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Page No: - 237-239

WORK OF VIRTUAL LABORATORIES OF ORGANIC CHEMISTRY FOR ACADEMIC LYCEUMS

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ABSTRACT
The work of virtual laboratory of organic chemistry, creative and academic lyceum in LabVIEW graphic programming environment is described. In particular, information is provided on the production of acetylene from calcium carbide and the process of synthesis of bromethane.

KEYWORDS
LabVIEW, Organic chemistry, Virtual laboratory, Bromethane, Acetylene, Synthesis.

INTRODUCTION
In recent years, the use of virtual laboratories in practical and laboratory experiments has become increasingly popular in education[1], especially in chemistry.
There is a need for frequent updating of the equipment and laboratory equipment used in laboratory work, the need to quickly and at a high level acquire skills in working with complex instruments, dangerous and rare and expensive chemicals. The use of "virtual" laboratories is appropriate to solve this problem. It allows modeling any complex process using current computer technologies[2].
The following factors have led to the need to create virtual laboratory work in organic chemistry for academic lyceums:

- difficulties in students in mastering and using practical aspects of using measuring and control instruments used in the laboratory, understanding and analyzing the content, essence of the processes involved in measurements in a sufficient amount of time;
- the need for safe and error-free simulators to prepare for performing real laboratory work;
- the need to acquire the skills to conduct experiments independently and reduce the time spent on real laboratory work;
- the scarcity of measuring instruments and reagents in training laboratories, the limited ability to conduct frontal experiments;
- to create the opportunity to conduct laboratory exercises in cases where there is a need for distance or online education.

“Virtual laboratory work in organic chemistry” consists of a virtual version of 11 laboratory works designed for academic lyceums in the physics program [3], each virtual laboratory work consists of parts such as experimental equipment, theoretical part, procedure and control questions. Virtual laboratory works in organic chemistry are placed in the software module in the following order and can be launched separately:
1-VLI. Preparation of acetylene from calcium carbide (Figure 1).
2-VLI. Addition of bromine to acetylene.
3-VLI. Oxidation of acetylene by potassium permanganate (Figure 2).

Published Date: - 25-07-2025
Page No: - 237-239

4-VLI. Synthesis of bromethane (Figure 3).
5-VLI. Iodapharm reaction.
6-VLI. Reaction of glycerol with copper-(II) hydroxide.
7-VLI. Silver mirror reaction.
8-VLI. Copper mirror reaction.
9-VLI. Dibenzalacetone reaction.
10-VLI. Obtaining acetic acid by oxidation of ethanal
11-VLI. Obtaining benzoic acid
A view of the virtual lab project "Acetylene production from calcium carbide" (see Figure 1).

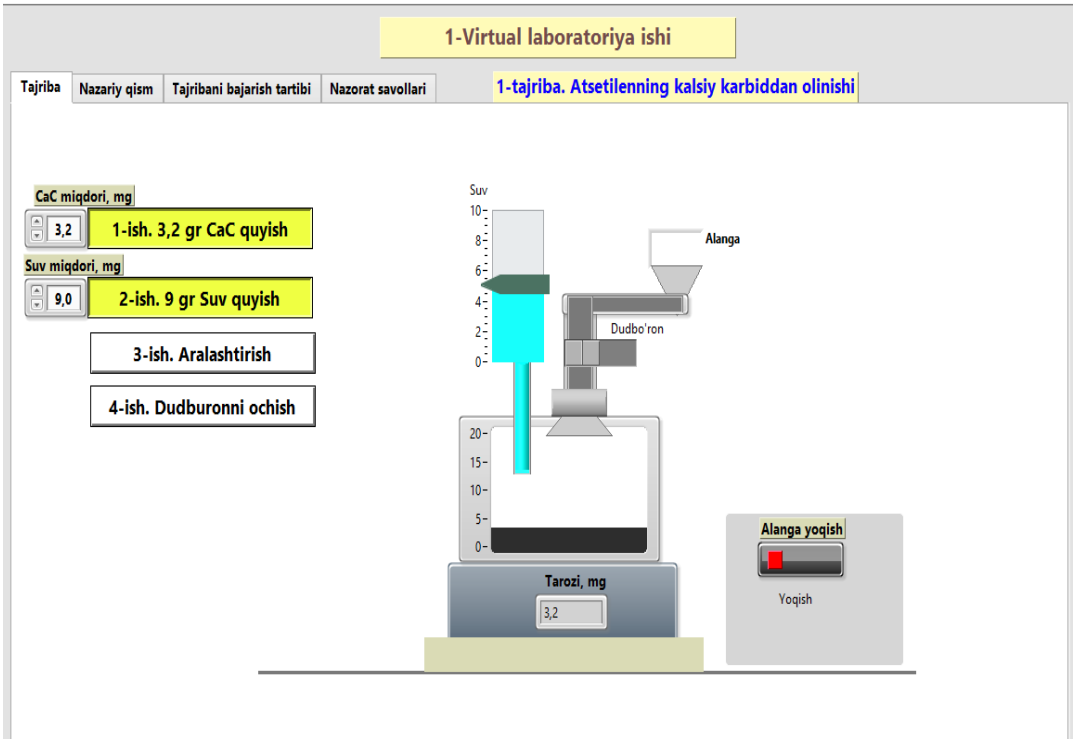

Figure 1. Virtual laboratory work "Accetylene production from calcium carbide"

View of the virtual laboratory work "Oxidation of acetylene by potassium permanganate" (see Figure 2).

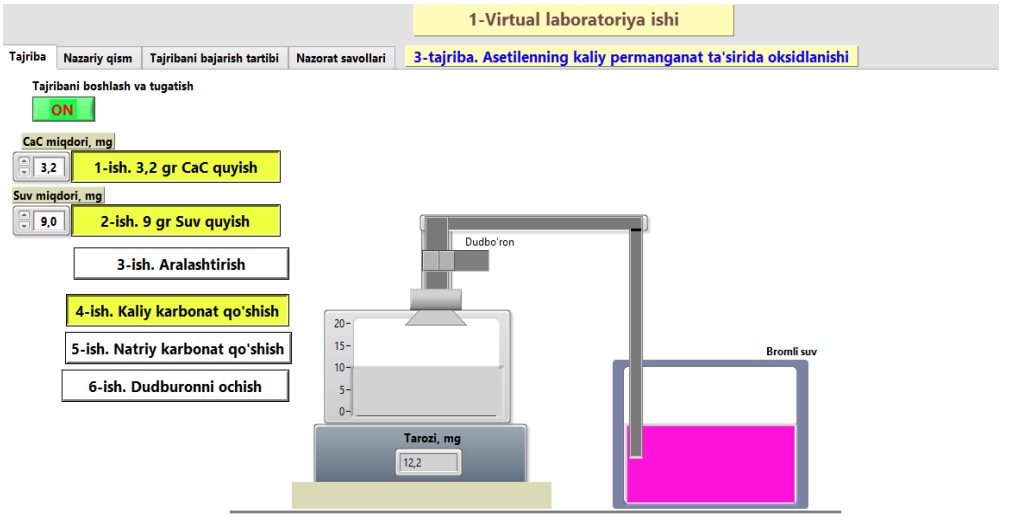

Figure 2. Virtual laboratory work "Oxidation of acetylene by potassium permanganate"

The process of synthesis of bromoethane (see Figure 3).

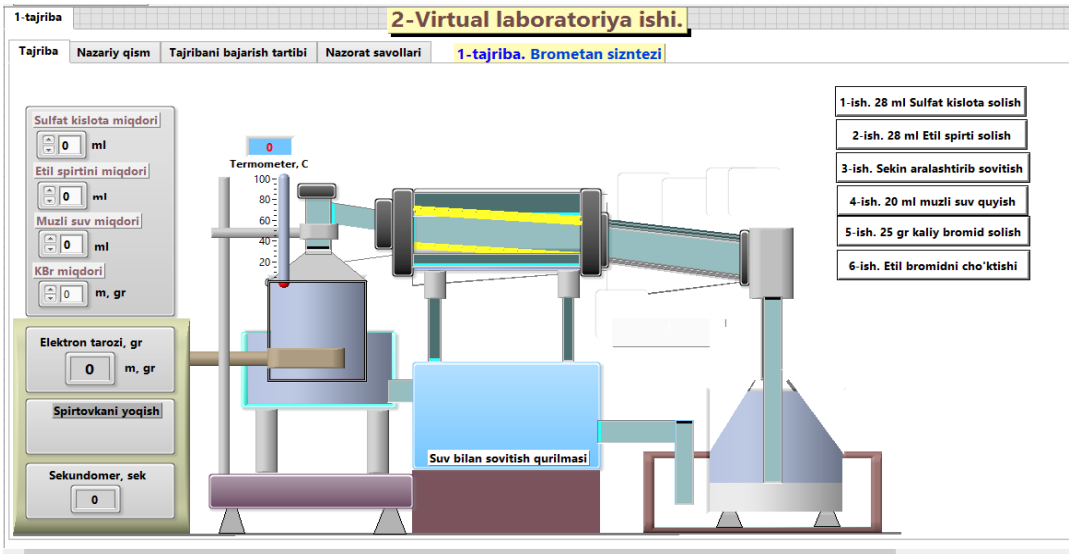

Figure 3. Synthesis of bromoethane

In virtual laboratory work, it is possible to conduct experiments, select parameters, control devices, and monitor changes in results.

The virtual laboratory work software module is installed on a computer and does not require large resources during operation, and additional knowledge or skills in the field of special information technologies are not required for use.

The virtual laboratory program "Virtual laboratory work in organic chemistry" is an independently installed application created in the LabVIEW graphical programming environment of the National Instrument company.

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