

Sustainability Resource of Natural and Technogenic Systems to External Influences

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Considering the issues of human interaction with the environment, there is often a need to know the permissible limits of impacts under which the natural-technogenic system does not leave a stable permissible state. This applies to the most diverse areas of scientific and practical activity in natural or human-modified environments. For example, in geotechnics - it is necessary to know the limits of static and dynamic loads on soils, resistance to shear and other stresses; in hydrogeology - to additional infiltration feeding of groundwater, pressure gradients; in thermal physics - resistance to temperature effects. That is, it is necessary to assess the permissible limits in a wide variety of areas of physical interactions in the "human - environment" system.

In geotechnical, hydrogeological surveys for construction, the maximum permissible indicators of significant impacts are determined and taken into account in each specific case. Then measures are taken to regulate (limit) the intensity of impacts or to increase the ability of the object to perceive and withstand these impacts. In general, this approach is an elementary control of a *cybernetic* nature.

However, at the current level of development of our civilization, it is required to move from cybernetic control methods to *synergistic* ones, that is, to the harmonization of interactions in controlled systems. In this case, a human should not be a primitive consumer, but act as a system-forming element that harmoniously interacts with the environment. We assume that in order to achieve such an engineering and environmental goal, it is necessary to introduce new concepts of a general (methodological) level into science and education. As such, we proposed the concept of «sustainability resource to external influences», which allows us to combine the consequences of a variety of activities by laws of a general (high) level.

Based on our many years of experience in surveying geotechnical and hydrogeological works in Ukraine, we have systematized and considered the main processes of changes occurring in the upper part of the underground hydrosphere. Their main number is observed in urban and industrial agglomerations and is almost always associated with engineering, construction and economic activities of a human. An analysis was made of the causes of such changes and the consequences, which are often sharply negative.

Technogenic impacts lead to negative changes in the hydrogeological environment, one of which is the process of flooding urban areas with groundwater. This process causes the following negative consequences:

- There is a decrease in the strength of soils and subsidence, which cause deformation of the structures of buildings;
- There are landslide displacements of soils on slopes;
- Changes in the chemical composition of groundwater and soil salinity;
- The propagation zone and intensity of seismic and artificial shock-vibration effects on buildings and structures increases;
- Increases the corrosive activity of groundwater in relation to concrete and metal underground structures;
- The operational suitability of the basements of buildings is reduced due to the penetration of groundwater into them;
- Sanitary and hygienic conditions worsen due to bacterial contamination of groundwater and acceleration of infection transmis-

sion processes in the aquatic environment;

- There is a direct swamping of the territory;
- Suffusion and karst processes are intensified, dips of the earth's surface may occur;
- There is a degradation of tree plantations due to the "wetting" of the root system.

On the basis of the indicator «sustainability resource to external influences», we carried out a typification of the stability of the hydrogeological and geotechnical conditions of the territory of the city of Kharkiv (Ukraine) with an assessment of the possibility of developing negative engineering-geological processes. A number of incidents at urban infrastructure facilities were considered, which are associated with shortcomings in forecasting and accounting for changes in the hydrosphere of urban areas. We have typified and identified characteristic areas with different levels of resource resistance to additional infiltration and the possibility of hazardous processes; a corresponding map of the city was developed. The results of this work were presented by us at the I World Congress on Geoethics and Water Resources Management, received favorable reviews and published [Viacheslav Iegupov and Gennadiy Strizhelchik "Sustainability Resource of the Hydrogeosphere to Anthropogenic Impacts with Urbanization". *Advances in Geoethics and Groundwater Management: Theory and Practice for a Sustainable Development. Proceedings of the 1st Congress on Geoethics and Groundwater Management (GEOETH&GWM'20), Porto, Portugal 2020. // Springer, (2021): 267-271*].

The concept of «Sustainability resource or resource of resistance to external influences» is quite universal and applicable to various natural and natural-technogenic systems.

Let us emphasize the need for a transition to a strategy of regulated interaction with the geoecological environment, in which ethical principles are aimed at maintaining rational homeostasis in natural-technogenic systems. In the future, the proposed concept can contribute to the creation of a global theory of the interaction between the constituent systems and acquired or retained properties without degradation of characteristics that are significant for humans. And this must be done in order to pass on to our descendants an environment suitable for safe and comfortable living.

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