Environmental Safety of Biosphere

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Abstract. The present paper researches the matter of human impact on atmosphere that is currently the focus object of specialists and environment researchers all over the World. And it is not a coincidence as the most significant environmental problems of today - the "greenhouse effect", ozone layer depletion, acid rains are in relation with the anthropogenic pollution of atmosphere. The paper also touches upon the impact of atmosphere pollution on human health and environment. There are considered various means of pollution – from direct and immediate threats (smog, etc.) to slow and gradual destruction of various organism life support systems. In many cases air pollution erodes ecosystem structural components to a degree when regulatory processes are unable to restore the initial state that causes homeostasis mechanism failure.

1. Introduction
A human – an element of biosphere. A human gets all the life resources like air, food, water and the significant part of energy and construction resources from the biosphere. And he also dumps waste, both household and industrial, to the biosphere [14, 15]. For a long time such human activity haven't disturbed the biosphere balance. Currently spontaneous methods of handling the nature impose danger to existence of not only particular objects, territories, countries, etc. but to existence of the whole humankind.

It is due to the fact that a human is closely related to wildlife by its origin, material and spiritual needs, but unlike for other organisms these relations of a human reached a scale and forms causing near-100% involvement of the planet biosphere in life support of a modern human that brings him to the edge of an environmental disaster.

Due to the mind given to a human by nature he strives to create "convenient" environment, to be independent from its physical factors like climate, lack of food, to get rid of animals and plants harmful for him (but not harmful at all for other wildlife), etc. Thus a human is different from other species primarily by that he interacts with nature through the culture created by him. But as K. Marx noted "a culture if it develops spontaneously and is not being consciously directed, then it leaves a desert behind".
2. Actuality

Only the knowledge how to handle events can stop their spontaneous development, and in the context of environment studies this knowledge shall "capture the masses", the major part of society that is only possible due to introduction of mandatory environmental education.

Protection of air is the key issue of environment rehabilitation [4]. Air holds a special position among other components of biosphere.

It is impossible to over esteem its importance for life on Earth. A human can live for five weeks without food, for five days without water and only for five minutes without air. Moreover, air shall be of particular purity while any deviation from it is a health danger.

Air fulfills an immensely complex environmental protective function saving the Earth from absolute cold of the Space and protecting it from sun radiation. In the atmosphere there run global meteorological processes, there is formed the climate and the weather, and the atmosphere stops plenty of meteorites.

The atmosphere is capable of self-cleaning. It occurs due to washing out of aerosols from atmosphere by precipitations, turbulent mixing of near-ground layer of air and due to depositing of pollutants on earth surface, etc. Nevertheless, the self-cleaning properties of nature systems are wasted nowadays. Massive impact of anthropogenic pollutants on the atmosphere resulted in occurrence of highly undesirable environmental consequences. For this reason air fails to fulfill completely its protective, temperature regulating and life supporting environmental functions [1, 2].

3. Theoretical part

Today the main contribution to pollution of air on the territory of the Russian Federation is made by the following industries: thermal generation of electric power (thermal and nuclear power plants, industrial and urban boilers, etc.), iron and steel industry, oil and petrochemical industry, roadway transport, non-ferrous metals and construction materials production.

The situation is slightly different in the West. Thus the major share of polluting emissions in 2017-2018 in the USA, Great Britain and Germany belongs to roadway transport (50-60%) while thermal generation of electric power contributed much less (16-20%).

Physiological impact of the main pollutants on human organism [17] may cause the most severe consequences. Thuswise sulfur dioxide combines with moisture producing sulfuric acid that destroys lung tissue of humans and animals. This is most vividly seen in the analysis of child lung pathology and concentration of sulfur dioxide in large cities atmosphere. According to researches of american scientists at the level of SO₂ pollution of up to 0.049 mg/m³ the rate of diseases in 2017 (in man-days) in population of Nashville (USA) amounted to 8.1%, at 0.150 - 0.349 mg/m³ it amounted to 12%, and in the regions where air pollution exceeded 0.350 mg/m³ it reached 43.8%. Sulfur dioxide is most dangerous when it deposits on dust particles and then enter the respiratory tract.

Dust containing silicon dioxide (SiO₂) causes severe lung disease called silicosis. Nitrogen oxides irritate and in severe cases even erode mucosae of, e.g. eyes, lungs, take part in formation of poisonous vapors, etc. They are especially dangerous if the air is also polluted with sulfur dioxide and other toxic substances. In this event even small concentrations of pollutants result in increased toxicity of the whole gaseous mixture due to synergy effect.

Effect of carbon monoxide on human organism is widely known. Acute poisoning manifests in general weakness, dizziness, vomiting, sleepiness, loss of consciousness and it may result in death (even after 3-7 days). However, due to low concentration of CO in atmosphere it usually causes no mass poisonings although it is very dangerous for people suffering anemia and cardiovascular diseases.

Among suspended particles the most dangerous are those under 5 μm as they can penetrate lymph glands, stay in lung alveoli and pollute mucosae.

Consequences of human organism exposure to pollutants [12, 13] (Table 1) containing in exhaust gas of cars are pretty severe and diverse ranging from cough to death.
Table 1. Effect of car exhaust on human health.

| Adverse substances          | Consequences of exposure                                                                 |
|-----------------------------|------------------------------------------------------------------------------------------|
| Carbon monoxide             | Prevent absorption of oxygen by blood thus reducing cognitive functions, slowing down reflexes, causing sleepiness and may cause loss of consciousness and death |
| Led                         | Affects blood circulating, nervous and genitourinary system causing reduction of mental capacity in children, it deposits in bones and other tissues thus it remains dangerous for a long time |
| Nitrogen oxides             | May increase organism sensibility to viral diseases, they irritate lungs causing bronchitis and pneumonia |
| Ozone                       | Irritates mucosae of breathing organs, causes cough, disturbs lung function; reduces resistance to colds; may aggravate chronic conditions of heart, cause asthma and bronchitis |
| Toxic emissions (heavy metals) | Cause oncology diseases, disturbances of reproductive system and defects in newborn children |
| Anthropogenic emissions of pollutants | in large concentrations during long period of time cause significant damage not only to humans but also adversely affect animals, plants and ecosystem in general. |

Existence of biosphere and human has always been based on the use of water [9]. Humankind has been always striving to increase water consumption thus imposing diverse pressure on hydrosphere. Water pollution manifests in change of physical and organoleptic properties (change of transparency, color, odor, taste), increase of content of sulfates, chlorides, nitrates, toxic heavy metals, reduction of the amount of oxygen in water, occurrence of radioactive elements, pathogenic bacteria and other pollutants.

4. Practical part

Russia has one of the largest water potentials in the world – over 30000 m³/year is accrued per each dweller of Russia. But today due to pollution about 70% of rivers and lakes in Russia lost their properties of sources of drinking water and it results in that over a half of the country’s population consume polluted water of low quality.

It is proven that over 400 substances may cause water pollution. If the actual value of any of the three parameters falls outside the normal range:

- toxicological sanitation;
- general sanitation;
- organoleptic properties.

Then water is deemed polluted.

There are distinguished chemical, biological and physical pollutants. The most widespread among chemical pollutants are oil and petroleum products, synthetic surfactants, pesticides, heavy metals, dioxins, etc. Biological water pollutants are of extreme danger: viruses and other pathogenic microorganisms. So are the physical pollutants like radioactive substances, heat, etc.

Processes of surface waters pollution are determined by various factors. The main of them are as follows:

1. Dumping of raw sewage to water bodies;
2. Washing of poisonous chemicals by rainwater;
3. Gas and fume emission;
4. Oil and petrochemical spills.
Table 2. Priority pollutants of water ecosystems by industry branch.

| Industry branch                        | Main type of polluting components                                                                 |
|----------------------------------------|---------------------------------------------------------------------------------------------------|
| Oil and gas extraction, oil refining   | Petroleum products, synthetic surfactants, phenols, ammonium salts, sulfides                      |
| Pulp and paper production              | Sulfates, organic substances, lignins, resinous and greasy substances, nitrogen                   |
| Timber industry                        | Petroleum products, phenols, resins                                                               |
| Chemical industry                      | Phenols, petroleum products, synthetic surfactants, aromatic hydrocarbons, non-organic substances |
| Mining industry, coal mining           | Flotation reagents, non-organic substances, phenols, suspended matters                             |

Besides surface waters the groundwaters are also continuously polluted primarily in the heavy industry regions. Pollutants may reach groundwaters by various ways: by seeping of industrial and household sewage from reservoirs, containment ponds, settlement ponds, etc., through annular space of faulty bores, through absorbing wells, sinkholes, etc.

Mineralized groundwaters or sea waters are distinguished as natural sources of pollution as they may infiltrate non-polluted fresh water sources during operation of water intake facilities and water pumping out of wells.

It is important to highlight that pollution of groundwaters is not limited only to the areas occupied by industrial enterprises, waste storages, etc. but it spreads down the flow stretching up to 20-30 kilometers and over from the source of pollution. This fact represents a real danger for drinking water supply.

Pollution of water ecosystems is a tremendous danger for all living organisms and particularly for a human. Adverse consequences of polluted water use and even contacting with it (swimming, washing clothes, fishing, etc.) manifest either immediately at drinking or after biological accumulation. In case of direct contact of human with bacterially polluted water and living or staying nearby a body of water various parasites may penetrate skin and cause severe diseases which are especially typical for tropical and sub-tropical regions. In contemporary conditions there grows the risk of catching such epidemic diseases like cholera, typhoid fever, dysentery, etc.

One of the most important issues of water protection is development and implementation of effective methods of disinfection and purification of surface waters used for drinking [6-8].

Since 1896 and till present time the method of disinfection with chlorine remains the most widespread means of combating bacterial contamination in our country. However, it turned out that water chlorination implies significant danger for human health. It is possible to eliminate the dangerous effect on human health and to reduce the amount of carcinogenic substances in drinking water be using ozone treatment or UV rays treatment instead of primary chlorination and by application of chemical agent-free methods of preliminary purification at biological reactors.

It should be noted that water treatment with ozone or UV rays almost completely replaced water chlorination at water purification stations in many countries of the Western Europe. Application of these environmentally efficient technologies in our country is limited due to high cost of re-equipment of water purification stations.

Modern technology of drinking water purification from the substances dangerous for environment – petroleum products, synthetic surfactants, pesticides, organochlorine and other substances is based on use of sorption processes with application of activated carbons or similar products like graphite mineral sorbents.
5. Conclusion
Everybody should understand that saving and multiplication of the wealth given to us by nature is possible if the human society, each person in his or her everyday activity is dedicated to the common goal of saving the biosphere.

Environmental awareness is understanding of the fact that the biosphere, production and society are unite and that the biosphere is the system that can be easily disturbed and that is much harder and costly to restore. Environmental awareness is the sense of responsibility for the nature to the society and to the nature itself as far as a human is only one of its elements [10, 11].

Nowadays the new thinking is reflected in attitude to the nature. Saving the nature has become one of the categoric conditions of saving the life on Earth. We shall introduce global standards and take active part in the international environmental cooperation [3]. We shall legislatively set forth the strictest procedure of scientific expert evaluation and consideration of public opinion for settlement of issues related to establishment of new production facilities.

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