Man-Made Hazards Environmental Management in the Sakha Republic (Yakutia)

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Abstract. It is shown that the technological safety ensuring is in demand in the modern world, the person and society interests protection is impossible without the environment preservation. The safety problem of socio-natural-technogenic systems is relevant in the territory of the Republic of Sakha (Yakutia). The technological hazards specificity of the region’s territory is determined by the extreme climate characteristics. Probable man-made hazards on the republic territory are shown and the main indicators of water pollution are given. Common technogenic dangerous objects on the Republic territory are established: production associated with the extraction, transportation, oil and petroleum products storage and tailing dumps. Social components determined by the traditional environmental management violation and the way of indigenous peoples’ life are not sufficiently taken into account in the damages assessment. The basic principles of environmental policy are given.

1. Introduction
The present human development stage is characterized as global and is determined by unified global economic space formation, high technology development pace and increasing volume of natural resources involvement in the economy. All this contributes to the depletion of existing natural resource potential of Land and the environment pollution. In recent years there has been the public’s focus attention to the environment protection in the Republic. There are changes in the population consumer behavior. People are beginning to show increased demand for environmentally friendly products and living conditions.

2. Relevance and issue scientific significance with a brief literature review
The 21st century is as a quality century, therefore the focus is on the individual and society interests protecting. It is impossible without the environment preservation. One of the main features of the “man-machine-nature” system is the concept of “security” [7, 8, 12]. Danger is an integral part of every person vital activity, society, state, bio- and techno sphere. The objects of the technosphere pose a potential hazard to the public and the environment despite the measures to improve safety. The safety problem of socio-natural-technogenic systems is also relevant in the territory of the Republic of Sakha (Yakutia).

3. Problems formulation
The region territory specificity is as follows: extreme climatic conditions, long low temperatures; large reserves of mineral and biological raw materials; high environment vulnerability to human impact and...
slow rate of disturbed natural objects recovery; lack of an effective system for monitoring the state of pollution sources. Many industrial enterprises in the Republic of Sakha (Yakutia) are sources of environmental risk and impact significantly on all elements of the geosphere: the hydrosphere, lithosphere, biosphere and atmosphere, lead to the natural landscapes disruption.

4. Theoretical part

Environmental risk assessment of the Republic's population residence territory from technogenic impacts is based on the collection and analysis of data described emergency situations in the operation of industrial facilities. Analysis of man-made hazards in the republic territory based on a review from various sources is provided below [1, 3, 4, 5, 9, 10, and 11]. There are 65 potentially dangerous objects on the Republic territory - sources of emergency situations (ES) threatening the human settlements life support. 606 thousand people live in the danger zones from damaging factors of emergency sources of man-made and natural character with a total area of 1603 sq. km. Dangerous sources of man-made emergencies are explosive and fire hazardous energy facilities, housing and communal services, petroleum products storage. Probable chemical hazards come from cities facilities where 8 industrial facilities store highly toxic substances that are necessary for technological processes. The pollution area may be more than 100 sq. km. with 120 thousand populations in case of accident. Dangerous sources of man-made emergencies are explosive and fire hazardous energy facilities (Cascade of Vilyuyskaya HPPs (hydroelectric power plant), including Svetlinskaya HPP; Yakutskaya, Neryunginskaya and Mirinskaya DWP (hydroelectric power station); Yakutskaya TPP (thermal power plant) and Chulmanskaya TPP; facilities of the Central Energy Network and other energy facilities). For example, a catastrophic flooding area of 19 thousand square km with city of Vilyuisk and several villages with about 50 thousand populations may occur in the case of Vilyuiskaya hydroelectric station dam break on the river Viluy. As a result, several dozen settlements with a population of 380 thousand people may be without electricity as well as without heat in winter.

In the Republic of Sakha (Yakutia) there are 19 tailing dumps. The inactive tailing depot of the Deputatskiy GOK (ore-mining plant) since 1996 contains a large amount of polluted water and waste from tin processing. Deputatskiy GOK widely used flocculants - polycrylamide, xanthate, ferrosilicon and other chemicals besides commonly accepted reagents. The actual state of the tailings area is described in the work of A.P. Pesterev [5]. The tailing dump area of the Central concentrating plant of the Deputatskiy GOK has a high content of copper, zinc, selenium, lead, iron and bismuth. An increased content of beryllium, magnesium, nickel, lead, zirconium, tin, titanium, strontium, thallium and copper is recorded in the bottom sediments of the river bed. By magnification ratio to the backdrop, zinc (34.25 times), manganese (20.6 times), iron (9.46 times) are prevailed. There is also a significant increase in sulfates (4.9 times), arsenic (3.5 times), magnesium (3.25 times), and calcium (2.47 times). There is a filtration through the body along the spillway structures on the tailings and the subsidence of the earthen dams and dams’ body. So, pollution levels on the Irgichyan River exceed the MPC (maximum permissible concentration) by many indicators. Water acidity sometimes reached pH = 2.4. Significant exceeding of MPCs for oil products (40 times), zinc (24 times), iron, (66 times), manganese (189 times), and copper (86 times) was observed in 1998–99.

The Lena River is the only remaining great rivers of the world with a preserved unique ecosystem and the main drinking water source for the majority of Yakutia population is under the real threat of technogenic pollution. The water in the river corresponds to the 3rd quality discharge class according to the State Report on the State and Environmental Protection of the Republic of Sakha (Yakutia) in 2005 taking into account the 16 main pollutants for the Russian Federation. About 380 thousand people live in 90 settlements along the Lena River. 11 wastewater treatment plants in residential areas on the Lena do not provide a standard treatment. The most common pollutants are non-oxidizable organic substances and phenols. The phenols content exceeds the permissible level by 3 times on average in the basins. Standards for the water content of fishery water use standards exceeded by 3–4 times, aluminum 12 times, manganese 2.6 times according to the laboratory studies results on the
The Lena River major emergency risks are associated with an oil spill. One of the large objects on the Lena River with a high risk is the ESPO (Eastern Siberia - Pacific Ocean) trunk oil pipeline. It has a crossing over the Lena River and crosses the river on the territory of the Olekminskiy district where the river is 1,440 meters wide. The accidents consequences can be catastrophic. The oil behavior under the ice is almost unpredictable and difficult to monitor. 140 settlements with a population of over 500 thousand people may remain without drinking water especially in winter in the accident case at an underwater crossing. The Lena River protection issues have not been developed and are not sufficient to ensure the Lena River ecology safety. It is known that absolutely safe technical systems do not exist; the accidents causes can be associated not only with the facility technical condition but also with human factors or terrorist, climatic impact.

Nine large oil depots and fuel and lubricants warehouses with a total volume of more than 900 thousand cubic meters located on the river coastal part are acute environmental problems. The storage tanks are periodically flooded during spring flood on the Lena River and its tributaries. Such a situation increases the risk of water bodies’ pollution with oil products.

Technogenic pollution of the rivers Vilyui and Aldan were occurred last year. There was the Rederge River and the Elkon River pollution on the Aldan below the mouth of the Rederge [Fedorov skins]. The main pollution sources were the new river channel of the Rederge and drains drainage from the dam body of the last sedimentation tank. The fact of the discharge of waste water into the Rederge creek from the open dam of the sump was established. Exceeding the standards on the oil products and metals content in the waste water is set. The Rederge River is polluted by lead, aluminum, manganese, iron and copper.

Ecological disaster occurred on the Vilyui River in August 17, 2018. The dredge polygons dam of the ALROSA campaign on the Ireliah River (Fig.) in Mirninsky district of the Republic of Sakha (Yakutia) broke due to heavy rains. The Irelyah, the Malaya Botobuya and the Vilyui rivers were polluted by waste water with suspended substances, iron ions and copper.

The length of the polluted water on the Vilyui River was about 200 km. On August 20, the standards for suspended substances exceeded 728.6 times, iron 38.7 times, copper - 27.6. The analyzes showed the MPC exceeding on suspended particles more than 800 times at the beginning of the incident and they were 100 times on August 25. According to calculations, environmental damage along the Irelyah River is 11 million 190 thousand rubles and damage along the Malaya Botobuya River is 4 billion 67 million rubles (calculated by the Ministry of Environment of the Republic). The damage to the Vilyui River was calculated as 22 billion 700 million rubles by the Office of Rosprirodnadzor of the Republic of Sakha (Yakutia).

The analysis of man-made hazards areas shows:

- all technical systems and manufacturing in the North conditions are man-made dangerous objects as they are carried out with the chemical and toxic substances use;
- in case of production facilities accidents, environmental damage will be determined by the area of chemical-toxic substances distribution, their concentration, weather conditions;
- common technogenic dangerous facilities in the republic include production associated with the extraction, transportation and storage of oil and petroleum products and the tailing dumps;
- abandoned and ownerless tailing ponds increase environmental risks and pose the problem of their immediate disposal;
- accumulation of a large industrial waste amount in tailing ponds;
- the greatest environmental damage in accidents case occurs with river environments pollution;
- taking into account the climatic conditions (the water environment is under the ice eight months) and the territory large size it is not always possible to organize an effective monitoring system of disturbance and the natural environment pollution;
- social and ecological damages are not sufficiently taken into account which are determined by the violation of traditional nature management and the way of indigenous peoples life in the conditions of the Far North;
- preventive protective measures are needed to reduce the amount of possible environmental damage in order to reduce the pollution level in technical facilities accidents case.

5. Practical significance, suggestions and results

Environmental violations as one of the options are assessed relatively to the maximum permissible concentrations, levels and emissions (MPC). There are various methods for environmental damage determining. For example [2], the damage amount from steady-state pollution is calculated by a definite indicator of the assessing natural resources cost, the amount or pollution area and the MPC excess ratio.

The MPC technology is also used to classify the environment state. The complexity of the methodology application is the knowledge of reliable values of specific environmental damage in the study area. Specific loss values are not known in all directions due to the type’s diversity and environmental pollution effects and social and environmental requirements increasing require constant research on improvements in this direction. At present, the MPC concept is common in Russia and included in the legal documents. The rationing concept does not take into account regional climatic conditions [6, 13]; they are the same for the whole country and for any time of year [13]. For example, some components of the environment value of the European countries MPC are much lower than Russian. Therefore, the established value of the maximum permissible concentrations or pollution levels is an indicator of a country’s development and the population life quality.

A high environmental hazard is represented by abandoned tailing dumps containing toxic substances in dangerous concentrations located in the arctic zone territory. Under existing laws on environmental safety, there is a need to eliminate decommissioned tailing dumps as foci of atmospheric, lithospheric and hydrochemical pollution that cause disruption of the natural landscape, land degradation, deterioration of surface and groundwater quality and negative impact on the atmosphere, flora and fauna.

The development of subsoil wealth is always environmental risk, the consequences of which significantly affect the population life quality. Environmental impact assessment and economic and social coordination with resident population are required to reduce the subsoil use effects. The ecological violations difficulty predicting of the environment is not only insufficient knowledge but also the lack of demand and understanding of the environmental danger of society.

6. Conclusion

In this regard, the problem of environmental risk reducing is economic and political and depends on the possibilities of the country economic state. Social components are not enough taken into account in the damages assessment as well as compensation for damages in violation of the traditional environmental management and the indigenous people’s lifestyle of the North. The development and improvement of models and methods for analyzing and assessing natural and man-made hazards and risks are required. They are the basis for the quality improving of the population’s habitat in the region.

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