University Of Technology
Building and Construction Eng. Dept.
Final Exam–2016/2017

Branch: Sanitary & Envi. Eng. **Class:** Fourth
subject : Environment Protection **Time:** 3hours.
Examiner: Lec. Shaimaa Taleb Kadhum **Date :**2[illegible]/ 5/2017

NOTE: Answer four questions only

Q. 1 /A) A wastewater treatment plant disposes of its effluent in a surface stream. Characteristics of the stream and effluent are shown below:

Parameter	Flow (m^3/d)	BOD_5 at20°c (mg/l)	DO (mg/l)	Temperature	K1 at 20°c (d^{-1})	K2 at 20°c (d^{-1})
wastewater	0.2	100	1	15°c	0.09	-
stream	5	2	8	20.2°c	-	0.13

Saturated level of oxygen is (9.17 mg/l)

a) What will be the dissolved oxygen concentration in the stream after 2 days?

b) What will be the lowest dissolved oxygen concentration as a result of the waste discharge?

(15%)

Q.1 /B) Write in details about Alfa radiation.

(10%)

Q.2/ A) An air stream with a flow rate of (10 m^3/s) is passed through a cyclone of standard proportions. The diameter of the cyclone is (4m), the viscosity of air is (2.1 x 10^{-5} Kg/m.s), and the number of effective turns within the cyclone is (5 turns). Determine the removal efficiency for a particle with a density of (1.9 g/cm^3) and a diameter of (8μm).

(15%)

Q.2/ B) Sketch the changes in population of microorganisms caused by waste discharge into a clean stream. (10%)

Q.3/ A) A lake has average length, depth and width of 25, 0.09 and 4.5 Km respectively. The discharge is 600 m^3/sec, mass density of water during the summer varies from 998 Kg/m^3 at the surface to 1025 Kg/m^3 at the bottom. Estimate the stability of the lake using ρ_o = 1000 Kg/m^3.

(15%)

Q.3/ B) What are the acceptable boundaries for human environmental impacts which have been suggested by Daly and his colleagues? (10%)

Q.4/ A) A fabric filter is to be constructed using bags of (0.4 m) in diameter and (6.8 m) long. The bag house receives (13 m^3/sec) of air, and the appropriate filtering velocity has been determined to be (2.5 m/min). Determine the number of bags required for a continuously cleaned operation. (13%)

Q.4/ B) Write only six causes of water pollution. (12%)

Q.5/ A) An electrostatic precipitator is to be constructed to remove fly ash particle from stack. Gases flowing at (130000 m^3/hr). Analysis of similar system shows that the drift velocity can be taken as ($W = 3.4 \times 10^5\ d_p$ m/s). Determine the plate area required to collect a (0.8 μm) particle with 98% efficiency. (15%)

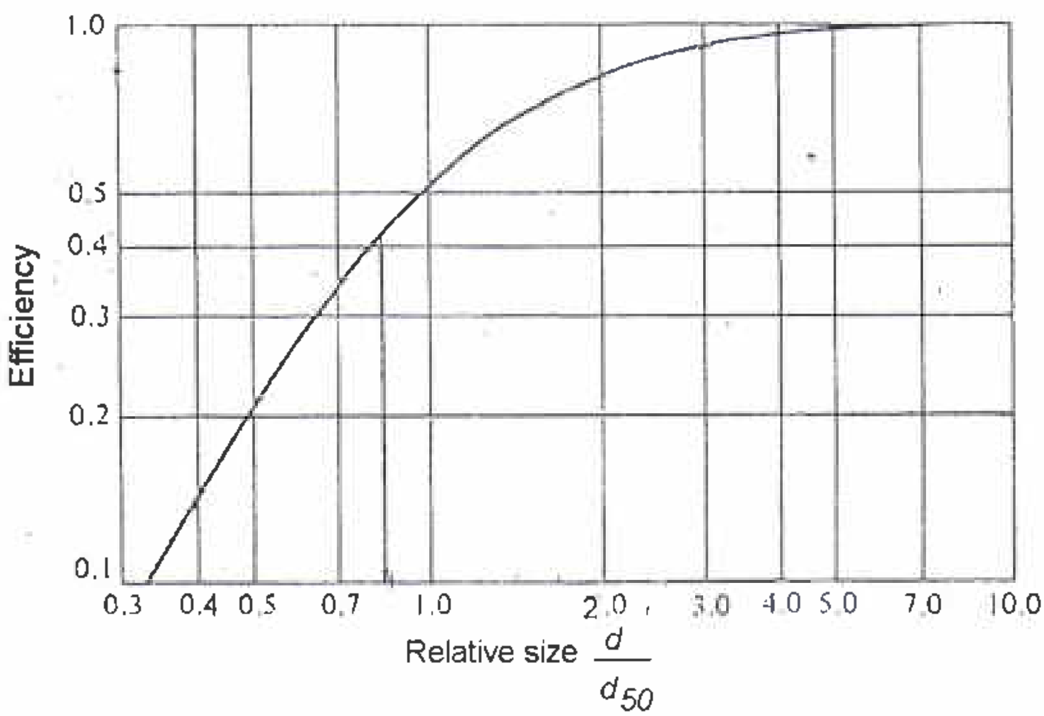
Q.5/ B) Define **(five)** of the following
(1) Glovebox, (2) EIA, (3) Non-biodegradable organics, (4) Metaliminion, (5) Environmental protection, (6) Oxygen deficit, (7) Mixed – film – controlled (10%)

<u>Useful information:</u>

$Y_t = L_o(1-e^{-k1t})$, $D = \frac{k1\ L_o}{k2-k1}(e^{-k1t} - e^{-k2t}) + D_o\ e^{-k2t}$. $D_c = \frac{k1}{k2} L_o e^{-k1\ tc}$,

$t_c = \frac{1}{k2-k1} \ln\left[\frac{k2}{k1}\left(1 - D_o \frac{k2-k1}{k1 L_o}\right)\right]$, $k_T = k_{20}\theta^{T-20}$, $E = 1 - \exp(-\frac{w}{Q}A)$,

$FD = \frac{V}{\sqrt{(\frac{\Delta\rho\ Dg}{\rho_a})}}$, Area=πDH, $b = \frac{1}{4}D$, $h = \frac{1}{2}D$, $d_{50} = \sqrt{(\frac{9\mu b}{2\pi\ Ne\ vi\ \rho p})}$



Q3/A

Sol.

$$V = \frac{Q}{BD} = \frac{600 \, m^3/sec}{90m \times 4500 \, m} = 14.81 \times 10^{-4} \, m/s$$

$$\Delta \rho = 1025 - 998 = 27 \, kg/m^3$$

$$F_D = \frac{V}{\sqrt{\left(\frac{\Delta\rho}{\rho_0}\right) D g}}$$

$$= \frac{14.81 \times 10^{-4}}{\sqrt{\left(\frac{27}{1000}\right) \times 90 \times 9.81}} = 3.03 \times 10^{-4}$$

$$\therefore F_D = 3.03 \times 10^{-4} < 0.01$$

Therefore this lake is strongly stratified

Q1/A

$$BOD_{mix} = \frac{100 \times 0.2 + 2 \times 5}{0.2 + 5} = 5.769 \ mg/L$$

$$DO_{mix} = \frac{1 \times 0.2 + 8 \times 5}{5.2} = 7.730 \ mg/L$$

$$T_{mix} = \frac{15 \times 0.2 + 20.2 \times 5}{5.2} = 20^\circ C$$

$$y_5 = L_0 (1 - e^{-K_1 5})$$

$$5.769 = L_0 (1 - e^{-0.09 \times 5})$$

$$5.769 = L_0 (0.362)$$

$$L_0 = 15.936 \ mg/L$$

$$D_0 = 9.17 - 7.73 = 1.44 \ mg/L$$

a)

$$D_2 = \frac{0.09 \times 15.936}{0.13 - 0.09} \left(e^{-(0.09)(2)} - e^{-(0.13)(2)}\right) + 1.44 \ e^{-(0.13)(2)}$$

$$= \frac{1.43424}{0.04} (0.835 - 0.771) + 1.11$$

$$= 3.4 \ mg/L$$

$$\therefore DO_{2 \ days} = 9.17 - 3.4 = 5.77 \ mg/L$$

b)

$$t_c = \frac{1}{0.13 - 0.09} \ln \left[\frac{0.13}{0.09} \left(1 - 1.44 \frac{0.13 - 0.09}{0.09 \times 15.936}\right)\right]$$

$$= \frac{1}{0.04} \ln [1.385] \Rightarrow t_c = 8.16 \ d$$

$$D_c = \frac{0.09}{0.13} \times 15.936 \ e^{-(0.09)(8.16)} = 5.293 \ mg/L$$

$$DO_{min} = 9.17 - 5.293 = 3.877 \ mg/L$$

Q2/A

Sol.

$$b = \frac{D}{4} = \frac{4}{4} = 1\,m$$

$$h = \frac{D}{2} = \frac{4}{2} = 2\,m$$

Area of inlet = $1 \times 2 = 2\,m^2$

$$V_i = \frac{Q}{A} = \frac{10\ m^3/s}{2\ m^2} = 5\ m/s$$

$$d_{50} = \left(\frac{9\mu b}{2\pi N_e V_i \rho_p}\right)^{\frac{1}{2}}$$

$$= \left(\frac{9 \times 2.1 \times 10^{-5} \times 1}{2\pi \times 5 \times 5 \times 1900}\right)^{\frac{1}{2}}$$

$1.98\ \frac{g}{cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{(100)^3\ cm^3}{m^3}$

$$= 2.51 \times 10^{-5}\ m$$

$$= 25\ \mu m$$

$$\frac{d}{d_{50}} = \frac{8}{25} = 0.32$$

From fig the efficiency for the 8 μm particle is found to be about 95%

Q4/A

Sol.

$$Q = 13 \frac{m^3}{s} \times \frac{60\,s}{min} = 780 \frac{m^3}{min}$$

Cloth area required

$$A = \frac{Q}{V} = \frac{780\ m^3/min}{2.5\ m/min} = 312\ m^2$$

The area of one baghouse is :—

$$= \pi D H = \pi \times 0.4 \times 6.8 = 8.54\ m^2$$

The total number of bags is

$$\frac{312}{8.54} = 36.5 \quad \therefore \text{ use } 37$$

Q5/A

Sol.

$$W = 3.4 \times 10^{5} \times 8 \times 10^{-7} = 0.27 \; m/sec$$

$$Q = 130000 \; \frac{m^3}{hr} \times \frac{1}{60 \times 60} \frac{hr}{sec} = 36.11 \; m^3/sec$$

$$0.98 = 1 - \exp\left(-\frac{0.27}{36.11} A\right)$$

$$1 - 0.98 = \exp(-0.007 A)$$

$$-3.91 = -0.007 A$$

$$A = \frac{3.91}{0.007} = 558.57 \; m^2$$

Q2/A

Sol:

$b = \frac{D}{4} = \frac{4}{4} = 1m$

$h = \frac{D}{2} = \frac{4}{2} = 2m$

Area of inlet $= 1 \times 2 = 2m^2$

$d_{50} = \left(\frac{9 \mu b}{2\pi N_e V \rho_p} \right)^{1/2}$

$= \left(\frac{9 \times 2.1 \times 10^{-5} \times 1}{2\pi \times 5 \times 5 \times} \right.$