

Soil Physical Chemistry - SOIL.710
2011 Course Outline

INSTRUCTOR: Dr. O. O. Akinremi

What we shall cover over the next 24 or so lectures:

- A) Introduction 1** - Brief mathematical Reviews
- ODE, PDE, Solution of differential equation
 - Definite integral, indefinite integrals
 - Analytical solution, numerical solution
 - Boundary conditions, initial conditions
- B) Introduction 2** - What is soil physical chemistry?
- Chemical Thermodynamics - 1st and 2nd Laws
 - Basic definition of system and thermodynamic variables.
 - Thermodynamics of soil solution
- C)** Ion Exchange Equilibria
- D)** Chemical Kinetics
- E)** Application of thermodynamics and kinetics to soil system
- Adjusting rate constant for water and temperature effects
 - Adsorption, sorption and retention processes
 - P sorption using an equilibrium approach
 - P sorption using a kinetic approach.
 - Convergence of kinetic and equilibrium approaches
- F)** Redox Chemistry of Soils
- Oxidation-reduction reactions and potentials
 - Eh vs pH and oe vs pH diagrams
 - Measurement and use of redox potentials
- H)** Diffusive transport of ions in soil (e.g. Phosphorous)
- Ficks First Law
 - Ficks Second Law
 - Diffusive transport without chemical reaction assuming no adsorption
e.g. Cl⁻ and Br⁻
 - Diffusive transport with chemical reaction

e.g. Using Sorption Isotherm
-Effect of type of sorption isotherm
-Differences amongst soils

- I)** Movement of water in the soil water - Darcy=s law
1) Saturated Flow 2) Unsaturated Flow
Water movement in 1, 2 & 3 dimensions
Convective-Dispersive Equation of Chemical Transport
e.g. Nitrate vs. chloride

Soil Physical Chemistry - SOIL.710 2011 Course Evaluation Scheme

- Assignment 1 - Sensitivity analysis and modification of Fortran program GROWTH - **5%**
- Assignment 2 - Literature review paper and class presentation on methods of studying soil chemical kinetics - **20%**
- Assignment 3 - Generating water and temperature correction factors for a kinetic model -**10%**
- Assignment 4 - Analysis of sorption data using adsorption isotherms - **10%**
- Assignment 5 - Analysis of sorption data using kinetic approach - **10%**
- Final examination - 45%**

Except for assignment 1, all assignments involve a written paper (5-7 pages worth 50% of total mark for the assignment) and a class presentation on the assigned topic (50% of total mark for the assignment).

Recommended Texts

1. Soil Physical Chemistry (2nd Edition, 1998) - Sparks D.L. (Editor)
2. Rates of Soil Chemical Processes (1991) SSSA Special Publication No. 27
3. Kinetics of Soil Chemical Processes (1988) - Sparks D.L.
4. Chemistry of the Solid-Water Interface - (1992) W. Stumm

5. Physical Chemistry (1965) Moore, W.J.
6. Environmental Soil Chemistry - (2nd Edition, 2003) D.Sparks
7. Environmental Soil Physics - (2000) D.Hillel
8. Chemistry in the Soil Environment (1981) - ASA Special Publication No. 40