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LEVEL OF MODERN MAN-MADE IMPACT ON THE STATE OF THE INHULETS RIVER

The Inhulets belongs to the rivers of the Black Sea basin and, having a length of 549 km, is a surface water source for the population of Kirovohrad, Dnipropetrovsk, Mykolaiv and Kherson Oblasts. The river originates in Kirovohrad Oblast (Topylo village) and flows into the Dnieper as its right tributary 45 km before its mouth. The Inhulets has 9 tributaries, the main of which are the Saksahan, Bokova, Zhovta, Zelena and Vysun rivers. The total drainage basin is 14,460 km^2 [1]. According to the Water Code of Ukraine, in terms of annual runoff (0.36-0.82 km^3/year) and basin area, the Inhulets belongs to the medium-level rivers and should have a coastal protection zone on both banks of at least 100 m. Today, the riverbed is regulated by two reservoirs: Iskrivka and Karachuny. To increase the water supply for the population and industrial facilities of Kryvyi Rih, the Dnieper - Kryvyi Rih canal was built in 1957-1961, through which the water from Kakhovka reservoir is supplied to Pivdenne reservoir, which is connected to the Saksahan by canal. In 1988, in the upper reaches of the Inhulets riverbed, an additional canal from Kremenchuk reservoir of the Dnieper to the Inhulets near Svitlovodsk was put into operation [2]. This canal is designed to increase the reserves of reservoirs for high-quality periodic flushing of the riverbed for the purpose of ecological river restoration, as well as for more complete water supply to enterprises and population of Kryvyi Rih and farmland of Southern and Eastern Ukraine [3]. The actual area of lands irrigated with water of the Inhulets is now 62.7 thousand hectares, including 42.6 thousand hectares in Mykolaiv Oblast and 18.2 thousand hectares in Kherson Oblast [4].

Determining the significant water and economic importance of the Inhulets and the entire irrigation system created on its basis as a source of fresh water, it should be noted that the man-made factors of Kryvyi Rih and, in particular, Kryvyi Rih mining and metallurgical plant have a huge negative impact on the state of river.

In 1968-1972, the technical project *Drainage of Kryvyi Rih mine water outside the Inhulets basin* was developed [5], according to which a mine water storage pond was created in the southern part of Kryvyi Rih on the basis of Svistunov ravine. This allowed regulating the discharge of highly mineralized mine waters of 7 southern mines of Kryvyi Rih through a network of pipelines and pumping stations. However, the capacity of the storage pond is limited (up to 12 million m^3) and allows collecting only the annual volume of discharge water, so in fact there is no other way than to periodically discharge the collected mine water with an average mineralization of up to 38690

mg/dm^3 for 2005-2220 to the Inhulets. The developed system provides for the accumulation of sulfate-chloride-calcium mine water during the growing season (April - October) and its discharge into the river during winter period (November - March). To protect water users of agricultural enterprises in Southern Ukraine from saline water, special regulation has been developed for the supply of fresh water from Karachuny reservoir simultaneously with discharge of mine water. Firstly, it allows dissolving and reducing the concentration of dirty water by 10-12 times, and secondly, it provides flushing of the riverbed and pushing the "salt plug" to the mouth of the Dnieper and further into the Black Sea.

However, the implemented system of centralized drainage of mine water of part of Kryvyi Rih mines currently does not provide complete environmental protection of the Inhulets from the unauthorized man-made and domestic pollution.

We performed chemical analysis of water samples taken at various points along the part of the Inhulets riverbed that flows within Kryvyi Rih from North to South. The samples were taken according to the established procedure along the river waterway a month after completion of the next discharge of mine water from Svistunov ravine and cessation of riverbed flushing. The sample taken at the level of Iskrivka reservoir (the northernmost point of the river delta before it enters the city's sphere of impact) is taken as the derived level of water mineralization. The total mineralization was 640 mg/dm^3, the pollutants were composed mainly of carbonates (354 mg/dm^3), sulfates (167 mg/dm^3), potassium and sodium cations (105 mg/dm^3). At the level of Karachuny reservoir (the main source of drinking water for Kryvyi Rih residents), mineralization increased by a third and reached 998 mg/dm^3, which is probably due to filtration leaks from the tailings dumps of Pivnichnyi and Tsentralnyi Mining and Processing Plants (GZK). At the same time, the chemical composition of pollutants changed significantly: the main ones are sulfates, chlorides, potassium and sodium cations (725 mg/dm^3). The next water sample was taken at the level of residential area Pivdennyi GZK. At this point, the Saksahan, the largest left tributary, flows into the Inhulets, and there is also the point of discharge of the sewage treatment plants. The analysis showed an increase in the level of water pollution to 2538 mg/dm^3 mainly due to sodium and potassium chlorides and sulfates (2088 mg/dm^3). The polluted water of the Saksahan, which suffers due to iron ore quarries and large tailings dumps of Tsentralnyi GZK and mines of the northern part of Kryvyi Rih located in its basin, takes the lead on the increase of the Inhulets water pollution in this part of the riverbed.

Further, the Inhulets passes through the territory of Novokryvorizkyi GZK, where the quarries № 2 and № 3 and dump of oxidized ores are located, as well as at the distance of 6-7 km along the river there is a significant destruction of the natural landscape, including in the protected coastal zone. At this distance, the bypass canal of Arcelor Mittal-Kryvyi Rih metallurgical plant enters the river and there are significant outflows of polluted water from under Livoberezhnyi waste dump of Pivdennyi GZK. Near the dumps № 2 and № 3 of ArcelorMittal Kryvyi Rih quarries, the water outflows and waterlogging on the territory of up to 6-8 hectares are observed. According to the chemical composition, such water is mainly sulfate, sodium-calcium-magnesium, its mineralization

ranges from 2400 to 3800 mg/dm^3. Due to these outflows, the level of water pollution in the Inhulets increases to 3186 mg/dm^3, of which 2598 mg/dm^3 is caused by sodium and potassium chlorides and sulfates. The next section of the riverbed is characterized by the fact that on the left bank there are numerous outflows of highly mineralized water - filtrates of Voikovo tailings dump of Pivdennyi GZK and mine water storage pond in Svistunov ravine. In this section of the river, the water mineralization increases to 5000 mg/m^3, of which 4013 mg/dm^3 are sodium and potassium chlorides and sulfates. In the next section of the riverbed (below the mine water discharge point), the left bank is waterlogged for 8-9 km with numerous outflows of highly mineralized liquid (concentration 10800-15600 mg/m^3), the origin of which is due to the filtration of mine water from Svistunov ravine. The volume of such unauthorized outflows reaches 170-195 thousand m^3 per year. The level of river water pollution at this level ranges from 3436 to 3600 mg/m^3, of which 2984 mg/m^3 are calcium-chloride- sulfate impurities.

Thus, despite the established system of discharge of the main volume of highly mineralized mine water of most of the existing Kryvyi Rih iron ore mines from the Inhulets basin, there is still its significant unauthorized contamination by mining and metallurgical enterprises along the entire length of the riverbed within the city, as evidenced by the increase in total water mineralization by 3 times during the riverbed flushing, and in the period between flushing - by 6 times relative to the natural level.

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JUSTIFICATION OF ECOLOGICALLY SAFE APPROACHES TO RECULTIVATION OF TERRITORIES OF CLOSED COAL MINES OF WESTERN DONBAS

The amount of mining enterprises, which are planned to be liquidated in Ukraine, is constantly growing (for example, in the Dnipropetrovsk region, these are the coal mines of the Western Donbas). These liquidations are accompanied by a significant reduction of jobs and growing social tensions in the region. At the same time, these enterprises have a developed infrastructure, a production complex for