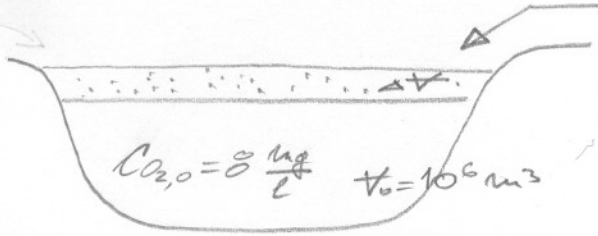
Zadatak 3



početna masa rastv. kisenika u jezeru:

$$M_{O_2,0} = 8\ \frac{mg}{l} \times 10^6\ m^3 \times 10^2\ \frac{l}{m^3} = 8000\ kg$$

- ulaz mase organske materije ($C_6H_{12}O_6$):

$$M_{OM} = \underbrace{120\ \frac{l}{s} \times 200\ \frac{mg}{l}}_{Q_{uL,OM}} \times \underbrace{2 \times 86400\ s}_{\Delta t} = 4147.2\ kg\ C_6H_{12}O_6$$

u ekvivalentima rastvorenog O_2: $M_{OM} = 1.07 \times M_{OM} = 4437.5\ kg\ O_2$

- maseni ulaz amonijum jona (NH_4^+)

$$M_{NH_4^+} = 120\ \frac{l}{s} \times 30\ \frac{mg}{l} \times 2 \times 86400\ s = 622,08\ kg\ NH_4^+$$

u ekvivalentima O_2: $M_{NH_4^+} = 3.56\ \frac{kg\ O_2}{kg\ NH_4^+} \cdot 622.08 = 2214.6\ kg\ O_2$

- masa O_2 nakon razgradnje ($t = t_1$)

$$M_{O_2,1} = M_{O_2,0} - M_{OM} - M_{NH_4^+}$$

$$M_{O_2,1} = 8000\ kg - 4437.5\ kg - 2214.6\ kg = 1348\ kg$$

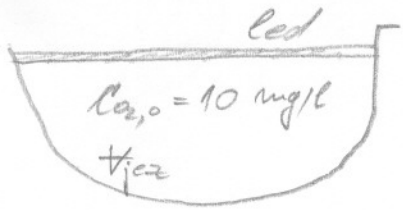
- ukupna zapremina jezera:

$$V_1 = V_0 + Q_{uL} \cdot \Delta t = 1\,020\,736\ m^3$$

- koncentracija O_2 nakon razgradnje:

$$c_{O_2,1} = \frac{M_{O_2,1}}{V_1} = 1.32\ \frac{mg}{l}$$

Zadatak 4



$r = 1.4 \frac{mg}{l \cdot ned}$

hipoksični uslovi: $c_{O_2} < 2$ mg/l

– potrošnja O_2 (respiratorna)

$Q_{m,r} = r_0 \cdot V_{jez}$

j-na održanja mase O_2: $m_1 = m_0 - m_r$

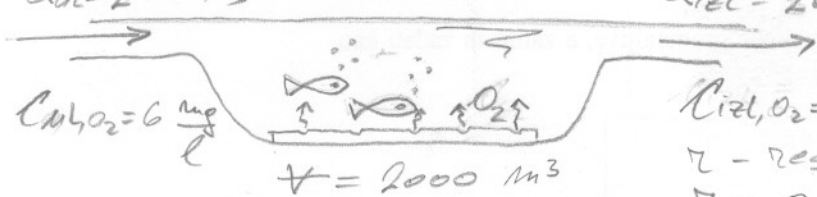
$$\underbrace{c_{O_2,1}}_{2\ mg/l} \cdot V_{jez} = c_{O_2,0} \cdot V_{jez} - r_0 \cdot V_{jez} \cdot t$$

$$2\ mg/l = 10\ mg/l - 1.4 \frac{mg}{l \cdot ned} \cdot t$$

$t = 5.7$ nedelja $= 5$ nedelja i 5 dana

Za 5 nedelja i 5 dana nastaće hipoksični uslovi

Zadatak 5 (otvoreni reaktor sa potpunim mešanjem)



$c_{O_2} = c_{izl}$ / potpuno mešanje

$c_{izl,O_2} = 10$ mg/l

r – respiracija + raspadanje org. mat.

$r = 0.2$ mg/(l·h)

(2)

ulaz – izlaz + proizvodnja – potrošnja = 0

$Q_{m,ulaz} - Q_{m,izlaz} + Q_{m,aer} - Q_{m,r} = 0$; $Q_{m,r} = r_0 \cdot V$

$$20 \frac{l}{s} \times 6 \frac{mg}{l} - 20 \frac{l}{s} \times 10 \frac{mg}{l} + Q_{m,aer} - 0.3 \frac{mg}{l \cdot h} \cdot \frac{1}{3600 s} \times 2 \times 10^6\ l = 0$$

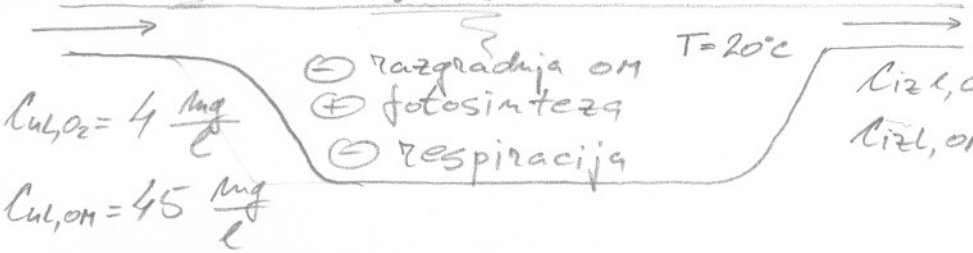
$$Q_{m,aer} = 247 \frac{mg}{s} = 247 \frac{mg}{s} \times \frac{10^6 \frac{kg}{mg}}{\frac{1}{3600} \frac{h}{s}} = 0.9\ kg\ O_2/h$$

Aeracija se postiže ovazdušavanjem

$$Q_{m,vazduha} = \frac{0.9\ kg\ O_2/h}{20\%} = 4.44\ kg\ vazduha/h$$

$$Q_{vazduha} = \frac{Q_{m,vazduha}}{S_{vazduha}} = 4.44\ m^3\ vazduha/h$$

Zadatak 6 (otvoreni reaktor sa potpunim miješanjem)



$K_a = 0.34 \times 10^{-3}$ m/s; $r = 2.4$ mg/l dan; $f = 6.2$ mg/l·dan

- Jednadžba održanja mase O_2:

ulaz (1) − izlaz (2) + proizvodnja (3) − potrošnja (4) = 0 $\left[\frac{M}{T}\right]$

potrebna zapremina: $V = Q_{UL} \cdot 2$ dana $= 8640$ m³

(1) ulaz: $Q_{m,ul} = 4 \frac{mg}{l} \cdot 50 \frac{l}{s} = 200 \frac{mg}{s}$

(2) izlaz: $Q_{m,izl} = 7 \frac{mg}{l} \times 50 \frac{l}{s} = 350 \frac{mg}{s}$

(3) proizvodnja

(3.1) fotosinteza: $Q_{m,f} = f \cdot V = 6.2 \frac{mg}{l \cdot dan} \frac{1}{86400} \frac{dan}{s} \times 8640 \times 10^3$ l

$Q_{m,f} = 620$ mg/s

(3.2) aeracija: $Q_{m,aer} = K_a \cdot A \cdot (c_{sat} - c_{O_2})$; $A = ?$

$T = 20°C$ pa je $c_{O_2,sat} = 9.2$ mg/l

$c_{O_2} = c_{IZL,O_2} = 7$ mg/l

(4) potrošnja

(4.1) razgradnja organske materije u ekvivalentima O_2: $Q_{m,OM} = r_{og} \cdot c_{UL,OM} \cdot Q_{UL}$

$Q_{m,OM} = 1.07 \frac{mg\,O_2}{mg\,gl.} \times 45 \frac{mg}{l} \times 50 \frac{l}{s} = 2408$ mg/s

(4.2) respiracija $Q_m = r \cdot V$

$Q_m = 2.4 \frac{mg}{l \cdot dan} \times \frac{1}{86400} \frac{dana}{s} \times 8640 \times 10^3$ l $= 240$ mg/s

Zadatak 6 (nastavak)

$$Q_{m,uL} - Q_{m,izl} + Q_{m,+} + Q_{m,aer} - Q_{m,om} - Q_{m,r} = 0$$

$$200\frac{mg}{s} - 350\frac{mg}{s} + 620\frac{mg}{s} + Q_{m,aer} - 2408\frac{mg}{s} - 240\frac{mg}{s} = 0$$

$$Q_{m,aer} = 2178\frac{mg}{s}\ ; \quad Q_{m,aer} = k_{va}\cdot A\cdot(c_{sat} - c_{O_2})$$

$$0.34\times10^{-3}\frac{m}{s}\cdot A\cdot(9,2-7)\frac{mg}{l} = 2178\frac{mg}{s}$$

$$0.34\times10^{-3}\frac{m}{s}\times A\times 2,2\times10^{3}\frac{mg}{m^3} = 2178\frac{mg}{s}$$

$$A = 2912\ m^2$$

Zadatak 7

$BPK_5 = 250\ mg/l$

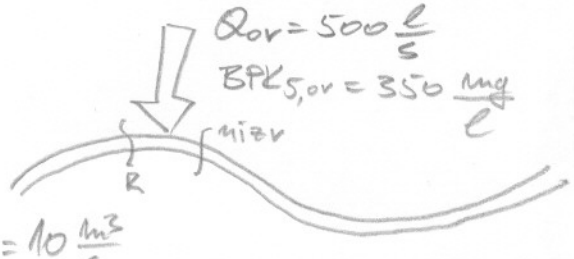
$t = 5\ dana$

$k = 0.15\ dan^{-1}$

$$BPK_5 = L_o(1-e^{-k_1\cdot 5})$$

$L_o = 474\ mg/l$

Zadatak 8



$Q_R = 10\frac{m^3}{s}$

$c_{O_2,R} = 8\ mg/l$

$BPK_{5,R} = 3\ mg/l$

$c_{O_2}(x=?) = 2\ mg/l$

$v = 0.5\ m/s$

$k = 0.35\ dan^{-1}$

$c_{O_2,mizv} = 7.6\ mg/l$

$BPK_{5,mizv} = 19.5\ mg/l$

$$L_{o,mizv} = \frac{BPK_{5,mizv}}{(1-e^{-0.35\times5})} = 23.6\frac{mg}{l}$$

$$c_{O_2} = c_{O_2,mizv} - L_{o,mizv}(1-e^{-0.35\cdot t})$$

$$L_{o,mizv}(1-e^{-0.35\cdot t}) = (7.6-2)\frac{mg}{l}$$

$t = 0.77\ dana$

$x = 33,2\ km$