

CIEG 430/630 Water Quality Modeling
Spring 2006
Assignment No. 5

Date Assigned	Date Due	Reading Assignment
20 March	24 March	Lecture 40; Lecture 41, Section 41.1

1. Determine how r_2/r_1 and c_{d2}/c_{d1} change with partition coefficient. For $v_b = 0.365$ cm/yr, $m_1 = 10$ mg/L, $m_2 = 0.5$ kg/L, $v_s = 1.0$ m/d, $v_d = 5$ cm/d.

a. Compute v_{rs} using solids mass balance.

b. For $\log K_{OW} = 2,3,4,5,6$, $K_{OC} = K_{OW}$, $K_p = f_{OC}K_{OC}$, $f_{OC,1} = 10\%$ (0.1), $f_{OC,2} = 1\%$ (0.01), tabulate the following parameters and make a graph of r_2/r_1 and c_{d2}/c_{d1} vs $\log K_{OW}$

Log K_{OW}	$(v_{rs} f_{p2} + v_b f_{p2})$	$v_d f_{d2} K_{p2} / K_{p1}$	r_2/r_1	c_{d2}/c_{d1}
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2. Consider the Delaware Estuary to be a completely mixed volume. The approximate parameters for the pentachloro PCB homolog are (see the Delaware Estuary handout for the data)

Volume	V	2.50E+10	ft ³
Average Flow	Q	3000.0	ft ³ /sec
Depth	H1 =	10.0	m
PCB loading	W =	20.0	lb/yr
Settling velocity to sediment	$v_s =$	1.0	m/d
Water column solids concentrations	$m_1 =$	1.0	mg oc/l
Burial velocity	$v_b =$	0.5	cm/yr
Diffusive mass transfer coeff.	$v_d =$	1.0	cm/day
Resuspension velocity	$v_{rs} =$	5.0	cm/day
Sediment depth	H2 =	10.0	cm
Sediment solids concentration	$m_2 =$	0.5	kg/L
Fraction OC in the water column	$f_{oc1} =$	0.10	gOC/g solids
Fraction OC in the sediment	$f_{oc2} =$	0.02	gOC/g solids
Observed water column total PCB conc.	CT1	1.5	ng/l
Observed water column dissolved PCB conc.	Cd1	0.5	ng/l
Observed sediment particulate PCB conc	r2	1.5	ug/gOC

- a. Compute the steady state concentration of total (CT1) and dissolved (Cd1) PCBs assuming only loss to the sediment. Use the approximation $K_{oc} = K_{ow}$ and the log K_{ow} from the previous assignment. Compare to observed CT1, Cd1, Cp1, r1.
- b. Include the sediment into the calculation. Include diffusive and resuspension exchange with the sediment. Compute the various parts of the effective removal rate: k_T separately. Compare to observed CT1, Cd1, Cp1, r1 and r2.
- c. Attempt to calibrate the model results by changing the diffusive exchange and resuspension velocities. Comment on the results.