Urban Planning Problems of Agglomerations

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Abstract. The article explores the state of the air basin of the Chelyabinsk agglomeration and gives the examples of solutions for the pollution problems from the point of view of city planning. The main features and structure of the modern urban agglomerations are considered, the methods for determining their boundaries are studied and the main problems are identified. The study of the boundaries and territorial structure of the Chelyabinsk urban agglomeration is conducted, and a general description of the territory is given. The data on the change in the volume of pollutant emissions into the atmosphere and the index of atmospheric pollution for the period 2003-2015 are given basing on the annual comprehensive reports regarding the state of the environment. The review of the world experience of city-planning actions on the decision of ecological problems is carried out. The most suitable ways for the ecological problems solving in the Chelyabinsk agglomeration are considered. The authors give recommendations for the ecological situation improving in the territory of the Chelyabinsk agglomeration.

Keywords: urban agglomeration, environmental problems, pollution, air basin, atmospheric pollution index, urban planning activities.

1. Introduction
The problem of polluting the atmosphere of the urban environment of Russian cities arose with the beginning of active industrialization in the late XIX century. The active growth of the industrial complex for decades has had a negative impact on the state of the air basin of the urban area. And if dust (suspended substances) and combustion products of the main fuels (coal, wood - carbon monoxide (II), carbon monoxide (IV)) initially appeared as the main pollutant, then in the process of rapid development of industry there appeared pollutants of more negative nature. As never before, the issue of uncontrolled air pollution became urgent in the second half of the XX century, when the growth rates of industrial production increased by many times. The active generation and consumption of electricity, the creation and use of a large number of vehicles have expanded a number of harmful factors, thereby increasing the risk of morbidity among the urban population.

The most acute issues are environmental pollution in the largest industrial centers. The high concentration of production and population, the low cultural and technical level of exploitation of technical systems, the residual principle of financing environmental programs have ultimately led many cities into "environmental emergency zones," including the cities of the Chelyabinsk region. In particular, Chelyabinsk, being one of the largest metal producers in Russia, is among the cities with the worst air pollution situation. According to Rosstat, Chelyabinsk ranks 9th among the Russian cities in terms of air pollution. In the environmental rating of the NGO "Green Patrol", as of winter 2016-
2017, the Chelyabinsk region is on the last 85th place among the subjects of the Russian Federation [1,2].

Consideration of ecological problems of urban agglomerations at the initial stages of their formation will allow in the long term to get rid of many unfavorable consequences. Preventive measures in addressing such issues are, first of all, urban planning activities.

2. Research of the state of the air basin in Chelyabinsk

The main polluters of the region's air basin are fuel power plants, coke-chemical, electrode and other enterprises of the metallurgical complex. In general, the region has more than 15 thousand industrial enterprises and organizations that are objects polluting the atmospheric air, of which more than 600 have significant emissions of pollutants into the atmosphere from more than 23 thousand stationary sources. On average, every inhabitant of the Chelyabinsk region annually drops from 150 to 500 kg of harmful substances [3,4].

The dynamics of changes in the volume of emissions of pollutants can be displayed using a graph compiled on the basis of data from the annual comprehensive reports on the state of the environment in the Chelyabinsk region. Figure 1 presents data on emissions from stationary and mobile sources in Chelyabinsk for the period from 1988 to 2015.

The chart of total emissions of harmful substances shows that during the considered period this indicator was reduced almost 2 times. That is, as a result, the trend of changes in emissions from all sources is prone to decline.

One of the main criteria determining the quality of atmospheric air is the atmospheric pollution index (API). API is a complex indicator of the degree of atmospheric pollution, calculated in accordance with the methodology as a sum of average concentrations in MPC units, taking into account the hazard class of the relevant pollutant.

Based on the information provided in the comprehensive reports on the state of the environment of the Chelyabinsk region for the period from 2003 to 2015, a graph was drawn comparing the API data of Chelyabinsk, Figure 2.
The highest level of atmospheric air pollution is observed during periods of unfavorable meteorological conditions that contribute to the accumulation of harmful impurities in the surface layer in areas subject to the influence of large industrial enterprises. Annually, the average annual concentration of benz(a)pyrene and formaldehyde in the air exceeds the maximum permissible, on average, 3-4 times in the territory of Chelyabinsk. Also, the average annual concentrations of nitrogen dioxide are most often exceeded by MPC (on average 1.5 times) [4].

Benz(a)pyrene refers to substances of the first class of danger, i.e. changes caused to them are irreversible and cannot be restored. Benz(a)pyrene is one of the most powerful carcinogens. Being chemically and thermally stable, possessing the properties of bioaccumulation, it, hitting and accumulating in the body, acts constantly and powerfully. In addition to carcinogenic, benzapyrene has a mutagenic, embryotoxic, hematotoxic effect [5-7]. Thus, the problem of atmospheric pollution from stationary and mobile sources is the most acute in the spectrum of factors for the formation of a healthy urban environment.

3. World experience of solving ecological problems of large cities by urban planning methods

The concept of providing a healthy urban environment with city-planning measures includes a list of issues to be addressed as first-priority due to their relevance against the background of a rapidly growing level of industrial production. These are issues of misuse of territories that are not subject to use for production purposes, issues of poor quality disposal and recycling of production wastes and uncontrolled emissions of gaseous substances into the atmosphere that can cause significant harm to the environment. The solution of these issues is based on the analysis of the existing state of the environment and the use of such urban planning measures as the definition of planning decisions taking into account the natural environment, the establishment of sanitary protection zones, fencing of nature protection zones from unauthorized construction of buildings and optimizing the decisions of development projects that provides favorable conditions for the urban environment [8, 9].

A clear example of the removal of industrial enterprises outside the city is St. Petersburg. In the late 1990s, there began the process of relocation of some enterprises from the central part of the city and the subsequent development of the liberated territories by public and business facilities [10]. A vast world practice is the re-mastering of disturbed and previously used territories. Germany has made great progress in this direction, where rehabilitation of abandoned areas has become an integral part of the urban planning process. State support of such initiatives gives tangible results and is one of the main factors of sustainable urban development. However, the state does not fully finance such projects, but only creates the necessary conditions for attracting investments and controls compliance with law enforcement measures and spending allocated funds.
This practice in urban planning is very common and enjoys the support of world organizations to combat environmental problems. In this regard, we can say that the development of the ecology of the urban environment is inextricably linked, primarily with support from the state, ensuring the investment potential of urban development projects and attracting the general public.

4. City-planning ways to solve environmental problems in the Chelyabinsk agglomeration

The existing situation on the territory of the Chelyabinsk agglomeration and the potential for its development make it possible to successfully apply the presented methods of solving the environmental problem, but the development and implementation of high-quality and effective measures most appropriate under these conditions require significant funding and thus a rational approach in selecting the most problematic sites and facilities. These are the following settlements and their problems:

- Chelyabinsk - a set of problems mentioned above;
- Kopeisk, Emanzhelinsk - the proximity of coal mines and related problems (coal dust and gas, mountain dumps and waterlogging of soils);
- Korkino, Rosa - dust, emissions of gases from the Korkino section;
- Emanjelinka, Argayash, Roshchino - smell and pollution from the poultry farm;
- Dolgoderevenskoye, Miasskoe - the state of the Miass River after Chelyabinsk takes a critical character;
- Etkul, the Etkul district - there is no quality drinking water [3,11-13].

Residential buildings in Chelyabinsk are actively developing in the south-western, western and north-western directions. This is accompanied by a gradual decrease in the area of natural areas and forest areas located to the west of the city and are one of the key factors to ensure a healthy and supportive environment, in terms of the purity of atmospheric air. To the south-west of Chelyabinsk, in the immediate vicinity of the city's main water supply, is the planned location of the Tominsky ore mining and processing enterprise, which in the future is a major threat to water, air and soil pollution. Residents of the city are extremely negative about this perspective. The problematic situation is aggravated by the fact that Chelyabinsk, so experiencing an acute air pollution problem, also needs to attract investments.

With reference to the territory of the Chelyabinsk agglomeration and the city of Chelyabinsk, the following most effective urban planning measures are worth mentioning:

- Integrated, stage-by-stage sanation of the city's territory, removal of the most problematic enterprises outside the city;
- Restriction of placement of new industrial enterprises in the city;
- Restoration and reuse of disturbed territories;
- Elimination or disposal of problem dumps or rational approach to their maintenance and use;
- Reduction of the pollution load on the city's water resources.

The above urban planning measures are reflected in Figure 3.

5. Conclusion

Currently, an action plan is being developed and research is underway. Local problems, assessment of the impact of enterprises on the environment are being studied, and the search and development of the most appropriate solutions and activities are conducted. In particular, the commissioning of the Chelyabinsk metro will significantly reduce the load on the air basin of the city from mobile sources and improve its quality. Together with the device of intercepting parking lots, which are very common in metropolitan areas with a developed metro system, this will help to save the city center from traffic congestion. In addition, plans were voiced to stimulate the transition to electric transport and to restrict the entry of heavy equipment into the city and distribute the permissible load on atmospheric air between enterprises through quotas. But such events require significant investment and attract investment, so are effective only in the long term [14,17,18].
Figure 3. The model of the general plan of the Chelyabinsk agglomeration: a - city center; b - main transport directions; c - railway directions; d - natural territories, forest tracts; e - industrial territories; f - territory of agricultural lands; g - water bodies, water resources; h - rivers; i - international airport; j - settlements; k - prevailing wind directions, which provide the influx of clean air; l - existing enterprises - air pollutants; m - planned enterprises - air pollutants (TMP); n - directions of development of residential areas; o - directions of relocation of industrial enterprises; p - favorable territories for the development of second-order agglomerations; q - limited favorable territories for the development of second-order agglomerations; r - unfavorable territories for the development of second-order agglomerations.

Acknowledgments
The work was supported by Act 211 Government of the Russian Federation, contract № 02.A03.21.0011.

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