

MIKHAIL NIKISHIN\*, DANIIL KRYMOV\*\*, NATALIA IVANOVA\*\*\*

## E-educational Resource for Simulator Training of Marine Engineers and Bachelors in Engineering

**Abstract.** Sustainable development of the Baltic Sea region cannot be imagined without the continuous improvement of the quality of higher education. Maritime and ecological education takes a special role in the development of this region. Shipping has always had a significant impact on the environmental safety of the Baltic Sea. Safe and reliable operation of a ship's equipment allows to minimize pollution from ships. The electronic educational resource TotDesigner has been developed for simulator training of marine engineers and bachelor students in the sphere of engineering. This resource allows for the study of the principles of operation, as well as, the design of machines and devices used in maritime and coastal engineering. Through the use of TotDesigner it is also possible to solve various operational tasks. The TotDesigner system may be used in lectures, and in laboratory and practical exercises to consolidate theoretical knowledge and practical skills. The next step in the development of the software is to use mathematical modelling to predict the working modes of the ship's refrigeration plant. The implementation of this idea will improve the quality of a bachelor student's scientific-research competence formation in the sphere of engineering.

**Keywords:** electronic educational resource, simulator training, maritime education, bachelor, scientific-research competence

### 1. Introduction

Sustainable development of the Baltic Sea region can not be imagined without the continuous improvement of the quality of higher education. Maritime educa-

---

\* Baltic Fishing Fleet State Academy, Kaliningrad, Russia, e-mail: miknik39@rambler.ru, phone: 892 161 668 74.

\*\* Baltic Fishing Fleet State Academy, Kaliningrad, Russia, e-mail: asu.daniil@gmail.com, phone: 890 056 323 45.

\*\*\* Kaliningrad Marine Fishing Industry College, Kaliningrad, Russia, e-mail: nado\_1@mail.ru, phone: 891 147 254 63.

tion takes a special role in the development of the region, namely training navigators, marine engineers and refrigeration engineers. Efficiency and safety of the vessel operation depends on the quality of their training.

A ship is one of the sources of pollution of the marine environment and atmosphere by different harmful substances, such as petroleum products (fuel, oil), waste water, garbage and emissions from the operation of internal combustion engines and refrigeration units [Slastikhin, Eydeyus & Eliseev 2014: 162-251]. This problem is very actual for the semi-closed type of sea such as the Baltic Sea, the Black Sea etc.

Modern ships are equipped with the necessary devices and mechanisms to prevent the discharge of oil-contaminated water (bilge water) overboard, for cleaning and disinfection of waste water, for recycling garbage and preventing the release of refrigerant into the atmosphere.

To minimize pollution from the ship it is necessary to follow two ways: 1) improving quality of marine engineer's training; 2) using modern devices and mechanisms for preventing pollution.

The training of Marine Engineers is impossible without computer simulator practice. There are a lot of different computer simulators, which are used in the marine education, but most of them allow students to solve only operation tasks.

The electronic educational resource TotDesigner has been developed for simulator training of marine engineers and bachelors in the sphere of engineering. Using this e-resource it is possible to form the scientific-research competence of bachelors in engineering, who want to continue their education to get master's degree.

## 2. Main provisions

The information technology is currently widely used in the training of marine engineers and bachelors in engineering [Ganieva & Krymov 2009: 63-64]. As mentioned above, there are a lot of different simulators and some of them are made in the form of computer game. Unfortunately, almost all of the existing simulators do not allow to study design and the working principle of various machines and mechanisms. The effective and safe operation of any equipment is impossible without knowledge of its design and working principle. In this regard, in 2011 on the Department of Refrigerating, cryogenic equipment and air conditioning (BFFSA, Kaliningrad) the development of the computer simulator for studying the structures and working principle of machines and apparatus of ships' refrigeration plant was started. The result of this work is the electronic educational resource TotDesigner, which functions are not limited by studying the refrigeration plant.

The basic working principles of this program are described in the sources [Krymov, Nikishin & Ivanova 2011: 296-298; Nikishin, Krymov & Ivanova 2012: 83-89], that is why only some information about e-educational resource will be presented in this article. The basic idea of a computer simulator is that marine engineers should study design and working principle of machines and apparatuses and consolidate their knowledge. After a student has successfully completed all the tasks, concerning the design and working principle of the device, he/she begins to solve basic operational tasks, thus acquiring the necessary skills for the operation of certain equipment. Fig. 1 is a screenshot of one of the apparatuses of refrigeration plant when you are working with the computer simulator.

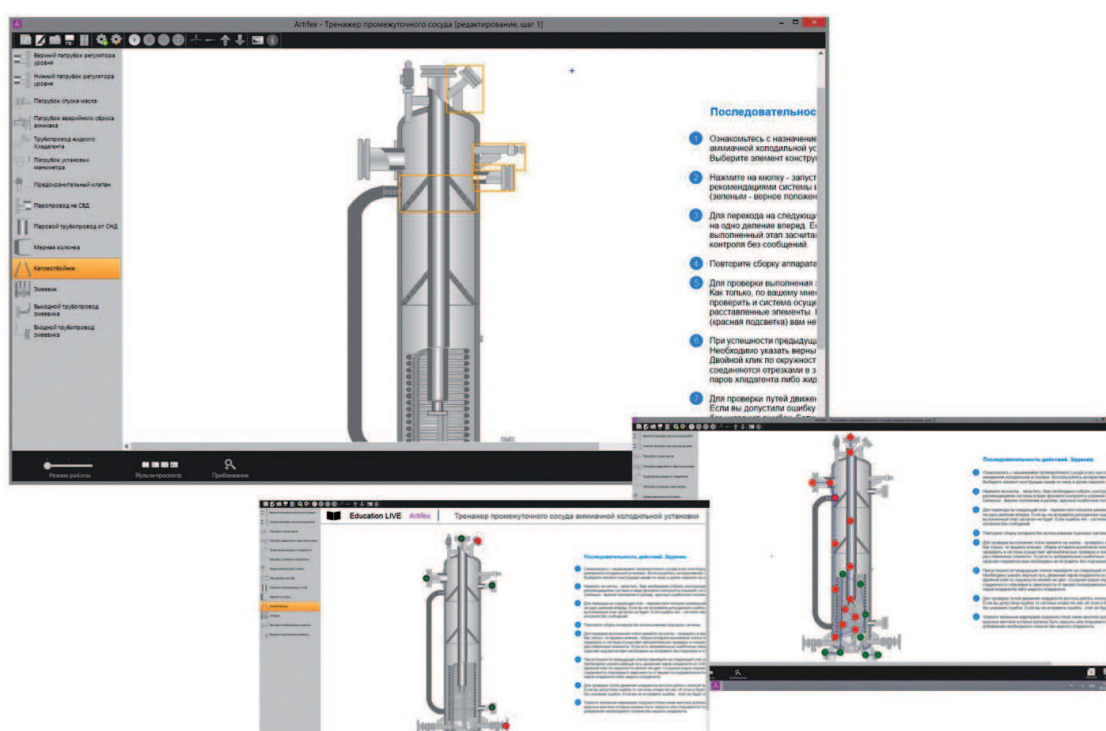


Figure 1. The example of work with the computer simulator of intermediate vessel

Source: Nikishin, Krymov & Ivanova 2012.

In the first stage the student must assemble the apparatus or mechanism using suggested elements of it. Second stage is to indicate moving direction of main working substances inside the apparatus. Third stage is to solve operational tasks (for example, preparing for start, start, stop, serving during work and etc.).

The main feature of the e-educational resource is that its software platform may be used to study the machines and apparatus of various plants, for example, not only the ships' refrigeration plants, but also power plants. To do it you must have a sufficient amount of data, drawings and diagrams of real equipment. For example, using this e-educational resource, students can study the design of die-

sel engines, boilers, diesel generators and other main and auxiliary machinery of the ship power plant.

Now TotDesigner is actively introduced in school education, where it is used to study a variety of subjects such as biology (studying human body), astronomy (studying our solar system), geography etc. (Fig. 2).



Figure 2. The example of using TotDesigner in school education

Source: own elaboration.

You can review all possibilities of the e-educational resource on our web-site <http://balticitc.jimdo.com>.

The next step in the development of the e-resource is application of mathematical modeling to predict the working modes of the ship's refrigeration plant. Ship's refrigeration plant operates in highly changeable environment, which influences the efficiency and reliability of plant operation. Using mathematical modeling, it is possible to calculate all the operating parameters under different external conditions. The implementation of this idea will improve the quality of the formation of the scientific-research competence of bachelors in engineering.

Scientific-research competence of the future bachelor in engineering is integrative quality of his/her personality based on the motivation and value priorities regarding research activities [Serykh & Nikishin 2013: 151-153]. This quality includes, on the one hand, the ability to make independent decision concerning creative and research tasks and skills of scientific research. On the other hand it is readiness to take the position of a researcher in the scientific, technical and industrial spheres. The content of the scientific-research competence of the bachelor



in engineering is a complex synthesis of intellectual and social experience and, accordingly, is characterized by diversity and interaction of various components – cognitive, motivational, and operational.

The cognitive component includes the complex of knowledge about the object/phenomenon being researched, scientific knowledge, theoretical and methodological foundations of the scientific-research activities, a high level of logical, creative, critical, analytical and research thinking, as well as the skills necessary for formulating and solving scientific-research problems in technical and industrial spheres.

Motivational component is inner motivation for scientific and educational activity, a high level of interest in research work, in professional activity, independence in the process of scientific learning, self-motivation, a manifestation of strong-willed qualities of the person in achieving their scientific-research goals and motivational readiness for the development and realization of scientific-research activity.

The operational component demonstrates the ability of the future bachelor in engineering to produce scientific researches, articles, reports, etc., to work in task groups, to work with modern information technology and database of scientific data, as well as the ability to analyze actual scientific problems in their own professional activity.

Formation of scientific-research competence of the bachelors in engineering can be accomplished through a number of activities: 1) the introduction of an optional lecture course “young researcher,” 2) participation in the Student Scientific Society and the research work of the department, 3) participation in scientific conferences, 4) using of various forms of information technology in the education process.

It is understood that the using of mathematical modeling in our e-educational resource will help to improve the efficiency of the formation of the scientific-research competence operational component. Any bachelor who wishes to continue their education to get Master’s degree should be able to apply mathematical modeling in their scientific research.

It should be noted that the introduction of mathematical modeling to predict the working modes of ships’ refrigeration plants in e-educational resource Tot-Designer is very time-consuming and complicated process.

### **3. Conclusion**

The Baltic Sea is a semi-closed type and special attention is paid to its ecology. Despite the existing of the Convention for the Prevention of Pollution from Ships, it

is impossible to avoid the transfer of pollutants into the sea. Nowadays the most common reason of this is the “human factor.” This is poor quality of training of marine engineers, lack of knowledge about structures and working principle of ship equipment that leads to the transfer of pollutants into the sea. In this regard, in addition to training on board of the ship, it is absolutely necessary to improve the simulator training of engineers who want to work at sea and plan to be busy in project activities.

## References

- Ganieva R., Krymov D., 2009, Modern Information Technologies in Education: Status, Prospects, in: *The problems of inter-regional relations – Research Almanac*, Saint-Petersburg: Science.
- Krymov D., Nikishin M., Ivanova N., 2011, Project of simulator for apparatus and machinery refrigeration equipment for the preparation of refrigeration engineers, in: *Marine industry, transport and logistic in countries of Baltic Sea region: New challenges and responses. IX International conference*, Kaliningrad: BFFSA.
- Nikishin M., Krymov D., Ivanova N., 2012, Simulator training of marine engineers, in: *AGA 13 Expanding Frontiers – Challenges and Opportunities in Marine Education and Training*, eds. R. Mercer, J. Cross, C. McCulloch, Saint John: The Fisheries and Marine Institute of Memorial University of Newfoundland.
- Serykh A., Nikishin M., 2013, Structure of scientific-research competence of the bachelors in the area of refrigeration and cryogenic technique, *Science and business: ways of development*, no. 4: 151-153.
- Slastikhin Y., Eydeyus A., Eliseev E., 2014, *Technical exploitation of ship refrigeration plants*, Moscow: Morkniga.

## Elektroniczne zasoby edukacyjne dla szkolenia symulatorowego na studiach inżynierskich i licencjackich na kierunku inżynieria morska

**Streszczenie.** Trudno sobie wyobrazić trwały i zrównoważony rozwój regionu Morza Bałtyckiego bez ciągłego doskonalenia jakości studiów wyższych. Szczególne znaczenie dla rozwoju regionu ma edukacja morska i ekologiczna. Żegluga zawsze istotnie wpływała na bezpieczeństwo ekologiczne Bałtyku. Bezpieczna i odpowiedzialna eksploatacja osprzętu jednostek pływających pozwala zminimalizować ryzyko zanieczyszczeń powodowanych przez statki. TotDesigner to elektroniczne narzędzie edukacyjne, które zostało stworzone do celów treningu symulatorowego absolwentów wyższych studiów morskich. Pozwala ono na przybliżenie zasad działania oraz konstrukcji maszyn i urządzeń używanych w inżynierii morskiej i brzegowej. TotDesigner może być ponadto wykorzystywany do wielu zadań operacyjnych. System może również znajdować zasto-

sowanie w sali wykładowej, uczelnianym laboratorium i w czasie ćwiczeń praktycznych dla utrwalenia teoretycznej wiedzy i rozwijania praktycznych umiejętności. Następnym etapem rozwoju tego oprogramowania będzie wykorzystanie modelowania matematycznego do prognozowania trybów pracy agregatu chłodniczego statku. Realizacja tego pomysłu poprawi jakość przygotowania absolwentów do pracy naukowej w zakresie nauk inżynierskich.

**Słowa kluczowe:** elektroniczne zasoby edukacyjne, szkolenie symulatorowe, edukacja morska, studia licencjackie, kompetencje naukowe