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To cite this article: M V Volkodaeva *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **687** 066041

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Functional zoning of urban areas with regard to environmental quality is one of ways to create more favourable conditions for life

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Abstract. The planning structure of modern cities is complex. It includes diverse functional areas. At the same time, the increase of population in cities leads to the building density growth, but this process has its limits. Consequently, the adoption of new urban planning decisions on the functional zoning should be based on the objective assessment of the quality of the environment. In this regard, an important role belongs to the development of ecological monitoring systems, which should provide the most reliable information about the negative impact on the environment. The article describes different functional zones of cities, their properties and requirements for their environmental quality control.

1. Introduction

Various factors are involved in the creation of a city. These factors that are fundamental in this process and directly affect its growth are called city-forming. Accordingly, enterprises that were the cause of the emergence of a city and the significance of which goes beyond its limits are called city-forming enterprises.

The planning structure of modern cities is complex and diverse. It includes the following functional areas: industrial, residential and recreation areas, sanitary protection and traffic zones, storehouse and public utilities zones.

The industrial zone is designed to accommodate industrial enterprises and related facilities. The sanitary protection zone is designed to reduce the negative impact of industrial and transport facilities on the population. Residential zone is designed to accommodate dormitory areas, public centers (administrative, scientific, educational, medical, etc.), green spaces. Recreation area includes city parks, places of tourism.

In the conditions of an acute shortage of residential lands, city planners follow the path of maximum building intensification: the number of floors is increasing; fundamentally new structures of residential houses and public buildings are being created. However, the possibilities of increasing the building density are not limitless. The adoption of urban planning decisions on the functional zoning of urban areas, the need for expensive environmental measures, and the evaluation of the taken measures effectiveness should be based on an objective assessment of the quality of the environment. In this regard, such an important role belongs to the development of systems for environmental monitoring of environmental quality, which should provide the most reliable information about the levels of exposure of various sources to environmental components [1-3].



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2. Results and discussion

Industrial zones are formed taking into account production and technological, transport, sanitary and functional requirements. The location of enterprises in the industrial zone, their assignment to the appropriate classes depending on the sanitary classification of production and occupational hazards, as well as the establishment of the size of sanitary protection zones should be done in accordance with the requirements of construction codes and regulations. The requirements for environmental quality in the areas of industrial zones [4,5] differ from the requirements for residential areas. [6-9]. Site designs of industrial zones are developed taking into account town planning requirements [10]. The most hazardous enterprises, including explosive and fire hazardous ones, are located far from the residential zone, and on the leeward side, meaning that the prevailing winds blow from the residential area to the industrial one. For this purpose the average annual wind rose or one of the seasonal wind roses (summer, winter), obtained on the basis of long-term observations, is taken into account. Industrial areas with enterprises that pollute the water are located downstream, below the residential and recreation areas.

For the cost-effective use of utility lines, repair, energy and transport facilities, individual industrial enterprises are currently grouped into complexes. However, this complexation has some drawbacks associated with excessive concentration of industrial enterprises and, as a result, the summation of harmful effects. Therefore, some sanitary indicators should be taken into account in addition to technological parameters in the process of grouping enterprises. Enterprises, emitting aggressive gases and dust, should be removed from other enterprises in order not to put workers and the products they produce at risk of adverse influence.

In accordance with the Section 30 of the Federal Law No.96-FZ "On the Protection of Atmospheric Air", enterprises must register emissions of harmful (polluting) substances into the atmospheric air and their sources, conduct production control over compliance with the established standards for emissions of harmful (polluting) substances into atmospheric air [11]. Each enterprise is an object of the first, second or third category, depending on the negative impact on the environment. It develops and approves a program of industrial environmental control in accordance with the order of the Ministry of Natural Resources and Environment of the Russian Federation No.74 "On approval of the requirements for the content of the environmental monitoring program, the procedure and deadlines for reporting on the organization and the results of the implementation of industrial environmental monitoring". This program contains information about the emission inventory and the frequency and methods of industrial environmental monitoring [12].

During the industrial emissions control, the following parameters of the gas-dust mixture are determined: temperature, pressure, humidity, velocity, concentration of pollutants (marker for the enterprise). The need to measure the above mentioned aerodynamic parameters is caused by the fact that volumes of waste gases from emission sources, as well as measured pollutant concentrations, require correction and reduction to normal conditions (0°C, 101.3 kilopascals and dry gas). The measurement of these parameters is regulated by the relevant state standards [13,14]. The measurement of the moisture content of a gas-and-dust mixture is carried out in accordance with State Standard No.17.2.4.08 [15]. The lack of consideration of this parameter can lead to significant overestimations of pollutant emissions [16]. The control of the pollutants concentrations in industrial emissions is carried out strictly in accordance with the measurement method, which in most cases involves sampling a gas-air mixture directly at the emission source and then transporting the samples to the laboratory where they are analyzed. However, in connection with the adoption of the Federal Law 7-FZ "On Environmental Protection" in 2018, enterprises must equip their stationary sources with automated monitoring systems. These systems provide an opportunity to monitor atmospheric releases in real time and quickly react to an emergency pollutant concentration increase [17,18].

Sanitary protection zone is a zone of space and vegetation, which is situated between an industrial enterprise and a residential area. Sanitary protection zone provides space for safe dispersion of hazardous industrial waste [19]. The width of the sanitary protection zone is defined as the distance between the industrial site and the residential area and calculated on the basis of air pollution

distribution, the presence of self-cleaning processes in the atmosphere, and the standards for maximum allowable concentrations of pollutants. Planting the industrial enterprise territory and sanitary protection zones is linked to the system of green spaces and natural greenery in the surrounding area, as well as to the surrounding landscape. The sanitary protection zone organization does not exclude the need for equipping enterprises with wastewater treatment plants, but is an additional measure for the purpose of pollution control.

Ambient air monitoring and observations of physical parameters at the sanitary protection zone boundary are an integral part of industrial environmental control. The number of measurements is determined according to the observation program approved as part of the sanitary protection zone project. Different requirements concerning the duration and frequency of the environmental monitoring are set for objects of different hazard classes. For example, for objects of the first and second classes the required amount of in-situ measurements should include at least 50 days for each substance at each point, while for objects of the fifth class - at least 10 days. The list of measurement parameters is also determined during the sanitary protection zone planning and depends on the specifics of the enterprise's operation and the nature of the impact on the environment. For each production, its own characteristic substances are identified and included in the observation program [20]. Moreover, the noise levels must be determined at the sanitary protection zone boundary in all cases.

Generally, measurements are carried out in accordance with Guiding Document No.52.04.186-89, where the techniques involve sampling at monitoring sites and transporting them to a specialized laboratory for further analysis [21]. Also, the environmental monitoring at the sanitary protection zone boundary should be conducted as specified in "List of indicators and data for the formation of the Federal Information Fund for Social Hygienic Monitoring", approved by order of Rospotrebnadzor dated December 30, 2005 No.810, by order of Rospotrebnadzor dated November 17, 2006 No.367 "On the procedure of social and hygienic monitoring, data presentation and exchange", letters of Rospotrebnadzor No.0100/10460-06-32 "On the organization of laboratory control during the social and hygienic monitoring" from 02.10.2006 and No.0100/4317-06-32 "On the organization of sanitary protection zones" dated 04.17.2006.

In a residential area, the construction of industrial, transport and other enterprises that pollute the environment is prohibited [9]. The living area is placed on the windward side for the winds of the prevailing direction, as well as upstream in relation to industrial and agricultural enterprises with technological processes, which are the sources of harmful substances releases into the environment. The prevailing wind direction is determined by the average wind rose of the summer and winter periods of the year (taking into account the daily variation) on the basis of long-term observations by hydrometeorological stations. In areas with the opposite direction of the prevailing winds in the summer and winter periods of the year, residential areas are located to the left and to the right of the indicated wind directions in relation to industrial enterprises.

The increase in the number of industrial enterprises and, consequently, the increase in emissions of toxic substances in the urban agglomerations, has a negative impact on the quality of atmospheric air and the state of the environment at large. As a result of technological development of cities, industrialization processes, urbanization and westernization of the population, toxic emissions from industrial enterprises spread over considerable distances from their sources, thereby upsetting the ecological balance of country areas (nature reserves, forests). In this regard, there is a need for continuous monitoring of the air pollution level outside the urban areas and outside the zone of industrial enterprises activity.

Pollution, which is formed due to the interference of distant transfers of toxic substances, is called background. According to [21], background monitoring is an integral part of the global environmental monitoring system and the unified state system of atmospheric pollution monitoring in Russia. The background monitoring station is a closed-type pavilion, which is located at the observation site and includes a chemical laboratory. Station locations should be representative of the region of observation. Background stations should be located in the cleanest places, where will be no significant changes in

land use practices within 100 km from it in all directions during the next 50 years. The main aim of background stations is to monitor the state of atmospheric air in places remote from local sources of environmental pollution.

The list of pollutants measured by background monitoring stations is based on the physicochemical parameters of the atmosphere, the main of which are: the prevalence and sustainability of toxic substances in the environment. Background monitoring stations monitor ozone, nitrogen and carbon monoxide, suspended particles, sulphates, organochlorine compounds and heavy metals. The data obtained during the background monitoring provides an opportunity to adapt urban agglomerations taking into account the quality of the environment.

The main structural element of the residential area of cities and towns is considered to be a neighborhood. Within the microdistrict, apart from residential buildings, there are institutions and enterprises of primary service. The territory of neighborhoods should be crossed by the main and local streets. Dormitory areas are also formed in the residential area of cities. These areas consist of microdistricts, connected by a community center with institutions and service enterprises of regional significance. Formation of residential areas is carried out taking into account the division of the residential area into areas by natural and artificial boundaries (rivers, canals, ponds, green spaces, railways and others).

The recreation area includes city parks, forest parks, sports complexes, beaches, holiday villages, resorts, and places of tourism, where the strict requirements for environmental quality should be satisfied [8,9].

3. Conclusion

The increase in population concentration in large cities is accompanied by an increase in building density and the number of floors in buildings, a reduction in areas for service institutions and landscape areas, an incorrect functional zoning of a residential area, a noise level increase in residential buildings, outdoor territory, in micro-districts and neighborhoods.

In view of urban population increase, urban planners embark on a course of increasing the building density and the development of suburban areas; however, these measures have limitations. It is necessary to conduct an assessment of the quality of the environment before making various urban planning decisions. Consequently, it is necessary to develop an environmental monitoring system that involves automated control systems, which should provide the most reliable information about the levels of environmental impact. Otherwise, unreasonable decisions on the development of one or another territory of a city will be taken, which may require the implementation of expensive environmental protection measures in the future.

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