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Method for Controlling the Groundwater Polluted by the Surface Waters through Injection Wells

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Abstract : Introduction: The optimum exploitation of agricultural land in the presence of an aquifer polluted by the surface sources requires close monitoring of groundwater level in both periods of intense irrigation and in absence of the irrigations, in times of drought. Currently in Romania, in the south part of the country, the Baragan area, many agricultural lands are confronted with the risk of groundwater pollution in the absence of systematic irrigation, correlated with the climate changes. Basic Methods: The non-steady flow of the groundwater from an aquifer can be described by the Bousinesq's partial differential equation. The finite element method was used, applied to the porous media needed for the water mass balance equation. By the proper structure of the initial and boundary conditions may be modeled the flow in drainage or injection systems of wells, according to the period of irrigation or prolonged drought. The boundary conditions consist of the groundwater levels required at margins of the analyzed area, in conformity to the reality of the pollutant emissaries, following the method of the double steps. Major Findings/Results: The drainage condition is equivalent to operating regimes on the two or three rows of wells, negative, as to assure the pollutant transport, modeled with the variable flow in groups of two adjacent nodes. In order to obtain the level of the water table, in accordance with the real constraints, are needed, for example, to be restricted its top level below of an imposed value, required in each node. The objective function consists of a sum of the absolute values of differences of the infiltration flow rates, increased by a large penalty factor when there are positive values of pollutant. In these conditions, a balanced structure of the pollutant concentration is maintained in the groundwater. The spatial coordinates represent the modified parameters during the process of optimization and the drainage flows through wells. Conclusions: The presented calculation scheme was applied to an area having a cross-section of 50 km between two emissaries with various levels of altitude and different values of pollution. The input data were correlated with the measurements made in-situ, such as the level of the bedrock, the grain size of the field, the slope, etc. This method of calculation can also be extended to determine the variation of the groundwater in the aquifer following the flood wave propagation in envoys.

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