Available online at http://jess.esrae.ru/

"Journal of Economics and Social Sciences"

Economic prospects of helium industry development in Russia

Tomsk Polytechnic University

Danil Dubinskiy[a], Dmitry Nechaev[a], Denis Efimov[a], Alexander Vagapov[a]

[a] Tomsk Polytechnic University

Abstract

In this article authors examine the global and local Russian helium market and future helium trade trends; perform the analysis of helium industry development in East Siberia, its prospects and benefits, possible consumers of Russian helium; make several suggestions on its economic stimulation. The amounts of helium deposits in leading producing countries, geographical location of Russian helium resource base, technological problems on storage and transportation are also reviewed. As East Siberian gas fields are rich in helium and located near Asia-Pacific region – the main consumers of this high-technological associated gas – the problem of helium industry becomes topical. Moreover, annual losses of this resource will grow rapidly from East Siberia – Pacific Ocean pipeline system is commissioned, so the quick protective actions are strongly required.

Keywords: Helium, East Siberia, resource base, storage and transportation, economic stimulation;

1. Introduction

Nowadays, natural gas is considered one of primary energy sources. It mainly (70–98%) consists of methane and its heavier homologues. But, instead of them, there are some non-hydrocarbonaceous substances such as hydrogen, hydrogen sulfide, nitrogen, carbon dioxide, helium. Despite the potential prospects of associated recourses application, they are burned along with fuel hydrocarbonaceous products.

Natural gas is currently the only source of helium industrial production. This gas is widely spread all over the world, however, there is no helium in a free form in the subsoil and its production by air separation plants is ineffective and unprofitable because of the low helium content in atmosphere (only 0.00052%).

2. Global helium market

Global helium demand grows every year parallel to modern innovative technologies development. This connection caused by unique properties of the resource and wide range of spheres where it is involved. Its indispensability in high-technological, science-intensive industries (electronics, semiconductor industry, fiber optics, cryogenics, medical tomography) determines the list of main consumers. Primarily, this list includes Asia-Pacific countries: Japan, China, South Korea, Taiwan, Singapore. For example, high-speed magnetic levitation trains (or

simply maglevs), which use helium superconductivity, are commissioned in China (32-kilometre branch line linking the city with Pudong International Airport). The usage of "cold"(0,1–10 K) and "warm" (273–6000 K) helium in reactor cooling systems increases the safety in atomic energetics which is uncontested and vitally important energy source in Japan and Korea and gradually displacing environmentally unfriendly coal raw-stuff. Generally, helium industrial consumption in Asia-Pacific region annually rises 6–7% in average, sometimes jumping to 9 – 10% [6].

At the same time, a small number of countries possess resources of such a valuable fossil. Decreasing trend is observed in many traditional producing countries, for example, in Poland (from 0,8 to 0,3 billion cubic meters) and the Netherlands (from 0,7 to 0,6 billion cubic meters). According to report introduced by OAO Scientific Production Association *"Geliymash"* on Siberian Energetics Congress (Novosibirsk, 2005), total amount of helium was estimated at 27,8 billion cubic meters; the biggest resource bases were located in Russia (9,1 billion cubic meters), the USA (8,9 billion cubic meters), Algeria (3,0 billion cubic meters) and Qatar (2,0 billion cubic meters) [5]. Future prospects of their production potential are represented in table 1.

Tab. 1. Prospects of helium production in the leading countries-producers [1, 5]

Country	Counted resources in 2005, billion m^3	Counted resources in 2009, billion m^3	Production forecast, 2020, million m^3	Production forecast, 2030, million m^3
Russia	9.1	16.2	35–75	90–150
USA*	8.9	8.5	57–91	44–78
Algeria	3.0	8.4	33	33
Qatar	2.0	10	14–29	14–35

* *With reserves of Cliffside Field helium storage reservoir.*

The USA have lost their first position in the beginning of XXI century while still being one of the greatest helium consumers in amounts close to volumes of extraction. In the short term, the United States do not plan a development of helium industry, besides, a reduction of reserves by their intensive sale is presumed. Due to this fact, Qatar, Algeria and, the most, the Russian Federation have opportunities to occupy this almost empty economic niche.

3. Helium resource base in Russia

Initial resources of the main helium fields in Russia total approximately 9403 million cubic meters. At the moment, amounts of production along with the loss of this gas are evaluated as 673 million cubic meters. The majority of deposits is located in gas-petroliferous basins of the Siberian Craton: about 4590 million cubic meters (more than 50%) in the Siberian Federal District, mostly in Krasnoyarsk Krai and Irkutsk Oblast, and 3169 million cubic meters (nearly 35%) in the Far Eastern Federal District – in the Sakha (Yakutia) Republic. The Volga Federal District (primarily, Orenburg Oblast) as well as the Southern Federal District (mainly Astrakhan Oblast) has 7% of all-Russian reserves. Among explored gas fields, 176 facilities can be considered as helium sources. It is worth noting that amounts of helium in the above-mentioned regions are not declining because of continuing geologic exploration (probable and possible resources are estimated as 34 billion cubic meters). Moreover, in contrast to North American fields of the Mid-Continent, which are significantly

depleted, the development of most Russian, especially East Siberian, fields has not actually begun and their industrial reserves are still increasing [1].

4. Prospects of helium trade on domestic and export market

Advantageous geographic location of the resource base near its main consumers – Asia-Pacific countries – is also an important factor of becoming an exporting country. Russia has already supplied Japan with liquefied helium in annual amounts of 500 tons since 2006. Also a consignment of this non-hydrocarbon substance was sent to a South Korean company *Samsung Electronics* on a trial basis in 2014.

At the same time, the Russian Federation gets an opportunity to assume the role of not only the leading helium producer but also a one of its greatest consumer. Helium resources would be actively used in exploitation of the *Vostochny* Spaceport which is being constructed in 180 km from Blagoveshchensk, the end point of the *Power of Siberia* first section. Moreover, they are used in construction of the pipeline itself as a helium and helium-argon medium for welding and cutting of metal details. To continue the topic of oil and gas industry, the prognostic growing demand for helium on Sakhalin should be mentioned. This fact is connected with expansion of the offshore works. Helium-oxygen breathing gas is three times lighter than air and increases possible diving depth from 50 m to 200–300 m, i.e. to a level of the continental shelf. An advanced regional trunk pipeline system facilitates the supply of this works with required resources [6]. However, petroleum engineering and industry is not the only consumer of helium. An availability of own reserves will be able to stimulate experimental design and scientific researches, if these resources are sold to Russian research institutes cheaper than market price.

In spite of the above-mentioned prospects, nowadays helium is commercially extracted only at the Orenburg Gas Processing Plant, but also it is planned to build Boguchany and Amur Gas Processing Plants for these purposes. Unless protective actions are taken, annual losses of this resource will be near the volumes of its production since East Siberia – Pacific Ocean pipeline system is commissioned. The protection of helium reserves is required on a governmental level. Helium should be included in the list of strategic resources of Russia and its production and selling should be regulated by a special law. An experience of the USA, where similar program was being successfully implemented in 1925–1996, can be used as a basis.

5. Helium storage and transportation

For now, the only one way to save quality helium deposits and not to slow down natural gas production is their extraction in amounts exceeding demand and injection of the surpluses into underground storage reservoirs as a helium crude (nitrogen-helium concentrate). There are three possible variant of storages: exploitation of small depleted gas fields, return of helium concentrate to one of the layers of developed field, disposition in salt caverns. OOO *"Podzemgazstroy"* has considered prospects of the third variant and specified the following geographic locations: p. Balagansk and p. Tyret (Irkutsk Oblast), p. Boguchany (Krasnoyarsk Oblast) and the region of Chayadinskoe gas field [3].

Another important aspect of helium industry development is gas transportation. The only industrial helium pipeline system in the world links Cliffside Field helium storage reservoir (USA) with Mid-Continent oil and gas fields. At present times, it is beneficial to use this type of pipeline just in field development. Nevertheless, this type of pipeline is considered to become a more effective alternative to auto transport of liquefied gas in tanks, which is commonly used now, so there is a possible prospect of trunk helium pipelines construction several decades later, as the resource demand grows rapidly. Particularly, the delivery of 20 tons of cargo by auto roads from

Kovykta gas condensate field to Vladivostok (approximately 4000 km) can be evaluated as nearly 250–270 thousand rubles, container turnover equals to 160000 tonne-kilometres. The continuous supply of helium by a pipeline would cost less as well as exclude a number of technologic and organizational operations such as registration of vehicle entry and exit to the protected area, connection and disconnection of flexible metal hoses, package and product quality control, package security check [4].

In addition, helium pipeline transport is environmentally friendly and has nearly zero accident rate. Inert and non-explosive properties of helium determine the possibility of constructing pipelines practically ubiquitously: in protected areas, railway zones of alienation, riverbeds, along with fiber optic lines, parallel to hydrocarbonaceous trunk pipelines. At the same time, careful monitoring is required because helium easily volatilizes and the slightest defect can cause heavy losses.

Concerning the above-mentioned benefits, it is highly recommended:

- to construct the main helium pipeline "East Siberia – Pacific Ocean" for helium-containing gas transportation without withdrawal (or, at least, with a minimal withdrawal) on the territory of East Siberia;
- to locate helium withdrawal and liquefaction factories near the Asia-Pacific area to minimize automobile and railway transportation of liquefied helium;
- to construct a regional gas supply system and to connect it with the Unified Gas Supply System (UGSS) of Russia near Proskokovo (Kemerovo Oblast) [2].

Conclusion

Thus, helium is one of the most prospective natural resources and is demanded more intensive year in year out because of its usage in innovative technologies. Russia, while possessing the greatest reserves of helium, can fulfill its potential on a global scale as well as in own resource-efficient projects. That is why, in the short term, Russian Fuel and Energy Complex needs to solve legislative, technological and transport-infrastructure problems. To develop helium industry economically, the following measures should be assumed:

- carrying out institutional reforms for more efficient helium industry control and improvement of its competitiveness (foundation of the state company *"Rosgeliy"*, implementation of a long-term helium industry development program);
- improvement of authorization framework for design and construction of new productions (because strict, sometimes duplicate, requirements extend the term of design and cost of construction and, consequently, prolong putting new productions into operation);
- greater transparency as required with respect to modern foreign technologies and package supplies;
- stimulation of investment and innovative activity in helium industry;
- implementation of a customs fee policy to create favorable terms for new helium productions;
- protection of interests of domestic exporters on foreign markets (trade policy);
- stimulation of the domestic demand [2].

References

1. Kontorovich, A.E., Korzhubayev, A.G., Eder, L.V. (2006). Syr'evaya baza i perspektivy razvitiya gelievoy promyshlennosti Rossii i mira (The resource base and potentialities of the helium industry in Russia and the world). *Mineral'nye resursy Rossii. Ekonomika i upravlenie,* No 2, pp. 17-24.

2. Kryukov, V.A., Silkin, V.Yu., Tokarev, A.N., Shmat, V.V. (2012). Integrated reengineering of helium resources development in Russia's eastern regions. Novosibirsk: IEIE.
3. Ruban, G.N., Bondarev, V.L., Koroleva, V.P., Korolev, D.S. (2010). Kriterii vybora khranilisch gelievogo kontsentrata v Vostochnoy Sibiri (Object selection criteria for helium concentrate storage in Eastern Siberia). *Georesursy*, No 4 (36), pp. 29-32.
4. Pipeline transportation of industrial gases. *Gasworld Russia and CIS*, No 28, pp. 24-25 [available at: http:// http://mvif.ru/truboprovodnyij-transport-promyishlennyix-gazov] [viewed on 03/04/2016]
5. Udut, V. N. (2005). Perspektivy gelievoy promyshlennosti v Vostochnoy Sibiri i Respublike Sakha (Yakutia) (Helium industry prospects in East Siberia and Sakha (Yakutia) Republic). *EKO*, No 10, pp. 75-81.
6. Yakutseni, V. P. (2009). Traditsionnye i perspectivnye oblasti primeneniya geliya (Traditional and prospective spheres of helium use). *Neftegazovaya geologiya. Teoriya i praktica*, Vol. 4, No 1, pp. 1-13.