



BOD

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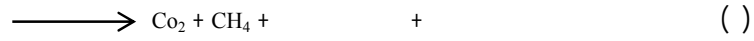
(Aerobic)

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(Anaerobic)

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(Thomann and Mueller 1987)

(Akram and Donald, 1997)

$$\frac{\partial(A_c C)}{\partial t} + \frac{\partial(QC)}{\partial x} = \frac{\partial Q}{\partial x} C_d - k A_c C \quad ()$$

(m^2) = A_c

(mg/Lit) = C

(s) = t

(m^3/s) = Q

(mg/Lit) = C_d

$(1/s)$ = k



(Diffusion)

$$\frac{\partial(A_c C)}{\partial t} + \frac{\partial(QC)}{\partial x} = D \frac{\partial^2(CA_c)}{\partial x^2} + \frac{\partial Q}{\partial x} C_d - k_1 A_c C \quad ()$$

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(FTBCS) - -

(Forward time)

(Central Space)

(U > 0)

(Backward Space)

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(L_d)

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$$A_i^{n+1} L_i^{n+1} = A_i^n L_i^n - \frac{dt}{dx_i} [Q_i^n L_i^n - Q_{i-1}^n L_{i-1}^n] + \frac{dt D_i^n}{(dx_i \times dx_{i+1})} [A_{i+1}^n L_{i+1}^n - 2(A_i^n L_i^n) + A_{i-1}^n L_{i-1}^n] - \frac{dt}{dx_i} (Q_i^n - Q_{i-1}^n) L_{d_i}^n - k_i^n A_i^n L_i^n dt$$

(MacCormack Explicit) - -

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$$A_i^n L_i^* = A_i^n L_i^n - \frac{dt}{dx_{i+1}} (Q_{i+1}^n L_{i+1}^n - Q_i^n L_i^n) + \frac{D_i^n dt}{dx_i \times dx_{i+1}} (A_{i+1}^n L_{i+1}^n - 2(A_i^n L_i^n) + A_{i-1}^n L_{i-1}^n) + \frac{dt}{dx_i} (Q_i^n - Q_{i-1}^n) L_{d_i}^n - k_i^n L_i^n A_i^n dt$$

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$$A_i^{n+1} L_i^{n+1} = \left(\frac{1}{2} A_i^n L_i^n - A_i^n L_i^* + \frac{dt}{dx_{i+1}} (Q_i^n L_i^* - Q_{i-1}^n L_{i-1}^*) + \frac{D_i^n dt}{dx_i \times dx_{i+1}} (A_{i+1}^n L_{i+1}^* - 2(A_i^n L_i^*) + A_{i-1}^n L_{i-1}^*) \right) + \frac{dt}{dx_i} (Q_i^n - Q_{i-1}^n) L_{d_i}^n - k_i^n L_i^n A_i^n dt$$

L_iⁿ⁺¹

L_iⁿ

L_i^{*}

L_iⁿ⁺¹

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(Chapra, 1997)

$$16 \left(\frac{\text{mil}}{\text{day}} \right)$$

$$L(x,0) = 0$$

$$L(0,t) = A + B \cos(wt)$$

(k_{20}) BOD

$$w = \left(\frac{1}{\text{day}} \right) \quad B = 13 \left(\frac{\text{mgr}}{\text{lit}} \right) \quad A = 37 \left(\frac{\text{mgr}}{\text{lit}} \right)$$

40(mile)

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$$D_2 = 1290 \left(\frac{\text{ft}^2}{\text{s}} \right), D_1 = 150 \left(\frac{\text{ft}^2}{\text{s}} \right)$$

0.3(m/s)

(SI)

$$D_2 = 126 \left(\frac{\text{m}^2}{\text{s}} \right), D_1 = 14.65 \left(\frac{\text{m}^2}{\text{s}} \right)$$

0.9(m³/s)

3(m²)

Excel

BOD

(mile)

(km)

FTBCS MacCormak



FTBCS

MacCormak

BOD

D

$$D = 1290 \left(\frac{ft^2}{s} \right)$$

$$D = 150 \left(\frac{ft^2}{s} \right)$$

BOD

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$$30(m^2)$$

$$7(m^3/s)$$

$$k = 0.1 \quad k = 0$$

(k_{20}) BOD

$$52(m^2/s)$$

(s)

dt

(m)

dx $22^\circ C$

$$2/1(m^3/s)$$

$$3 \left(\frac{mgr}{lit} \right) \text{ BOD}$$

$$4/2(m^3/s)$$

$$6 \left(\frac{mgr}{lit} \right) \text{ BOD}$$

$$Q = 0/04 + 0/015 \text{ Cos}(wt)$$

$$\text{BOD} \quad 1/3(m^3/s)$$

$$Lt = 120 + 40 \text{ Cos}(wt) \text{ BOD}$$

$$2/4(m^3/s)$$

$$3/1 \left(\frac{mgr}{lit} \right)$$

$$6 \left(\frac{mgr}{lit} \right) \text{ BOD}$$

$$95 \left(\frac{mgr}{lit} \right) \text{ BOD}$$

$$0.08(lit/s)$$

$$450 \left(\frac{mgr}{lit} \right) \text{ BOD}$$

$$0.003(lit/s)$$

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$$k = 0 \left(\frac{1}{\text{day}} \right)$$

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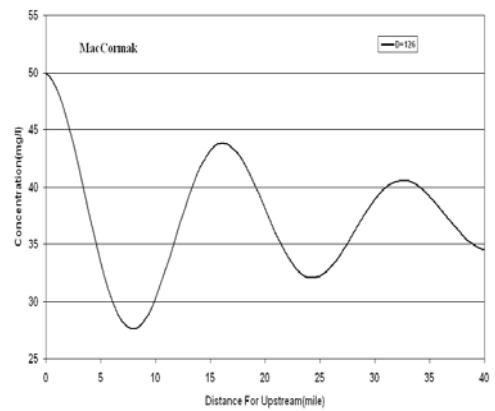
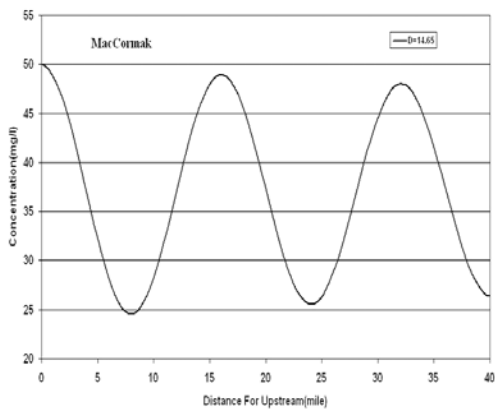
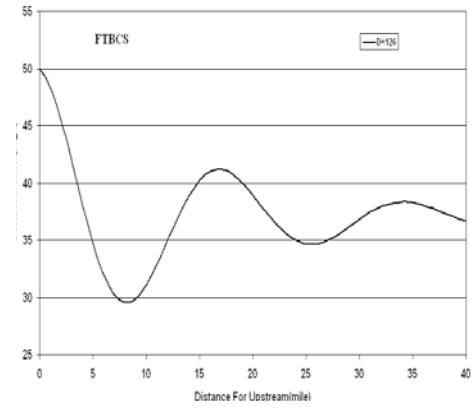
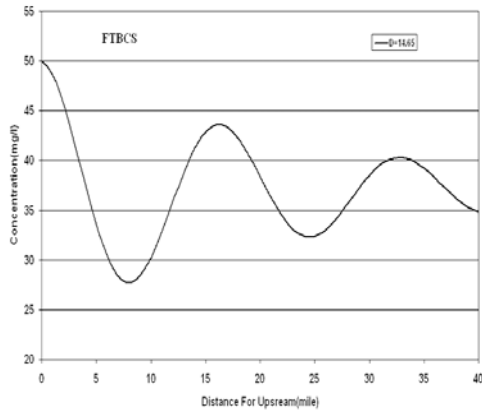
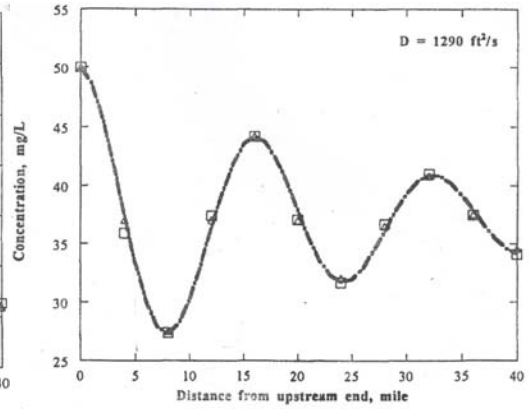
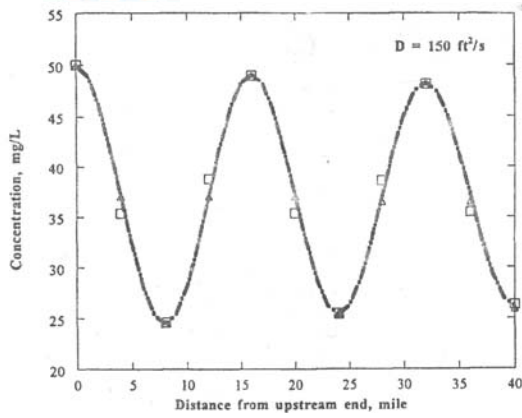
$$k = 0.1 \left(\frac{1}{\text{day}} \right)$$

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MacCormack⁺⁺)
(

FTBCS

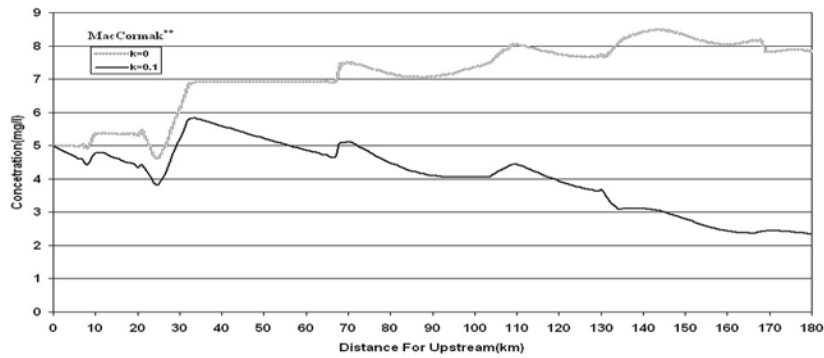
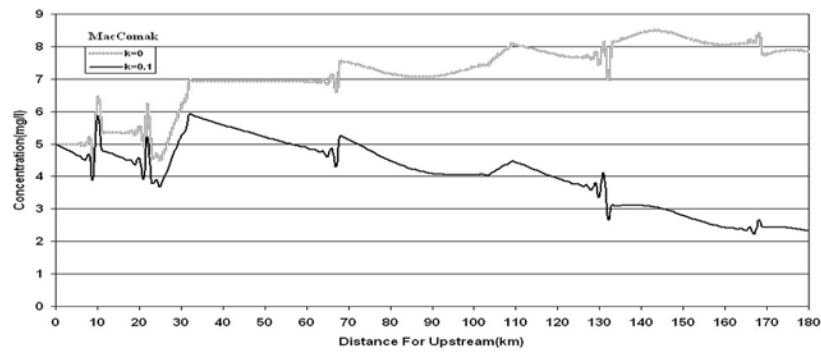
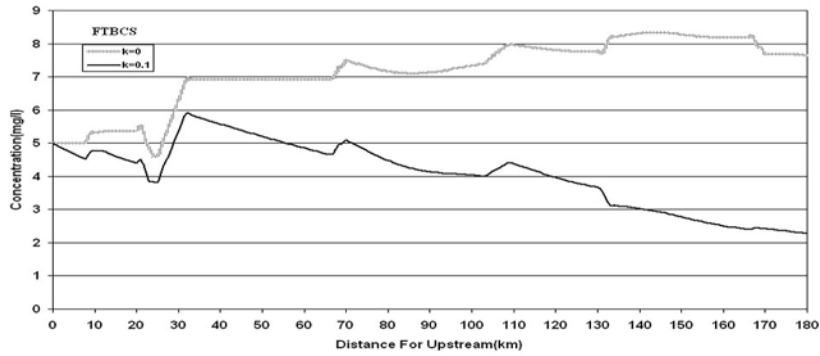
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- 1- Akram, Alshwabkeh and Donald, Dean Adrian, "Analytical water quality model for a Sinusoidally varying BOD discharge concentration", Vol.31, No.5, pp.1207-1215, 1997.
- 2- Chapra, S. C., "Surface water-quality modeling", McGraw-Hill, New York, 1997.



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