Experimental Study on Mass Transport in Geologic Porous Media

Koji Shimizu[1]; Yuko Hatano[2]

[1] Col.Eng.Sys.,Tsukuba Univ; [2] Inst. Eng. Mech & Sys., Tsukuba Univ.

http://www.kz.tsukuba.ac.jp/˜hatano

1 Introduction

The advection-dispersion equation(ADE)has been used widely about a movement prediction of contaminants in groundwater. This equation uses a constant water velocity, a constant diffusion coefficient to give a concentration profile. Recently, it has pointed out that there is a part which cannot reproduce real concentration profiles. It is for a dispersion coefficient not to be constant that it is thought as a cause. We compare the ADE with the fractional advection-dispersion equation (fADE)which used fractional calculus based on a study of Benson(1998). Specifically, we peformed a tracer experiment in porous media and measure the break-through curve. We use Toyoura sand (average particle diameter 0.175mm) as porous media. In addition, as a supporting experiment we do a dye-experiment to see advection-dispersion flow in glass beads (average particle diameter 0.1mm).

2 Experimental Setup

Experimental devices consist of container made by acrylic of 1000(side)x120(depth)x710 (height)mm, marriott tank, amplifier, electrode for measurement. At first, we fill up sand by hydraulic falling method. We continue injecting tracer(0.5%NaCl water solution) from a tank of the upper side with a constant head. Electrodes monitor at five places in sand and the measured electrical conductivity is converted to the concentration in the PC. We tried with KCl tracer (0.5%KCl water solution) as well. Finally, we perfomed dye-tracer experiment in a glass beads bed. The dye-tracer is added methylene blue hydrate (C16H18N3S-3H2O).

3 Results

We analyzed experiment results. We compare break-through curve with the advection-dispersion equation. The low part of the concentration was fitted well, but was not fitted in the high part of the concentration. Therefore, we try to fit with the fADE. When compared with ADE, the low part of the concentration fitted moderately and the high part of the concentration fitted considerably better. As a whole, the curves by the ADE are symmetrical and the tail part was sharp, but break-through curve of experiment results is the form that right and left are non-symmetric and the tail part is gradually increased. A general tendency of the graph resembles fADE very much. About the dye-tracer experiment, we saw that a density wedge was negligible in the flow of low speed such as groundwater.

4 Conclusion

We did a tracer experiment with a sand box type container. In fADE, we were able to express the part which we were not able to express in ADE. Other experimental results with different kinds of tracers will be shown at the presentation.