بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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MONA MAGHRABY

A Numerical Model for Simulating Deep Injection Wells

A Thesis
Submitted to Faculty of Engineering
Ain Shams University in Fulfillment of the Requirement for M.Sc. Degree in Civil Engineering
(Irrigation and Hydraulics Engineering)

Prepared by

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B.Sc. in Civil Engineering, June 2014
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Cairo, 2021

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Statement

This dissertation is submitted to Ain Shams University, Faculty of Engineering for the degree of M. Sc. in Civil Engineering.

The work done in this thesis was carried out by the author in the Department of Irrigation and Hydraulics, Faculty of Engineering, Ain Shams University.

No part of the thesis has been submitted for a degree or a qualification at any other University or Institution.

The candidate certifies that the work submitted is his own and that proper credit has been given where other people's work has been referenced.

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ABSTRACT

The growing tourism investments and urban developments at the coastal regions increased the demand on desalinated seawater, especially in the light of fresh water shortage. For the majority of Arab countries, water desalination became a necessary sector. The number and capacity of desalination units have expanded considerably in the previous decades, particularly in the Gulf States. One of the main stages of desalination is selecting a proper method to dispose undesired brine, which is a by-product from the plant, in a safe and economic manner to ensure the success and continuity of the desalination process. One of the widely used methods of desalination brine disposal nowadays is using deep injection wells. The construction cost of these wells is relatively high. So the decision of using this method and its success in disposing the entire capacity of brine from desalination plants must be precisely studied prior to well construction in the early planning stages to assess the feasibility of injection.

This thesis investigates the problem of pressurized injection of desalination brine into deep aquifers by conducting a numerical modeling approach using SEEP/W software in order to simulate the pressure-discharge relationship in the injection well. The model is then validated using observed data from in-situ injection test that was conducted in a coastal area at Zafarana region near the western coast of the Gulf of Suez in Egypt.

The results showed that the model could fairly explain the pressure-discharge relation into the injection well. The validated model was also used to determine the effects of well design parameters on the desalination brine injection capacity. These parameters are the pressure of injection,

soil hydraulic conductivity, aquifer thickness, screen length, and well diameter. Our initial assessment of the modeling approach indicates that the developed approach constitutes a valuable tool for the planning and assessment of deep injection wells, this is important to assess and determine the injection feasibility early prior to well construction.

Finally, the thesis developed multiple design charts that can help engineers in determining the brine injection capacity of wells. The injection capacity is represented in terms of the well design parameters. The study also introduced a non-linear regression model (power equation) that can be used as an alternative to the design charts.

KEYWORDS: Deep; Injection; Wells; Modeling; Desalination; Brine

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