CLUSTER SYSTEM OF SPECIALIST TRAINING FOR PETROCHEMICAL INDUSTRY

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ABSTRACT

The Russian petrochemical trends determining the relevancy of the cluster-based approach to organizing professional training have been analyzed. The composition and the role of an industry-specific educational cluster subjects are discussed. The practical experience of a cluster system aimed at training professionals in the area of petrochemistry and oil processing for the petrochemical industry is presented. The advantages and results of an innovative clustered approach to managing educational processes are shown.

Keywords: petrochemistry, education, industry-specific educational cluster, competence, manufacturing, technology.

INTRODUCTION

Education today is one of the key factors of society’s sustainable development, its competitiveness, and the national security of a country. The general understanding of the multiple purposes in higher education is built within the framework of implementing the Bologna Declaration. The main of these are: training for the labor market, socialization of the active citizens of the democratic society, personal development, development of a wide range of advanced knowledge fundamentals [1].

Training for the labor market is the task that dominates within the social-educational discourse. The rapidly changing modern labor market determines ever-increasing requirements for the competence of specialists. Thus, high-level competency, ability to forecast changes in the manufacturing situation, rapid adaptation to production innovations, ability to develop, estimate, and implement innovative proposals and developments, high-level creative thinking, social adjustment, and economic competences are actual for petrochemical engineers.

Each economy has a block of industries playing the most important role in forming the trends of social and economic development. In Russia, these are the fuel-and-energy complex and a complex of resource-consuming industries, including the petrochemical industry. World Bank’s experts have evaluated the GDP breakdown in Russia and have come to the conclusion that the share of oil and gas sector makes about 25 % of it [2]. The main trends in the innovative development of the petrochemical sector are described in a document named “Energy Strategy of the Development of Russia for the Period through to Year 2020”: as efficient use of the explored oil reserves; guarantees for the oil and gas industry raw materials base expanded reproduction; resource and energy saving; reduction of losses at all stages of the procedures used for oil reserves preparing, oil producing, transporting and processing; advancing the oil processing; comprehensive extraction and use of all valuable components and solutes; development of new large oil processing centers; modernization of the existing oil and gas refining and petrochemical facilities, development
and implementation of innovative technology [3].

In accordance with the production development priorities, engineers must have high professional qualification, to be able to forecast changes in manufacturing situations, quickly adapt to production innovations, be able to develop, evaluate and implement innovative elaborations, have a high level of creative thinking, and be economically competent.

Petrochemical recruitment needs to actualize vocational training which provides educating competent, forecasting/innovation-oriented professionals, that are able to operate in the mode of actual productions and permanently advance their existing status. The key factor that determines the efficiency of such education is the integration of science, education and manufacturing in the conditions of an industry-specific academic and educational cluster [4].

EXPERIMENTAL

An educational cluster is a complex of interdependent vocational education institutions, united by their common industry specifics and by their partner relationships to the enterprises of the same industry. The distinctive features of an industry-specific educational cluster are: creation of environment for educating specialists at various levels of vocational training; improving the status of highly-skilled working professions; integrating education with science and manufacturing.

The scientific and educational cluster of petrochemistry and oil and gas processing (Republic of Tatarstan, Russia) includes:

- Science-oriented general education schools,
- Profession-oriented institutions of elementary and secondary vocational education,
- The Kazan National Research Technological University (KNRTU), which is the key component within the cluster structure, since it implements training of specialists for all areas of the petrochemical industry and acts as a coordinator of continuous education;
- Partnering industry-specific enterprises, research institutions and centers where students do their laboratory research and practical work, as well as find their employment.

The multilevel vocational education cluster system provides a significant potential for improving the quality of specialist training.

Pre-university training is a mediator between general education and vocational training in the cluster. Its purpose consists in taking focused efforts aimed at building up a profession-oriented population of school leavers. The profession-oriented population of school leavers is trained in a staged manner and presupposes implementing the “Young Chemist” program of further education. The program is aimed at the development of schoolchildren’s practical skills in chemical analysis and synthesis. It includes conducting laboratory research on the following topics: Classes of inorganic compounds (properties of metals and nonmetals), d-element chemistry, identification of inorganic substances, titration analysis (acid-base titration), organic compounds synthesis and refining (halogenated compounds synthesis, refining a synthesized matter by simple distillation), water hardness testing, etc.

The primary chemical-process education is performed through studying a special elective course of Applied Chemistry. Theoretical training includes studying the current state and trends of world fuel-and-power systems, raw materials base and the assortment of goods manufactured by the leading oil and gas refining, and petrochemical companies within the region: the chemical production structure; the technological processes, and the special features of oil production processes; the methods of oil treatment and processing; the fractional composition of petroleum products, and petroleum production applications. In practice, school children master the techniques of conducting laboratory research in petrochemical synthesis, the ways of oil emulsion breaking, the methods for separating the light-end hydrocarbons (gasoline fraction) from oil [5, 6].

The cluster-oriented approach allows optimizing the educational process within the targeted training of engineers on the basis of the field-focused vocational secondary education, considering prior learning. According to the chain “college – higher educational institution – basic enterprise”, educational complexes that implement integrated educational programs are developed.

The integration of science, education and manufacturing within the cluster promotes organizing of an innovative educational process at the university, which is focused on the demands of the labor market in the industry. It includes:

- Training engineers under individual study plans, taking into account the manufacturing specifics.
They do not contain disciplines on organization, technology and equipment, company automated control systems, processing safety, 3D process simulation, and project team working. Specialized training of engineers for an Ammonium company includes studying the technology for manufacturing ammonium nitrate, ammonia, carbamide, methanol, carbamide-formaldehyde concentrate. Working in project teams is aimed at solving the companies’ scientific and production problems. For example, performing the “Crude Methyl Alcohol Manufacturing Work” a team project provides for performing the projects on the following topics: synthetic natural gas catalytic purification facility (comparative analysis of various catalytic systems), department for synthesizing methyl alcohol from synthetic natural gas, crude methyl alcohol purification facility, development of a safe process conducting system, 3D design of a plant for manufacturing methyl alcohol, economic evaluation of the efficiency of the project developed, development of a raw material supply and products sales logistic scheme.

Training specialists for an oil refinery includes studying the technology of the crude oil fractional separation, gasoline octane improvement, producing multifunctional additives for fuels [7].

- Training design/process engineers in the manufacturing branches of the university departments is guided by the representatives of enterprises. It includes theoretical and practical training in designing innovative technologies for hydrocarbon production and processing and performing project research on the theme of their master’s theses. Design includes the development of P&ID, choosing state-of-the-art equipment elements in Unisim, MathCad, or ChemCad and justifying the optimal operation, 3D layout of equipment, performing Piping Isometric, developing the measures aimed at production safety control, and preparing a business case.
- Training managing engineers with the programs for masters of administration of the programs of Chemical Engineering of Petrochemical Facilities and Petrochemical Enterprise Lifecycle Management;
- Further education in qualifications, such as instrument control man, process unit operator, or chemist and economic education.

RESULTS

The efficiency of pre-university training within the cluster is confirmed by enhancing the status of engineer-
The cluster-based specialist training system has been widely acknowledged by all educational process participants. School children that have been trained at the pre-university level prove the better adaptation to the university. Directors and teachers of general education schools recognize good progress of senior pupils in chemistry and their increasing interest in obtaining chemical-engineering education.

The university students demonstrate high interest in studying in the real production conditions. Graduates confirm a better adaptation to professional activities.

Employers’ interest in cluster-based training is proven by the growth of specialized training agreements with the university.

REFERENCES

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