

# 3D simulation of groundwater advection and diffusion in Kyoto basin.

Takafumi Kitaoka, Makoto Nakamura and Harushige Kusumi

Graduate School of Kansai University  
3-3-15 Yamate-cho, Suita-shi, Osaka  
JAPAN

E-mail: k111781@kansai-u.ac.jp

## Abstract

*The purpose of our study is to maintain the groundwater resource that supports the life and culture of people in Fushimi ward. So, we need to make a 3D model for groundwater from the viewpoint of groundwater conservation as a general assessment method. For the purpose of groundwater conservation, we would like to use this simulation model as a general assessment to protect the resource and the environment of groundwater.*

## 1. INTRODUCTION

Fushimi's groundwater has long supported Kyoto's traditional industries. Kyoto city has various traditional cultures and industries. One of them is the production of Japanese sake, for which Fushimi-Ward in Kyoto is famous. This area has a plentiful supply of good quality groundwater suited to making Japanese sake, and consequently. The purpose of our study is to maintain the groundwater resource that supports the life and culture of people in Fushimi ward. Previous research recreated the ground water behavior over a wide area in the shallow-strata. In this research, we analysed the advection and diffusion in order to predict how an assumed pollutant spreads in 5 years.

## 2. EXPERIMENTAL PROCEDURE

Firstly, we measured the groundwater level and came to understand the groundwater properties in this area. Next, we analyzed the 3D simulation of groundwater while using those data. Having arranged the bore data, we then constructed an accurate stratum model necessary for analyzing. We then analyzed the seepage flow in order to reproduce the groundwater flow. The analysis method is FEM. Finally, we assumed how contamination occurred in groundwater by using the result of the seepage flow analysis with maximum accuracy, and subsequently carried out the advection and diffusion analysis. As pollutants we used iron which in high-concentrations is undesirable for brewing.

## 3. RESULTS AND DISCUSSION

In the horizontal direction, the extent of iron contamination would expand 20 meters per 5 years. In the vertical direction, compared to horizontal flows the speed of downward flows is 2 orders lower, and it is estimated that it doesn't diffuse at a rate greater than 3 meters per 5 years.

## 4. CONCLUSIONS

Through this research we established that the range of behavior of iron in this region is small. Further, as between the aquifer containing the underground structures, and the aquifer in which pumping is performed, there is a generally continuous clay aquiclude stratum, there is a low risk of an increase in iron concentration due to elution from underground structures into strata deeper than second aquifer.