

# Environmental Problems of Industrial Territories

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**Abstract.** At the present stage, one of the key tasks of mankind is the solution of environmental problems associated with the production of industrial products. A harmonious combination of scientific and technological progress and the protection of the ecosphere can be realized through the development of a circular economy, the introduction of "green" industrial technologies, and the development of effective methods for restoring industrial areas. Within the framework of this article, environmental problems of industrial territories are considered and the main directions for their solution are proposed.

## 1 Introduction

An industrial territory is a territory of predominant location of various production facilities, as well as engineering and transport infrastructure facilities that ensure their efficient functioning [1]. Industrial territories can have different scales - from a small industrial site and a quarter to a large industrial and residential area and a technology park.

An industrial site is a fenced area for the location of industrial, administrative and auxiliary buildings and structures of one industrial enterprise. An example is the industrial site of the Mosinzhbeton plant. An industrial quarter is a production area within an urban environment, bounded on all sides by highways, streets or driveways. On the territory of the industrial district there is usually one large or several small adjacent manufacturing enterprises. An example of an industrial quarter is Medvedkovo 51-II with an area of 76.47 hectares, located in the South Medvedkovo district of Moscow.

The territories of several interconnected industrial enterprises with a single engineering and transport infrastructure form an industrial hub. Industrial nodes usually form enterprises of the machine-building, petrochemical and metallurgical industries. So, for example, an enterprise for the production of power equipment, a small repair company, an electrical appliance plant, a cable plant and a district power plant and other similar enterprises can be combined into an industrial hub.

## 2 Materials and Methods

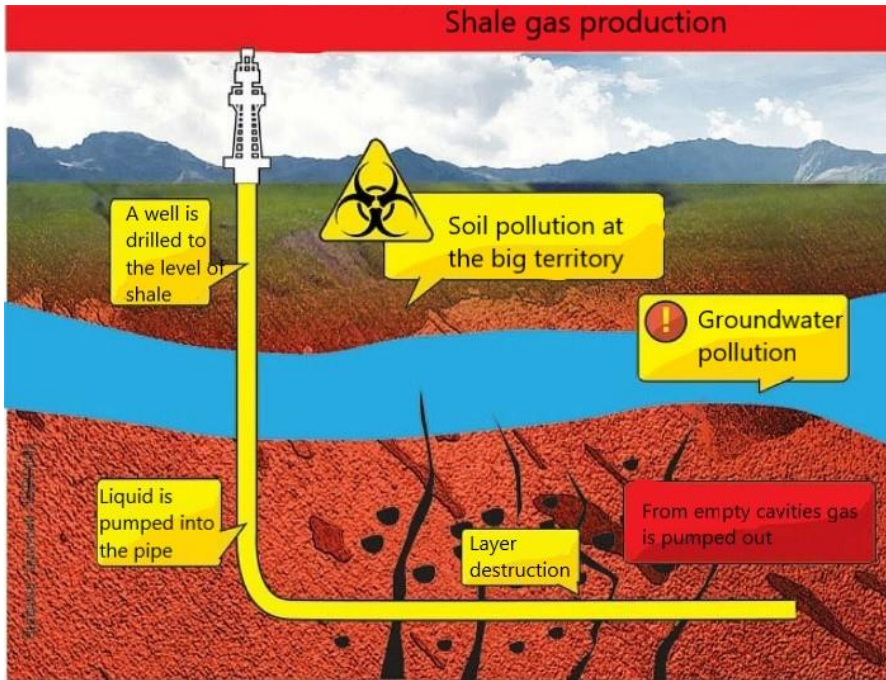
A large-scale territory with a clearly defined industrial and production specialization is called an industrial region. To simplify the access of workers to enterprises in such areas, residential zones are allocated, that is, land for the construction of residential and public buildings, which turns such territories into industrial and residential zones or zones of mixed use. On the territory of these zones, sites are allocated for the placement of communal facilities of citywide significance, as well as small businesses.

A special category of industrial territories for accommodating high-tech industries are technoparks that provide a territorial, scientific, technical and technological base for the implementation of innovative projects. The most famous object of this category is the Technopark of the Novosibirsk Academgorodok.

The functioning of industrial areas has an adverse impact on the environment. Simultaneously with the necessary industrial products, enterprises produce by-product chemicals that are not included in the natural biotic cycle - xenobiotics. This category includes heavy metals, polycyclic aromatic hydrocarbons, freons, pesticides. Also, industrial activity leads to an increase in the concentration of nitrogen and sulfur dioxide, surfactant ions and phenolic compounds, which adversely affects the state of the atmosphere.

Uncontrolled runoff of used water from industrial enterprises leads to chemical pollution of the hydrosphere. Inside industrial areas in rivers and lakes, elevated concentrations of toxic heavy metals such as lead, mercury, chromium, and cadmium are found. Irreversible withdrawal of surface runoff leads to the depletion of water resources, soil degradation and desertification of surrounding areas. The activity of industrial facilities can also lead to a decrease in the quality of drinking water due to the active reproduction of pathogenic microorganisms and helminths. The steady increase in the release of toxic substances into the environment also leads to premature destruction of metal structures in civil and industrial buildings.

The deformation of the geological environment as a result of subsoil use entails the transformation of the mountain range, the occurrence of landslides and karsts, and catastrophic subsidence of the earth's surface. The use of hydraulic fracturing to intensify the operation of oil and gas wells can lead to contamination of groundwater with chemicals and seismic instability. For example, the environmental impact of shale gas production on the surrounding industrial area is shown in Figure 1.



**Fig. 1.** Environmental impacts of shale gas production for industrial area [2]

### 3 Results

Thus, as a result of the extraction of shale gas by hydraulic fracturing, large areas and groundwater are polluted with substances such as benzene, ethylbenzene, xylene, and toluene.

As a result of accidents at the enterprises of the oil and gas complex, oil products can get into the water, which pollute not only the industrial territory, but the entire environment in a wide radius.

Of particular danger is radioactive contamination, which can occur in the event of a man-made accident at the enterprises of the nuclear energy complex. The main pollutants in this case are iodine-131 and cesium-137, which have a mutagenic and carcinogenic effect on humans.

Industrial pollution of the natural environment has an extremely negative impact on the viability of biological organisms. Under conditions of strong anthropogenic pressure, the quality of the vegetation cover is deteriorating, the volumes of phytoplankton and zooplankton are declining, and terrestrial ecosystems are degrading. Under the influence of various technogenic emissions, destruction of leaf tissue, seed molding, diffuse diseases, necrosis and other damage are noted in vegetation in industrial areas. Pollution of the leaf surface with dust and soot leads to a reduction in the productivity of photosynthesis, which has an adverse effect not only on the plants themselves, but also on the environment.

The negative impact of industry is experienced by residents of industrial areas. Vibration and noise effects are felt near the factories, increased ionizing and electromagnetic radiation is noted, and dust pollution is observed. At the same time, emissions of harmful substances that affect human health, cause chronic respiratory diseases and oncological diseases represent the greatest health hazard. Medical and demographic criteria for the deterioration of the health status of the population in industrial areas are infertility problems, an increase

in perinatal and infant mortality, an increase in the frequency of congenital malformations, the occurrence of genetic mutations, and a deterioration in the immune status of people.

## 4 Discussion

Environmental problems of industrial territories are studied within the framework of a separate area of environmental science - industrial ecology. Its purpose is a comprehensive study of the mechanism of technogenic impact on the environment and substantiation of the standards of rational nature management, which must be strictly observed by industrial enterprises. Within the framework of industrial ecology, it is supposed to establish the structure and laws of development of ecological and economic systems, analyze their dynamics and internal relationships, as well as develop effective engineering solutions to neutralize negative deviations.

So, for example, to prevent pollutants from industrial enterprises from entering the atmosphere, planning, technological and special measures should be taken to reduce emissions and reduce their surface concentrations (Fig. 2).

### Planning activities

- the location of enterprises and other facilities on the industrial territory, taking into account the prevailing wind directions;
- location of enterprises on the site in such a way that smoke flares do not enter the residential area;
- rational arrangement of the barrier between the industrial area and the residential area in the form of a mountain range or forest, etc.;

### Technological events

- cooperation of new designed facilities with other enterprises in order to reduce the number of "dirty industries" in the territory;
- support for advanced industrial production technologies; an increase in the unit capacity of industrial units with the same total productivity;
- the use of more "clean" types of fuel in industrial production; application of flue gas recirculation in industrial enterprises;

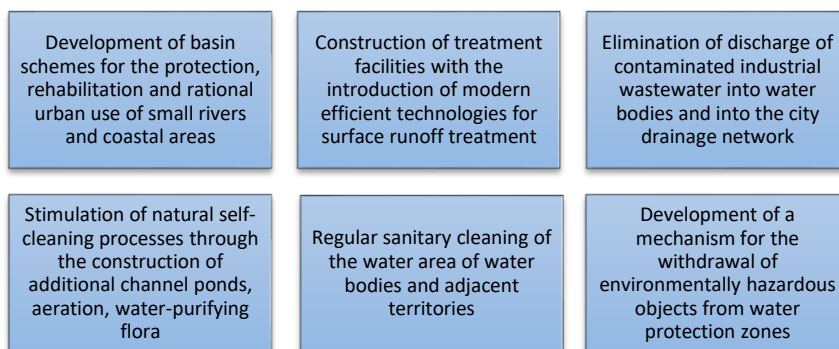
### Special Events

- reduction of fugitive emissions in the industrial area;
- purification and neutralization of harmful substances from exhaust gases;
- improving the conditions for dispersion of emissions in the industrial area.

**Fig. 2.** Directions for increasing the protection of the atmosphere of industrial areas and the natural environment

To protect the atmosphere from harmful emissions, industrial electrostatic precipitators, systems of gravitational, inertial and electric dust collectors, as well as battery-type centrifugal scrubbers, which provide wet cleaning of non-toxic and non-explosive air flows from harmful impurities, are installed on the output systems of industrial enterprises [3].

The administration of industrial territories must also take comprehensive measures to protect water bodies. For this purpose, the following main activities should be implemented (Fig. 3).



**Fig. 3.** Directions for improving the protection of water bodies on industrial areas

One of the key areas for solving the environmental problems of industrial areas is the introduction of "green" technologies - environmentally friendly technological processes, production lines and logistics that provide the most optimal parameters of resource saving, energy efficiency and environmental safety in the current conditions. At the level of individual enterprises and the industrial area as a whole, a closed cycle model can be introduced and used: "production - recycling - new production", shown in Fig. 4.



**Fig. 4.** Model of the circular economy in the industrial area

An example of the implementation of "green" technologies is the use of only recyclable types of plastic in the production, as well as the development and implementation of its biodegradable counterparts. To reduce the environmental harm of industrial production, priority should be given to the use of environmentally friendly raw materials. Such materials are characterized by the following properties: they do not deplete natural resources and do not have a negative impact on the environment and human health. "Green" materials should be made using modern environmentally friendly technologies, be durable and recyclable. Such materials must retain their properties throughout the entire life cycle and do not imply decay into elements harmful to the natural environment.

## 5 Conclusion

Of great importance is the partial reorientation of enterprises to renewable energy sources. The basic principle of the use of renewable energy is to extract it from processes constantly occurring in the environment and provide it for technical use. Renewable energy is obtained from natural resources such as sunlight, water currents, wind, tides and geothermal sources. The main advantage of renewable energy sources is inexhaustibility and environmental friendliness, their use does not transform the energy balance of the planet.

Of particular importance is the redevelopment of abandoned industrial areas to transform them from an exclusion zone into a zone of attraction. So, in Moscow, these events in 2021 were combined into a comprehensive program called "Industrial Quarters". As part of the program, about 150 territories with a total area of almost 2,000 hectares have been allocated in order to further create residential complexes, social infrastructure and public spaces on them.

To create technological processes and industries that meet environmental requirements, it is necessary to conduct a comprehensive environmental analysis of the technologies used and methods for their modernization. Such an analysis would make it possible to find vulnerabilities in production processes in terms of negative impact on the environment, as well as to improve the environmental components of production. Practice shows that the solution of environmental problems is often associated with a significant improvement in technical and economic indicators.

The creation of environmentally friendly methods and technologies is, as a rule, intersectoral in nature. A radical reduction in the negative impact on the environment is possible only with a review of decades-old ideas about the inexhaustibility of natural resources and the possibility of increasing the consumption of raw materials, which follows the growth of industrial production. Thus, in order to change the current situation, it is necessary to introduce an attitude about the inadmissibility of a negative impact on nature, to cultivate a sense of personal environmental responsibility, which implies the preservation of wildlife for future generations.

Based on the results of the study, it can be concluded that the main environmental problems of industrial areas are associated with the use and production of environmentally harmful materials, waste of resources and energy, lack of adequate purification of emissions and restoration of industrial areas. The solution to this problem is the comprehensive introduction of "green" technologies in all areas of industrial production in all industrial areas of the country.

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