

UDC 378

A. A. GOLDMAN (Candidate of Philological Sciences, Director of Mirny Polytechnic Institute (branch) of Ammosov North-Eastern Federal University), mptisvfu@mail.ru

K. O. TOMSKY (Candidate of Engineering Sciences, Associate Professor of Mirny Polytechnic Institute (branch) of Ammosov North-Eastern Federal University), kirilltom@mail.ru

R. P. IVANOVA (Candidate of Philological Sciences, Associate Professor of Mirny Polytechnic Institute (branch) of Ammosov North-Eastern Federal University), Raissa1@yandex.ru

PERSPECTIVES OF PETROLEUM ENGINEERING EDUCATION IN WESTERN YAKUTIA

Introduction

Sakha Republic (Yakutia) is the largest region of the Russian Federation adjacent to the Arctic territory with a harsh climate and permafrost. It is known for its rich natural resources. Famous diamond, gold, oil and gas deposits are located here. The sustained development of Yakutia has a great importance for the Russian Far East. The main attractions for investors in the republic are the natural resources potential and the geographical position.

As of January 1, 2015, Yakutia's State Register of Mineral Reserves included 59 types of mineral and hydrocarbon deposits located in more than 2,000 fields. 455 of the deposits are widespread mineral deposits. Also on the territory of Yakutia, more than 16,000 emersions of different kinds of mineral and hydrocarbon crudes were discovered, as the First Deputy Chairman of the Sakha Republic State Committee for Geology and the Use of Subsurface Resources Vitaliy Kalashnikov reported at a meeting with ROSGEOLOGIYA on May 28, 2015 [1].

Petroliferous territories cover all western part of the republic. The list of oil and gas deposits of the Sakha Republic, Russian Federation, includes 34 fields.

A continuous, steady growth of gas consumption in domestic households, industry and power plants has gradually turned natural gas into a major source of energy. Main drivers in this development are the technical and economic advantages of natural gas as a clean, versatile, and easily controllable fuel [2].

Gas prospecting in Yakutia has reached 2.3 billion cubic metres, and oil development 300 billion tons. In the two neighbouring regions of the Republic – Lensk and Mirny – the largest oil, gas and condensate fields are located: Chayandinskoye, Talakanskoye, Srednebotuobinskoye and Taas-Yuriakhskoye. These fields are included in the federal oil and gas transportation project "Power of Siberia".

All in all, 21 license holders are operating in 60 license blocks on the territory of Yakutia. The most prominent of them are GAZPROM, ROSNEFT, SURGUTNEFTEGAZ, SAKHATRANSNEFTEGAZ, Yakut Fuel Energy Co., TAASYURIKHA NEFTEGAZODOBYCHA, IRELYAKHNEFT, GAZPROM-NEFT ANGARA, IRKUTSK Oil Company, and others.

To meet the needs for specialists in the field of oil and gas, the government of the Republic issued the opening of the Petroleum Engineering Department in the Mirny Polytechnic Institute (branch) of Yakut State University (today's NEFU) in 2008.

The article deals with the oil and gas industry in the Sakha Republic (Yakutia), Russia and petroleum engineering higher education in the Mirny Polytechnic Institute (branch) of the Ammosov North-Eastern Federal University (NEFU). The core of the Yakutian oil and gas complex is in Western Yakutia, as the majority of the positive reserves of hydrocarbon crude are located in the western and south-western parts of the Republic. The largest oil and gas fields Chayandinskoye, Talakanskoye and Srednebotuobinskoye are situated in western Yakutia. The discovery and exploitation of petroliferous deposits resulted in the opening of Petroleum Engineering major in the Mirny Polytechnic Institute of NEFU. The Mirny Polytechnic Institute is located in the industrial centre of western Yakutia, Mirny city, the heart of the diamond mining centre of Russia and the centre of the oil and gas industry of the Republic. Specializing in the field of petroleum engineering, the Mirny Polytechnic Institute's portfolio of programmes has been specifically tailored to meet the demands of the oil and gas employment market in the area and offers specializations in the operation and maintenance of oil fields; and the operation and maintenance of gas, gas condensate and subsurface fields. The Institute provides high-quality education through modern laboratory facilities as well as actual practice in the working fields within the conditions of permafrost. The curriculum is intended to prepare graduates to operate the latest equipment and to follow a research approach to work. Students can analyze real oil and gas equipment and apparatus indicators to make calculations. Final year individual student projects are designed to be relevant to the needs of the local oil and gas mining industry; many are carried out in collaboration with companies, which benefit from the student's innovative thinking while providing them with experience of real-life challenges. Today, the Mirny Polytechnic Institute is the prominent educational, scientific and cultural centre of western Yakutia, always at the forefront of innovative education and research.

Key words: *Mirny Polytechnic Institute, petroleum engineering, industrial enterprises, oil and gas, education, pipeline, East Siberia, Yakutia, research, oil and gas laboratory*

DOI: [dx.doi.org/10.17580/em.2016.01.10](https://doi.org/10.17580/em.2016.01.10)

Oil and Gas Production in the Sakha Republic

Russia possesses nearly a quarter of the world's proven natural gas reserves and produces around 18% of world output, second only to the US (BP, 2010 and IEA, 2012). Historically, the bulk of Russia's gas production came from the West Siberian area, which provided some 85% of the country's production in the 1990s and early 2000s. Today, the region's three major fields – Urengoyeskoe, Yamburgskoe and Medvezhe – are in steady decline [3]. Many analysts suggest that future of Russia's oil and gas sector will be connected with the Arctic region [4, 5, 6].

Among the greatest uncertainties in future energy supply and a subject of considerable environmental concern is

the amount of oil and gas yet to be found in the Arctic. By using a probabilistic geology-based methodology, the United States Geological Survey has assessed the area north of the Arctic Circle and concluded that about 30% of the world's undiscovered gas and 13% of the world's undiscovered oil may be found there, mostly offshore under less than 500 meters of water. Undiscovered natural gas is three times more abundant than oil in the Arctic and is largely concentrated in Russia [5].

According to Geological Society of London survey, the vast Arctic region contains nine proven petroleum provinces with giant resources but over half of the sedimentary basins are completely undrilled, making the region the last major frontier for conventional oil and gas exploration. The nine petroleum provinces of the Arctic contain recoverable resources totaling 61 Bbbl liquids and 269 Bbbloe of gas [6].

As it is known, the Arctic environment is fragile, climate conditions are harsh and the operational season is short. Success in this remote area will depend on appropriate selection of existing technologies and development of novel, more efficient ones [7].

The Sakha Republic of the Russian Federation the vast territory of which is included to the Arctic and sub-Arctic regions possesses 34 deposits of natural gas (2716 billion cubic metres) and crude oil (546 billion tons). Inferred resources of the Republic are estimated at 12 trillion cubic metres of gas and 546 million tons of oil. At the moment, only 20% of the inferred resources of the Republic have been exploited [8].

The crucial year in the development of the oil and gas industry was 2004, when one of the most prominent Russian oil and gas companies SURGUTNEFTEGAZ OJSC became a license holder in Yakutia. The entrance of this company resulted in the rapid growth of the oil and gas industry. The lion's share of this volume belongs to the Talakanskoye field. Severo-Talakanskoye, Vostochno-Alinskoye, Peleduyskoye and Yuzhno-Talakanskoye fields were discovered by SURGUTNEFTEGAZ OJSC in the Sakha Republic during the period of 2007–2011 [9]. Talakanskoye, Alinskoye, Severo-Talakanskoye and Vostochno-Alinskoye fields were joined to the East Siberia — Pacific Ocean pipeline system and put into operation and maintenance. In Talakanskoye field, a pilot operation of a bitumen plant is being held at the moment.

In 2009 the completion and commissioning of the first stage of the pipeline system East Siberia – Pacific Ocean signified one step up in the oil production of the Republic. In previous years it was limited to the extraction of oil only for housing and utility services. Following the commissioning of the pipeline system, oil companies now have the opportunity to arrange oil delivery beyond the Republic.

TAASYURIAKH plans to produce up to 1 million tonnes a year (20,000 barrels per day) from its East Siberian Srednebotuobinskoye field and aims to increase its output to 6.15 million tonnes (120,000 bpd) by 2016. The field with reserves of almost 1 billion barrels is connected to the East Siberia – Pacific Ocean by a 160 km pipeline [10].

Chayandinskoye oil and gas condensate field is located in the Lensk district of Sakha (Yakutia) Republic in the Far East region of Russia. The onshore field, also known as the Chayanda field, is being developed by GAZPROM. The onshore oil and gas field development forms a key part of the

\$38bn project to build the Yakutia gas production centre along with the Yakutia-Khabarovsk-Vladivostok pipeline. The integrated project is expected to create 15,000 construction jobs. The first oil production from the Chayandinskoye field is expected in 2015 and gas production is expected to start in late-2018. The field development cost is estimated to be \$13.66bn. [11].

The immanent resource potential of the Russian East and the foundation of a series of large gas production centres, along with the construction of transportation links, will together launch a new phase in the exportation of Russian gas to the Asia-Pacific Region.

The development of Chayandinskoye field and the commissioning of the main gas pipeline “Yakutia-Khabarovsk-Vladivostok” have given Russia an opportunity to discover new horizons for gas exportation. As a result, negotiations have begun with China.

May 21, 2014, Russia and China signed a 30-year, \$400bn (£237bn) deal for GAZPROM to deliver Russian gas to China. The contract, which is to provide 38 billion cubic metres of gas each year, was signed by the state-owned gas companies GAZPROM and CNPC (China National Petroleum Corporation) in the presence of the countries' leaders, Vladimir Putin and Xi Jinping [12].

Natural gas will be supplied to China via the Power of Siberia gas pipeline. The pipeline is designed to pump natural gas from the giant Chayanda oil and gas condensate deposit in Yakutia in northeast Russia and the Kovykta gas condensate field in the Irkutsk Region in Eastern Siberia. The Power of Siberia will run along the operational East Siberia - Pacific oil pipeline. The gas pipeline's first stage is scheduled to be commissioned in 2018 [13].

GAZPROM and the Republic of Sakha (Yakutia) entered into the Agreement of Cooperation and the Accord on Gasification in 2007 and 2008 respectively. In 2009 the regional General Gas Supply and Gasification Scheme was approved. In 2010 the parties entered into the Partnership Agreement for socioeconomic development within the Eastern Gas Program. A gas production center based on the large Chayandinskoye field will be established in the region. In future the Power of Siberia GTS will be laid in the region [14].

The foundation of the Yakutian oil and gas production centre will increase local employment. Over 3,000 local petroleum engineers will be in demand to serve this sector.

Perspectives of Petroleum Engineering Education in Mirny Polytechnic Institute

Rapid development of the oil and gas complex in Yakutia brought to an acute demand for local, highly-qualified petroleum engineers.

The core of the Yakutian oil and gas complex is in western Yakutia, as the majority of the positive reserves of hydrocarbon crude are located in the western and south-western parts of the Republic. The largest oil and gas fields Chayandinskoye, Talakanskoye and Srednebotuobinskoye are situated in western Yakutia (**Fig. 1**, Ref. [10]). All of them are oil, gas and condensate fields with the prevalence of a certain kind of petroleum commodities. Moreover, this part of Yakutia possesses a number of large deposits which have not yet been allocated to any producer companies.

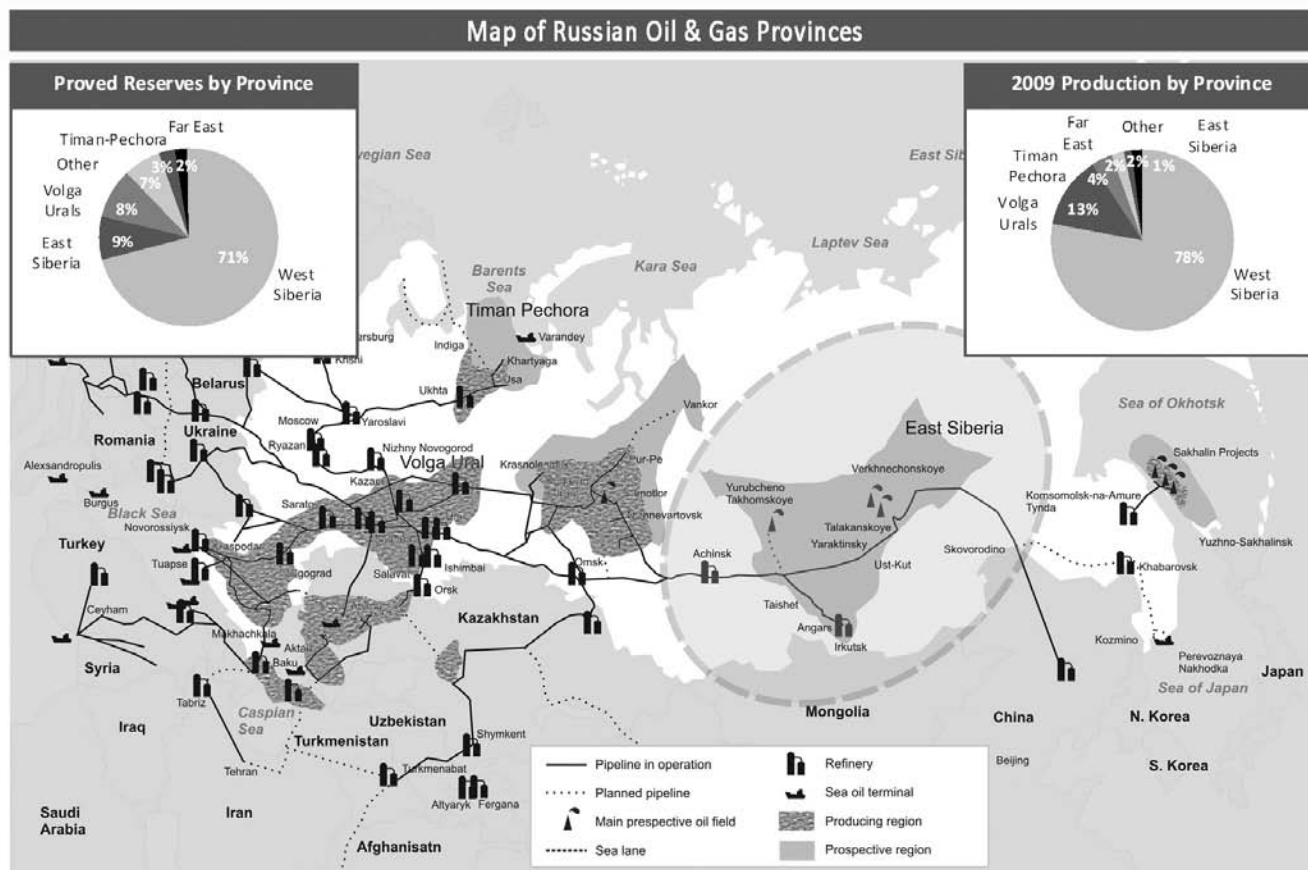


Fig. 1. Map of Russian Oil and Gas Provinces

The Mirny Polytechnic Institute (branch) of the Ammosov North-Eastern Federal University is located in the industrial centre of western Yakutia, Mirny city, the heart of the diamond mining centre of Russia and the centre of the oil and gas industry of the Republic. It was founded in 1994 by a decision of Mikhail E. Nikolaev, the first President of the Sakha Republic who proclaimed this education policy to be a priority in the development of the Republic for the decades hence. It was intended to provide the ALROSA Company with needed specialists [15].

ALROSA is the world's leading diamond mining company, accounting for more than 25% of global diamond production. It accounts for 95% of Russia's overall diamond output. The headquarters of ALROSA and the largest high-grade diamond deposits are situated in the Mirny region, Sakha Republic [16].

Today, the Mirny Polytechnic Institute is the prominent educational, scientific and cultural centre of western Yakutia, always at the forefront of innovative education and research.

The Institute's fully equipped campus provides a challenging while supportive learning environment for its students. Our facilities include student accommodation in two comfortable dormitories with internet access, reading rooms, gym and cafeteria; high quality engineering laboratories, multi-purpose auditoriums with video-conferencing facilities, a language studies centre with facilities for a virtual learning environment, two specifically equipped language laboratories, and a modern gym with a range of athletic facilities [17].

Our Institute trains mining engineering students for the Specialist Degree in three majors:

- Underground Mining of Mineral Deposits
- Electrical Engineering and Automation in Mining
- Mining Machines and Equipment

And five majors for the Bachelor's Degree:

- Petroleum Engineering
- Mathematics
- Applied Mathematics and Computer Science
- Philology (the English language and literature)
- Economics

The rapid development of the oil and gas industry and the integration of prominent oil and gas enterprises in Yakutia motivated the former President of the Sakha Republic Vyacheslav Shtyrov to issue the opening of the Petroleum Engineering major in the Mirny Polytechnic Institute in 2008. This was a pioneering project in Yakutia.

Specializing in the field of petroleum engineering, the Mirny Polytechnic Institute's portfolio of programmes has been specifically tailored to match the demands of the oil and gas employment market in the region, giving our students the best possible career advancement opportunities.

The petroleum engineering programmes offer specialisations in the operation and maintenance of oil fields; and the operation and maintenance of gas, gas condensate and subsurface fields. The Institute provides high-quality education through modern laboratory facilities as well as actual practice in the working fields within the conditions of perma-

frost. The curriculum is intended to prepare graduates to operate the latest equipment and to follow a research approach to their work [18].

The academic staff of the Oil and Gas Department is mostly represented by graduates of the Gubkin Russian State University of Oil and Gas. All of them hold Candidate of Science and Master's Degrees in Petroleum Engineering.

The rapid development of the oil and gas sector requires up-to-date education technologies. The following petroleum engineering laboratories are being equipped in the Institute:

Laboratory of Petrophysics and Core Examination enables the students to analyze oil and gas field cores according to their physical, mechanical and chemical properties.

Laboratory and Field Testing Site of Oil and Gas Production Equipment requires wells with full scale oil and gas equipment: an electrical centrifugal pump unit, a deep well pump, screw pulsers. This equipment is used both in the learning process and research work.

Laboratory of Oil and Gas Geology imitates oil and gas reservoirs. Geological surveys of virtual production fields can be carried out through high resolution graphics in this laboratory.

Laboratory of Oil and Gas Chemistry and Process Liquids carries out laboratory works for the Chemistry and Oil and Gas Chemistry courses. The laboratory is geared for learning methods and instruments for chemical analysis. The students can hold chemical experiments; get acquainted with chemical substances and their alterations, and analyze oil and oil products according to certain requirements.

Laboratory of Oil and Gas Wells Exploitation is provided with state-of-the-art equipment for oil and gas wells work analysis in different operation conditions.

Gas-hydrodynamic and Field Development Simulation Class-Laboratory deals with research work in geological and hydrodynamic field development and design, 3D models construction and project data.

The students of the Petroleum Engineering Department take part in numerous contests, grant programmes and scientific conferences.

The most prominent of them are:

Nyurgun Alexeev – 2012 graduate; the winner of North2North Student Mobility Program grant of the University of the Arctic, took a course in Stockholm University in 2011-2012. In 2013, he undertook scientific research of heavy oil recovery at the Enhanced Oil Recovery Institute in China's University of Petroleum. In 2014, he received an internship for the Master's final work on multi-lateral wells at the the Field Operation Department at Total EP, Russia. In 2014, he obtained a Master's Degree in Petroleum Engineering (Gubkin Russian State University of Oil and Gas). At present, he works at SEIC Company as a Graduate Wells Engineer.

Victor Popov – 2012 graduate; the winner of the 66th International Youth Scientific Conference "Oil and Gas – 2012", Moscow. In 2014, he earned the Master's Degree (Gubkin Russian State University of Oil and Gas). At present, he works at Baker Hughes oil and gas company.

Aytal Struchkov – 4th year student; the winner of Hokkaido Short Term Education Program grant, studied in Japan

from September 2014 to January 2015; the winner of The 8th All-Russian Herzen Youth Forum 'My Initiative in Education' (St. Petersburg); bronze medalist of Open International Students' Internet Olympiad on History.

Pavel Dobrolyubov – 4th year student; the winner of the 6th and 8th All-Russian Herzen Youth Forum 'My Initiative in Education' (St. Petersburg) in 2013; a participant in the London International Youth Science Forum, 2014; the winner of the Russian Far Eastern and Moscow International UN Models; the winner of a Program Grant for Student Leaders on Global Environmental Issues at the Study of the United States Institutes (SUSI); participant of the London International Youth Science forum; bronze medalist of the Open International Students' Internet Olympiad on Ecology and Economics.

The results of the scientific activity of our students are exhibited at different conferences and forums including the London International Youth Science Forum, the International Youth Scientific "Oil and Gas" Conference, the International Scientific Conference on "Student and Technological Progress", the All-Russia Research and Practice Conference on "Youth and Technological Progress in the Modern World", the All-Russia Conference on "The challenges of the development of hydrocarbonaceous and ore mineral resources deposits", the All-Russia Scientific Forum of Federal Universities, the Annual Students' Scientific Forum, and many others [19].

Undergraduate students apply the results of their scientific activity to their course and diploma papers. They also take part in various sponsored projects together with their scientific supervisors.

Due to the convenient geographical position of the Institute in Mirny – the centre of oil and gas province – we hold practical classes in the working oil and gas fields. The institute has close ties with industrial enterprises GAZPROM, ROSNEFT, SURGUTNEFTEGAZ, ALROSA GAS, TAASYURIAKH NEFTEGAZODOBYCHA, IRELYAKHNEFT, and others.

Students can analyze real oil and gas equipment and apparatus indicators to make calculations. This experience will help them to solve similar tasks in their future professions. Our final year individual student projects are designed to be relevant to the needs of the local oil and gas mining industry; many are carried out in collaboration with companies, which benefit from the student's innovative thinking while providing them with experience of real-life challenges.

We also take part in public hearings of industrial enterprises and monitor environmentally safe technologies for the extraction and processing of natural resources in the Mirny region [20].

The Institute collaborates with leading oil and gas universities of Russia in research programmes and on-line distance learning: Gubkin Russian State University of Oil and Gas, Tyumen State Oil and Gas University, National University of Science and Technology (Moscow), National Mineral Resources University (Saint-Petersburg). We conduct joint scientific and analytical research on the following issues:

- Construction of problem-oriented simulators of hydrodynamic modelling of oil and gas condensate fields;

- Simulation of polyphase hydrocarbonaceous systems filtration;
- Construction of subsurface storage of gas and gas condensate in permafrost;
- Methods of controlling of natural and industrial gas hydrate and asphalt, gum and paraffin sedimentation;
- Complex analysis and monitoring of natural environment;
- Analysis of hydrocarbon fluids at oil and gas fields development and operation.

Conclusion

Petroleum engineering education is fundamental for the development of the oil and gas industry in Russia and beyond. Our graduates have already taken up various posts with an impressive list of companies in the oil and gas employment market.

At present, 111 petroleum engineers have graduated from our Institute, 59 of them from full-time studies, 52 from part-time studies. The majority are employed in leading oil and gas enterprises: GAZPROM, SURGUTNEFTEGAZ, LUKOIL, SAKHALINENERGY, SAKHATRANSNEFTEGAZ, LENSKGAS, ALROSA GAS, IRELYAKHNEFT, and foreign oil and gas companies Total and Baker Hughes.

30% of our graduates have the Master's Degree in Petroleum Engineering taken at Gubkin Russian State University of Oil and Gas.

By the summer of 2016, a new building of the Institute will be put into operation with all the necessary facilities and modern laboratories. This will be another step in the development of oil and gas education in western Yakutia and consequently an important contribution to the sustained development of oil and gas extraction in the Sakha Republic, Russia.

References

1. Yakutia possesses 59 types of mineral and hydrocarbon crudes (2015, May 28). Information analytical portal SakhaNews. Available at: <http://www.1sn.ru/140291.html> (in Russian)
2. Correljè A. F. Markets for Natural Gas (2016, May 1). Reference Module in Earth Systems and Environmental Sciences. 2013. Available at: <http://www.sciencedirect.com/science/article/pii/>
3. Lunden L. P., Fjaertoft D., Overland I., Prachakova A. Gazprom vs. other Russian gas producers: The evolution of the Russian gas sector. *Energy Policy*. October 2013. Vol. 61. pp. 663–670.
4. Aalto P. Modernization of the Russian Energy Sector: Constraints on Utilizing Arctic Offshore Oil Resources. *Europe-Asia Studies*. 2016. Vol. 68, Iss. 1. pp. 38–63.
5. Gautier D., Bird K., Charpentier R. et al. Assessment of Undiscovered Oil and Gas in the Arctic. *Science*. 29 May 2009. Vol. 324, Iss. 5931. pp. 1175–1179.
6. Spencer A. M., Embry A. F., Gautier D. L., Stoupakova A. V., Sorensen K. Arctic Petroleum Geology. Geological Society Memoir. No. 35. London: Geological Society of London, 2011. 818 p.
7. Bishop A., Bremmer Ch., Laake A., Strobba C., Parno P., Utskot G. Petroleum Potential of The Arctic: Challenges and Solutions. *Oilfield Review Winter 2010/2011*: 22, No. 4. pp. 36–49.
8. The Republic of Sakha (2015, May 30). About the Republic. Official Site of The Republic of Sakha. Available at: <http://www.sakha.gov.ru/> (in Russian)
9. Surgutneftegaz Launched Severo-Talakanskoye Oil Field (2011, December 28). Moscow's XIII International Energy Forum "Russian Fuel and Energy Complex in the XXI Century". Available at: <http://www.mief-tek.com/564.php>
10. Eastern Siberia: Oil and Gas (2015, October 14). Capable Translations. Available at: <http://www.capabletranslations.com/>
11. Chayandinskoye Field, Yakutia, Russia (2015, October 13). News, views and contacts from the global Hydrocarbons industry. Available at: <http://www.hydrocarbons-technology.com/projects/chayandinskoye-field-yakutia-russia/>
12. Russia signs 30-year deal worth \$400bn to deliver gas to China (2014, May 21). *The Guardian*. Available at: <http://www.theguardian.com/world/2014/may/21/russia-30-year-400bn-gas-deal-china>
13. Gazprom Ready to Launch Gas Supplies to China Within 4 Years (2015, April 30). *Oil and Gas Eurasia*. Available at: <https://www.oilandgaseurasia.com/en/news/gazprom-ready-launch-gas-supplies-china-within-4-years>
14. Eastern Gas Program Potential of Far East and Eastern Siberia (2015, October 13). Official site of Gazprom. Available at: <http://www.gazprom.com/>
15. Goldman A. A. Budushchee sozdaetsya v nastoyashchem (Mirny Polytechnic Institute: Future is created in the present). *Gornyy Zhurnal = Mining Journal*. 2014. No. 1. pp. 6–9.
16. About us. Alrosa (2015, June 22). Available at: <http://eng.alrosa.ru/> (in Russian)
17. Goldman A.A., Nikiforov I.I., Ivanova R.P. Prioritetnye napravleniya vospitatelnoy raboty v vuze (na primere MPTI (f) SVFU) (Priorities of Higher Social Education at Mirny Polytechnic Institute of NEFU). *Sovremennyye problemy nauki i obrazovaniya = Issues on Science and Education*. 2015. No. 2. Available at: www.science-education.ru/129-22000
18. Mirny Polytechnic Institute (branch) of Ammosov North-Eastern Federal University (2015, May 27). Official Site. Available: <http://en.unimir-ysu.ru/> (in Russian)
19. Goldman A.A. Petroleum Engineering Education in NEFU, Yakutia. *Journal of Siberian Federal University*. 2015. No. 8. pp. 1551–1559.
20. Zyryanov I. V., Dvoychenkova G. P., Kovalchuk O. Y. Nauchno-obrazovatelnyy tsentr MPTI – platform razvitiya vsshego obrazovaniya v zapadnoy Yakutii (Scientific Educational Centre of MPTI – the Platform of Higher Education Development in Western Yakutia). *Gornyy Zhurnal = Mining Journal*. 2014. No. 1. pp. 31–33. 