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9TH INTERNATIONAL YOUTH SCIENCE FORUM «LITTERIS ET ARTIBUS» & 14TH INTERNATIONAL CONFERENCE «YOUNG SCIENTISTS TOWARDS THE CHALLENGES OF MODERN TECHNOLOGY»

Materials

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SCIENCE FORUM WAS ORGANIZED BY:

Lviv Polytechnic National University (Ukraine)

Scientific Society of Students, Doctoral Candidates and Young Researchers of Lviv Polytechnic National University

Students and PhD Students Board and Union of Lviv Polytechnic National University

Warsaw University of Technology (Poland)

PhD Students Board of Warsaw University of Technology (Poland)

Foundation for Young Scientists (Poland)

Alumni Association of Lviv Polytechnic National University

Wroclaw University of Science and Technology (Poland)

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Young Scientists Council at the Ministry of Education and Science of Ukraine

NGO "Association of Ukrainian PhDs"

All-Ukrainian NGO "National Students Union"

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The Materials contain original papers presenting research results in the areas corresponding to the scope of multidisciplinary International Youth Science Forum "Litteris et Artibus": computer science and engineering; geodesy, architecture and construction; electric power engineering and control systems; humanities and social sciences; economics and management; mechanical engineering, materials science and transport; chemistry and chemical technology; law and psychology; biotechnology, ecology & sustainable development.

In 2019 the Forum was organized as a joint event with 14-th International Conference "Young Scientists Towards the Challenges of Modern Technology".

All papers included in the Materials were a subject of open peer review (by at least two independent reviewers) and selected by the International Programme Committee.

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Ecological Condition of Land Around Regulatory Basins of Irrigation Systems in the Dnipropetrovsk region

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Abstract – It is shown that the NPEMFE method is possible for using to allocate water filtration zones through the ground-based dams of basins of reclamation systems. It is allow to quickly taking measures to reduce water losses and deteriorate the ecological state of the underground hydrosphere around the regulatory basins.

Keywords – regulating irrigation basin, water losses due to filtration, geophysical research.

Introduction

Saving and increase soil fertility is perhaps the most important task of agriculture. One of the factors of fertility is the timely reclamation, in particular the creation of the necessary moisture reserves in the soils. For this purpose, an irrigation system has been constructed consisting of pumping stations, main and distribution water pipes, regulating basins, where water is accumulated.

Regulating irrigation basins are excavations in the soil, have the shape of an inverted cut square pyramid (Fig. 1). On all sides, they are surround by enclose ground-based dams. In the majority of the basins are equipped with waterproofing to prevent water filtration, but more often there are those where she is not provided for constructively. For waterproofing, a protective polyethylene membrane is applied, which is placed on the bottom and sides of the basin, and is loaded with concrete slabs. Between slabs are waterproofed with concrete or resin, bitumen, etc. This exasemple of preventing filtration is relatively inexpensive and very effective, especially in the first few years of exploitation of a hydraulic engineering structures.

a

b

Fig. 1. Appearance of the regulating irrigation basin (*a. empty; b. filled*)

Over time, there is a waterproofing violation and the development of filtration begins. The reasons for this violation are several, in many cases they relate to the exploitating mode. The main thing is that almost all regulating basins are filled with water in the spring and empty in autumn, they are all without water during the whole winter. Freezing weathering leads to the destruction of the material, which is located in the interstitial space of concrete slabs, which

revolve the insides of the basin – it is loses mechanical properties, becomes brittle and loose. Plates go down, strip off the protective membrane and violate the waterproofing.

The water filtration zones of regulating irrigation basins are divided into visible and hidden. The position of the first one is established unambiguously on the visual grounds. Hidden areas are determined by conducting special research. At present, the following methods for diagnosing the technical condition of hydraulic engineering constructions are known: geodetic, geological, geophysical and hydrogeological.

The most common geophysical methods of diagnostics are: electrometric, seismic acoustic, thermometric, methods of remote sensing (photography, infrared, radio shooting) and others. These methods are very expensive and time-consuming. So the search for new expressive and inexpensive survey methods is an actual task for this time.

Consider the possibilities of the geophysical method of the natural pulsed electromagnetic field of the Earth to establish water filtration zones through the ground-based dams.

Materials and Methods

The geophysical method of the natural pulsed electromagnetic field of the Earth (NPEMFE) has a wide application in the search of water, ore minerals, areas of increased filtration and fracture and it has well established itself on many geological and engineering objects [1]. The physical content is based on the generation of a pulsed electromagnetic field by rocks or fragile artificial materials that are under the influence of mechanical compression or stretching forces.

When changing the mechanical voltage (load) is jump-like, the amount of electromagnetic impulses (EMIs): an increase in load leads to an increase in the number of EMIs, and at the moment of destruction of the solidity of the rock and the formation of cracking of scraping or separation, the number of impulses drops sharply and remains very small.

In case of filling cracks with water, there is even more EMI absorption. According to the analysis of the schemes of the number of impulses NPEMFE in the body of the hydraulic engineering constructions and adjoining areas it is possible to allocate areas of a differently stressed state, to predict the areas of flooding, soaking, water filtration and the development of dangerous engineering and hydrogeological processes. In other words, absorption of electromagnetic impulses occurs in watered zones and areas of decompression, which is reflected by a decrease in the impulse flux density of the magnetic component of NPEMFE.

The fields of NPEMFE also experience the influence of external sources of electromagnetic emission, both natural (magnetic perturbations, activity of the Sun) and technogenic origin (transmission lines, radio and cellular communications, etc.). This leads to the fact that the NPEMFE field is unstable in time, it`s complicates the interpretation of results and impedes the widespread implementation of the method. But high performance, high-speed field-shooting and low cost of work makes the method very attractive for detecting filtering areas.

For order to verify the validity of the proposed method, the research of water filtration areas in the regulating irrigation basin was conducted in Dnipropetrovsk region (Ukraine) in 2013 and 2017 years.

The pedestrian survey was carried out along the perimeter of the basin in the profile version with a distance between the profiles of 3 m, between the points of observation on the profile of 3 m. The length of the profile was 110 m, the number – 5 profiles on each board (all 20 profiles with a total length of 2200 m). The microprocessor indicator of the electromagnetic field (Ukraine) was used for work. It consists of a block of registration and three antennas, which

measure the amount of electromagnetic impulses in a time interval. Time to conduct research – 4 hours.

Results and Discussion

According to the results of the survey of the density of the magnetic component of the pulsed electromagnetic field of the Earth with the package of programs "Golden Software Surfer 8" a map-diagram (Fig. 2) was constructed and it interpretation was executed, based on the effect of intense absorption of pulses of NPEMFE by essentially watered rocks or engineering structures.

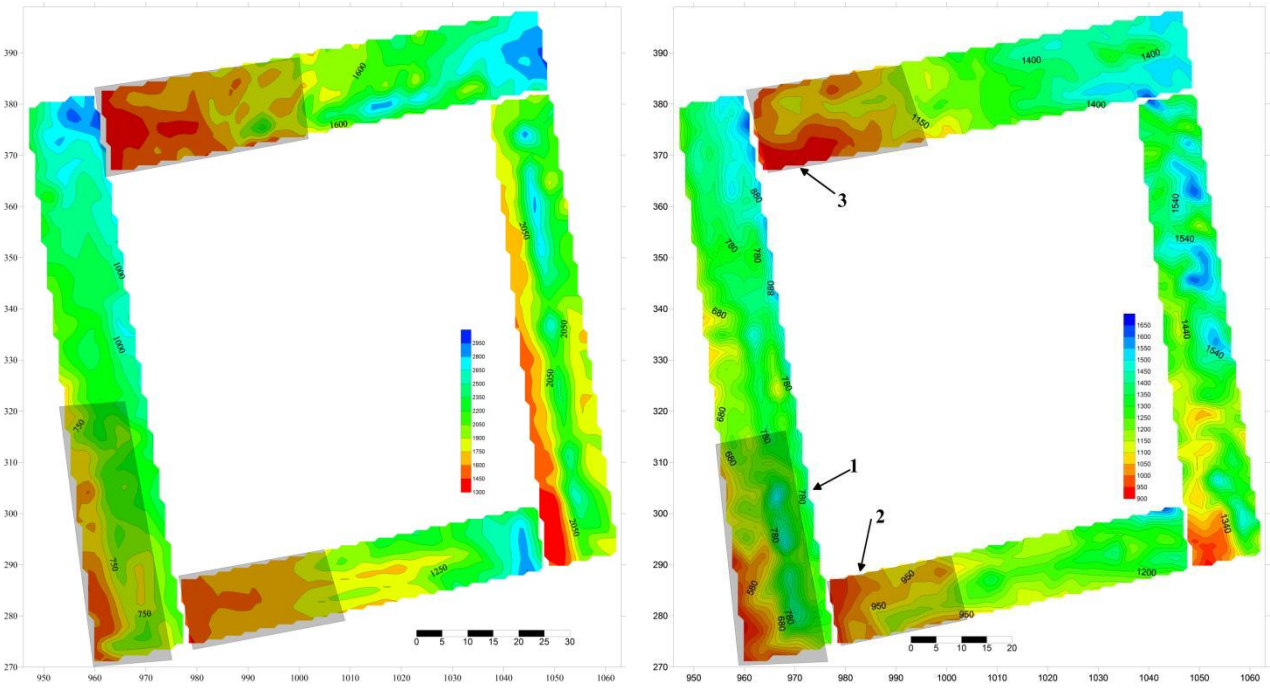

Fig. 2. Map-scheme of the impulse flux density of the magnetic component of NPEMFE at the regulating irrigation basin (*a. 2013, b. 2017*).

Legend: The hatchet shows the position of the signal absorption zone (filtration zone) and shows their numbers. The color scale characterizes the density of the magnetic component flow in a impulse/second. The coordinate system is a conditional rectangular, metric

On the maps of the area of the decrease in the flux density of the impulses of the magnetic component of the NPEMFE are identified as absorption zones corresponding to the filtration areas. The shape of the isoline and the general drawing of the NPEMFE field allows to separate these zones from each other and determine their size and reach at the investigated object. It should be noted that the NPEMFE method itself is qualitative (and not quantitative), so the precisely the relative values – an increase or decrease in the number of impulses for a certain time of measurement – come to the foreground.

As a result of the interpretation, three zones of signal absorption of NPEMFE are distinguished. The first two (No. 1 and No. 2) are located in the area of the joining of the western and southern boards, presumably, it is one filtration zone. The third zone is allocated on the north board. The width of the filtration zone No. 1 is 45-48 m, the filtration zone No. 2 is 10 m, the filtration zone No. 3 is 33 m.

Comparison of surveys in 2013 and 2017 (Fig. 2) shows that the position of the zones for almost 4,5 years has not change significantly, although there are changes in the field pattern and

in the absolute number of impulses (see the color scales in the figures). This gives grounds for asserting that the filtration zones are allocated reliably and objectively.

Due to the size of the filtration zones, it is possible to calculate the loss of water from the regulating irrigation basin through the enclosure dam.

Thus, it can be seen that, depending on the filling of the basin (it`s depth), monthly water losses only from the filtration will be from 8000 to 12000 m^3. Taking into account that the exploitation of the pools take to place from April to November, the loss of fresh water will be from 35000 to 45000 m^3. It should be noted that this pool belongs to the category of small, it volume is 12000 m^3.

Conclusion

As a result of comparing geophysical research of different years the method of the natural pulsed electromagnetic field of the Earth (NPEMFE), it is established that using this method is possible to reliably and quickly allocate zones of water filtration through fencing of dams of regulating water basins of reclamation systems. This allows to quickly take measures to reduce water losses and deteriorate the ecological state of the underground hydrosphere around the basins.

Considering the annual losses from regulated basins, the groundwater level in adjacent territories should rise by 10-15 cm per year. Over 30 years of exploitation of hydrotechnical structural it should lead to flooding and salinization of agricultural land. However, the negative environmental effects of filtering losses are not observed. The reason lies in the geological and geomorphological structure of the territory. Here the foundation is fractured and covered with a thin sedimentary cover. Filtration waters do not replenish the aquifer, but are drained into nearby beams and rivers. Thus, in the conditions of the central part of the Ukrainian shield, water losses from agricultural hydraulic structures do not lead to a deterioration of the ecological state of the adjacent lands.

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