

**EFFECTIVE APPROACHES TO TEACHING THE TOPIC
“CHEMICAL REACTION RATE” BASED ON THE PRINCIPLES OF
SUSTAINABLE DEVELOPMENT**

Islomova Iroda Ozod qizi, 1st year master's student of Urgench State Pedagogical Institute, islomovairoda245@gmail.com

Ataullayev Zokir Makhsudovich, Associate Professor at Urganch State Pedagogical Institute, ORCID: <https://orcid.org/0000-0002-6517-8163>
zokirjon16081987@gmail.com

Eshchanov Ruzumboy Abdullayevich, Professor, Chirchik State Pedagogical University, Chirchik
ORCID: <https://orcid.org/0000-0002-8594-2907>
ruzimboy@gmail.com

Today, integrating the principles of sustainable development into the educational process is considered one of the urgent tasks of the education system. Sustainable development implies not only economic and social progress, but also the preservation of ecological balance. In this regard, teaching chemistry plays an important role in promoting environmental protection, the rational use of natural resources, and the formation of ecological culture.

The topic “Chemical Reaction Rate” is one of the fundamental theoretical components of the secondary school chemistry curriculum, as it is directly related to industrial processes, environmental issues, energy efficiency, and the rational use of resources [1]. Teaching this topic based on the principles of sustainable development contributes to the formation of not only scientific concepts, but also ecological thinking, responsibility, and practical life skills among students [2].

Therefore, developing and implementing effective approaches to teaching the topic “Chemical Reaction Rate” through modern pedagogical strategies, integrative methods, and real-life examples is regarded as a pressing methodological issue.

Currently, there is a growing need in secondary schools to connect theoretical knowledge in chemistry with real-life processes. In particular, the topic “Chemical Reaction Rate” is often perceived by students mainly through formulas and mathematical expressions; however, its practical manifestations in everyday life are not sufficiently highlighted [3].

In fact, the reaction rate is constantly manifested in everyday life. For example, when coal is crushed, its surface area increases, and powdered coal burns faster than a large lump. This process demonstrates that the reaction rate depends on the surface area factor. Likewise, during the boiling of water, when the temperature increases, the motion of particles accelerates, and according to the Van't Hoff rule, when the temperature rises by every 10°C, the reaction rate increases approximately 2–4 times. In the process of baking bread, if the amount of yeast added to the dough (concentration) is increased, the fermentation process accelerates. This practically illustrates the dependence of the reaction rate on concentration.

From the perspective of sustainable development principles, understanding the reaction rate is of great importance in saving energy, ensuring efficient fuel use, reducing waste, and maintaining environmental safety. Therefore, teaching this topic in integration with real-life processes is one of the pressing methodological tasks of today's education system.

The purpose of the research is to develop and scientifically substantiate effective methodological approaches for teaching the topic “Chemical Reaction Rate” in secondary schools based on the principles of sustainable development and in close connection with processes occurring in everyday life.

In the process of achieving this objective, it is envisaged to harmonize the theoretical foundations of the topic “Chemical Reaction Rate” with the concept of sustainable development and to explain the factors affecting reaction rate—such as temperature, concentration, surface area, and other factors—through real-life processes encountered in everyday life. In particular, examples such as the acceleration of combustion due to the crushing of coal, the increase in process rate with rising temperature during the boiling of water, and the intensification of fermentation when the amount of yeast is increased in bread baking are intended to foster not only scientific thinking but also ecological awareness among students.

In addition, integrating the ideas of energy conservation and the rational use of natural resources into the content of chemistry lessons, as well as strengthening students' knowledge and increasing their interest in the topic through interactive methods and practical experiments, are considered important directions of the research.

The scientific novelty of the research lies in the fact that the topic “Chemical Reaction Rate” is methodologically substantiated for the first time in a systematic manner based on the principles of sustainable development and integrated with everyday life processes. Rather than limiting the explanation of factors affecting

reaction rate to theoretical formulas, a mechanism is developed to explain them through real-life examples such as coal combustion, water boiling, and fermentation in the bread-making process. This approach enables students to understand abstract concepts by relating them to practical life.

The research results make it possible to develop methodological recommendations for application in the process of teaching chemistry in secondary schools. The proposed approach contributes to the formation of competencies such as energy efficiency, effective fuel use, and environmental responsibility among students. This methodology helps to increase lesson effectiveness, strengthen students' interest in the topic, and enhance their understanding of the practical significance of knowledge.

As a result of teaching based on this approach, students' theoretical knowledge of chemical reaction rates is strengthened, and they develop the ability to analyze the factors affecting reaction rates through examples from everyday life. In addition, students' ecological thinking, culture of rational use of energy and resources, and understanding of interdisciplinary connections are enhanced.

Teaching the topic "Chemical Reaction Rate" based on the principles of sustainable development represents an innovative approach that meets the requirements of modern education. This methodological integration serves to develop students' scientific worldview and ecological culture by harmonizing theoretical knowledge with real-life processes. Therefore, enriching this topic with practical examples is considered one of the important factors in increasing the effectiveness of education.

References

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