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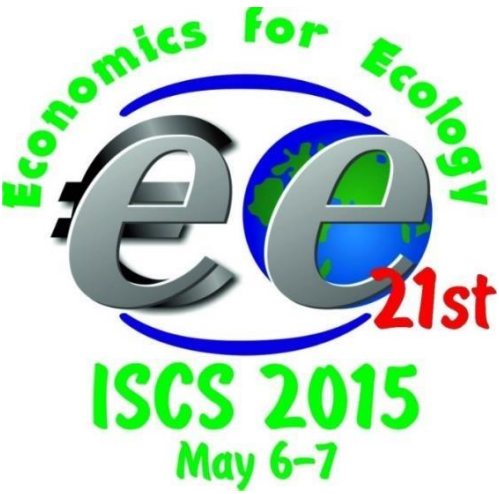

Економіка для екології

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- cost savings in energy transportation.

All these advantages give reason to believe that solving the problem of low power of cogeneration installations by increasing the number of turbines or by increasing the overall plant efficiency and reducing capital and operating costs make possible to apply cogeneration as the primary method of energy production in Ukraine and in a whole world.

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CRITICAL CHANGING GROUNDWATER LEVEL IN UKRAINIAN INDUSTRIAL CITIES

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Abstract: Paper treats the issue concerned with drastic increasing of groundwater level through the influence of technogenic factors of urban environment. The aim is to present possibilities of proposed mathematical model of prediction of groundwater level increasing for different areas of urban territory.

Keywords: mathematical modeling, flooding, groundwater level.

INTRODUCTION

Most objects of the Ukraine water supply system are in a poor technical condition. Leakages from water supply systems, sewerage

systems and from thermal networks in some regions have already reached 40-50 percent of water supply volume. Leakages from water communications lead to flooding and change qualitative composition of groundwater. In the industrial cities of Ukraine additional groundwater replenishment is many times greater than the natural infiltration of precipitation [4]. For example, for Kharkiv city the additional groundwater replenishment was 210 000 thousand m^3/year (575 300 m^3/day) in the period 2005-2014 years [1, 4]. Compensation of additional groundwater replenishment volume due to water abstraction for drinking and technical needs does not usually occur because of poor water quality of shallow horizons. Total water abstraction from the first of surface aquifer in the period 2005-2014 years is averaging 19700 m^3/day for Kharkiv. This difference in credit and debit water balance technogenic components is compensated by transpiration only when the ground water level closed to surface, i.e. in concrete flooded conditions [5].

Flooding processes currently do not have adequate expression by mathematical modeling. The issue of forecast has been solved by Averyanov, Muftahov, Sologaev, Polubarinova-Kochina, Verigin, Telima, Kremez etc. in incomplete statements, in different cases excluding additional groundwater replenishment, dependency of time, transpiration and evaporation [2, 3, 6].

MATERIALS AND METHODS

On the example of typical industrial city of Ukraine, Kharkiv for the groundwater regime prediction included changing water management conditions the mathematical model has been developed. Developed model considers all important water balance components. Such as, natural infiltration of precipitation, additional groundwater replenishment, transpiration, evaporation and water abstraction. The mathematical model describes by a boundary value issue for a non-stationary differential equation of filtration pressure. The solution of the boundary value problem is obtained in the form [5]:

h – groundwater level; $|$- l, l $|$- considered plot of territory, where from l to $l+a$, transpiration and evaporation are took place; γ – coefficient of anisotropy; D^n – coefficients which are determined by the technogenic impacts.

Calculations and visualization of the model were implemented by the software package Maple.

CONCLUSIONS AND DISCUSSION

The forecast based on calculations of groundwater level changing of Kharkiv for the next 50 years has been provided in the paper. The groundwater level will be increased to average 0,03 m on the 1st year and 1,5 m on the 50th year.

Developed model presented 2 ways of water balancing of debit and credit water balance components for the period 2005-2014 years. They are decreasing additional groundwater replenishment in 2,4 times, i.e. additional groundwater replenishment must be reduced by an average of 240,000 m^3/day and increasing of water intake from the first of surface aquifer in 15 times, i.e. increase the average water intake of 300 000 m^3/day. The sum of these amounts of water is 540 000 m^3/day. Because of bad conditions of groundwater at Kharkiv, waters to intake could be used for technical purposes. For example washing roads, pavements, automobiles, making skating rinks, watering plants, in construction, in industrial water-cooling and water-thermal systems, for firefighting have been proposed.

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