

## VORKUTA TRANSPORT HUB AND ITS ROLE IN DEVELOPMENT OF THE ARCTIC AREA

**Kiselenko, Anatoly N.**, Komi Scientific Center, Ural Branch of the Russian Academy of Sciences, Syktyvkar, Russia.

**Malashchuk, Petr A.**, Komi Scientific Center, Ural Branch of the Russian Academy of Sciences, Syktyvkar, Russia.

### ABSTRACT

The article describes Vorkuta transport hub as one of the few large regional centers of the Russian North, which, because of its location, is so important for development of transportation links in the European and Ural Arctic zone. It is shown that the capacity of this hub, which has in its infrastructure all modes of transport, except inland water transport,

meets region's current needs in freight and passenger transportation. Nevertheless, exploration of natural resources of the Arctic region and solution of other development tasks require strengthening of the existing transport capacity of Vorkuta region through implementation of transport projects under the study, particularly regarding renewal of railroads, civil aviation, road transport and pipelines.

*Keywords:* Arctic, Vorkuta, transport hub, infrastructure, modes of transport, development projects.

**Background.** The development of the Arctic zone of Russia (eight reference areas, including Vorkuta) is directly related to the development of transport infrastructure [1, p. 69]. It should be noted, however, that extreme climatic conditions ambiguously affect prospects of its development. On the one hand, there is a steady downward trend in the area regarding total space and thickness of the ice cover of the northern seas, which leads to an increase in the attractiveness of transportation along the Northern Sea Route. On the other hand, an increase in the average annual temperature leads to accelerated destruction of the coast and port infrastructure, as well as to accelerated degradation of permafrost area [2, p. 11], which critically affects the land transport infrastructure. For example, the expenses of Gazprom in Nadym to stabilize the carrying capacity of soils, along which roads and pipelines pass, amount to 1 thousand dollars/m<sup>2</sup> [3, p. 82].

Inland northern territories include Vorkuta as one of few cities that can be considered as a large one according to local standards, and whose infrastructure facilities are located in the permafrost zone [4, p. 65]. It was founded thanks to development of the Pechora coal basin and the emergence of the town-forming coal enterprise here [5, p. 22]. While the estimated capacity of the city's energy infrastructure allows to accommodate 300 thousand people [6, p. 130], the population of Vorkuta district as of January 1, 2017 was 80,1 thousand (the maximum was 218,5 thousand people in 1989 [7, p. 127].

Vorkuta geological and industrial region has the largest coal reserves in Europe (about 4 billion tons) and has a high industrial potential [8, p. 14]. There are rich deposits of limestone and slate near the town [9, p. 46], which are suitable for production of cement. In addition, Vorkuta is supporting and logistics base of Bovanenkovo–Ukhta gas pipeline, the supporting unit of the reindeer herders of Bolshezemelnaya Tundra [10, p. 56].

**Objective.** The objective of the authors is to consider the role of Vorkuta transport hub in development of the Arctic zone of Russia and to study its main elements.

**Methods.** The authors use economic, system and comparative analysis, evaluation approach, scientific description.

### Results.

#### Rails with access to the sea

Railway transport provides year-round communication with the rest of the country via Konosha–Vorkuta main line [11, p. 3]. The movement

of trains on it is carried out by using diesel locomotives. Up to Inta station the railway is double-tracked, and Inta–Vorkuta section is a single track. At Chum station, Vorkuta and Labytnangi sections branch off the railway.

The construction of the lines Inta–Vorkuta, Chum–Labytnangi and their subsequent operation caused significant changes in the conditions in permafrost areas. Those changes are determined by disturbance of heat exchange between the surface of the earth and the atmosphere as a result of removal of vegetation cover, emergence of water permeability problems, reformation of snow deposits and deterioration of surface runoff conditions. There are deformations of the roadbed, precipitation and spreading of embankments on thawing permafrost soils, as well as formation of thermokarst depressions on the territories adjacent to embankments [12, p. 2]. This leads to limitation of the weight of trains, especially those which are operated in the northern direction. For example, the weight rate of trains stipulated for diesel locomotives 2TE10 at Vorkuta–Labytnangi section is 3500 tons, Vorkuta–Inta – 4400 tons, and at Inta–Sosnogorsk section it rises to 4800 tons<sup>1</sup>.

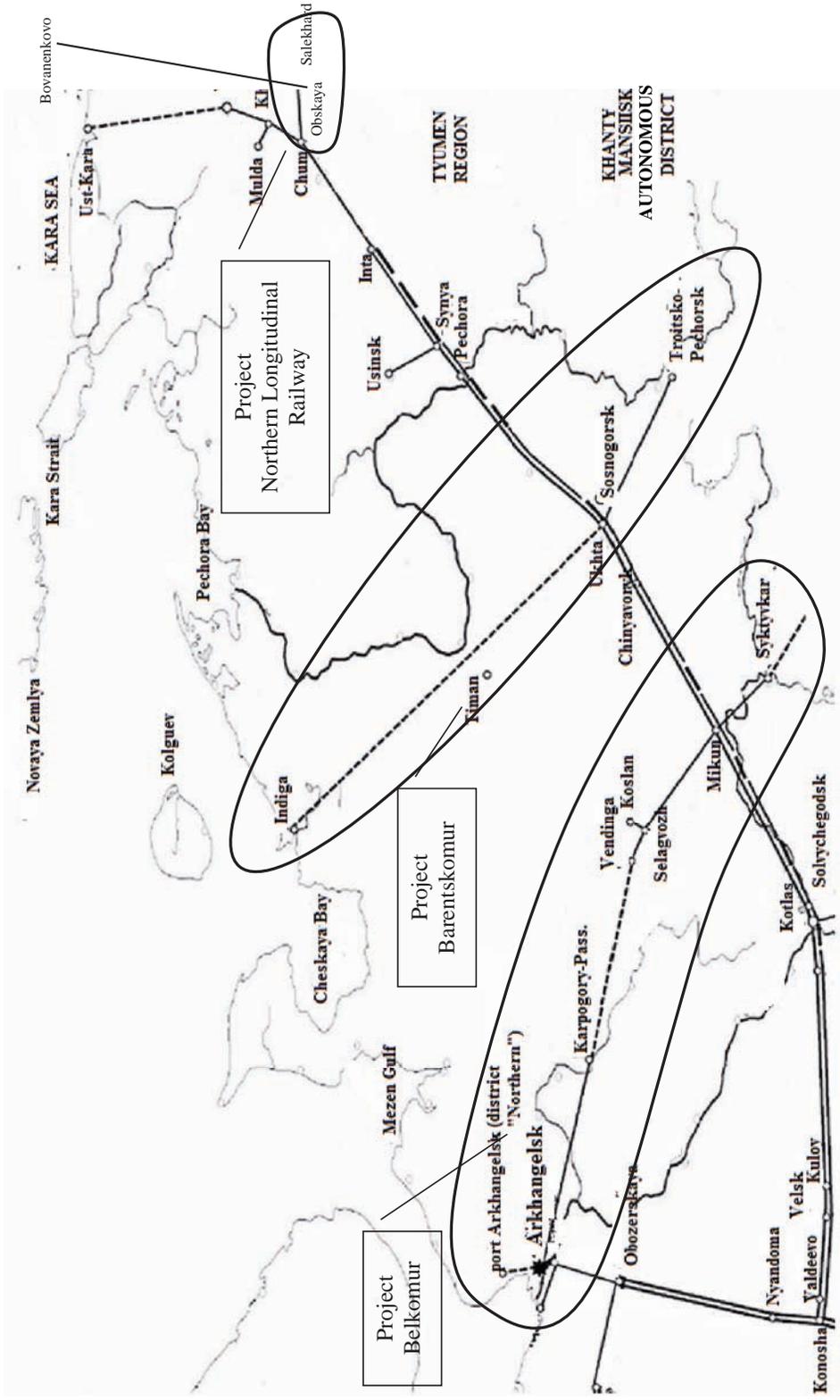
Large length of non-public tracks, which are the entrances to existing and closed coal mines, has always been a feature of Vorkuta hub. In the absence of the technological process agreed upon between the railway infrastructure unit of JSC Vorkutaugol and JSC Russian Railways, congestion may emerge at the approaches to Vorkuta station. This was observed, in particular, during construction of the first stage of Bovanenkovo–Ukhta gas pipeline due to the fact that the infrastructure on the secondary routes is not sufficiently prepared for handling of general cargo.

Vorkuta station of Sosnogorsk regional unit of the Northern Railway is a cargo station and handles operations of receipt and delivery of goods by small, carload shipments; receipt and delivery of goods in universal containers weighing up to 20 tons, for which both open areas and covered warehouses are equipped.

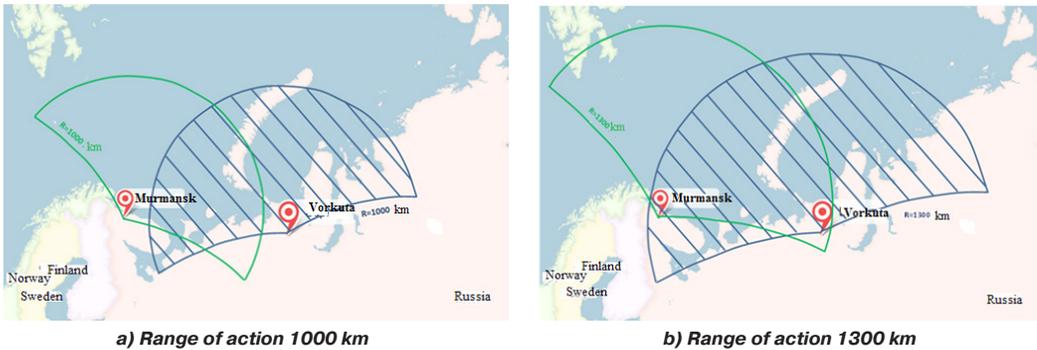
A 400 m long passenger platform is capable to receive a train of 15 coaches. Direct communication with the cities of Moscow, St. Petersburg, Syktyvkar, Labytnangi, Kirov, Adler, Nizhny Novgorod and others is provided.

<sup>1</sup> Railway. History, terminology, development history. Heavy traffic. [Electronic resource]: <http://rly/uk/node/6867>.





Pic. 1. Railway projects in the Republic of Komi and the Northern Urals.



**Pic. 2. Comparison of the polar aviation zone (developed by the authors).**

The operation depot provides technical maintenance of locomotives, besides there are a car shed and car maintenance points in Inta, Pechora, Mulda, Usinsk, Labytnangi.

The railway line connecting Vorkuta and Labytnangi is adjoined by the non-public railway Obskaya–Bovanenkovo owned by PJSC Gazprom, which is used as a technological route<sup>2</sup>.

The role of Vorkuta as a supporting transport hub will increase significantly after implementation of the Northern latitudinal railway project, which is supposed to connect the Northern and Sverdlovsk railways. Construction of the route with a total length of 707 km Obskaya–Salekhard–Nadym–Pangody–Novy Urengoy–Korotchaevo is planned for 2018–2023. The projected volume of traffic on the main line – 23,9 million tons per year<sup>3</sup>, transported goods comprising mainly oil cargo and gas condensate. The project is implemented on the principles of the private-public partnership in the form of a concession, the participants of which (JSC Russian Railways, PJSC Gazprom, Yamalo-Nenets Autonomous District) will finance reconstruction of objects of their own railway infrastructure, and construction of new ones will be carried out by a special project company (SPK-Concessionaire).

JSC Russian Railways will reconstruct Kotlas–Chum–Labytnangi section, including Obskaya railway station of the Northern Railway, as well as Pangody–Novy Urengoy–Korotchaevo section of Sverdlovskaya railway. Works on Nadym–Pangody section will be carried out by PJSC Gazprom. The concessionaire will provide financing, construction and operation of Obskaya–Salekhard–Nadym line, including construction of the railway part of the bridges across the Ob river and the river Nadym. The administration of Yamalo-Nenets Autonomous District will invest in construction of the automobile part of the bridge across the Ob river, as well as will provide land for laying the main line.

<sup>2</sup> Lebedeva I. Gordian knot. Northern railway line, No. 2, 2012. [Electronic resource]: [http://www.gudok.ru/zdr/179/?ID=654639&sphrase\\_id=8837](http://www.gudok.ru/zdr/179/?ID=654639&sphrase_id=8837).

<sup>3</sup> Order of the Government of the Russian Federation No. 1663-p dated 08.08.2018 «On Concluding a Concession Contract for Financing, Building and Operating the Public Transport Infrastructure Obskaya - Salekhard-Nadym». Reference and legal system Consultant Plus.

<sup>4</sup> Valinsky, O. Traction for the Northern course. Gudok, No. 195 (26568), 2018. [Electronic resource]: <http://www.gudok.ru/newspaper/?ID=1440877>.

According to the concession agreement to transport predicted cargo volume, it is proposed to build the second main tracks at Inta–Chum section, lengthen the receiving and departure tracks at the stations, and to develop additional side tracks and equip them with automatic blocking devices at Chum–Labytnangi section. In the framework of the project, in 2017, fiber optic cable was tested to monitor the movement of trains using the system of vibro-acoustic sounding of the railway track in permafrost conditions at Kharp–Labytnangi section. Measures to increase capacity will raise the weight rate of freight trains up to 6000 tons<sup>4</sup>.

The Northern Latitudinal Railway was originally a component of the large project «Ural Industrial – Ural Polar», the implementation of which will strengthen the importance of the transport hub of Vorkuta with regard to transshipment of resources in the western direction. Besides, some other transport projects, like Belkomur and Barentskomur, can be implemented in the territory of the Komi Republic, which can seriously affect loading of the railway network. Pic. 1 presents the projects, the implementation of which is able to increase the workload of the railway network of the Republic of Komi and of the Northern Urals area.

The implementation of the project «Northern Latitudinal Railway» gives access to cargoes from the east of the country to the Northern Sea Route through the non-public railway line Obskaya–Bovanenkovo–Sabetta. The 170 km long Bovanenkovo–Sabetta single-track railway is planned to be used for industrial transportation by oil and gas companies, the volume of which should be 7 million tons in the fifth year of operation and 14 million tons in the tenth year<sup>5</sup>.

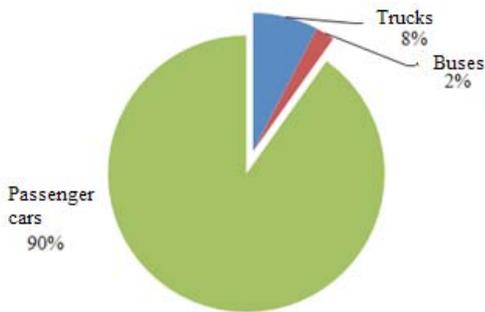
The construction of Vorkuta–Ust-Kara–Amderma railway will also be promising; it will allow the delivery of cargoes to the coast along the Northern Sea Route. However, the shallow waters in the seaports of Ust-Kara and Amderma will require additional costs for infrastructure development.

#### Revival of polar aviation

The city of Vorkuta has an airport which is operated JSC Komaviatrans. The airport is able to receive aircrafts like L-410, Antonov An-12, Anotonov An-24, Antonov An-26, Ilyushin Il-18,

<sup>5</sup> Parsadanian, S. The payback of the construction project of the Bovanenkovo–Sabetta railway line is laid down in the terms of the PPP agreement. RZD-Partner. Opinion. [Electronic resource]: <http://www.rzd-partner.ru/rzd-transport/opinions/okupaemost-proekta-stroitelstva-zheleznodorozhnoy-linii-bovanenkovo-sabetta-zalozhena-v-usloviyakh-s>.





**Fig. 3. The structure of the car fleet of the urban district of Vorkuta at the end of 2015. Developed by the authors [13, p. 4].**

Ilyushin Il-11, Yakovlev Yak-40, Yakovlev Yak-42, Tupolev Tu-134, CRJ-100 / 200, ATR-42, EMB-120ER, etc., as well as helicopters of all types and has limitations (natural) for the length of the runway. The capacity for arrivals / departures is two aircraft per hour, the average daily passenger traffic is 143 people; the average daily volume of freight transportation is 1,932 tons<sup>6</sup>.

Currently Komiaviatrans (Embraer ERJ-145) and RusLine (Bombardier CRJ 100/200) airlines carry out regular air transportation between Vorkuta and Moscow and Syktyvkar.

The existing capacities of Vorkuta airport fully satisfy the modern requirements for air transportation. The disadvantage of the airport is the technical impossibility of using of larger aircrafts for regular flights.

With the increasing intensity of shipping along the Northern Sea Route, the need for ice reconnaissance to determine the easiest, shortest and safest route for ships in ice increases, besides there is a need to patrol the 200-mile economic sea zone, to survey fish stocks. This is impossible without the revival of the Arctic (polar) aviation, one of the main bases of which should be Vorkuta transport hub.

Such placement will allow to control the territory on An-24 type aircraft (with a range of about 2000 km) from Murmansk in the west and almost to the Vilkitsky Strait in the east. More modern aircrafts, such as An-74 and An-140, have a range of more than 2500 km, and with a maximum fuel load – more than 3000 km. It should be noted that the straight line distance from Murmansk to the beginning of the Northern Sea Route (Karsky Gate) is about 1000 km, which is at the limit of the effective radius of the most common Arctic aircraft – An-24 (Pic. 2).

It is planned to replace the An-24 aircrafts by Il-114-300 twin-engine turboprop aircraft that will be produced from 2021. This aircraft will have passenger capacity of 64 seats and a flight range of 2100 km. Besides passenger version, medical, ice reconnaissance and fish resources patrolling versions might be manufactured, for which the flight distance with a maximum fuel reserve will be 4800 km, and with the installation of an additional fuel tank – 5600 km.

In order to improve the quality of work of Vorkuta Arctic Complex Emergency Rescue Center of the Emergency Situations Ministry, emergency response to emergencies in the region and possible man-made

<sup>6</sup>List of documents of Vorkuta airport. [Electronic resource]: <http://www.komiaviatrans.ru/airport/docs.php?id=5&m>.

disasters in the area of the hub it is necessary to arrange for a permanent base of the helicopters of the Emergency Situations Ministry aviation, and possibility to base its heavy aircrafts in case it can be required.

The availability of emergency medical care, especially for people living in hard-to-reach areas, can be significantly increased if there is an air ambulance service at Vorkuta Airport, the services of which are currently provided by Mi-8 helicopter based in the city of Pechora. This would allow to reduce the time of evacuation of patients from 6 to 2–3 hours and reduce the cost of a medical visit by about two times<sup>7</sup>.

#### **Combinations with road transport**

Vorkuta area has no direct road connection with other cities of the Komi Republic, either access to the federal highways.

At the end of 2015, 22,8 thousand cars were registered in the urban district of Vorkuta. The structure of the car fleet by type is presented in Pic. 3

Citizens own most of the vehicles (91,5 %). They own 95,9 % of passenger cars, 35,6 % of trucks and 29,7 % of buses [13, p. 5].

To provide the fleet with fuel, there are six petrol stations in Vorkuta, including one natural gas station.

The activities of road transport are characterized mainly by a decrease in performance. Thus, the volume of freight transportation in 2015 was 96,6 %, and the freight turnover was 55,8 % as compared to the results of the previous year. Low fleet utilization rates (51,4 %) and mileage utilization rates (22,7 %) indicate inefficient operation of road freight transport. The number of public municipal bus routes decreased from 43 (2014) to 36 (2015), and the number of passengers transported to 2,7 million people (81,4 % compared to 2014) [13, pp. 14–17, 19].

The road infrastructure has low density of local public roads (all surfaced) – 5 km/1000 km<sup>2</sup> of the territory, while Syktyvkar has 103,4 km/1000 km<sup>2</sup> of the territory. The length of these roads is 119 km, of which in 2015 28,6 % did not meet regulatory requirements [13, pp. 26–27]. In the cold season, the «winter roads» connect Vorkuta with Ust-Kara and Labytnangi.

As part of the project for construction of Bovanenkovo–Ukhta trunk pipeline system, a technological highway was constructed connecting three compressor stations from Vorkuta to the coast of the Baydaratskaya Bay. It is used to carry cargo and shift personnel to service facilities.

While the road network of Vorkuta has no direct access to the republican and federal highways, it is connected with them by rail. Automobiles, like other wheeled vehicles, are transported between Vorkuta and Ukhta on railway platforms, and arrive at Ukhta station on their own. To improve the current situation, there is a project «Construction of Syktyvkar–Ukhta–Pechora–Usinsk–Naryan-Mar highway with access to the cities of Vorkuta and Salekhard» [14, p. 145], the implementation of which has begun.

#### **Along pipes to Europe**

The system of gas pipelines is one of the most efficient types of transport operating in the territory of the Komi Republic [15, p. 196]. Bovanenkovo–Ukhta gas pipeline passes via Vorkuta transport hub, this pipeline delivers gas from Bavanensky and Kharasaveisky fields of Yamal

<sup>7</sup>Komi State Council voiced arguments about the need to create medical aviation base in Vorkuta. [Electronic resource]: <http://www.komionline/node/79760>.

<sup>8</sup>PJSC Gazprom. Bovanenkovo field. [Electronic resource]: <http://www.gazprom.ru/projects/bovanenkovskoe>.

to Europe [16, p. 41]. To ensure the technological process, nine compressor stations are provided, two of which are located in Vorkuta area.

Compressor stations KS-3 «Gagaratskaya» (located 70 km north of Vorkuta) and KS-4 Vorkutinskaya (located 30 km south of the city) maintain pressure of 11,8 MPa in pipelines with a diameter of 1420 mm using gas-pumping units GPA-25. The design pumping capacity is 115 billion m<sup>3</sup>/year with the prospect of an increase to 140 billion m<sup>3</sup>/year<sup>8</sup>.

**Conclusion.** The results of the study show that the current socio-economic situation of Vorkuta logistics and supporting zone, determined by number of inhabitants and state of industry, has sufficient transport infrastructure capacity, but to fulfill the plans for development of the Arctic area, it is necessary to enhance the transport hub, that is possible through implementing the projects mentioned in the article. Each mode of transport will perform its important functions:

- railways have to transport main volumes of freight and passengers, to provide delivery of the mineral resources from the Urals to the European part of the country, to arrange transport approach to new sea ports on the Arctic coast, to assist in redistribution of the traffic flows through the Trans-Siberian Railway;
- air transport is to facilitate the links of Vorkuta area with other regions of the country, to ensure safety of the Northern Sea Route operation (patrolling, ice reconnaissance), prompt response to emergency situations, provision of medical assistance to the population;
- road transport is to service enterprises, organizations and residents of Vorkuta, to transport goods and passengers to objects outside the city;
- pipeline transport is to maintain continuous gas transit through Vorkuta logistics and supporting zone.

## REFERENCES

1. Kondratov, N. A. Features of development of transport infrastructure in the Arctic zone of Russia [Osobennosti razvitiya transportnoi infrastruktury v arkticheskoi zone Rossii]. *Geograficheskiy vestnik*, 2017, Iss. 4, pp. 68–80.
2. Porfiriyev, B. N., Voronina, S. A., Semikashov, V. V. [et al.]. The implications of climate change for the economic growth and development of particular sectors of the economy of the Russian Arctic [Posledstviya izmeneniya klimata dlya ekonomicheskogo rosta i razvitiya otdelnykh sektorov ekonomiki rossiiskoi Arktiki]. *Arktika: ekonomika i ekologiya*, 2017, Iss. 4, pp. 4–17.
3. Porfiriyev, B. N. Nature and the economy: the risks of interaction (environmental and economic essays) [*Priroda i ekonomika: riski vzaimodeystviya (ekologo-ekonomicheskije ocherki)*]. Moscow, Ankil publ., 2011, 352 p.
4. Pilyasov, A. N. Cities of the Russian Arctic: comparison by economic indicators [Goroda rossiiskoi Arktiki: sravnenie po ekonomicheskim indikatoram]. *Vestnik Moskovskogo universiteta. Series «Geography»*, 2011, Iss. 4, pp. 64–69.
5. Kozlov, A. V., Gutman, S. S., Rytova, E. V., Zakharov, A. N. Problems of the choice of technologies for development of the Arctic territories: the experience of Russia

and Norway [Problemy vybora tekhnologii osvoeniya arkticheskikh territorii: opyt Rossii i Norvegii]. *Modernizatsiya. Innovatsii. Razvitie*, 2015, Iss. 4, pp. 19–28.

6. Kalinina, A. A., Lukanicheva, V. P. Energy infrastructure of the Arctic city of Vorkuta: problems, directions of development [Energeticheskaya infrastruktura arkticheskogo goroda Vorkuta: problem, napravleniya razvitiya]. *News of Komi Scientific Center, Ural Branch of the Russian Academy of Sciences*, 2016, Iss. 3, pp. 129–133.

7. Fauzer, V. V., Lytkina, T. S., Panarina, I. A. Vorkuta urban district in the Arctic area of Russia: population dynamics and population reproduction characteristics [Vorkutinsky gorodskoy okrug v arkticheskoy prostranstve Rossii: dinamika chislennosti i osobennosti vosproizvodstva naseleniya]. *News of Komi Scientific Center, Ural Branch of the Russian Academy of Sciences*, 2017, Iss. 4, pp. 123–131.

8. Kaplan, A. V., Pikalov, V. A., Sokolovsky, A. V., Shipunov, A. P. Evaluation of the prospects for development of coal mining in Pechora basin [Otsenka perspektiv razvitiya ugledobychi v Pechorskoy basseine]. *Rodnik budushchego*, 2010, Iss. 2, pp. 12–15.

9. Shamrikova, E. V., Vanchikova, E. V., Ryazanov, V. A., Kazakov, V. G. Snow and soil cover near the cement plant [Sostoyaniye snezhnogo i pochvennogo pokrova vblizi tsementnogo zavoda]. *Voda: khimiya i ekologiya*, 2010, Iss. 10, pp. 46–51.

10. Antonov, E. V., Denisov, E. A., Efremova, V. A., Fadeev, V. M. Modern Problems of development of descending cities in the North-East of the Komi Republic [Sovremennye problemy razvitiya ubyuyayushchikh gorodov na severo-vostoke Respubliki Komi]. *Vestnik Moskovskogo universiteta. Series «Geography»*, 2014, Iss. 2, pp. 55–61.

11. Kiselenko, A. N. On development of the transport system of the European North of Russia [O razvitiy transportnoy sistemy evropeiskogo Severa Rossii]. *Regionalnaya ekonomika: teoriya i praktika*, 2014, Iss. 11, pp. 2–11.

12. Shaposhnikov, N. A., Olenev, A. V., Ignatkin, C. N. Inspection of deformed areas of the roadbed on the line Inta–Vorkuta, Chum–Labytangi of the Northern Railway [Obsledovanie deformiruyushchikh uchastkov zemlyanogo polotna na linii Inta–Vorkuta, Chum–Labytangi Severnoy zheleznoi dorogi]. *Internet-Bulletin of VolgGASU. Series «Polythematics»*, 2011, Iss. 3. [Electronic resource]: <http://vestnik.vgasu.ru/?source=4&articulo=635>. Last accessed 30.11.2018.

13. Road transport activity in the Komi Republic in 2015 [Deyatelnost' avtomobilnogo transporta v Respublike Komi v 2015 godu]. *Statistical Bulletin No. 04–110–116/5*. Syktyvkar, 2016, 32 p.

14. Kiselenko, A. N., Malashchuk, P. A. Development scenarios for land transport of Russian North-Eastern European and Northern Transural areas. *World of Transport and Transportation*, Vol. 13, 2015, Iss. 4, pp. 138–153.

15. Fomina, I. V. Efficiency of the transport of the northern region [Efektivnost' funkcionirovaniya transporta severnoy regional]. *Transport of Russia: problems and prospects. Materials of the international scientific-practical conference. St. Petersburg, NGO «Professional»*, 2013, pp. 195–197.

16. Timonina, N. N., Nikonov, N. I. Development strategy of the oil and gas complex of the Komi Republic [Strategiya razvitiya neftegazovogo kompleksa Respubliki Komi]. *Georesursy*, 2013, Iss. 3, pp. 39–44. ●

Information about the authors:

**Kiselenko, Anatoly N.** – D.Sc. (Eng), D.Sc. (Economics), professor, head of the laboratory of transport problems of the North Institute of Komi Scientific Center, Ural Branch of the Russian Academy of Sciences, Syktyvkar, Russia, [kiselenko@iespn.komisc.ru](mailto:kiselenko@iespn.komisc.ru).

**Malashchuk, Petr A.** – Ph.D. (Eng), senior researcher of the laboratory of transport problems of the North Institute of Komi Scientific Center, Ural Branch of the Russian Academy of Sciences, Syktyvkar, Russia, [translab@iespn.komisc.ru](mailto:translab@iespn.komisc.ru).

Article received 30.11.2018, accepted 20.12.2018.

