



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

PUBLIC CUSTOMIZED TRAINING COURSE ON Well Hydraulics - Theory and Interpretation

The **International School for Geoscience Resources** of KIGAM presents an intensive training course on **Well Hydraulics - Theory and Interpretation**. The course will take place at the Mirinae room of International School for Geoscience Resources of KIGAM in Daejeon (Korea) in **April 8 to 10, 2014** and will include the following topics.

Topics	Date	Instructor
Day 1. The Pumping Test for Aquifer Evaluation Topic 1. Pumping Tests	April 8	James Butler (KGS, USA)
Day 2. Beyond the Pumping Test: Slug Tests, High-Resolution Characterization, and Interpretation of Well Hydrographs Topic 1. Slug Tests Topic 2. High-Resolution Characterization Methods Topic 3. Interpretation of Well Hydrographs	April 9	James Butler (KGS, USA)
Day 3. Field Application issues and Practical Exercise on Aqtesolv Topic 1. Field Application Cases and practical issues Topic 2. Practical Exercise on Aqtesolv	April 10	Jin-Yong LEE (KNU) Yongcheol KIM (KIGAM)



COURSE INFORMATION

• Agenda

- This course will provide an introduction to conventional and recently developed methods to characterize hydraulic properties of geological media for groundwater investigations with field examples drawn from various studies in Korea and the United States.
- This course will provide the practical exercise on Aqtesolv, the most commonly used program for analysing hydraulic test data.

• Course Coverage

- Design, performance, analysis, and interpretation of pumping tests and slug tests
- Exploiting water-level responses to natural stimuli, with an emphasis on responses to fluctuations in atmospheric pressure
- Introduction to and examples of new high-resolution characterization methods, with an emphasis on direct-push profiling methods, hydraulic tomography, and NMR logging (for small-diameter wells and boreholes)
- Interpretation of hydrographs from continuously monitored wells
- Field examples of pumping tests, slug tests, and other methods, with an emphasis on data analysis and test interpretation
- How to use 'Aqtesolv', the program for analysing various hydraulic tests

• Course Requirements: Prerequisite

- A basic knowledge of the physics of fluid flow in geological media
- Basic understanding of field methods for groundwater investigations
- Understanding of various geophysical logging methods
- Experience with Excel will help but is not necessary

• Who should Attend?

- This course is designed for scientists, engineers, and graduate students who are interested in conventional and recently developed methods for hydraulic characterization of geological media for groundwater investigations.

- **Day 1. APR.8. The Pumping Test for Aquifer Evaluation**

The first day of the course will be focused on the pumping test, the most commonly used method of aquifer evaluation for water-supply investigations. The day will begin with an introductory overview of pumping tests that will be followed by more detailed discussions of key conceptual and practical considerations. These discussions will then be followed by presentations on powerful approaches for pumping-test interpretation and analysis. The day will conclude with the analysis of field examples using the Aqtesolv well-test analysis software.

- The pumping test: Theory and analysis overview
- The pumping test: Some key conceptual considerations
- The pumping test: Some key practical considerations
- The pumping test: The power of diagnostic plots and derivative methods
- The pumping test: Recovery methods
- The pumping test: Field examples and Aqtesolv demonstration (free trial copy (cannot print or save) of Aqtesolv can be downloaded from www.aqtesolv.com)

- **Day 2. APR.9. Beyond the Pumping Test: Slug Tests, High-Resolution Characterization, and Interpretation of Well Hydrographs**

The morning of the second day will be focused on the slug test, a commonly used method for obtaining information about hydraulic conductivity at the scale of relevance for contaminant-site investigations. An introductory overview of the approach will be presented followed by a demonstration of key points using field examples. The first half of the afternoon of the second day will be focused on high-resolution methods for hydraulic characterization of the subsurface. The afternoon will begin with a presentation on direct-push profiling, an increasingly common approach for acquiring high-resolution information in relatively shallow, unconsolidated settings. This will be followed by an overview of high-resolution methods that can be used in both consolidated and unconsolidated settings. The second half of the afternoon of the second day will be focused on approaches for getting more information about the subsurface from well hydrographs. This portion of the course will begin with a presentation on exploiting water-level responses to fluctuations in atmospheric



pressure, with demonstrations from wells in confined and unconfined aquifers. The afternoon will conclude with a presentation on using the pumping-test methods discussed in Day 1 to interpret well hydrographs.

- The slug test: Theory and analysis overview
- The slug test: Field examples
- High-resolution characterization: Direct-push profiling
- High-resolution characterization: Additional methods
- Interpretation of well hydrographs: Exploiting variations in atmospheric pressure
- Interpretation of well hydrographs: Application of pumping-test methods

- **Day 3. APR.10 Field Application Issues and Practical Exercise on Aqtesolv**

Field application of pumping tests and slug tests, and practical exercise on Aqtesolv will be provided. Some issues and problems related to field performance of the aquifer tests and data analysis will be also discussed. Especially, a critical problem related to optimum pumping rate in the step-drawdown tests will be reviewed.

- Field Application practices and issues
- Practical exercise on Aqtesolv



About the instructor – *Dr. James Butler*



James Butler is a Senior Scientist and Chief of the Geohydrology Section of the Kansas Geological Survey at the University of Kansas, USA, where he has worked since 1986. He received a B.S. in Geology from the College of William and Mary and M.S. and Ph.D. degrees in Applied Hydrogeology from Stanford University. His research interests include the development of field methods for site characterization, well responses to natural stimuli, and the assessment of hydrologic processes in stream-aquifer systems. He is the author of the book *The Design, Performance, and Analysis of Slug Tests*, as well as numerous scientific papers on various aspects of applied hydrogeology. Dr. Butler was the 2007 Darcy Distinguished Lecturer of the National Ground Water Association and the 2009 recipient of the Pioneers in Groundwater Award of the Environmental and Water Resources Institute of the American Society of Civil Engineers. Since 2002, he has served as an Associate Editor for the journal *Groundwater*; he previously was an Associate Editor for *Water Resources Research*, the *Journal of Hydrology*, and the *Hydrogeology Journal*. He currently is serving as President of the International Commission on Ground Water of the International Association of Hydrological Sciences.

About the instructor – *Prof. Jin-Yong LEE*



Jin-Yong Lee is an Associate Professor in the Department of Geology at Kangwon National University. He received B.Sc. M.Sc., and Ph.D. degrees in hydrogeology from Seoul National University, Korea. He has published 167 papers in domestic and international journals, and given 195 talks and poster presentations in domestic and international conferences. Now he is studying the groundwater-stream water interaction in Yanggu and Inje, melt water chemistry in Antarctica, and sustainable use of open loop ground source heat pumps.

About the instructor – *Dr. Yongcheol KIM*



Yongcheol Kim received B. Sc. M. Sc., and Ph.D. degrees in hydrogeology from Seoul National University, South Korea. Dr. Kim researched at CESEP(Center for Experimental Study of Subsurface Environmental Processes) in Colorado School of Mines, Colorado, USA from 2003 to 2005 as a visiting scholar and post doctoral researcher. He joined Korea Institute of Geoscience and Mineral Resources in 2005 as a senior researcher. Dr. Kim has more than 20 publications, four patents registered and eleven patents reviewed. He has performed research in the area of artificial recharge for sustainable groundwater resources, flow and transport in saturated/unsaturated porous/fractured media, DNAPL problems, tracer test, hydraulic tests for site characterization, hydrogeological characterization of volcanic aquifer, karst aquifer, and groundwater contamination problem. Dr. Kim has received Young Geologist Award of Korea. In addition, he has served on expert panels of the Jeju Special Self-governing Province and Wonju Regional Environmental Office.