Theoretical Analysis of Invariant, Subinvariant and Variative Components of Inorganic Substance Properties

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ABSTRACT
Theoretical analysis of invariant, subinvariant and variative components of the properties of inorganic matter, the article considers these principles.

Keywords: inorganic substance, inorganic substance properties, subinvariant component, variative component, etc.

Introduction. Invariant description of a substance and its properties includes information about the following subinvariant components: composition of a substance, classification, naming procedure, appearance of the structure of a substance at different levels, physical (physical-chemical) properties, thermodynamic properties, chemical properties (reactivity properties, equilibrium and kinetics), physiological, toxicological and biological effects, methods of obtaining (in laboratory and industrial), important areas of application. Each component in the description of a substance and its chemical properties in turn will consist of a complex subsystem, that is, subinvariants.

Separately, it should be noted that after describing the general information about the substance, there will be no need to describe in detail the methods of obtaining this substance at once. From the point of view of historicism, this is the right approach: researchers usually first take a substance using certain methods, and then proceed to the study of its properties. However, when organizing educational activities, we must take into account not only the scientific logic associated with historical discoveries, synthesis processes and subsequent research of matter, but also the logic of organizing educational processes. This logic, that is, the logic of the organization of educational processes, means that it is advisable, first of all, to study the structure of a substance and, accordingly, its physical and chemical properties, and only then to discuss these properties and methods of obtaining it based on the order of the structure.

Generally, inorganic substances are classified according to one or two symptoms. In most cases, classification is carried out on the basis of important chemical properties. These chemical properties include: the manifestation of metallicity or non-metallicity properties in a substance; acid-base properties of bases and oxides. On important grounds, gross classification is not carried out.

Literature review. The classification of inorganic substances should be carried out according to several symptoms at the same time. These symptoms include properties such as substance structure, substance composition, cations and anions (for substances with Ionic structure), subinvariant chemical properties (stability, acid-base, redox), as well as the color of the substance, solubility in aqueous and non-aqueous solvents, volatilization (variability) of the substance. Such an approach to classification work allows you to systematize the properties necessary for the implementation of important practices on the substance. For example, the classification of substances according to their structure sets the stage for predicting the presence of one or another chemical and physical properties in a substance. Classification by chemical properties helps to have sufficient information about such factors as the procedure for working with a substance, storage conditions, application in which chemical processes. And the classification of substances by solubility, volatility (variability) characteristics and color creates conditions for solving experimental issues common in school practice, such as the identification of substances, the separation of mixtures of substances, and modeling the scientific activities of amateur researchers.

Research Methodology. There is a subinvariant complex of inorganic matter, which is called The “Order of naming”. This complex includes three subinvariant components:

-qualification to name a substance according to modern versions of the naming order: according to the recommendation of the International Association for Theoretical and practical chemistry (IUPAC), that is, by counting all the indices in the formula of a substance; according to the rules of IUPAC-Shtok, that is, on the basis of indicating the degree of oxidation; according to the IUPAC version However, the above three qualities are not enough for the future chemistry teacher to perform moderate activities.

In addition, unlike representatives of many fields related to chemistry, a teacher of chemistry: conducts activities based on constant relationships with students; reads additional literature, including translated and very previously published sources; works with reagents produced decades ago; prepares students for Olympiads of various levels and applies outdated, irrelevant names in these processes. Therefore, it is necessary for a chemistry teacher to know the naming rules of the old order, in particular the naming order developed by Hess-Mendeleev, to be able to distinguish them from the naming procedure introduced by the association for scientific education (ASE), as well as to know names that are outdated and have lost importance in relation to minerological, historical, scientific, domestic, These names are the variative components of the subinvariant complex” Order of naming".

Analysis and results. The subinvariant complex, known as” thermodynamic properties", contains several elements of the description of substances from the point of view of thermodynamics. These elements correspond to the qualification of describing the thermodynamic stability of a substance based on a comparative analysis of standard magnitudes such as Gibbs energy, entropy and enthalpy of substance formation with similar magnitudes of constituent substances. At the moment, there are such sizes in the composition of the complex that at first glance it is difficult to call them subinvariant or variative, at least with their help it is impossible to characterize the properties of certain substances. For example, the value of redox potentials of transitions from the oxidation form (OSH) to the reduction form (QSH) is known only for certain substances, in particular, substances that can be present in solutions. The degree of generalization of these values is very low for certain substances.

The composition of the subinvariant complex “substance structure” includes the structure of the substance at different levels, which is studied by the science of chemistry of atomic particles: the structure of atomic particles (atoms, atomic cations and anions, radicals, ion-radicals) → the structure of molecular particles (molecules, molecular cations and anions) and the structure of simple zvenos of Inorganic Polymers (atomic, Ionic, metallic), structure of macrostile colloidal particles (real gases, liquids, solids (amorphous and crystalline: molecular, metallic, atomic, ionic crystals)).

Starting from the level of molecular particles and zvenos of organic and inorganic polymers of the structure of the substance, the theory of chemical bonds (covelent, Ionic, metallic) begins to play an important role in the subinvariance of the description of substances (kovalentnoy, ionnoy I metallicheskoy). Covalent bonds to metallic and ionic bonds of Inorganic Polymers for a substance with a molecular structure in the associates and condensed phase are carried out through hydrogen bonds or Van-der-Vaals bonds. Given the structure of high molecular compounds, the spatial structure of their molecules, the possibilities for the formation of hydrogen bonds are manifested at the molecular level.

Between the components of a subinvariant complex known as " physical properties" :

- aggregate state of a substance under conditions of different temperatures;
- "organoleptic properties", that is, those properties that a person learns through his senses (vision, smell, taste cognition) (color, smell and taste);
- physical and mechanical properties: degree of hardness (or softness) of a substance in quantitative and qualitative terms; fragility (elasticity); elasticity (inflexibility); compressibility; density of a substance in different aggregate states, etc;
- optical properties: reflectivity property (glare); light absorption in various areas of the spectrum; radiation in a heated state; scattering light; refraction of light; polarization of flat-polar light, etc;
- thermal properties: melting, boiling, sublimation and other stage transition temperatures of a substance; heat capacity; thermal conductivity of a substance in different aggregate states;
- electrical properties: electrical conductivity in solid, molten and gaseous States; electrical conductivity, electrical resistance of a solution of a substance;
- magnetic properties: diamagnetic, paramagnetic, ferromagnetic, ferrimagnetic;
- polarity and polarity of individual bonds and molecular particles;
- solubility: in polar confessions and their mixtures, non-polar confessions in their admixtures of the WAA.

The physical properties of substances are descriptions of their important properties. Experts determine the structural composition of substances based on physical properties, predict their chemical properties. It is possible to carry out monitoring of the dynamics of chemical processes by recording changes in the components of chemical systems, to be more precise in terms of physical properties, yanayam. It must be admitted that in the study of chemical substances in the school (and in the ATM too), in most cases, the need for an excellent study of physical properties is not adequately assessed. Neither teachers nor students nor graduates of the CPSU (no matter what the educational orientation of the CPSU is) can give an excellent description of the physical properties of substances. One of the main reasons why school teachers do not have a sufficient idea of the importance and nature of physical properties is that when introducing students to the science of Chemistry for the first time, the physical and chemical description of substances is not fully quoted, including the complex of physical properties is not considered. The teacher of Chemistry, who relied on existing school textbooks on chemistry, does not consider it necessary to make a detailed description of the physical properties of matter. The authors of textbooks in universities also do not pay enough attention to this issue. Only from these considerations it should not be concluded that the physical properties of substances are not revealed at all in textbooks held in universities. However, the physical properties of many substances are described, showing only important and brightly manifested properties, as in school textbooks, or limiting themselves to citing a table of physical constants (invariant quantities) of substances: however, the analysis of these constants (invariant quantities) and their connection with the chemical properties and structure of the substance are neglected. For almost every substance, the set of physical properties that reveal its essence has the property of individuality, individuality. Most often, aggregate states of a substance, boiling point, color, density and solubility are indicated. Physical properties are also cited for somewhat significant, important compounds, such as simple substances, but the complex of physical properties presented for simple substances is more complex and heterogeneous. It is less often observed that the relationship of physical properties with chemical properties and the structure of matter is given. We have considered a somewhat detailed analysis of textbooks on chemistry of school and higher education. What is important is that the complex of significant physical properties that a professional researcher or technologist in the field of chemistry determines with a teacher in chemistry is significantly different from each other.

In a general way, however, all physical properties can be divided into three groups:

1) the properties that are recorded through the sense organs of a person: the state of aggregation of a substance, its color, smell, degree of gloss of the surface and so on;

2) properties that can be determined through somewhat simple instruments: melting and boiling temperatures, density, viscosity, hardness, consistency, etc;

3) properties determined by complex instruments; Spectra, chromatograms, mass spectrograms, etc.

If a teacher works in schools with limited material capabilities and relies only on the life, social experiences of students, which are not so rich in the organization of educational processes, then, first of all, two types of properties in the above group of properties will be enough for them. Professional researchers with a sufficient material and technical base, technologists in the field of chemistry (including the authors of textbooks, manuals in Chemistry for students of higher educational institutions) work with physical properties belonging to Group 3 more. It can be seen from this that there are certain levels of differences between the groups of physical properties that school teachers are forced to use and the complex of perfect physical properties that professional researchers use. It is understandable that the measure to eliminate these differences is almost non-existent.

Conclusion / Recommendations. At this point, the main issue is not in material and technical support or in the shortage of some modern complex tools. Even if the chemistry room of the schools was equipped in the most modern form, the above-mentioned discrepancy would have existed: this is due to the absolute immaturity of physical properties recorded to students using complex modern instruments.

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