



INTERNATIONAL SCHOOL FOR GEOSCIENCE RESOURCES (IS-Geo)
KOREA INSTITUTE OF GEOSCIENCE AND MINERAL RESOURCES (KIGAM)

PUBLIC CUSTOMIZED TRAINING COURSE ON Groundwater contamination transport modelling and remediation of contaminated subsurface systems

The International School for Geoscience Resources of KIGAM presents an intensive training course on **Groundwater contamination transport modelling and remediation of contaminated subsurface systems**. The course will take place at the Ara room of International School for Geoscience Resources of KIGAM in Daejeon (Korea) in **October 13 to 15, 2014** and will include:

Topics	Date	Instructor
Day 1. Contaminant transport modelling – Analytical models		
Topic 1. Fundamentals of groundwater transport – advection-dispersion processes	Oct. 13	Dr. Clement (Auburn University, USA) & Dr. Chang (KICT, Korea)
Topic 2. Development of advection-dispersion equation and solution to one-dimensional problems		
Topic 3. Introduction of EXCEL-Visual Basic		
Topic 4. Development of one-dimensional analytical models using Visual Basic		
Topic 5. Fundamentals of finite-difference solution to differential equations		
Day 2. Contaminant transport modelling – Numerical models		
Topic 1. Numerical solution to advections-dispersion equations and development of a visual basic code	Oct. 14	Dr. Clement (Auburn University, USA) & Dr. Chang (KICT, Korea)
Topic 2. Fundamentals of sorption and other chemical/biochemical reactive transport mechanisms		
Topic 3. Introduction to MODFLOW/MT3DMS and RT3D codes		
Topic 4. Demonstration of MODFLOW/MT3DMS codes		





Day 3. Remediation of groundwater contamination problems

Topic 1. Managing groundwater contaminated field site - LNAPL sites and active remediation option

Topic 2. DNAPL contamination problems and active remediation option

Topic 3. Discussion of bioremediation and natural attenuation processes

Topic 4. Case-study for natural attenuation screening and design using USEPA's BIOCHLOR model

Topic 5. Camp Lejeune case study presentation

Oct. 15
Dr. Clement
(Auburn University,
USA)
&
Dr. Chang
(KICT, Korea)



COURSE INFORMATION

- **Agenda**

The first day of the course will be focused on developing a strong fundamental understanding of the mathematical models that are used for predicting groundwater transport. The day will begin with an introductory overview of Darcy's law, advective transport processes, and dispersive transport processes. These discussions will then be followed by presentations on necessary ideas to develop the basic advection-dispersion equation which is routinely used for modelling contaminant transport in porous media systems. Simple one-dimensional analytical solution to the advection-dispersion equation will then be coded within a programmable visual basic environment, available within EXCEL. The day will conclude with a presentation focussing on the numerical solutions to advection dispersion equations.

The morning of the second day will be focus on developing necessary mathematics to implement a simple finite difference numerical scheme to solve the advection-dispersion equation. The lecture will be followed by a practical session where the participants will have an opportunity to develop a numerical model using the EXCEL-Visual Basic platform. In the afternoon, an introductory overview of more practical numerical models including MODFLOW/MT3DMS and RT3D will be presented, followed by an exercise to use these numerical tools to solve some practical problems.

During the morning session of the final day, we will present the details of two major types of contamination problems involving LNAPL and DNAPL spill, and present various remediation technologies available for managing these problems. Later we will discuss the details of various type to bioremediation options available for remediating LNAPL and DNAPL sites, and will also review the fundamentals of various natural attenuation processes and methods of implementing natural attenuation as a technology to manage contaminated field sites. These lectures will be followed by a case-study involving a DNAPL spill and using USEPA's BIOCHLOR model screen and design a natural attenuation for the site. The course will conclude with a case-study presentation that highlights some of the limitations of using mathematical models to resolve complex policy problems at DNAPL contaminated sites.

- **Course Covered**

- Contaminant transport modelling – Analytical models
- Contaminant transport modelling – Numerical models
- Remediation of groundwater contamination problems

- **Course Requirements: Prerequisite**

- A basic knowledge of the physics of fluid flow in porous media
- Basic understanding of groundwater hydrology
- Basic understanding of Excel
- Some knowledge and experience in using mathematical models will help but is not necessary

- **Who should Attend?**

- This course is designed for scientists, engineers, and graduate students who are interested in developing a deeper level of understanding of groundwater contaminant transport models, and understanding the use of various methods available for managing/remediating groundwater contaminated sites.

- **Summary of topic contents and learning objectives**

- **Day 1. Contaminant transport modelling – Analytical models**

- Fundamentals of groundwater transport – advection-dispersion processes
- Development of advection-dispersion equation and solution to one-dimensional problems
- Introduction of EXCEL-Visual Basic
- Development of one-dimensional analytical models using Visual Basic
- Fundamentals of finite-difference solution to differential equations

- **Day 2. Contaminant transport modelling – Numerical models**

- Numerical solution to advections-dispersion equations and development of a visual basic code
- Fundamentals of sorption and other chemical/biochemical reactive transport mechanisms
- Introduction to MODFLOW/MT3DMS and RT3D codes
- Demonstration of MODFLOW/MT3DMS codes

- **Day 3. Remediation of groundwater contamination problems**

- Managing groundwater contaminated field site - LNAPL sites and active remediation option

- DNAPL contamination problems and active remediation option
- Discussion of bioremediation and natural attenuation processes
- Case-study for natural attenuation screening and design using USEPA's BIOCHLOR model
- Camp Lejeune case study presentation

About the instructor – *Professor Prabhakar Clement*



Dr. Prabhakar Clement is currently the Harold Vince Groome Jr. Professor of Environmental Engineering in the Department of Civil Engineering at Auburn University, Alabama. Dr. Clement is an elected fellow of the American Society of Civil Engineers. Before joining Auburn University, he was a tenure-track faculty member at the Department of Environmental Engineering, Perth, Australia (1999-2002). He also worked at the Battelle Pacific Northwest National Laboratory, Richland, Washington, from 1994 to 1999. He received his PhD in Civil Engineering from Auburn University in 1993. Dr. Clement is the lead author of the widely used MODFLOW-family reactive transport code RT3D. He has served as an associate editor of several leading journals including Water Resources Research, and has served on various National Academy of Science and Engineering panels to review groundwater contamination problems. He has published over 80 journal articles that have received over 1600 web-of-science citations with an H-index of 22. Further details are available at: <http://www.eng.auburn.edu/~clemept/>

About the instructor – *Dr. Sun-woo Chang*



Dr. Sun-woo Chang is currently working at Korea Institute of Civil Engineering and Building Technology(KICT) as a principal researcher. Dr. Chang received her B.S. and M.Sc. in Seoul National University in 2001 and 2003 respectively. She studied on the characteristics of sulfur utilizing autotrophic denitrification of groundwater contaminated with mixed waste and the effect of alternative alkalinity source for her master's degree. Dr. Chang majored in Dynamics of saltwater intrusion processes in saturated porous media systems in department of Civil Engineering of Auburn University for her Ph. D from 2008 to 2012. Before she joined in KICT, she worked at Korea Institute of Geoscience and Mineral Resources (KIGAM) from 2010 to 2013.