Intermediate
Predicting the Toxicity of Metals to Aquatic Organisms:
An Introduction to the Biotic Ligand Model--
February 26, 2009
8:30 a.m. – 5:00 p.m.
EPA Region 10 Regional Office
15th Floor NPQS Conference Rooms
Park Place Building at the Freeway Park
1200 Sixth Avenue
Seattle, Washington 98101

Description:

Water quality criteria (WQC) for metals have been developed to protect the integrity of aquatic systems. However, tests used to develop WQC were performed in laboratory waters that often are not representative of natural waters. Water effect ratio (WER) tests account for the effects of substances that alter the toxicity of metals in natural waters but can be costly and time consuming.

The biotic ligand model (BLM), a computationally efficient alternative to conducting WER tests, has been developed. The BLM may assist in developing technically defensible site-specific criteria, waste load allocations, and ecological risk assessments. It is intended to promote more focused and efficient uses of resources in the regulation and control of metals and the protection of the environment. The BLM is under review by regulatory agencies and is being considered for use in refining water quality criteria in the United States and elsewhere.

This course provides an introduction, background and rationale for the BLM, a description of its applications and case examples. The course will cover special considerations, data needs and data quality objectives, and model demonstrations. Demonstrations will be brief scenarios using hypothetical data sets and will cover model navigation, data input, and model outputs.

Course Objectives:

The attendee will learn about metal toxicity, factors that alter metal acute toxicity, metal water quality criteria development, sites and modes of action of metals, metal speciation, ligands, toxicity modeling and applications of the biotic ligand model.

Course Outline:

1. Introduction (15 minutes)
    a. Greeting
    b. Review of course materials
    c. Survey instructions
    d. Introduction of instructors
    e. Course overview
2. Assessing the Effects of Metals in the Environment (30 minutes)
    a. Public awareness
    b. Assessing risk
    c. Natural sources
    d. Analytical complexity
    e. Speciation
    f. Toxicity testing
    g. History of Metal Water Quality Criteria
    h. The model: BLM
    i. Define: Bioavailability and Ligands
    j. Effects of ligands
    k. What the BLM Calculates
    l. SAB Review
3. Background and Rationale for the BLM (60 minutes)
    a. Introduction
    b. Metal Water Quality Criteria
    c. Limitation of Metal WQC
    d. The BLM of Acute Toxicity
4. Break (15 minutes)
5. Biotic Ligand Model of Acute Toxicity: Technical Basis (60minutes)
    a. Introduction
    b. Description of the model
        i. Toxicity model
        ii. Chemical model
        iii. WHA model (WHAM)
    c. Relationship of Metal Accumulation to Acute Toxicity
    d. Model Application
        i. Effects of DOC on toxicity
        ii. Effects of hardness on toxicity
        iii. Effects of pH on Toxicity
    e. Water Effect Ratio
    f. Summary and conclusion

6. Biotic Ligand Model of Acute Toxicity: Application to Fish and *Daphnia* (30 minutes)
    a. Introduction
    b. Model development
    c. Model testing: Chemical Adjustments in Synthetic and Natural Waters
    d. Model testing: Water Effect Ratios Using Fathead Minnows
    e. Model testing: Water Effect Ratios Using *Daphnia*
    f. Summary and Conclusion
7. Question and Answer (30 minutes)
8. Lunch (60 minutes)
9. Example Applications of the Biotic Ligand Model (45 minutes)
    a. Introduction
    b. Setting Site Specific Water Quality Criteria (POTW)
    c. Assessing Impacts of a Copper Discharge from Water Cooled Condensers
    d. Aquatic Risk Assessment for Copper in San Francisco Bay
    e. Determination of Water Effect Ratios from Historical Water Quality Data
    f. Summary and Conclusions
10. Application Definition Needed for Biotic Ligand Model (45 minutes)
    a. Introduction
    b. Defining the application
        i. Prediction of potential effluent or receiving water toxicity
            1. Measure or preserve in field
        ii. Prediction of toxicity in tests
            1. Measure or preserve in test
        iii. Prediction of toxicity in tests of metal amended effluent or field samples
            1. Time constraints for initiating tests
            2. Time needed for medal/ligand equilibrium
        iv. Prediction of toxicity in tests of metal amended lab water
    c. Special Considerations
        i. Prediction of toxicity in effluent or receiving water tests
            1. Aeration effects
            2. pH Drift effects
        ii. Prediction of toxicity in different types of tests
            1. Static
            2. Static renewal
            3. Flow through
        iii. Prediction of toxicity in estuarine or marine samples
            1. Salting up effects
            2. Time needed for medal/ligand equilibrium
        iv. Prediction of toxicity in lab water
            1. Low detection limits needed

11. Break (15 minutes)
12. Chemical Analyses for Biotic Ligand Model (45 minutes)
    a. Introduction
    b. Parameters and recommended methods for each metal including rationale
    c. Data Quality Objectives
        i. MDL
        ii. PQL
        iii. Reproducibility
13. Model Demonstration (45 minutes)
    a. Introduction
    b. Example 1
    c. Example 2
    d. Example n
14. Question and Answer (30 minutes)
15. Questionnaire

Instructors:

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