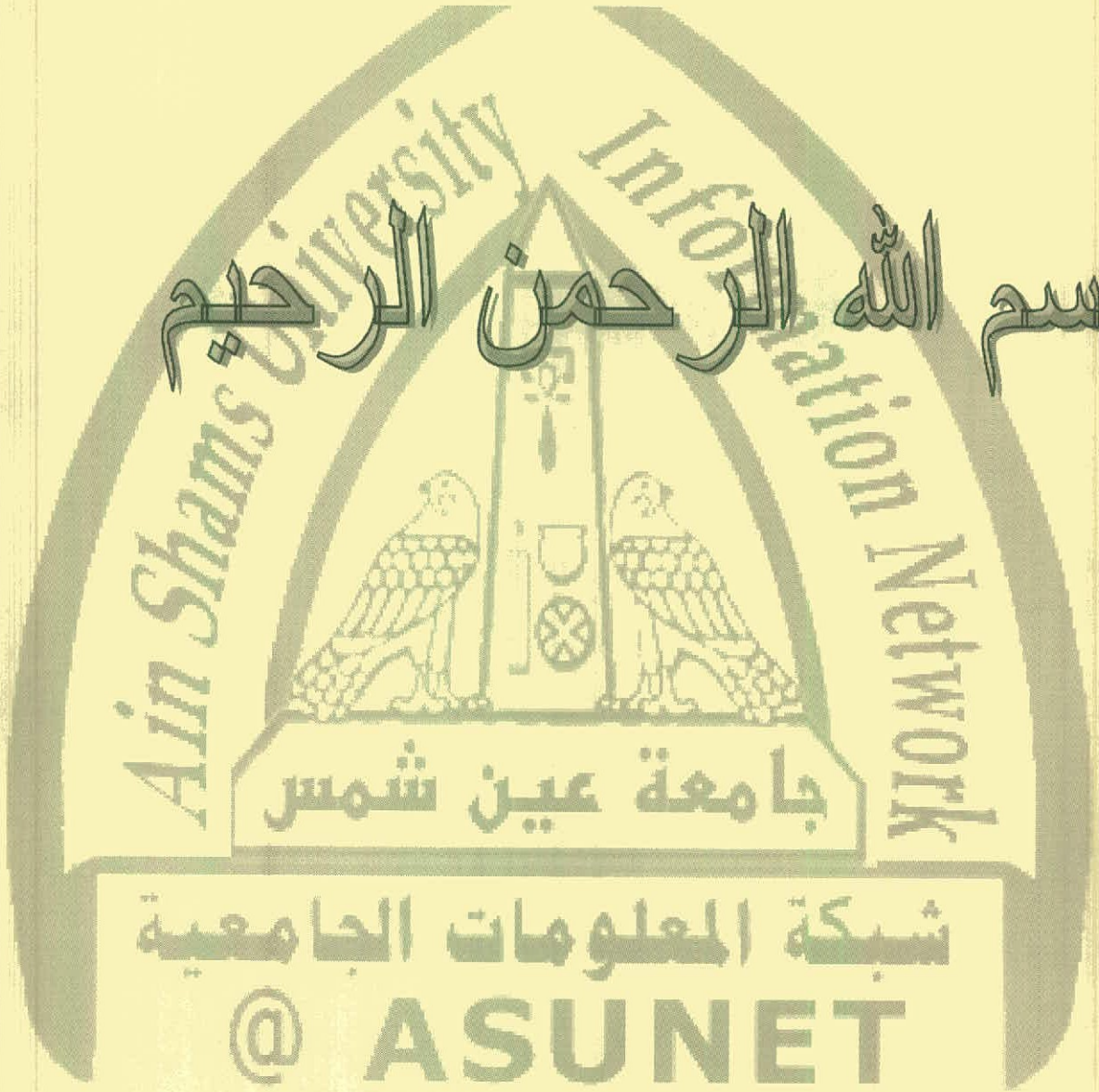
شبكة المعلومات الجامعية



بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of 15-25- c and relative humidity 20-40%

بعض الوثائـــــــق الاصليـــــة تالفـــة

بالرسالة صفحات لم ترد بالاصل

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
IRRIGATION AND HYDRAULICS DEPARTMENT

NUMERICAL SIMULATION FOR TRANSPORT OF REACTIVE MULTICHEMICAL COMPONENTS IN GROUNDWATER

By

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A Thesis Submitted in Partial Fulfillment of the requirements for the Degree of Doctor of Philosophy in Civil Engineer

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Ph.D. Thesis submetted by
Mohamed Abd El Hamyd Mohamed Dawoud
in Civil Engineering, (Irrigation and Hydraulics)

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STATEMENT

This thesis is submitted to Ain Shams University, Faculty of Engineering for the degree of doctor of philosophy in civil engineering (irrigation and hydraulics).

The work included in this thesis was carried out by the author in the Department of Irrigation and Hydraulics. The work was carried during the period from October 1977 to 2000 .

No part of this thesis has been previously submitted for a degree qualification at any other university or institution.

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ABSTRACT

Title : Numerical Simulation for Transport of Reactive Multichemical Components in Groundwater .

Name : Mohamed Abd El Hamyd Mohamed Dawoud

Saturated flow through a porous media and where a portion of the flow domain contains a certain mass of solute. This solute is referred to as a tracer. The concentration distribution of the tracer is mainly a function of advection, mechanical dispersion, and molecular diffusion in addition to other phenomena. Tracer interacts with the solid surface of the porous matrix in the form of adsorption of tracer particles on the solid surface, deposition, solution of the solid matrix, ion exchange, etc. These phenomena cause change in the concentration of a tracer in a flowing solution, Radioactive decay and chemical reactions within the solution also cause tracer concentration changes. Variations in tracer concentration cause changes in liquid density and viscosity. These changes affect the flow velocity that depends upon these properties.

Development of scientifically sound management for protecting groundwater resources must be based upon a firm understanding of contaminant behavior in natural subsurface environment. Realistic pollution scenarios share two important characteristics: First, surface chemical reactions such as adsorption are important due to the enormous solid water interface area of natural porous media. Second, groundwater aquifers exhibit significant small scale, three-dimensional spatial variability in permeability. Solute transport in soil and groundwater system is governed by a large number of complicated and often interactive physical, chemical and microbiological processes. Once released into the subsurface system, contaminants will interact hydrologically, physically, and chemically with both the native water and the granulated

solid matrix. The major hydrological and physical processes of interaction include advection, convection, dispersion, diffusion, and the decay if the contaminant is radioactive. The chemical reactions include aqueous complexation, reduction /oxidation (redox), acid base reaction, sorption via surface complexation (adsorption) or sorption via ion exchange, and precipitation/dissolution. Any of the above hydrological, physical and chemical processes can contribute to the distribution and redistribution of chemical components after they are introduced into the subsurface system. The combined effect of all these processes on solute transport must satisfy the principle of conservation of mass as well as the principle of conservation of charge.

In this thesis a numerical method was developed using a modified approach based on the sequential iteration approach for simulating two-dimensional multicomponent multispecies solute transport in groundwater. The model (REACTRANS) has the ability to treat equilibrium reactions of aqueous and surface complexation, adsorption, ion exchange, precipitation dissolution, redox and acid base reactions. The concentrations of aqueous component species, adsorbed component species and precipitated species are chosen as the primary dependant variables, and the other variables are considered as secondary dependant variables. The model is designed for application to heterogeneous, anisotropic, saturated unsaturated media under transient or steady state flow conditions.