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EXPERIENCE OF MINING SPECIALISTS TRAINING AT THE CHAIR OF PROCESS AND PRODUCTION AUTOMATION OF THE MINING UNIVERSITY

Introduction

The international experience shows that production and its efficient management is to a wide extent based on various level information systems [1–6]. Mining and processing industry needs specialists engaged in research, design and implementation of information–modeling systems to exercise control of complex energy-consuming objects, in particular, in ore processing.

The long-term experience gained by the fellows of the Saint-Petersburg Mining University in handling the problems connected with mining equipment operation using the modern computer programs for automation equipment as well as understanding of the importance of specialists training in the related area made the basis for the establishment of a new Chair at the University [7–9]. In 2006 the Academic Council of the University decided on the creation of the Chair of Process and Production Automation (PPA) at the Faculty of Mineral Processing (former Chemical and Metallurgical Faculty).

The founder of the Chair was Prof, Dr End I. N. Beloglazov, a full member of a number of high-rank Russian and international academies. His research and teaching activities were directly connected with the problems of mining and metallurgy.



PPA Chair founder—
Prof I. N. Beloglazov
(1950–2011)

Prof Beloglazov for many years headed the school on improvement of processing technologies for rebellious metallurgical raw materials and middlings, as well as for engineering and automation of chemical–metallurgical processes and equipment [10–14]. Now the Chair is headed by Prof V. Yu. Bazhin.

The PPA Chair team pursues traditions of the Chair for Furnaces and Metallurgy Control and Automation founded in 1966. Extensive research aimed to improve metallurgical processes and systems and toward their automated control was performed under the supervision and participation of Prof A. A. Galnbek, the Honored Worker of Science and Technology of the Russian Federation (1931–2002). Those activities initiated new lines in the nonferrous metallurgy such as technology and equipment for continuous converting of mattes, high-capacity and safe cooling systems for metallurgical furnaces [15–18].

At the present time, training of personnel in the field of mining and metallurgy production automation is an important area in the system of higher engineering education. The Chair of Process and Production Automation at the Saint-Petersburg Mining University efficiently participates in these activities. The Chair was established in 2006 by Prof I.N. Beloglazov and is now reputed one of the higher rank bodies in the field of personnel training for the high-tech objects of the mining industry of Russia. The founder of the Chair for many years investigated chemical and metallurgical processes under production of rebellious polymetal materials with a purpose of automation of these processes. High level and quality of research activities at the Chair is proved by victories in various contests and exhibitions. Until now the Chair keeps traditions and successfully implements continuity in personnel training. Since 2011 students are trained by the two-level higher trade education Bachelor–Master system in the areas of Process and Production Automation (specialties: metallurgy, oil refining, mining) and Production Machines and Equipment (specialty: petroleum and gas processing equipment). The modern equipment package represented by pilot-scale objects and laboratories of leading foreign companies ensures the qualitative training of specialists.

Key words: higher education, automation, personnel training, mining, laboratory, partnership and cooperation

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Primary part

Since 2011 the Chair educates students based on the two-level higher trade education Bachelor–Master system in the areas of Process and Production Automation (specialties: metallurgy, oil refining, mining) and Production Machines and Equipment (specialty: petroleum and gas processing equipment). The Chair has graduated round 700 specialists, including 38 Masters, in the course of 10 years.

Students enter the Chair within the limits of the planned entry figures at the expense of the federal budget as well as under agreements for education at the expense of physical and legal bodies (targeted education). As in the whole University, students enter the Chair based on the results of the Unified State Exam (USE) on the morrow of the secondary-level education, considering privileges if any. It is noteworthy that the minimal USE entry standards shown by the students in 2011–2015 exhibited a positive dynamics (**Fig. 1**). In 2015, the average entry standard was 228 at 8 applicants per place.

For the professional growth of students, the Chair annually arranges field studies and training activities: Kovdor Mining and Processing Plant, Kirishi Refinery, Monchegorsk Integrated Iron-and-Steel Works, Apatity Company, Torzhok Training Center, Pikalevsky Alumina Plant, Omsk Refinery, Syzran Refinery, Severstal Company, Rostov Iron-and-Steel Works, gas distribution stations across Russia.

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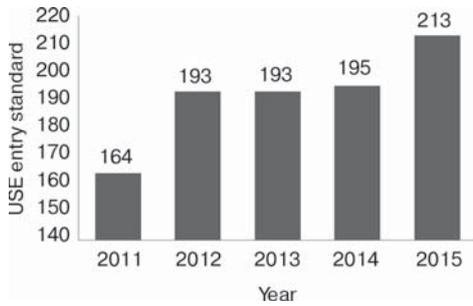


Fig. 1. Minimal USE entry standard in 2011–2015



Fig. 2. Modules of the Center of Competence

The Chair adheres to the traditional patterns of training, one of which is a scientific research project to be accomplished by students. In particular, the Student–Professor Assistant program enjoys success. The aim of the program is to ensure personal competence in the industry in languages of the University graduates (Bachelors, Engineers, Masters). Assistants are engaged with the outside research activities under the head of professors and leading associate professors of the Chair [18]. For the period from 2007 to 2016, more than 80 students participated in the research activities at the Chair as professor assistants.

The Chair efficiently educates prost-graduates. On the average, there are 2 applicants per place per year. In 2006–2015 more than 20 dissertations for the degree of Candidate of Sciences had been prepared and defended. The young Candidates of Sciences, who prepared and presented their dissertations at PPA Chair, include citizens of Cuba, China and Ethiopia.

The most important resource of the Chair are professors and lecturers. The number of in-service lecturers is 22, out of which there are 3 professors, 14 associate professors and 5 assistants. The Chair students get enrichment experiences from the lectures of the invited foreign professors, too.

The Chair students have an opportunity to study by the twin Master and Post-Graduate programs within the framework of cooperation with the Lappeenranta University of Technology (Finland). For the first time in Russia, the Chair staff together with the leading foreign professors gave the Mechatronics and Robotics Course in Russian and English.

The high level and quality of the scientific research management at the Chair is proved by the victories of the students in scientific competitions, in contests of research and graduation works, or in exhibitions. Within recent years, the R&D accomplished under the governmental contracts include: Development of Functional Charts and Algorithms to Control High-Temperature Installations in Pyrometallurgical and Hydrometallurgical Processes; Analysis of Suspension Separation Kinetics. Mathematical Model of the Process and Selection of Control Actions and Structure; Study of Alumina Dissolution in Alumina–Cryolite Melts under Varying Magneto-Hydrodynamic Conditions.

The Chair runs four international-level laboratories: calorimetry; production automation in mining; engineering of automated process-control systems; automation of continuous processes and production. The laboratories have modern equipment such as computerized laboratory test bench for electrohydraulics; set of equipment to study control and diagnostics of objects and processes in automated produc-

tion; set of labware for automated systems production processes; equipment to design and test electronic devices; programmable logic controllers Zelio supported by ZelioSoft programs; programmable logic controllers TSX Premium; lcd panels Magelis; a plant with TSX Quantum; programmable logic controllers Quantumn CPU671 60 with UnityPro, TSX Premium Telefast; models of technological objects by Festo Didactic.

The Mining University maintains long-term and fruitful cooperation with one of the blue-chip international companies in the field of energy systems and production automation, namely, Schneider Electric. For more than 10 years, the University’s Chairs use Schneider Electric’s equipment in teaching and research activities, the personnel and the students are offered traineeship at the production units of the company. One of the ways of the cooperation is Mining Institute–Schneider Electric Center of Competence initiated in 2006. For the first time in Russia, such center is generated as a 3-module structure (Fig. 2).

Module 1. Research activities: R&D under governmental projects and programs, grants, or initiated topics supported by the state budget or economic agreements; development of test benches, facilities and automated systems for the Mining University divisions, chairs and other units and outside institutions; hosting of scientific conferences and workshops on automation of processes and production, reliability and quality of power supply based on the automation hardware/software of Schneider Electric.

Module 2. Additional training center: refresher training and profession improvement of specialists in petroleum, mining and metallurgy industries of Russia in the fields of reliable power supply and automation of processes and production based on the automation hardware/software of Schneider Electric.

Module 3. Education: training of students, post-graduates and personnel of the Mining University and its divisions, as well as personnel of the outside institutions in the special fields connected with the process and production automation, higher reliability of power supply and enhanced quality of power, including protection of basic equipment of electric mains based on the automation hardware/software of Schneider Electric.

The Center keeps to training in a new form of adaptive–modular workshops. Educational activity of the adaptive modules in engineering disciplines shows itself in promotion of students to become fully competent in order to efficiently master the professional education programs on engineering. The modules are required to support studies under the basic

and variation parts of the program concurrently at the levels of theory and operating experience in mining. The practical training uses active methods and special chambers with software support in order to train in the real production environment created by virtualization.

At the present time, PPA Chair of the Mining University, while keeping traditions of the ancestors, pursues qualitative training of specialists for the mining industry of Russia. The main research lines at the Chair are:

- Mathematical modeling of physicochemical and production processes with a view to designing efficient technologies, equipment, algorithms and control systems for mining and processing of minerals and waste materials as applied to the mineral resources of Russia;
- Modeling of process and production (in mining, processing and petroleum industries) using dedicated software support and control systems;
- Integrated automation of electrolytic aluminum production process;
- Development of intelligent systems of process adjustment and control;
- Creation of optical-electronic contactless means of control of objects and processes;
- Investigation of functional and metrological characteristics of optical-electronic systems for contactless measurement;
- Analysis of operation of measuring transducers and data acquisition units in optical-electronic systems for contactless measurement;
- Modeling processes of data acquisition in optical-electronic systems for contactless measurement;
- Assessment of functional and metrological characteristics of optical-electronic systems for contactless measurement;
- Development of monitoring and control systems for metallurgical processes;
- Control algorithms for aluminum electrolytic bath using the achieved knowledge on the process;
- Development of control systems based on neural nets.

Conclusion

Today PPA Chair of the Mining University handles a wide range of science and education problems on automation of all stages of mineral production: exploration, mining, processing and beneficiation. After the University established the training center for specialists in mining, metallurgy, oil refinery and gas conversion, the Chair expands its area of activities, creates and purchases new automated training simulators and dedicated software. In recent years, the Chair has experienced the generational change. Now at the head of the Chair, there are young doctors of sciences, who have already acquired high reputation in the domestic and foreign scientific community. The Chair is writing a new history resting upon the good perennial traditions.

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