

Geology 474/574: Ground Water Contamination

Syllabus - Spring 2008 Dr. Robert Mitchell

Text

Contaminant Hydrogeology, C.W. Fetter, 2nd Edition, 1999

Prerequisite

Ground Water Hydrology (Geol 473) or an equivalent course is required, and knowledge of Mathcad.

Course Description

Introduction to the fundamental principles of some important physical, chemical, and biological processes which govern the transport, persistence, and/or degradation of pollutants in saturated and unsaturated ground water systems. Topics include advection, dispersion, molecular diffusion, sorption to soils/sediments, and biological degradation. Fundamental transport equations will be developed and analytical and numerical solutions will be discussed.

Homework and Exams

Your grade will be partially based on problem sets, which will be assigned periodically throughout the quarter. Problem sets will be deducted 10% for each day they are turned in late. Two exams will be given. The midterm will cover material from the first half of the quarter and the final exam will cover the material over the second half of the quarter. The exams will cover the material discussed in the reading, lectures, and homework assignments.

Graduate Student Projects

The graduate students will be required to do an additional research project if they are taking this course at the graduate level.

Grading

The grading breakdown will be as follows: (a curve is possible, but not certain)

Homework	35%
Midterm Exam	30%
Final Exam	35% (Wednesday, June 11, 3:30-5:30 pm)

General Topics

Physical Processes

- Mass Transport in Saturated Media
- Mass Transport in Unsaturated Media

Chemical Processes

- Organic Compounds in Ground Water
- Transformation Processes
 - Sorption
 - Biodegradation
- Multiphase Systems and Mass Transfer

Remediation Processes

- Site Remediation

I reserve the right to change the syllabus as required throughout the term to better meet the instructional needs of the class.

Learning Objectives

My main objective of the course is to help you develop a basic understanding of the physical, chemical, and biological mechanisms that govern the transport and fate of chemical constituents in ground water. I spend the first few weeks on physical transport, which includes diffusion, advection and dispersion, which are dominated by fluid velocity variations. Velocity variations develop from the pore scale to field scale and depend on the degree (and scale) of porous media heterogeneity. My discussions about fate topics will be restricted to organic compounds because the majority of ground water contamination is caused by organic chemicals or non-aqueous phase liquids (NAPLs).

Fate factors I address include the partitioning processes that govern the mass transfer between the air, liquid, NAPLs, and solid grain phases, as controlled by Henry's law, Raoult's law, sorption, diffusion, thin film theory, vapor pressure gradients, solubility, and kinetics. I also discuss the bacteria metabolic processes, and environmental conditions that control the destruction of NAPLs. I introduce remediation technologies as a means to review the theoretical factors that control the fate and transport of chemicals in ground water.

Assessment

Assignments

You will complete about five problem sets during the quarter (35% of the grade). The problem sets typically follow a mathematical modeling approach to develop concepts through computer applications using Mathcad. You will use analytical solutions to partial differential equations, subject to simple boundary and initial conditions, to examine a process by performing parameter sensitivity analyses. I require discussions of all your results, which forces you to thoroughly analyze the meaning of the result.

Exams

I give one midterm and a final exam. The final exam is weighted more on the second half of the course. My exams are typically short answer essay with an emphasis on process description. I want you to be able to tell me in words, what controls a chemical fate or transport process. Some times I integrate problems that require equation manipulation and calculations. I provide an equation sheet with each exam.

Academic honesty is an important part of every course at WWU. Please refer to Appendix D (p. 389-390) of the 2007-2008 Course Catalog for details.