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COMPARATIVE ANALYSIS OF VEHICLES AND STATIONARY SOURCES IMPACT ON THE ATMOSPHERE IN A BIG CITY

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The paper provides the analysis of the results of a multi-year monitoring of pollutant emissions from motor vehicles and stationary sources recorded in Rostov-on-Don. Conclusions on the composition, structure and scope of these emissions are drawn. The authors prepared a database covering 2009-2016 years to build mathematical models of atmospheric air pollution.

Keywords: atmospheric air, surface layer, sources of pollution, motor vehicles, stationary sources, ecology.

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СРАВНИТЕЛЬНЫЙ АНАЛИЗ ВОЗДЕЙСТВИЯ АВТОТРАНСПОРТА И СТАЦИОНАРНЫХ ИСТОЧНИКОВ НА АТМОСФЕРУ В БОЛЬШОМ ГОРОДЕ

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Проведён анализ результатов многолетнего мониторинга выбросов загрязняющих веществ в атмосферу от автотранспорта и стационарных источников, зафиксированных в Ростове-на-Дону. Сделаны выводы по составу и объёму выбросов. Подготовлена база данных за период 2009–2016 годы для построения математической модели загрязнения атмосферного воздуха.

Ключевые слова: атмосферный воздух, приземный слой, источники загрязнения, автотранспорт, стационарные источники, экология.

Introduction. Combustion of hydrocarbon and various types of alcohol-containing fuel in automobile internal combustion engines producing toxic products pollutes the air. This leads to the deterioration of environmental condition in large industrial cities, climate change, the disruption of equality in the ecosystem of the region and the deterioration of health of the people living on this territory.

Main part. In Rostov-on-Don, the share of emissions from motor vehicles in total emissions into the atmosphere has increased from 61.1% in the mid-1990s to 97.9% in 2014

The composition of air pollutants in Rostov-on-Don for two periods: 2009-2014 and 2014-2016 [1-3] was studied by statistical methods [1-3]. According to the results of the study, a database was created for the development of a mathematical model of pollution of the atmosphere surface layer by vehicles. The diagrams (Fig. 1, 2) show the results of air emissions analysis in Rostov-on-Don.

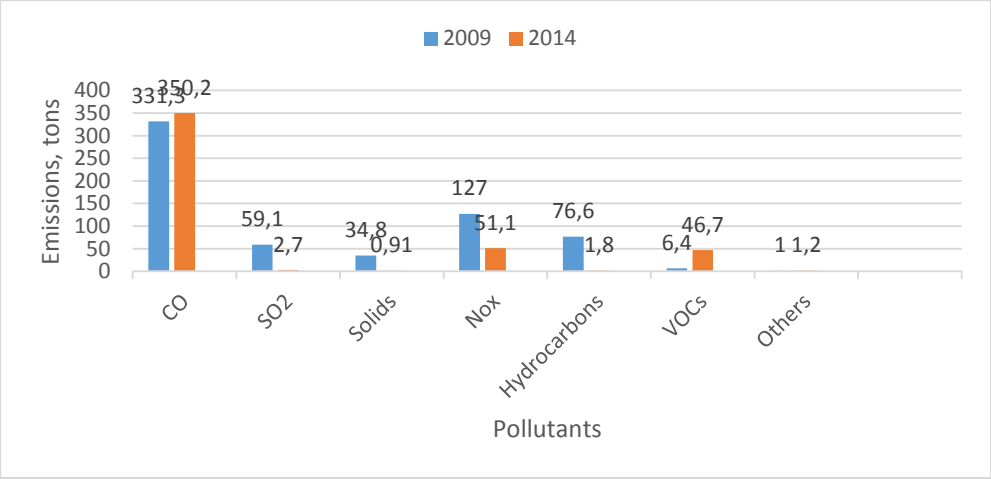

Fig. 1. Composition of pollutants emissions into the atmosphere in 2014 compared to 2009

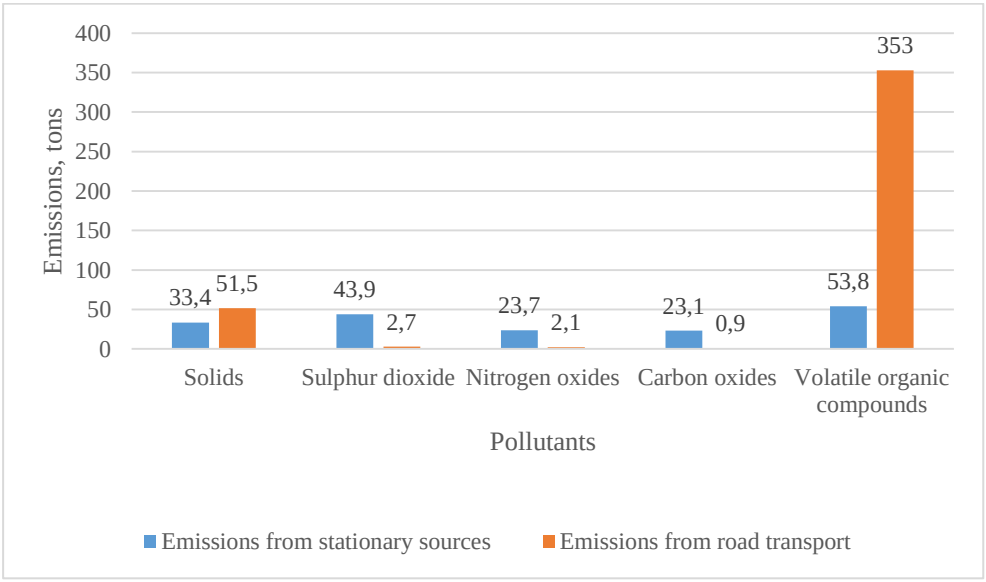

Fig. 2. Composition of pollutants emissions into the atmosphere in 2014 compared to 2009

The diagrams (Fig. 3, 4) show the specific contribution of motor transport to the dynamics of gross emissions (thousand tons) of pollutants into the atmosphere from stationary and mobile sources of pollution in Rostov-on-Don in 2009-2016.

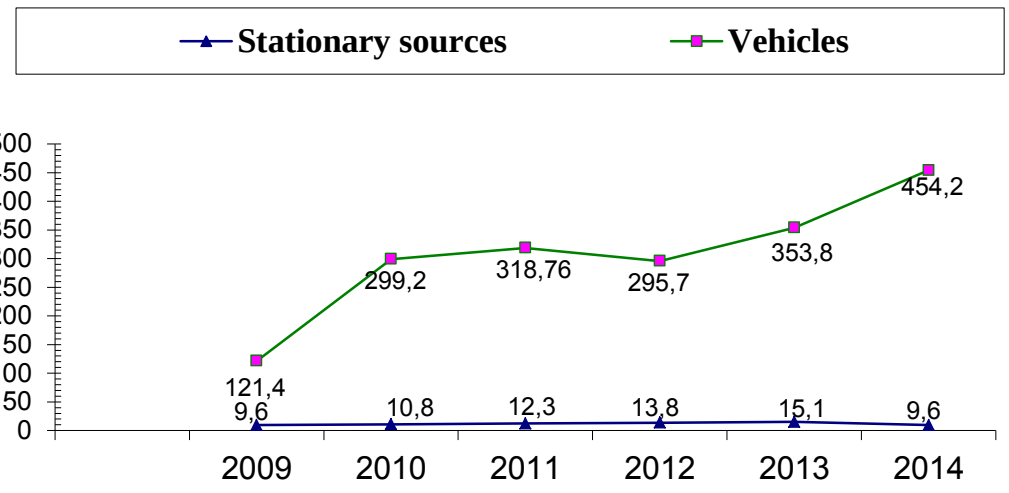

Fig. 3. Air emissions in Rostov-on-Don (thousand tons) in 2009-2014

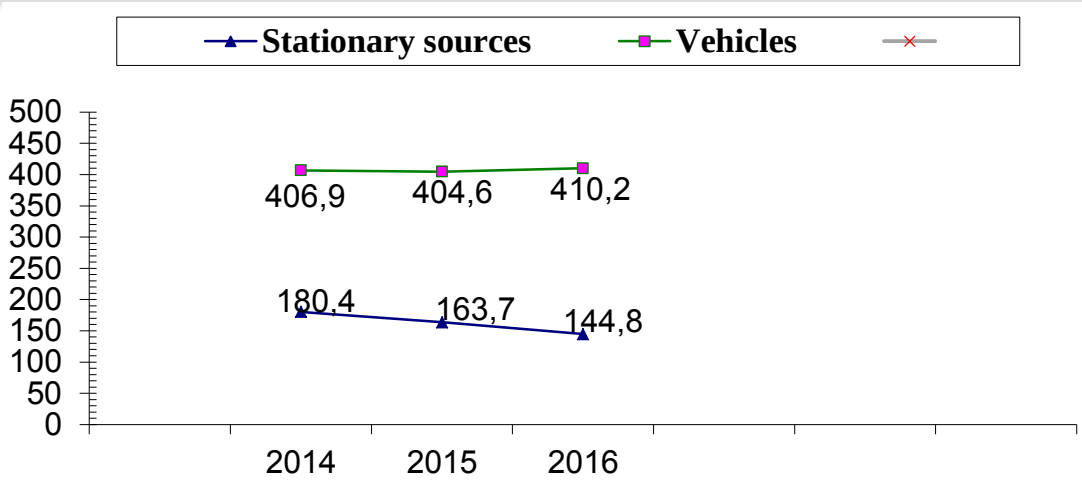

Fig. 4. Air emissions in Rostov-on-Don (thousand tons) in 2014-2016

Over the study period, there were two stages in the development of environmental protection in relation to the level of air pollution by vehicles. At the same time, the chemical composition of emissions depends on the growth of qualitative and quantitative composition of the vehicle park, as well as on the established requirements for imported cars, the requirements for their quality and compliance with environmental safety, and, finally, the requirements for the quality of hydrocarbon fuel produced in our country for cars [4-14].

In Rostov-on-Don in 2009-2014, there was a sharp increase in vehicles emissions. The emissions include carbon oxides, phenol, formaldehyde, other volatile organic compounds, as well as soot. All this is related directly to the significant increase in the operated fleet of vehicles and their non-compliance with the environmental requirements. At the same time, there is a decrease in the level of pollution with sulfur dioxide, nitrogen oxide, hydrogen sulfide and benzpyrene. During 2014-2016, the situation changed for the better. The growth of emissions into the atmosphere from road transport slowed down, which clearly demonstrates the effect of the decisions taken at the state level to limit the import of second-hand cars and to improve the quality of hydrocarbon fuel.

Conclusion. The data obtained demonstrate the dependence of the volume and structure of emissions that pollute the atmosphere on the qualitative and quantitative composition of the city's car park. The authors intend to create a mathematical model of pollution of the atmosphere surface layer in urban conditions, which can be used to predict the dynamics of the process. The solutions to this task will contribute to the implementation of measures to reduce the negative impact of emissions on the environment, which is a priority direction of modern environmental policy.

References

1. Gosudarstvennyy doklad "O sostoyanii okruzhayushchey prirodnoy sredy Rostovskoy oblasti v 2020 godu". Administratsiya Rostovskoy oblasti, Departament prirodnykh resursov po Yuzhnomu regionu; pod. obshch. red. V.P. Vodolatskogo, P.P. Ulyanova, M.V., Parashchenko. [State report "On the state of the environment of the Rostov region in 2000". Administration of the Rostov region, Department of natural resources in the Southern Region; under the general ed. of Vodolatskiy, V.P., Ulyanov, P.P., Parashchenko M.V.] Rostov-on-Don: LLC "Sintez tekhnologiy", 2001,136 p. (in Russian).

2. Ekologicheskiy vestnik Dona "O sostoyanii okruzhayushchey sredy i prirodnykh resursov Rostovskoy oblasti v 2009 godu". [Ecological Bulletin of the Don "On the state of the environment and natural resources of the Rostov region in 2009".] Ministry of Natural Resources and Ecology of the Rostov region. Available at: https://минприродыро.рф/projects/19/?nav-documents=page-1 (accessed: 11.04.2019) (in Russian).

3. Ekologicheskiy vestnik Dona "O sostoyanii okruzhayushchey sredy i prirodnykh resursov Rostovskoy oblasti v 2015 godu". [Ecological Bulletin of the Don "On the state of the environment and natural resources of the Rostov region in 2015"] Ministry of Natural Resources and Ecology of the Rostov region. Available at: https://минприродыро.рф/projects/19/?nav-documents=page-1 (accessed: 11.04.2019) (in Russian).

4. Ekologicheskiy vestnik Dona "O sostoyanii okruzhayushchey sredy i prirodnykh resursov Rostovskoy oblasti v 2017 godu". [Ecological Bulletin of the Don "On the state of the environment and natural resources of the Rostov region in 2017".] Ministry of Natural Resources and Ecology of the Rostov region. Available at: https://минприродыро.рф/projects/19/?nav-documents=page-1 (accessed: 11.04.2019) (in Russian).

5. Kuren, S.G. et al. Modelirovanie protsessov zagryazneniya vozdukha. [Modeling of air pollution processes.] Izvestiya Vuzov. Severo-Kavkazskii Region. Series "Natural sciences", 2014, no. 4 (182), pp. 78-81 (in Russian).

6. Zubareva, E.G., Kuren. S.G., Yurtaev, A.A. Ekologicheskiy monitoring toksichnosti otrabotavshikh gazov avtomobiley v YUFO. [Ecological monitoring of toxicity of vehicle exhaust gases in the Southern Federal District] Engineering journal of Don, 2018, no. 1. Available at: ivdon.ru/ru/magazine/archive/n1y2018/4642 (accessed: 11.04.2019) (in Russian).

7. Kuren, S.G. et al. Evolutsiya khimicheskogo sostava vybrosov zagryaznyayushchikh veshchestv v atmosfery v gorode-millionnike. [Evolution of chemical composition of pollutants emissions into the atmosphere in a city with more than 1 million inhabitants.] Engineering journal of Don, 2018, no. 2. Available at: IVD_30_Kuren_Zubareva.pdf_d2e48fd41d.pdf (accessed: 11.04.2019) (in Russian).

8. Kuren, S.G., Ryabykh, G.Yu., Yurtaev, A.A. Analiz zagryazneniya okruzhayushchey sredy na osnove matematicheskikh modeley. [Mathematical models analysis of environmental pollution.] Innovatsionnye tekhnologii v nauke i obrazovanii (ITNO-2017): materialy V mezhdunar. nauch.-prakt. conf. [Innovative technologies in science and education (ITNO-2017): materials of V international. sci.-pract. conf.] Rostov-on-Don, 2017, pp.147-150 (in Russian).

9. Kuren, S.G. et al. Razrabotka modeli, opisyvayushchey protsess zagryazneniya vozdukha. [Development of a model describing the process of air pollution.] Perspektivy razvitiya nauki i obrazovaniya: sb. trudov mezhdunar. nauch.-prakt. konf. [Development prospects of science and education: proceedings of the international. sci.-pract. conf.] Tambov, 2012, vol.13, pp. 77-78 (in Russian).

10. Kuren, S.G. et al. Puti snizheniya toksichnosti otrabotavshikh gazov avtomobiley. [Ways to reduce the toxicity of exhaust gases of vehicles.] Sovremennye tendentsii razvitiya nauki i tekhnologiy: sb. trudov VII mezhdunar. nauch.-prakt konf. [Modern trends in science and technology: proceedings of the VIII intern. sci.-pract. conf.] Belgorod, 2015, vol. 8, pp. 120-122 (in Russian).

11. Kuren, S.G., Ryabykh, G.Yu., Beluzhenko, O.V. Matematicheskoe modelirovanie i prognozirovanie atmosfernykh zagryazneniy. [Mathematical modeling and forecast of atmospheric pollutants.] Aktual’nye zadachi matematicheskogo modelirovaniya i informatsionnykh tekhnologiy: materiyaly mezhdunar. nauch.-prakt. konf. [Actual problems of mathematical modeling and information technologies: proceedings of intern. sci.-pract. conf.] Sochi, 2017, pp. 48-50 (in Russian).

12. Kuren, S.G. et al. Issledovanie dannykh dlya postroeniya matematicheskoy modeli zagryazneniya atmosfery. [Data research for the construction of a mathematical model of air pollution.] Sovremennye tendentsii razvitiya nauki i tekhnologiy: sb. trudov XI mezhdunar. nauch.-prakt. konf. [Modern trends in the development of science and technology: proceedings of XI international. sci.-pract. conf.] Belgorod, 2016, no. 2-2, pp. 134-137 (in Russian).

13. Kuren, S.G. et al. Matematicheskaya model’ zagryazneniya atmosfery. [Mathematical model of atmospheric pollution.] Innovatsionnye tekhnologii v nauke i obrazovanii (ITNO-2015): sb. trudov

mezhdunar. nauch. conf. [Innovative technologies in science and education (ITNO-2017): proceedings of the internat. sci. conf.] Zernograd, 2015, pp. 363-366 (in Russian).

14. Kuren, S.G. et al. Matematicheskaya obrabotka dannykh po zagryazneniyu atmosfery. [Mathematical processing of data on atmospheric pollution.] Dinamika tekhnicheskikh system: sb. trudov XII mezhdunar. nauch.-tekhnic. konf. [Dynamics of technical systems: proceedings of XII internat. sci.-techn. conf.] Rostov-on-Don, 2016, pp. 359-362.

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