Buletinul Ştiinţific al Universităţii "POLITEHNICA" din Timişoara

Seria HIDROTEHNICA

TRANSACTIONS on HYDROTECHNICS

Tom 55(69), Fascicola 2, 2010

Aquifer characteristics influence in transport processes

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Abstract:
The paper has sought an analysis of porosity and hydraulic conductivity on flow and transport phenomena in porous media and simulations were conducted which showed the influence of these characteristics. Simulation computer program was used ASMWIN and method was the finite difference solution.
The paper highlights that the hydrogeological properties, such as hydraulic conductivity or porosity, are summarized, despite the fact that it has a high degree of spatial variability at multiple length scales. Heterogeneous leads to uncertainty about property values aquifers and therefore the uncertainty in estimates of groundwater flow and the distribution of pollutants.
Keywords: porous media, hydraulic conductivity, porosity, heterogeneous

1. INTRODUCTION:

The word 'Hydrogeology' can be understood as a combination of 'hydraulic' and 'geology'

Hydraulic say that science is a relatively simple, as we know, at least in principle, the equations governing the hydraulic processes and we can solve analytically or numerically, given the system geometry, boundary conditions, etc.

Geology is more complex, it refers not only to describe the system today, it's in space, etc. It refers to the geological history of the training system, as geologists have been trained to accept the succession of complex processes involved in the creation and modification give the system time. To understand this complexity, geologists have a limited number of indicators or data, whose interpretation requires several assumptions and may lead to alternative solutions.

Geology also includes a set of disciplines whose contribution is necessary to study or describe the system: sedimentology, tectonics, geophysics, geochemistry, etc.

'Hydrogeology' is, therefore, science in which the two disciplines are combined to find solutions for flow and transport processes in a complex geological system.

If such geologically homogeneous system, if properties of rocks would be constant in space and / or easily determined, hydrogeology would be an extremely boring subject.

Fortunately, geological system is heterogeneous, with properties varying in space, making hydrogeology a fascinating discipline, as shown in Fig. 1.

Fig.1 Complexity of real porous medium

Spatial heterogeneity of hydraulic conductivity is one of the main problems facing scientists and hydrogeology.

In a porous medium, hydraulic conductivity varies from one place to another very strong. This variability can be reduced, not necessarily by study over larger areas, as and macroscopic heterogeneity of the aquifer is variable (exe. clay lenses).

A finding showing that the empirical K, but log (K) follows a normal distribution (fig. 2). The values plotted are obtained by field measurements. Hydraulic conductivity varies by several orders of magnitude, and this is the main difficulty in describing the processes in the aquifer.

At first aquifer modeling was used to investigate the hydrogeological parameters, currently is used to study pollution and risk assessment occurred after pollution monitoring network optimization and creation of groundwater protection zones.

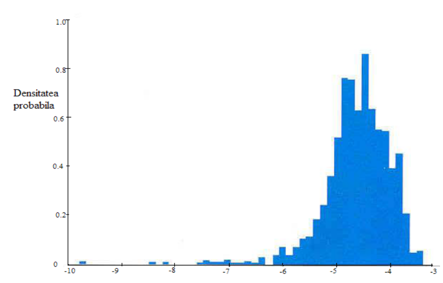

Fig.2. Hydraulic conductivity distribution in different parts of an aquifer

Depending on the objectives, describe the aquifer flow modeling, contaminant transport, heat transfer and deformation phenomena. (Fig. 3)

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Some types of models presented in the paper, we refer to the transport of pollutants and heat transfer in heterogeneous environments.

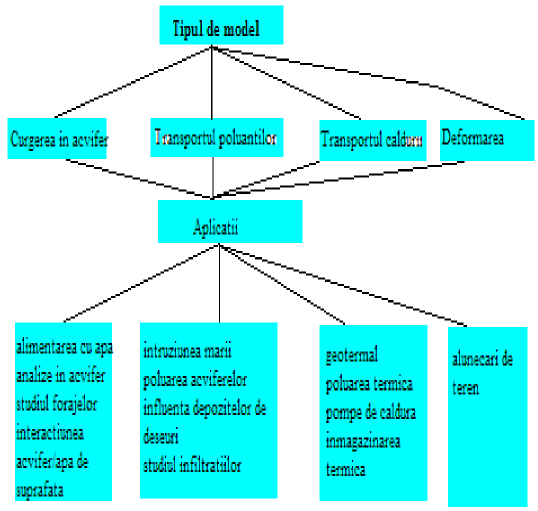

Fig.3 Types of aquifer models and their applications

2. BASIC EQUATIONS USED IN MODELING

For the study we propose a model one-dimensional convection - dispersion processes describing aquifer. The two dispersion equations: that of a substance miscible with water in a porous medium and the dispersion of heat are very similar.

Dispersion equation for a miscible substance is:

$$\frac{\partial c}{\partial t} + v_a \frac{\partial c}{\partial x} - D \frac{\partial^2 c}{\partial x^2} = 0 \quad (1)$$

The initial and boundary conditions:

$c(x=0, t)=c_0 f(t)$ (2)

$$\frac{\partial^2 c}{\partial x^2} = 0, pentru\ x = L \quad (3)$$

If we heat transfer in the aquifer:

$$\frac{\partial T}{\partial t} + v_a \frac{\partial T}{\partial x} - D \frac{\partial^2 T}{\partial x^2} \quad (4)$$

In these equations c is the pollutant concentration in space and time, D is the dispersion coefficient of porous environment, temperature T.

3. RESULTS AND DISCUSSION

The model was analyzed influence on porosity and hydraulic conductivity of aquifer transport.

Thus they have been rolling homogeneous environment, for situations in which porosity and hydraulic conductivity range is constant, in case the hydraulic conductivity and porosity range is constant and if both parameters vary.

In table 1 are input data used in simulations, and field modeling is in fig.4.

Table 1: Input data used in simulations

Pasul de discretizare	$\Delta x = \Delta y = 1m$
Tipul de acvifer	Cu niveliber
Grosimea acviferului	10 m
Gradientul hidraulic	0.016
Nivelurile de apa	H1=9 m, H2=8 m
Conductivitatea hidraulica/Transmisivitatea	$K=10^{-4}$ m/s, $2*10^{-4}$ m/s, 10^{-5} m/s, $5*10^{-5}$ m/s, 10^{-6} m/s, $7*10^{-6}$ m/s
Puncte de observatie	La 25,35,55 m sursa
Sursa de poluare	C0= 3 kg/m3
Timpul de modelare	T=1 an
Coeficient de dispersie	α_L=10 m, α_T = 1 m,
Factor de degradare	1

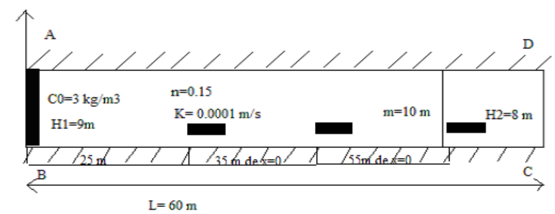

Fig.4 Field modeling

a) Influence of porosity

To study the influence of porosity were analyzed situations

a.1) the only situation where we have a whole range of porosity to 0.15, the flow is parallel to the layer (Fig. 5), source of pollution is constant and the variance observed in three observation points.

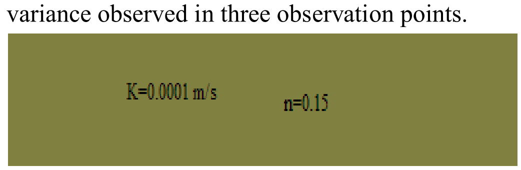

Fig.5 Homogeneous medium

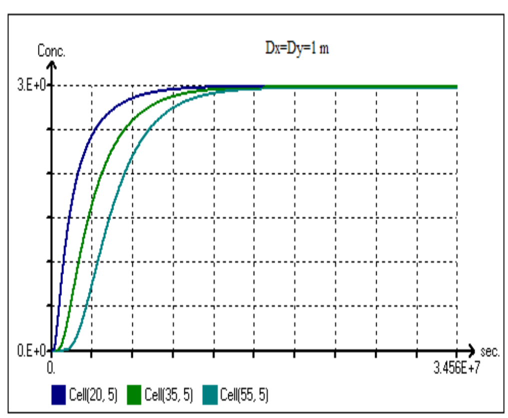

Fig.6 Changes in concentration, homogeneous medium, permanent source, constant K, in steady parallel flow

a.2) situation where we have six porous, upright, from 10 to 10 m, flow is perpendicular to the layer (Fig.7), the source of pollution is constant and the variance observed in three observation points

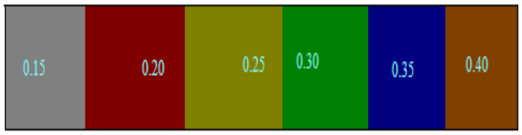

Fig.7 Arrangement porosity

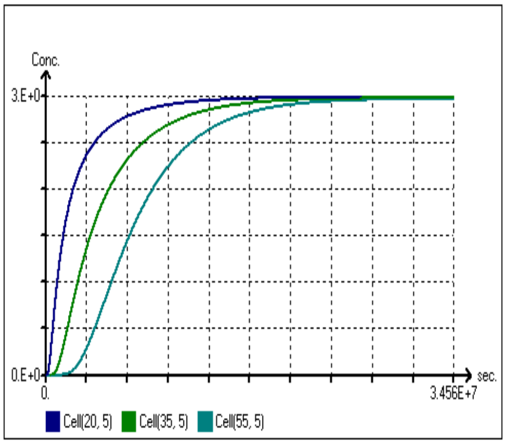

Fig.8 Variation of concentration, constant power, constant K, n varies

a.3) situation where we have six porous, upright, 10 to 10 m, flow is perpendicular to the layer (Fig.9), the source of pollution is constant and the variance observed in three observation points. In this case begins with porosity of 0.40, in descending order to the situation prior

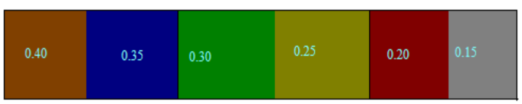

Fig.9 Arrangement porosity

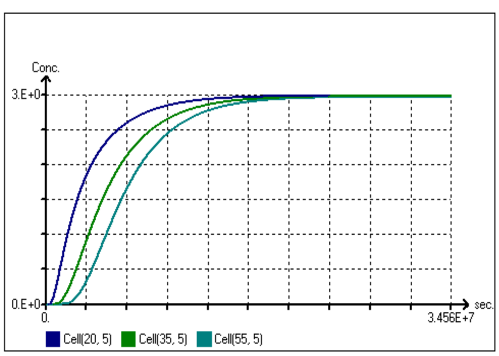

Fig.10 Changes in concentration, permanent source, constant K, n varies

a.4) situation where we have five porous horizontally in two 2-m layer flow is parallel (Fig.11), the source of pollution is constant and the variance observed in three observation points

Fig.11 Arrangement porosity

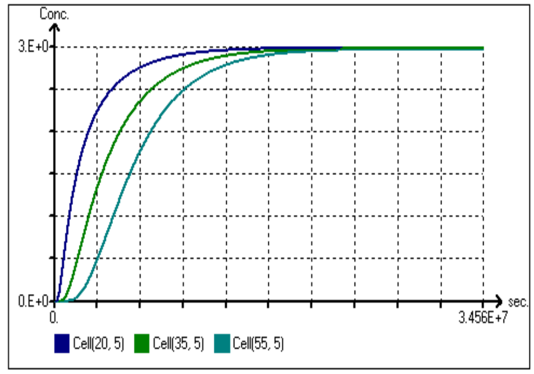

Fig.12 Changes in concentration, permanent source, constant K, n varies

b) Influence of hydraulic conductivity

b.1) situation where we have a single hydraulic conductivity in the whole area of 0.0001 m / s flow is parallel to the layer (Fig. 5), source of pollution is constant and the variance observed in three observation points

b.2) The situation where we have six hydraulic conductivity, upright, from 10 to 10 m, flow is perpendicular to the layer (Fig. 13), source of pollution is constant and the variance observed in three observation points

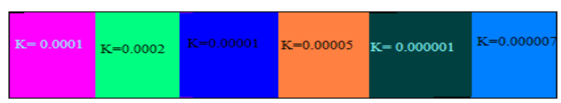

Fig.13 Distribution of hydraulic conductivity

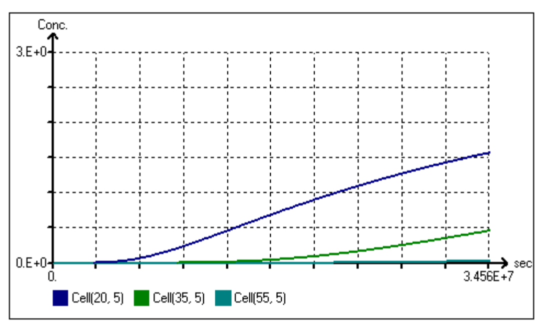

Fig.14 Changes in concentration, permanent source, K varies in constant flow perpendicular

b.3) situation where we have five hydraulic conductivity, horizontal, 2 to 2 m, the flow is parallel to the layer (Fig.15), the source of pollution is constant and the variance observed in three observation points.

Fig.15 Distribution of hydraulic conductivity

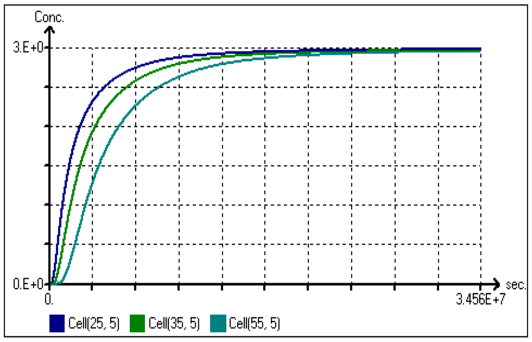

Fig.16 Changes in concentration, permanent source, K varies in constant parallel flow

c) Influence of porosity and hydraulic conductivity

c.1) Hydraulic conductivity and porosity varies vertically and horizontally, (Fig.17). The source of pollution is constant and the variance observed in three observation points.

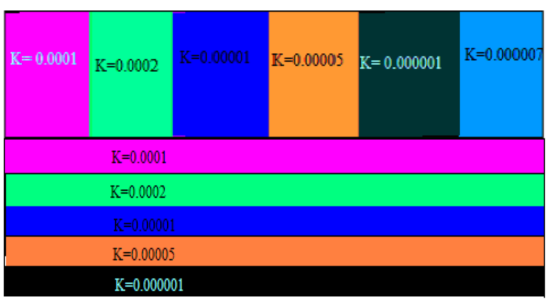

Fig. 17 Distribution of porosity and hydraulic conductivity

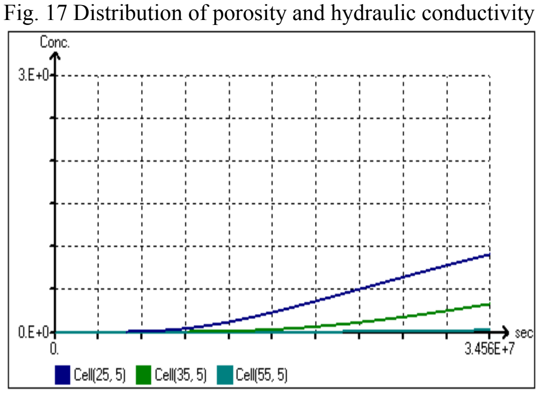

Fig. 18 Changes in concentration, permanent source, K varie, n varies

Note that the distribution of graphite vertical hydraulic conductivity strongly influences the concentration variation in space and time, especially if it is accompanied by a horizontal variation of porosity.

4. CONCLUSIONS

Often, for complex areas, it is preferred mixing surface horizons mixing system; otherwise the system is too complex and can not understand what is happening. There are two important aspects that are lost by homogenization system: the fascination of study time

spatial heterogeneity and that the results are mostly unnecessary, because the world is heterogeneous.

Pollution and heat transfer phenomena are very complex and their prediction of a large aquifer requires determination of hydrogeological parameters, including porosity and permeability coefficient and today presents a great interest for scientists.

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