

CURRENT DIRECTIONS OF DEVELOPMENT INCREASING THE FIRE RESISTANCE OF POLYMER MATERIALS BASED ON MAGNESIUM-CONTAINING FIRE RETARDANTS IN CONDITIONS OF MODERNIZATION OF EDUCATION

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Abstract. *Technologies for teaching chemistry become a tool for effectively organizing the educational and cognitive process, focused on obtaining a given result. The emergence and development of technologies became possible thanks to the theoretical development of the subject methodology and the criterion for the development of the theory of learning to increase the fire resistance of polymer materials based on magnesium-containing fire retardants.*

In the course of studying the professional and methodological training of chemistry cadets at a university as a self-organizing system, we relied on a multidimensional analysis of the phenomenon of self-organization in chemical science and education.

Keywords: *chemistry, physics, technology, polymer materials, magnesium-containing fire retardants, development, increasing fire resistance, education, training, training of cadets.*

The rapid increase in the flow of educational information, radical socio-economic, scientific and technical transformations and conceptual changes in the structure and content of science have necessitated the modernization of education. The success of solving modernization problems is determined by the level of training in increasing the fire resistance of polymer materials based on magnesium-containing fire retardants and its readiness for professional activities in changing conditions.

Systematic, compact and accessible presentation of established knowledge has become difficult due to the constantly accelerating renewal of knowledge. The problem of updating and self-organizing knowledge, adding it to an already formed system, is especially acute in higher education. The knowledge of students in the field of basic physical and chemical science at all stages of professional and methodological training (students, cadets at the university is deepened and supplemented with professional and methodological knowledge from the perspective of future professional activities.

In the modern world, presenting ready-made, systematized knowledge to students for assimilation requires taking into account their constant change, addition and clarification.

Structural changes in the educational sphere are the reasons for the rapid obsolescence of acquired professional knowledge. There is a need to prepare cadets for functioning in conditions of uncertainty, constantly changing established approaches depending on the level of chemical training of schoolchildren, the profile of training, the existing social conditions and material and technical means of training, program requirements and specific training situations.

Modernization of the education system, and in particular the professional and methodological training of cadets in chemistry at a university, requires new methodological guidelines to achieve the integration of educational and professional components in order to ensure

continuity of education in higher education, develop strategies and tactics of one's own individual holistic methodology and techniques for teaching chemistry in changing conditions.

Building a flexible, functional and effective system of professional and methodological training at a university, capable of adapting to ongoing changes, requires taking into account the basic patterns of its development. To solve the problems of improving the professional and methodological training of cadets, it is promising to use new approaches based on already established ones. Performing these and other functions, developing the ability of future chemistry teachers to self-organize in changing conditions requires turning to new approaches focused on interdisciplinary synthesis and integration of knowledge and professionally significant skills.

An essential manifestation of integration in education is the penetration of synergetic ideas into it.

Synergetics, created by I. Prigogine, G. Haken and their followers on; based on nonlinear thermodynamics, explained the tendency of open systems of any nature and scale into a more ordered state due to the cooperative functioning of subsystems (277, 278, 358, 406).

Synergetics complements and develops cybernetics and the theory of general systems, performing methodological and heuristic functions as a strategy for modern research into systemic objects of any nature, including social ones. As a new interdisciplinary direction, it discovered universal, qualitative patterns of development existing in complex, non-linearly developing, open systems, and revealed their ability to self-organize.

Current directions of development, increasing the fire resistance of polymer materials based on magnesium-containing fire retardants, considering the problems of modernizing the professional and methodological training of cadets in the context of the concept of self-organization is determined by the need:

- revision of the content and process of professional and methodological training in accordance with the changing conditions of activity of chemistry cadets in a modern school and the need for self-organization of their professional activities;
- increasing the level of professional and methodological training of chemistry cadets through the fundamentalization of education and integration of all its components;
- eliminating the leading contradiction in chemical education - the gap between the scientific content of teaching chemistry at a university and at school, the level of mastery of the object of chemical knowledge, and the form and depth of its reflection in the educational process;
- orientation of professional and methodological training towards the formation of professional competence in future chemistry cadets and the development of reflective thinking.

Having developed within the framework of the previous technocratic paradigm, natural science education of teachers is built on a disciplinary principle. The content of chemical training at a university is poorly oriented towards the future professional activity of a specialist. Interdisciplinary fragmentation and fragmentation of knowledge within the main chemical disciplines hinder the formation of systems thinking, the ability to consider the object of study of chemistry as a system consisting of many components in dynamics and interaction. These and other reasons determined the most important direction of modernization of higher education in the conditions of a rapidly changing society and increasing information flows - its fundamentality.

The fundamentality of education is understood by many researchers as a focus on the deep essential foundations and connections between various processes of the surrounding world. V.V. Ilyin defines the fundamental nature of education as "the assumption of ultimate unitary principles that form the basis for cognitive diversity" (135). Synergetic ideas about the universal mechanisms

of development of complex systems, about their self-organization can become a means of ensuring the fundamentalization of student education, a methodological guideline in updating the content and structure of professional and methodological training.

The place and role of chemistry in modern civilization and culture require determining ways to equip students not only with basic chemical knowledge, but also to develop their chemical thinking, master it and equip it with the methodology of pedagogical activity and the corresponding methodological tools.

Modern goals and objectives of subject teaching require a deep restructuring of the composition and content of students' professional activities, flexible use of teaching methods and technologies in accordance with the modernization strategy and real learning conditions. The systematic knowledge of future chemistry students presupposes a holistic vision of chemistry as part of the scientific picture of the world, identifying the main components of chemical knowledge in their interrelation and interdependence. It presupposes "a quality of knowledge that is characterized by the presence in the consciousness of structural connections that are adequate to the connections of scientific knowledge" (L.Ya. Zorina).

An analysis of the existing practice of chemical training in the system of professional and methodological training of chemistry teachers revealed the presence of the following contradictions:

- between objectively existing schematization, coarsening, simplification in the study of chemical reactions and the real complexity of these processes in nature and production;
- chemical education - the gap between the level of development of scientific knowledge and the degree of its presentation in educational content;
- between the discrete nature of the process of obtaining chemical knowledge and its interdisciplinary fragmentation and the need to build a holistic chemical picture of the world.

Within the framework of systemic-structural ideas about matter in teaching chemistry at school and partly at university, the determinism of the manifested properties of substances from composition and structure and the fairly strict dependencies arising from this approach have traditionally dominated: composition - structure - properties; the ability to unambiguously predict the formation of chemical transformation products.

The synergistic vision of chemical processes as kinetic systems is based on an understanding of the multiplicity of manifestations of the properties of substances, identifying the phenomenon of randomness and the influence of many factors in changing the course of the reaction and the formation of its products.

Chemical training in the professional and methodological training of chemistry cadets at a university should be associated with the professional orientation of training, ideas about interconnection, modern ideas about the scientific picture of the world and the role of chemicals in it, the ideas of global evolutionism.

The university education system, as part of a multi-level system for training specialists in a changing society, is an area where the traditions of reproductive education and the academic style of conducting classes dominate. Pedagogical practice, being a natural continuation of reproductive activity on the study of theory, continues to carry the features of imitation and repetition of the content and types of professional behavior of teachers learned over the years of study at school and university. However, all of the above does not ensure the formation of a holistic and versatile system of views of future cadets on professional activities in new conditions.

A possible condition for overcoming these contradictions may be the understanding of the processes of self-organization in the professional and methodological training of students at a university. Elimination of these contradictions is possible on the basis of the development of an integral system of professional and methodological training of future chemistry teachers at a university, taking into account new approaches to assessing the current state of educational development. This system should not be the result of the total influence of various aspects of education; it should integrate teaching technologies into an integral system of methodological knowledge, transform subject chemical knowledge into the educational process.

The current state of the education system is characterized “as strategically uncertain, not established, unstable, and internally contradictory. In domestic education, the features inherent in the Soviet school and previous education systems are preserved, completely new trends appear in connection with socio-economic transformations, signs of the functioning of a Western school and the subjectivism accompanying all this” (205, p. 21).

In the search for new models of education that can reflect and ensure the achievement of modern goals of training and education, teacher-researchers are increasingly turning to synergetics (34, 57,67,125, 133,134, 209,251,314,323,383).

The connection between science and education is obvious. The foundation of all educational programs in chemistry is based on generally accepted ideas and views about its basic laws and patterns of chemical processes. The content of students' basic chemical knowledge should include the most important achievements of modern science.

The increased pace of development of chemical science and the conservatism of the education system should not lead to a constant widening of the gap between science and education. The rigid determinism that dominated until recently in explaining the behavior of objects of chemical knowledge gradually began to give way to a synergistic vision of chemical processes. An attempt to compare the chemical properties of a substance only with the structure and composition of reagent molecules collided with the latest advances in the field of nonlinear thermodynamics. The introduction of methods of chemical thermodynamics and kinetics into the presentation of experimental material required a rethinking of chemistry courses in general and their radical reworking (249).

Chemistry, which is one of the fundamental sciences about nature and the basis for the formation of synergetic ideas, contributes to the creation of a modern scientific picture of the world. As is known, chemical objects were the basis for the development of the concept of self-organization and the formation of synergetics. Examples of self-organization in chemistry served as the basis for establishing the relationship of development processes, their unity for living and inanimate nature, and for revising existing ideas about the chemical picture of the world.

The need to form a holistic natural science worldview generates interest in the integrative knowledge accumulated by science, and the search for ways to resolve many contradictions in education is the motivational key for reforming education and developing pedagogical innovation. However, assessing the current state of the content of education as a whole, it should be noted that the processes of integration are growing over the processes of differentiation. “The change from centrifugal to centripetal processes first began to manifest itself in educational material, where interdisciplinary connections and integrated courses began to appear, and then began to be reflected in technologies and educational approaches based on Haken’s synergetics and the theory of self-organization” (386).

“The content of education is increasingly understood as the result of the synergistic interaction of educational material (programs, plans), pedagogical and educational technologies, forms of organization of the educational process, methods of managing education in various types of educational infrastructures” (387).

Building a system of professional and methodological training for chemistry cadets at a university requires an analysis of the state of the education system in general. The key idea of education reform was the idea of development;

The ultimate goal of the reform was to create conditions for personal development, the formation and launch of the education mechanism into an effective factor in the development of society, in the sphere of cultural development. Hence the orientation of the reform towards openness and multidimensionality.

The sources of the reform process that began were a spontaneous movement of innovative teachers, focused on changing the old, established education system, who used non-traditional approaches to teaching and education in their practice.

Thus, the current situation in the chemical education system as part of general education is characterized as complex, internally contradictory, unstable, constantly changing under the influence of social and cognitive influences, scientific and technological progress and conceptual changes in science. In this system, new alternative directions exist and are developing, such as: integration and differentiation, expressed in the wide variability of chemistry teaching and its focus on fundamentalizing the content;

- globalization and regionalization of the content of chemistry courses at various levels;
 - technologization and personality-oriented orientation
- learning process;
- subject-centered content of chemistry courses;
 - standardization and multi-level teaching of chemistry;
 - instrumental and cultural, humanitarian orientation of the generated chemical knowledge.

In conclusion, a content analysis of existing concepts of chemical education revealed the development of opposite trends in the selection and presentation of chemistry educational material: globalization and regionalization of the content of chemical education. Thus, in the content of chemistry courses at various levels, a line towards covering global problems of humanity: environmental, economic and others is increasingly visible. At the same time, mechanisms are being developed to ensure the formation of an open educational space. Developing distance education, a wide exchange of methods for studying natural sciences and humanities, and the inclusion of heterogeneous knowledge in the context of the chemical material being studied makes the chemical education system open and dynamically changing.

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