A review of chemistry principles associated with contaminant transport, fate, and remediation

Course I.D. CHEM-403A (Course 1 of 3 in a Series)
December 6, 2010, 8:00AM - 5:00PM
Bellevue Hilton
300 112th Avenue SE | Bellevue, WA 98004

Instructor: Erick McWayne, Northwest Environmental Training Center

Description: This course provides participants with an overview and refresher of key chemistry concepts associated with environmental contamination, contaminant transport, fate, and remediation. It also includes a review of chemical naming rules (e.g., understanding what 1,1,1-TCA is) and the ways in which they can be used to predict molecular geometry and environmental behavior. This material is intended for non chemists in the environmental field seeking a fundamental understanding of chemistry principles to use in their work. Moreover, this course is recommended for all environmental professionals working with contaminated soil and water who have had minimal formal training in the subject. It is also recommended for project managers seeking a review of contaminant chemistry.

Course Topics:

- Overview of Physical and Chemical Properties of Contaminants (S, KOC, KOW, KH, TB, TM)
- Periodic Chart Applications to Remediation
- Isotopes, Ions, and Chemical Bonds
- Predicting Molecular Geometry and Behavior
- Solubility Rules, Precipitation, and Applications for Inorganic
- Remediation Chemical Reactions, Kinetics, and Thermodynamics
- Stoichiometry (balancing reactions)
- Oxidation States and Redox Reactions
- Chemical Equilibrium and Limiting Reactants
- Empirical, Chemical, and Structural Formulas
- Mass-Based and Molar-Based Concentrations
- Visualizing Molecules with Lewis Dot Notation
- Polyatomic Oxoanions (nitrate, phosphate, chromate, perchlorate, permanganate, etc.)
- Organic Molecules and IUPAC Nomenclature
- Functional Groups - Alcohols, Aldehydes, Amines, Aromatics, Ethers, Ketones, and Organometallics
- BTEX - Benzene, Toluene, Ethylbenzene, and Xylene

This course is part one of a three-part series. It is immediately followed by Contaminant Chemistry and Transport in Soil and Groundwater Workshop (CHEM-403B) from December 7-8, 2010, and Monitored Natural Attenuation (GHYD-410) from December 9-10, 2010. Attendees may register for these courses individually or as a package. A discount applies when registering for two or more courses. Courses will begin at 8 AM and end at 5 PM each day.
After completing this course, participants will be able to:

- Identify common physical and chemical properties that affect chemical fate and transport in soil and water;
- Use molecular shape to predict chemical behavior (solubility, vapor pressure, Henry's law constant, boiling point, melting point, and viscosity);
- Understand chemical solubility in polar versus nonpolar solvents;
- Predict whether anions or cations will be more mobile in groundwater;
- Express contaminant concentrations in terms of mass and moles, and predict limiting reactants;
- Understand the concepts of chemical equilibrium, kinetics, and thermodynamics and how they affect remediation;
- Describe the structure of common organic chemical contaminants using diagramming methods such as the condensed structural formula and Lewis Dot notation; and
- Identify and name simple organic chemicals (e.g., 2,4,5-trichlorophenol) using the International Union of Pure and Applied Chemistry nomenclature system.

Prerequisites: Some college level chemistry is required (even if it was a long time ago).

Education Level: Fundamental overview/refresher

Course Materials: Each participant will receive a copy of the course proceedings including notes and reference material on the first day of the course.

Continuing Education Units: 0.75 CEU's

Registration: Early Bird rate $300/$245 if registered by September 24; $350/$295* thereafter (*reduced tuition is available to employees of Native American tribes, government agencies, and nonprofits; students; and NAEP members). An additional discount applies when registering for CHEM-403B and GHYD-410. You may register via the link below or by calling the Northwest Environmental Training Center at (425) 270-3274. Register Online!

What to Bring: Scientific calculator, mechanical pencil, coffee mug and water bottle (to reduce waste). Please wear comfortable clothing appropriate for the prevailing weather.

About the Instructor: Mr. McWayne has fifteen years of experience leading soil, groundwater, and geophysical investigations for the characterization of contaminant transport and fate. In addition, he has extensive experience teaching contaminant chemistry, transport, natural attenuation, and hydrogeology. As an environmental consultant, Mr. McWayne served as a project manager for remedial investigation and feasibility studies at numerous Department of Defense and other contaminated sites. He founded and instructs for the Northwest Environmental Training Center teaching workshops in transport and fate, environmental chemistry, and hydrogeology across the country.

Cancellation Policy: Registration fees are fully refundable up to 30 days prior to the event and 50 percent refundable (or 100% credit) thereafter up to 3 business days prior to the event. No refunds are issued for cancellations occurring less than 3 business days before the start day. Course registration fees and cancellation policy are subject to change without notice.

Disability Accommodations: To request disability accommodations, please contact us at info@nwetc.org or (425) 270-3274 at least 30 days prior to the event.
Description: This course provides participants with an overview of key concepts essential for understanding soil and groundwater contamination and the selection of appropriate remediation approaches. This material is intended for environmental professionals seeking a solid understanding of contaminant behavior, monitoring parameters, and how both relate to site remediation. This course is recommended for all environmental professionals working with contaminated soil and groundwater seeking a thorough review of essential topics. The course material will greatly enhance on-the-job training and is also recommended for project managers seeking a more thorough understanding of contaminant behavior.

Course Topics:

**Contaminant Chemistry Overview**
- Functional Groups, Chemical Properties, and Hazards

**Transport Mechanisms**
- Advection
- Mechanical Dispersion
- Diffusion (Chemical Dispersion)

**Contaminant Solubility Rules**
- Molecular Geometry
- Effective Solubility

3- and 4-Phase Equilibrium Partitioning
- Adsorption and Absorption
- Applications of $K_d$, $K_{oc}$, $f_{oc}$, $K_{ow}$, and $K_{hi}$
- NAPL and the One Percent Rule
- Molar Fraction Calculations - Contaminant Mass Fraction Calculation
- Residual Saturation Calculation

**Groundwater Transport**
- Hydrogeology Review
- Three Point Problem
- Groundwater Velocity Calculations
- Retardation and Solute Velocity Calculations

**Nonaqueous Phase Liquid (NAPL) Transport**
- Capillary Fringe Interactions and Smear Zones
- Estimating LNA PL Thickness from Well Free Product
- Estimating DNAPL Critical Height

**Vapor Transport**
- Vapor Pressure, Solubility, Molecular Weight, and Vapor Density
- Contact Surface and Henry's Law Partitioning
- Vapor Diffusion and Air-Filled Porosity

**Natural Attenuation**
- Overview of Natural Attenuation Processes
- Biodegradation Pathways for Common Contaminants

**Focus on Hydrocarbon Contamination**
- Gasoline and Diesel Chemistry
- BTEX, Oxygenates, Additives, and Other Potential Concerns
- Ethanol Cosolvation and Plume Elongation
- Geochemical Indicators of Natural Attenuation
- Plume Behavior and Zones

**Focus on Chlorinated Hydrocarbon Contamination**
- Chlorinated Solvent Chemistry
- Type I, II, and III Plume Behavior
- Reductive Dechlorination and Cometabolization
- Geochemical Indicators of Natural Attenuation

**Focus on Metal Contaminants**
- Mobility, pH, and Amphoterism
- Dissolved and Particulate Forms
- Cation/Anion Exchange and Variably Charged Soils
- Complexation, Chelation, and Ligands
- Hydrated Metals as Acids

This course is part two of a three-part series. It is preceded by Fundamentals Contaminant Chemistry (CHEM-403a) on December 6, 2010, and followed by Monitored Natural Attenuation (GHYD-410) from December 9-10, 2010. Attendees may register for these courses individually or as a package. A discount applies when registering for two or more courses. Courses will begin at 8AM and end at 5PM each day.
After completing this course, participants will be able to:

- Understand basic soil and groundwater chemistry;
- Calculate chemical partitioning;
- Understand the significance of temperature, redox potential, pH, DO, and other monitoring parameters;
- Apply soil chemistry principles to soil investigations;
- Apply water chemistry principles to groundwater investigations;
- Understand the chemical and biological aspects of natural attenuation;
- Estimate partitioning coefficients and calculate solute average linear velocities;
- Demonstrate an improved overall understanding of contaminant chemistry; and
- Use site-specific chemistry data for selecting appropriate remediation strategies.

**Education Level:** Introductory to intermediate/refresher.

**Prerequisites:** Completion of CHEM-403a - Fundamental Contaminant Chemistry workshop, equivalent course work, or on-the-job experience.

**Course Materials:** Each participant will receive a copy of the course proceedings including notes and reference material.

**Continuing Education Units:** 1.5 CEU’s

**Registration:** Early Bird rate $545/$445 if registered by September 24, 2010; $595/$495* thereafter (*reduced tuition is available to employees of Native American tribes, nonprofits, and government agencies; students; and NAEP members). An additional discount applies when registering for CHEM-403a and/or GHYD-410. You may register via the link below or by calling the Northwest Environmental Training Center at (425) 270-3274. Register Online!

**What to Bring:** Scientific calculator, mechanical pencil, coffee mug and water bottle (to reduce waste). Please wear comfortable clothing appropriate for the prevailing weather.

**About the Instructor:** Mr. McWayne has fifteen years of experience leading soil, groundwater, and geophysical investigations for the characterization of contaminant transport and fate. In addition, he has extensive experience teaching contaminant chemistry, transport, natural attenuation, and hydrogeology. As an environmental consultant, Mr. McWayne served as a project manager for remedial investigation and feasibility studies at numerous Department of Defense and other contaminated sites. He founded and instructs for the Northwest Environmental Training Center teaching workshops in transport and fate, environmental chemistry, and hydrogeology across the country.

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Description: This course provides participants with a practical overview of the science and techniques used to implement monitored natural attenuation for soil and groundwater remediation. More specifically, individual topics include monitored natural attenuation of petroleum hydrocarbons, fuel oxygenates, and chlorinated hydrocarbons (solvents). Software tools for natural attenuation analysis and methods for enhancing natural attenuation will also be discussed.

Course Topics:

Overview of Monitored Natural Attenuation (MNA)
- Physical, Chemical, and Biological Processes
- Advantages and Disadvantages of MNA
- State and Federal Policies on MNA

Geochemical Context for MNA
- Geochemical Processes
- Redox Zonation and Biodegradation Efficiency

Biodegradation of Petroleum Hydrocarbons and Fuel Oxygenates
- Determining Site Specific Assimilative Capacity with Terminal Electron Acceptor (TEA) Evaluations
- Phase Considerations (LNAPL, dissolved, sorbed, and vapor)
- BTEX and Fuel Oxygenate Plume Behavior and Degradation Rates
- Daughter Products (toxicity and mobility)
- Geochemical Indicators of MNA

Biotransformation and Degradation of Chlorinated Hydrocarbons
- Determining Site Specific Assimilative Capacity
- Phase considerations (DNAPL, dissolved, sorbed, and vapor)
- Mixed Plume Behavior
- Daughter Products (toxicity and mobility)
- Geochemical Indicators of MNA

Site Hydrogeology and MNA Efficiency
- Groundwater Velocity Characterization
- Estimating Mechanical and Chemical Dispersion
- Assessing Sorptive Capacity of Aquifer Solids
- Microbiologic Testing - When is it necessary?

Natural Attenuation Feasibility Study
- Establishing Remediation Goals
- Evaluating Plume Characteristics
- Source Decay and Removal
- Predicting Plume Behavior
- Measuring and Estimating Degradation Rates
- Interpreting Geochemical Tracers
- Using Fate and Transport Models
- Developing the Conceptual Site Model

Implementing MNA
- Groundwater Monitoring Plan Requirements
- Well Position and Number: How many wells are enough?
- Determining Trends in Contaminant Mass
- Collecting Lines of Evidence for Natural Attenuation
- Refining the Conceptual Site Model
- Selecting and Implementing Primary Source Control
- Evaluating Natural Attenuation and Plume Status
- Using Institutional Controls
- Risk Management

Addressing Commingled Plumes
- Impact on Plume Geometry
- Geochemical Indicators
- Degradation Rates

Criteria for Success and Site Closure
- Understanding the Persistence of Contaminant Mass
- Understanding Variations in Groundwater Velocity and Direction
- Correlating Groundwater Elevation with Contaminant Concentrations
- Cross Contamination Challenges and Forensics
- Rapid Site Assessment Technologies
- Adaptive Management
- Completing MNA and Demonstrating Site Restoration

MNA Case Studies and Interactive Exercises (throughout both days)
This course is part three of a three-part series. It is preceded by Fundamental Contaminant Chemistry (CHEM-403A) on December 6, 2010, and Contaminant Chemistry and Transport in Soil and Groundwater (CHEM-403B) from December 7-8, 2010. Attendees may register for these courses individually or as a package. However, a discount applies when registering for two or more courses, and registrants are encouraged to enroll in the full workshop series. Courses will begin at 8AM and end at 5PM each day.

After completing this course, participants will be able to:
- Understand and apply the core principles of natural attenuation policy and science during the remedy selection process;
- Select appropriate water quality parameters for analysis and understand the relevance of each parameter with regard to natural attenuation processes;
- Determine whether site geochemistry is favorable for natural attenuation;
- Assess whether geochemical changes suggest that natural attenuation has occurred in the past;
- Understand microbial processes and how to enhance them for improved biodegradation rates; and
- Compile and present site data to demonstrate whether monitored natural attenuation is a reasonable remediation strategy for a contaminated site.

Intended Audience: This course is intended for environmental professionals seeking an improved understanding of the science and techniques used to implement monitored natural attenuation.

Prerequisites: Familiarity with general contaminant chemistry and transport is essential. Completion of CHEM-403A and CHEM-403B or similar coursework is strongly recommended.

Course Materials: Attendees will receive a binder containing workshop proceedings and reference material.

Continuing Education Units: 1.5 CEU’s

Registration: Early Bird rate $545/$445 if registered by September 24, 2010; $595/$495* thereafter
(*reduced tuition is available to employees of Native American tribes, government agencies, and nonprofits; students; and NAEP members). An additional discount applies when registering for CHEM-403A, CHEM-403B and GHYD-410. You may register via the link below or by calling the Northwest Environmental Training Center at (425) 270-3274. Register Online!

What to Bring: Pen or pencil, scientific calculator, coffee mug, and a water bottle (to reduce waste). Please wear comfortable clothes appropriate for the prevailing weather. Lunch will be on your own. There are numerous restaurants within walking distance. Drinks and snacks will be provided each day.

About the Instructor: Mr. McWayne has fifteen years of experience leading soil, groundwater, and geophysical investigations for the characterization of contaminant transport and fate. In addition, he has extensive experience teaching contaminant chemistry, transport, natural attenuation, and hydrogeology. As an environmental consultant, Mr. McWayne served as a project manager for remedial investigation and feasibility studies at numerous Department of Defense and other contaminated sites. He founded and instructs for the Northwest Environmental Training Center teaching workshops in transport and fate, environmental chemistry, and hydrogeology across the country.

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Northwest Environmental Training Center, 501(c)(3)
A nonprofit program of EOS Alliance
230 NE Juniper St. Ste 201 | Issaquah, WA 98027
Phone: (425) 270-3274 Fax: (425) 526-2071
www.nwetc.org
Directions to:

**Bellevue Hilton**
300 112th Avenue SE
Bellevue, WA 98004
(425) 455-1300
bellevuehilton.com/

**King County Transit:** [http://tripplanner.kingcounty.gov/](http://tripplanner.kingcounty.gov/)

**Parking:** Free on-site parking is available

**FROM I-5 North/ I-90**
Take exit 164A to merge onto I-90 E toward Spokane
Take exit 9 for Bellevue Way
Slight right at 112th Ave SE
Take a slight right to stay on 112th
Venue will be on the right

**FROM I-5 South/ WA-520 E**
Take exit 168B to merge onto WA-520 E toward Bellevue/Kirkland
Take exit onto I-405 S toward Renton
Take exit 12 for SE 8th St
Take the 2nd right onto 112th Ave SE
Venue will be on the right

**REGION MAP:**

![Region Map of Bellevue, Washington](image-url)
REGISTRATION FORM

Name: ____________________________  Today’s Date: ____________

Agency/Organization: ____________________________________________________________

Street Address: ________________________________________________________________

Street Address (cont’d): _________________________________________________________

City: ____________________________  State: ____________  Zip: ____________

Phone: ____________________________  Fax: ____________________________

Email: ____________________________  Title: ____________________________

Indicate Course[s]:

Fundamental Contaminant Chemistry Workshop $__________
  Course ID: CHEM-403A, December 6, 2010
  Bellevue Hilton
  Registration: $350 ($295*)

Contaminant Chemistry and Transport Workshop $__________
  Course ID: CHEM-403B, Dec. 7-8, 2010
  Bellevue Hilton
  Registration: $595 ($495*)

Monitored Natural Attenuation Workshop $__________
  Course ID: GHYD-410, Dec 9-10, 2010
  Bellevue Hilton
  Registration: $595 ($495*)

*Reduced rates for Native American Tribes; nonprofits; government; students; and NEBC, NAEP and NWAEP members. An additional $100 discount applies to all registrants when registering for two classes, or $200 if registering for all three.

Payment Method: Check ☐  PO ☐  Credit Card (☐ Visa  ☐ Mastercard) Total: $__________

Credit Card or PO #: ____________________________  Exp: ____________________________

Notes: Please make checks payable to Northwest Environmental Training Center.

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