

APPLYING THE PRINCIPLES OF "GREEN CHEMISTRY" IN ONLINE STUDENT LEARNING AND CHEMICAL TECHNOLOGY

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The article examines the question of the use of virtual training and work tools by chemists. In our time, one cannot do without a computer even in the teaching of chemistry. What we are talking about is not banal text and video files, but full-fledged virtual laboratories. Such virtual laboratories can well be attributed to one of the options for applying the principles of "Green Chemistry" in teaching students.

The International Union for Pure and Applied Chemistry (IUPAC) has formulated twelve principles of "green chemistry". To paraphrase the precise formulations of these principles, they can be summarized as follows:

1. Priority direction - loss prevention;
2. Choice of synthesis methods according to the maximum conversion of initial components into reaction products;
3. Selection of synthesis methods based on starting substances and end products less harmful to humans and the environment;
4. Release of new chemical products with stable performance and reduced toxicity;
5. Avoid the use of harmful auxiliaries in production, such as solvents or separating agents;
6. Accounting for energy costs, that is, the desire to conduct synthesis at a temperature close to ambient temperature and at atmospheric pressure;
7. Use of renewable reagents;
8. Carrying out the synthesis without obtaining intermediate products;
9. Catalytic processes should always be preferred (as selective as possible);
10. Production of a chemical product capable of decomposing after use into environmentally friendly products;
11. Analytical techniques need to be developed to enable real-time monitoring of the formation of hazardous products;
12. Selection of reagents to minimize the risk of chemical hazards, including leaks, explosions and fires.

The direct implementation of these principles in chemical technology can take more than a dozen years, while emergency situations can occur that entail dangerous injuries for employees, environmental pollution and man-made disasters.

That is why the use of virtual chemical laboratories is so important. Firstly, nothing threatens the lives of students and the teacher even as a result of an unsuccessful passage of the reaction. Secondly, students become qualified specialists and scientists who are able to conduct all the necessary research without endangering themselves and the environment.