of the products of thermolysis (calcination) of a sample of a solid analyte, one can sometimes judge the presence of certain cations and anions in the analyte. Based on the above experiments, we can conclude that the Pb2+ cation and CH3COO-, NO3- anions are present in the analyzed mixture.

Having analyzed the experimental data and preliminary observations, we come to the conclusion that this mixture consists of two salts Pb (NO3)2 and (CH3COO)2Pb.

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