بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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MONA MAGHRABY

EXPERIMENTAL AND NUMERICAL INVESTIGATIONS OF USING NANO-PARTICLES IN GROUNDWATER REMEDIATION

By

Ahmed Shawky Mahmoud Mohamed Okasha

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Irrigation and Hydraulics Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Under the Supervision of

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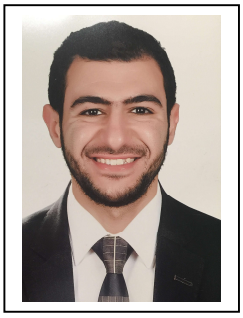
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Title of Thesis:

Experimental and Numerical Investigations of Using Nano-particles in Groundwater Remediation

Key Words:
Groundwater remediation; Zeolite nano-clay; Iron removal; Permeable reactive barrier; Adsorption isotherm

Summary:

This study investigates the efficiency of using Zeolite nano-clay and silica sand in the removal of iron from groundwater. The objective of the study was achieved through a number of steps. Firstly, batch experiments are conducted to determine the right size of silica sand to mix with nano-clay and their iron removal efficiency. Secondly, an experimental model simulating permeable reactive barrier (PRB) is built to identify the parameters that affect the removal efficiency and evaluate such effect (e.g., iron concentration, head difference, contact time, nano-clay dosage and thickness of PRB). Finally, a numerical contaminant transport model simulating nanoparticles' effect on contaminated groundwater is developed to obtain sorption isotherm coefficients. The results indicated that increasing iron concentration 20-80 ppm and head difference 4-15 cm decreases iron removal efficiency 58-31 % and 54-51 %, respectively. The mix of zeolite nano-clay and coarse silica sand improves iron removal efficiency specially at high concentrations 58-85 % at 20 ppm and 31-76 % at 80 ppm. Furthermore, increasing nano-clay dosage 1:30-1:15 slightly increases the removal efficiency about 6 %. However, increasing the thickness of filter layer 10-25 cm significantly improves the removal efficiency about 15 %. The MT3DMS numerical model included within the Groundwater Modeling System (GMS) was used along with the different experimental data to obtain reaction rate values for linear, Freundlich, and Langmuir isotherms.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Ahmed Shawky Mahmoud Mohamed Okasha Date: / /2021

Signature:

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Symbols:

C_i	is the initial concentration (mg/l)
C_f	is the final concentration (mg/l)
% removal	is the percentage removal efficiency
$\bar{C}$	is the adsorbed concentration (mg/g)
Δ H	is the head difference (cm)
K_d	is the distribution coefficient (L^3M^{-1})
C	is the solute concentration (mg/l)
K_f	is the Freundlich constant (L^3M^{-1})
a	is the Freundlich exponent (dimensionless)
K_L	is the Langmuir constant (L^3M^{-1})
$\bar{S}$	is the total concentration of sorption sites available (MM^{-1})
K_r	is the reaction rate constant (T^{-1})
K_f	is the forward reaction coefficient
K_b	is the backward reaction coefficient