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Greenhouse gases as a global environmental challenge at the stage of transition to a new technological order †

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Abstract: Civilizational development, the formation of a contradiction between the technosphere and the biosphere with the consequences of greenhouse effects, carried out within the framework of technological structures independent of socio-economic formations. Allocate: governing bodies and activities that provide significant growth (or control planetary environmental safety); the key factors are the technological innovations that created the sensation; carrier industries - consume consuming factors that play a key role in the spread of a new technological order. The technosphere, as the main product of civilizational development, has gone through a number of pre-industrial and at least five industrial technological modes and will most likely move into the sixth (post-industrial) technological mode. The main causes of greenhouse gases are gas emissions, methane, ozone. The rise in the 20th century of increased temperature on the surface of the planet as a result of a reaction to anthropogenic emissions of gases - oxides of accidents, tropospheric ozone and its "expectations", halogenated hydrocarbons, nitrogen oxides, etc.

Keywords: technological order, technosphere development, biosphere, technosphere, entropy, ecological principles

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The modern nitrogen-oxygen atmosphere was about 200 million years ago under the influence of photosynthetic living matter in the biosphere. In atmospheric conditions, the so-called. greenhouse gases that observe and re-emit infrared radiation, providing optimal climatic conditions for the development of the biosphere. The main sources of greenhouse gases are water vapor, carbon dioxide, methane, and ozone. Since the middle of the 20th century, there has been a rise in temperature on the surface of the planet as a result of additional thermal energy of anthropogenic components of greenhouse gases - carbon oxides, tropospheric ozone and its "precursors", halogenated hydrocarbons, nitrogen oxides, etc.

This phenomenon, an integral part of the global environmental challenge of the 21st century, can be considered as a manifestation of a dialectical contradiction between the biosphere losing its stability and the developing technosphere [1].

The biosphere is a general planetary shell, the composition, structure and energy of which are mainly determined by the past or present activity of living organisms (living matter) during geological time. As a complex material system, it is characterized by adaptability, independently establishes and maintains vital functions at a certain level. As a non-equilibrium and open system, it requires external material and energy sources. The main source of energy for the biosphere is the radiation of the Sun, and the ecosphere (lithosphere, hydrosphere and atmosphere) serves as a material source of chemical elements necessary for living matter and a receiver of waste products.

The technosphere is a part of the biosphere, radically transformed by man into man-made objects. As a complex dynamic material system of an open type, it exchanges matter and energy with the environment. The technosphere, formed on the basis of reason, is an ecological niche for mankind, designed primarily to provide optimal conditions for its life and production of relevant products and services. Until now, due to objective conditions, the development of the technosphere is carried out through the exploitation of material and energy resources and the life-supporting functions of the biosphere. At the same time, its degradation occurs, threatening the existence of mankind as a biological species.

Civilizational development, which creates contradictions between the technosphere and the biosphere with inherent greenhouse effects, is carried out within the framework of technological structures that are independent of socio-economic formations [2]. Allocate: the core - the leading industries and activities, thanks to which capital has the maximum growth (or planetary environmental safety is ensured); key factors - technological innovations, thanks to which the core arose; carrier industries - industries that intensively consume a key factor, playing a leading role in the spread of a new technological order. The technosphere, as the main product of civilizational development, has gone through a number of pre-industrial and at least five industrial technological modes and is preparing for the transition to the sixth (post-industrial) technological mode.

The goal of the core of industrial technological structures is, in accordance with the postulates of the "consumer society" and the economic principles of development, the maximum return on capital invested in the key factor and supporting industries. The current core, key factor and supporting industries imply the dominance of the exploitation of natural material and energy resources of the biosphere over life-supporting functions.

Natural material and energy resources are inert matter removed from the modern biogeochemical cycle and stored in the ecosphere. Its return during anthropogenic activity to the planetary circulation of substances is the main objective cause of the challenge associated with the greenhouse effect, which is mainly due to the combustion of natural hydrocarbon reserves and the release into the atmosphere of combustion products - carbon oxides, water vapor, nitrogen oxides, "precursors" of ozone and others. Based on the environmental aspects of the upcoming civilizational crisis (pollution of the human environment, depletion of traditional hydrocarbon energy sources, dispersion of chemical elements necessary for production, etc.), the core of a new post-industrial technological structure may become:

- formation of a nature-like technosphere, based on constant monitoring of the stability of the biosphere;
- alternative and renewable energy;
- the formation of technogenic useful reserves from waste of various types, by analogy with natural ones, etc. This should ensure the dominance of the life-supporting functions of the biosphere (eco-sphere) over its material, energy and environmental (ability to self-purify) resources.

As noted above, the core of the post-industrial technological structure can be the formation of a nature-like technosphere, based on the constant control of factors in the human environment. Because The basis of the technological process under consideration is the use of technical ozone (a chemical analogue of natural atmospheric gas O3); it is advisable to assess the concentrations of tropospheric (ground-level) ozone in the places of its use.

O3 is widely used in water purification/water treatment processes. The high oxidizing ability of ozone and the formation of free oxygen radicals in many reactions with its participation determine its high toxicity. Ozone in the Russian Federation is classified as the first, highest hazard class.

Ozone standards:

- maximum single maximum permissible concentration (MPCm.r.) in atmospheric air 160 mg/m3;

- average daily maximum permissible concentration (MPC s.s.) in atmospheric air is 30 mg/m³.

In the "pre-industrial" period in the troposphere, the natural concentration of ozone was presumably 10 - 20 mg/m3. At concentrations above 70 mg/m3 (biologically hazardous), there is a correlation between ozone concentration and the number of deaths from bronchopulmonary diseases. Conducted by the authors in 2010-2023. Monitoring the concentration of total (man-made and natural) tropospheric ozone in the Moscow region revealed patterns and showed a high probability of exceeding existing standard indicators.

In particular, to ensure a nature-like approach to the development and implementation of water purification and water treatment technologies, based on the preservation of the existing planetary (including tropospheric) ozone cycle (technogenic and natural), technical ozone (ozone-oxygen mixture) must be completely recovered.

The most important component of ozone-membrane technologies is the purification of water from finely dispersed (solid and liquid) components formed during ozone oxidation of pollutants. In most industrial technologies, it is carried out on polymer membranes, the production, regeneration and disposal of which can have a negative impact on the biosphere.

The objectivity that the economic principles of the development of the technosphere give rise to the degradation of the bio-ecosphere determined the ecologization of the economy and the promotion of the concept of the "Fourth Industrial Revolution" [3], based on the massive introduction of cyber-physical systems into production and the service sector. But this trend will not carry out a radical transformation of the core of the technological order associated with the maximum extraction of profit through the exploitation of natural resources.

It is possible to maintain the existing unstable balance and convert antagonistic contradictions into non-antagonistic ones (taking into account the general biogenic identity of the technosphere - biosphere, their mutual penetration and complementarity) with the ecological principle of technosphere development, which implies ensuring optimal conditions for the life of living matter and man, the production of necessary products and services for a reasonable civilizational development ("society of reasonable consumption") in the conditions of a stable state of the biosphere, taking into account the material and energy possibilities of the nearest Cosmos.

To do this, it is necessary to realize that living matter is the main asset of the Earth, capable of increasing effective material and energy resources with a decrease in the entropy of the planet, and to make a transition to a post-industrial technological order, the task of the core of which will be, along with the production of necessary products and services, the sustainable development of an interconnected living and inert matter of the biosphere and technosphere, and the key factor and the bearing industries are formed under the dominance of the life-supporting functions of the biosphere over its material and energy resources.

The change in the technological order to the post-industrial one can be considered as an integral part of the concept of co-evolution of the technobiosphere and the formation of the noosphere. The initial stage of the post-industrial technological order should, first of all, "restore the balance between the biosphere and the technosphere disturbed by man" [4]. In our case, to reduce the carbon content of anthropogenic emissions on the basis of scientific validity, systematic and comprehensive approaches that comply with the provisions of federal law.

Nature-like technologies should become a key factor in the post-industrial technological order [5]. Nature-like technologies for ensuring optimal conditions for human life, production of necessary products and services should be understood as co-evolutionary developments based on the fundamental laws of nature, cyber-physical systems, convergence and logistical approaches that preserve the life-supporting functions of the biosphere and the existing material and energy cycles and the entropic planetary circulation that ensure the maintenance sustainable balance between the biosphere and the

developing technosphere. Based on the above, organizational and technical measures should be developed and implemented as part of the transition to a post-industrial technological order based on environmental principles and provisions of nature-like technologies.

Based on the above, taking into account the Federal Law dated 07/02/2021 No. 296 "On limiting greenhouse gas emissions", RP dated 10/29/2021 N 3052-r "On approval of the strategy for the socio-economic development of the Russian Federation with low greenhouse gas emissions until 2050" ", organizational and technical measures should be developed and implemented as part of the transition to a post-industrial technological structure based on environmental principles and provisions of nature-like technologie

References

1. Zhuravleva E.V., Tsedilin A.N., Voronov S.I. Ecological principle of technospheric development // Achievements of Science and Technology of APK. 2021 Vol. 35 No. 11, p. 9-14
2. Glazyev S. Yu. World economic structures in global economic development // Economics and Mathematical Methods. 2016 No. 2 S. 3–29.
3. Schwab K. The fourth industrial revolution. M.: Eksmo, 2016 - 320 p.
4. 70th session of the UN General Assembly. URL: http://kremlin.ru/events/president/news/50385 (date of access: 23.03.2023).
5. Tsedilin A.N., Makarenkov D.A., Berengarten M.G. Principles of the transition of chemical and related industries to the post-industrial technological structure // Industrial processes and technologies. Vol. 1 no. 2 (2021), 12s.
6. Sister V.G., Tartakovsky I.S., Tsedilin A.N., Vorobeva N.V. Transformation of components of human environment under anthropogenic impact // Biogeosystem Technique. 2014. № 2 (2). C. 174 – 181
7. Georgiev A.M., K. Koetze, Tsedilin A.N. Study of the influence of physical factors on the concentration of tropospheric ozone in a megalopolis - Novosibirsk: OMEGA SCIENCE, Part 3, November 28, 2019. p. 223-226.