01-August-2017

ENVIRONMENT, ECOLOGY AND BIOLOGY

https://groups.google.com/forum/#!forum/evsbio2017-i/new

quiz, Assgn : 5% Attn. + Presn. - 10% Find Exam: 75%

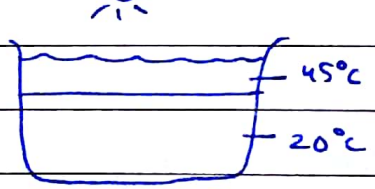
Topics:

(i) Fundamentals of aquatic chemistry.
(ii) Water pollution.
(iii) Wastewater Treatment.
(iv) Air pollution
(v) Solid waste management
(vi) Population growth.
(vii) Ecology
(viii) Biodiversity
(ix) Sustainable Development.

- Characteristics of Bodies of water:

  (i) Thermal stratification
  (ii) Physical Properties

Thermal Stratification



(thermal expansion)
↳ ↑vol., ↓den.
∴ it seems as if upper layer is floating.

non-moving body say ocean

Due to temper.-density rels, thermal stratification takes place

Teacher's Signatur

- Upper layer → have algae → photosynthesis → more rich in oxygen.
- Fe will exist in +3 O.S. in upper layer.
- At lower layer, +2 O.S.

- Physical Properties: Temperature.
- At 25°c, O_2 conc. in H_2O = 8.32 mg/lit
- Clausius - Clapeyron Eqn:

$$\log \frac{C_2}{C_1} = \frac{\Delta H}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$R = 1.987 \text{ cal } K^{-1} mol^{-1}$$

Q. What would be O_2 conc. in water saturated with air to 10°C.

19.5M

At 25°C: $C_1 = 2.60 \times 10^{-4}$ mol/L x 32 g/mol

$= 8.32 \times 10^{-3}$ g/L

ΔH = enthalpy of vapourisation = 40.65 KJ/mol.

$$\log\left(\frac{C_2 \times 10^3}{8.32 \times 10^{-3}}\right) = \frac{40.65 \times 10^3}{2.303 \times 1.987}\left[\frac{1}{25} - \frac{1}{10}\right]$$

$\frac{1}{273+25}$ $\frac{1}{273+10}$

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Q° The Vapour pressure of H_2O at 20°C is 17.5 Torr. What is ΔH_{vap} of water? $R = 8.31$

42.9 KJ/Mol.

P_2/P_1

$$\log \frac{C_2}{C_1} = \frac{\Delta H}{2.303 R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

Hidden: B.P. of water : 100°C ., Take $P_2 = 760$ Torr.

$$\log \left(\frac{760}{17.5} \right) = \frac{\Delta H}{2.303 \times 8.31} \times \left[\frac{1}{20} - \frac{1}{100} \right]$$

03- August · 2017

- 2 types of autotrophs:

(i) get energy by photosynthesis
(ii) without light, by chemosynthesis.

- microorganisms decompose dead orgs.

- Decomposers are subclass of heterotrophic organisms.

- Photosynthesis Reaction:

$$CO_2 + H_2O \xrightarrow{h\nu} C_6H_{12}O_6 + O_2$$
$$(CH_2O)$$

- Microbial Decomposition Reaction:
(by m.orgs. on dead orgs).

$$(CH_2O) + O_2 \longrightarrow CO_2 + H_2O + PO_4^{3-} + NO_3^- + SO_4^{2-} + \text{new cells}$$
(aerobic condn)

However, we have, N, P & S (etc) as well in body. They'll oxidise, if present

Anaerobic:

$$(CH_2O) \longrightarrow CO_2 + H_2O + CH_4 + PH_3 + H_2S + NH_3 + \text{new cells}.$$

P, N & S reduced.

They do so, just to get energy ∴ new cells

Teacher's Signature

Productivity: The ability of a body of water to produce living organisms is called Prod...

- Eutrophication: "well nourished condition".
  when water bodies are overloaded with nutrients (excess).
- Algal bloom: excessive growth of algae.
- sources of extra nutrients:
  - untreated Municipal sewage effluent. (major source of P & N)
  - agricultural runoff. (phosphates, nitrates)

↓ used as Polyphosphates (to bind Ca^{2+}, Mg^{2+}).

Polyphosphates: called Binders. (in Detergents) to avoid

$$\text{Soap} + Mg^{2+}/Ca^{2+} \rightarrow \text{white ppt.}$$

Thus,

- Eutrophication reduces quality of water.
- Calculating conc. of gas by Henry's law.
- actual pH of water: 5.6 (slightly acidic) due to presence of dissolved carbon dioxide.
- $CO_2 + H_2O \rightleftharpoons H_2CO_3$
  - $H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$, $K_{a_1} = 4.45 \times 10^{-7}$
  - $HCO_3^- \rightleftharpoons H^+ + CO_3^{2-}$, $K_{a_2} = 4.69 \times 10^{-11}$

Thus, HCO_3^- is predominant in water to make its pH 5.6.

- Limestone caves / carbonated beverages: not possible if CO_2 doesn't mix with water.

$$CaCO_3 + H_2O + CO_2 \rightarrow Ca^{2+} + 2HCO_3^-$$

- Above $pH > 10.3$, CO_3^{2-} is the predominant species.
  $pH < 5.3$, CO_2.

1a

- Henry's law:

$$[X_{aq}] = K P_x \quad \text{(partial pressure of that gas)}$$

$$= K \left[P^\circ - P_{H_2O}\right] \times \text{mole fraction of that gas in the atmosphere.}$$

P° → 1 atm. P_{H_2O} → partial pressure of H_2O.

Q Calculate conc. of O_2 in water at 25°C, $K = 1.38 \times 10^{-3}$ mol/L/atm

~~$O_2(aq) = 1.38 \times 10^{-3}$ mol/L/atm~~

Vapour pressure of water in atmosphere: 23.45 mm Hg.

↓ convert to atm.

1 atm = 760 mm
23.45
23

$$[O_2(aq)] = K \times \left[P^\circ - P_{H_2O}\right]$$

$$= 1.38 \times 10^{-3} \times \left[1 \text{ atm} - \frac{23.45}{760}\right] \times 0.21$$

1.38 × 0.97 × 0.21
10^3

mol/L/atm

$$= 1.38 \times 10^{-3} \times (1 - 0.0313) \times 0.21$$

$$= 2.60 \times 10^{-4} \text{ mol/L}$$

$$= 2.60 \times 10^{-4} \frac{\text{mol}}{\text{L}} \times \frac{32 \text{ g}}{\text{mol}}$$

$$= 8.32 \text{ ppm}$$

Teacher's Signature

- Biota.
- Functions of Decomposers.
- Stages of Water Cycle.
- Types of Ecosystems.
- Biomes.
- Carbon Cycle.
- Oxygen Cycle.
- Nitrogen Cycle.
- Bacterias involved in different processes.

08-August-2015

∂ Hard water:
charact. that prevents lathering of soaps.

$CaHCO_3$, $CaSO_4$, $MgSO_4$ etc.

- Two types
- Soap molecule acts as surfactant.
- Temporary & Permanent.
  - ↳ dissolved bicarbonates of Ca & Mg.
    Destroyed by boiling.
  Perman: sulphates.
- Soda lime Process: for perm.

- $CaCO_3$ equiv. = $\frac{\text{equiv. weight of } CaCO_3}{\text{equiv. weight of hardness producing substance}} \times \left[\text{Mass of hardness producing subs.}\right]^{ppm = mg/L}$

Multi. factor: $\frac{\text{equiv. weight of } CaCO_3}{\text{equiv. weight of hardness producing subs.}}$

Q Calc. the $CaCO_3$ equiv. hardness of a water sample having 204 mg of $CaSO_4$ per litre.

$$M.F. = \frac{100/2}{136/2} = \frac{100}{136}$$

$$CaCO_3 \text{ equiv} = \frac{100}{136} \times \frac{204}{3/2} = 150 \text{ ppm}$$

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PAGE NO. :

- Degree of Clark (°Cl) : 1ppm = 0.07°cl.
- Degree of French (°Fr) : 1ppm = 0.1°Fr.
- 1°Cl = 1.43° Fr = 14.3ppm.

Q. Calculate tempo, perma., & total hardness of a sample of H_2O containing :

$Mg(HCO_3)_2$ = 7.3 mg/L ; $Ca(HCO_3)_2$ = 16.2 mg/L.

(95g) $MgCl_2$ = 9.5 mg/L ; $CaSO_4$ = 13.6 mg/L.

(136g).

Express in °Fr.

Temp: $Mg(HCO_3)_2$ + $Ca(HCO_3)_2$

(146)g (162g)

$$= \frac{100/2}{146/2} \times 7.3 + \frac{100/2}{162/2} \times 16.2$$

$$= \frac{100}{146} \times \frac{73}{10} + \frac{100}{162} \times \frac{162}{10}$$

$$= 5 + 10 = 15 \text{ ppm}.$$

Perma: $CaSO_4$ + $MgCl_2$.

$$= \frac{100/2}{136/2} \times \frac{13.6}{10} + \frac{100/2}{95/2} \times \frac{95}{10}$$

$$= 10 + 10 = 20 \text{ ppm}.$$

Total : Perma + Temp. = 35ppm

= 3.5 °Fr.

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- Soda lime process

Permanent	Need
For Ca salts	Soda
Mg salts	Soda + Lime.

Temporary

Ca & ~~Mg salts~~	1 mole lime for 1 mol Ca salt.
Mg salts	2 mole lime " " Mg ".

- Lime requirement for softening:

$$= \frac{74}{100}\left[(\text{T.H. of } Ca^{2+}) + (2 \times \text{T.H. of } Mg^{2+}) + \text{P.H. of } Mg^{2+}\right] \times$$

Vol. of water in litre. (in l).

- Soda requirement for softening

$$= \frac{106}{100}\left[(\text{P.H. of } Ca^{2+} + Mg^{2+})\right] \times \text{Vol. of water in litre.}$$

(Q) Calculate amt. of lime & soda required for softening 50,000 l. of hard water containing:

$Mg(HCO_3)_2$ = 146 ppm ; $Ca(HCO_3)_2$ = 81 ppm

$MgCl_2$ = 95 ppm , $CaCl_2$ = 111 ppm , Fe_2O_3 = 25 ppm

Na_2SO_4 = 15 ppm.

Teacher's Signature

Step 1 : List out the given data:

Given data: $MgCO_3 = 146$ ppm, $CaCO_3 = 25$ppm, $MgCl_2 = 95$ppm, $CaCl_2 = 111$ppm, $Fe_2O_3 = 25$ppm, $Ca(HCO_3) = 81$ppm, $Na_2SO_4 = 15$ppm.

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PAGE NO.:

Here Fe_2O_3

7a

For lime:

T.H. of Ca^{2+} :

$$= \frac{74}{100}\left[\left[\frac{100/2}{146/2} \times 146 \times 2\right] + \left[\frac{100/2}{162/2} \times 81\right] + \left(\frac{100/2}{95 \times 2} \times 95\right)\right] \times 50,000$$

T.H. of Mg^{2+} due to $Mg(HCO_3)_2$ | T.H. of Ca^{2+} by $Ca(CO_3)_2$ | P.H. of Mg^{2+} due to $MgCl_2$.

May be N/A

$= 16.25$ kg.

For soda :

$$= \frac{106}{100}\left[\frac{100/2}{111/2} \times 111 + \frac{100/2}{95/2} \times 95\right] \times 50,000$$

$$= \frac{106}{100}[200] \times 50,000.$$

$= 10,600,000 = 10.6$ kg.

7) 7a
7)
- Topic - Biodiversity, Reason of exploitation.
- Conservations
- Water Conservation.
- Drought.
- Watershed Management.

10-August-2017

Surface Water Quality

Founding water quality monitoring prog. in 1995:

- pH
- Turbidity
- Dissolved Oxygen: most widely used to check H_2O pollu.
- Biochemical Oxygen Demand (BOD): & Chemical Oxygen Dem. (COD)
- BOD: amt. of O_2 needed to degrade the organic matter biologically in a given volume of water.
- DOi, keep the bottle in dark for 5 days & then measure DO_f

During 5 days, we are allowing microorganisms to ~~degrade~~ decompose org. matter avail.

Thus non-biodegra. will be left.

Biodecomposition Reaction.

$$\{CH_2O\} + O_2 \xrightarrow{\text{micro organisms}} CO_2 + H_2O.$$

(O_2: oxidising agent.)

Thus oxygen is consumed. Hence ~~we~~ we check its amount.

- Not kept in light, else algae present carries out photosy. & can add dissolved oxygen.
- $BOD_s = DO_i - DO_f$
- DO_f should not be zero.

n moles

- If DOf drops to zero, we again carry out by Dilution Method.
- DOf dropping to zero: 2 reasons (possible). We do not know:
  (i) 1 mole of O_2 is required to degrade 1 mole of O_2. What? This means, no. of O_2 was just enough to decompose the o.w.
  (ii) If n moles of DO & no. of moles of o.w > n. Say n+3. ie. whole of the O_2 got consumed.
- Dilution Method: we add more oxygen.
- If BOD = drops to 0, then

$$BOD_5 = \frac{DO_i - DO_f}{P}$$

P = dilution fraction = $\frac{\text{vol. of waste water}}{\text{vol. of waste water + dilution water.}}$

Ex: 10 ml of sample mixed with enough water to fill 300 ml bottle with DO_i = 9 mg/L. Calculate BOD_5 in
(i) 2 gm/L drop in DO
(ii) desirable to have DO_f at least 2 mg/L.

(i) $BOD_5 = \frac{2 \text{ mg/L}}{P = \frac{10 \text{ ml}}{300 \text{ ml}}} = 60 \text{ mg/L}$

(ii) To assure at least 2 mg/L of DO remain after 5 days:

$$BOD_5 = \frac{9-2}{10/300} = 210 \text{ mg/L}.$$

Q. How can measure amt of O.W by BOD.

See reaction: $\{CH_2O\} + O_2 \xrightarrow{m.org.} \{CO_2\} + H_2O$

See, 1 mole OW requiring 1 mole O_2.

- Convert BOD value to no. of moles.

  Eg: if BOD_5 is 8 mg/L

  $\therefore$ 32g → 1 mole of O_2

  → 0.008g → 0.00025 mole of O_2

  $\therefore$ 0.00025 mole O.W.

& then: 1 mole CW → 30gm $\{CH_2O\}$

$\therefore$ 0.00025 mole → 0.0075 gm.

Q. Wastewater contains 250 mg/L Benzoid Acid. What is BOD of H_2O. m.m. weight of Benz. Acid = 122 g/mol.

$Ph-COOH + O_2 \rightarrow CO_2 + H_2O$.

no. of moles of PhCOOH $= \frac{\frac{125}{250}}{1000 \times \frac{122}{61}} = 2.04$ m.moles

$C_6H_6COOH + \frac{15}{2} O_2 \rightarrow 7CO_2 + H_2O$.

$\therefore$ no. of moles of O_2 required for 1 mole = 7.5

For 2.04 m. moles → $\frac{7.5 \times 2.04}{1000}$ mol of O_2 require

Teacher's Signature

∴ BOD (in mg/L) → [illegible] × 1.5 × 2.09 / 1000 × 32 g/mol = 493 g of O_2.

Q. A plant 'treatment' removes 4.54×10^7 g of O.W each day. If this have to release in river, how many L. of H_2O can be contaminated to the extent of totally depleting the water of all O_2?

808 $\{CH_2O\} + O_2 \longrightarrow CO_2 + H_2O$.

moles of O.W = $\frac{4.54 \times 10^7}{30} = \frac{4.54 \times 10^7}{30} = 1.5 \times 10^6$ moles of O.W.

= no. of moles of O_2 consumed.

At NTP, O_2 conc. in H_2O = 8.32 ppm

1 mol = 32 g.

∴ $15.13 \times 10^5 = 32 \times 15.13 \times 10^5$ g. = 48×10^9 mg.

& at 25°C, conc. of O_2 is 8.32 mg/L.

∴ 48×10^9 mg will be mixed in $\frac{48 \times 10^9 \text{ mg}}{8.32 \text{ mg/L}} = 5.76 \times 10^9$ L.

o Carbonate Buffering.

Submit hardcopy of .. ppt by 20 Sept.

More info & pages ~ 40-45 pages.

17-August-2017

Chemical Oxygen Demand (COD):

COD measures the conc. of organic subs. that can be oxidized by acidified dichromate at 150°C.
By BOD, we calculated biodegradable matter.

COD: To calculate wt. of non-biodegradable matter.
We can measure total amount of organic waste also.

$$3CH_2O + 16H_3O^+ + 2Cr_2O_7^{2-} \rightarrow 4Cr^{3+} + 3CO_2 + 27H_2O$$

Dichrom. acts as oxidizing:

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

(+6) (+3)

+29

BOD	COD
• Takes place biologically	chemically.
• only bio-deg. can be decomposed	• both
• specific	• less specific
• BOD is slower than COD.	•
• BOD value is less than COD value.	• often greater than BOD by a factor of 2.

Water Pollution

Oil Spilling.

Sources of Liquid Waste

Municipal sewage effluents
Agricult. runoff
industrial wastewater
Coalwashing
Acid Mine Drainage. : Thiobacillus ferrooxidans. → 1.5 to 2.0 : highly acidophilic.

Overall: $FeS_2 + \frac{15}{4}O_2 + \frac{7}{2}H_2O \rightleftharpoons Fe(OH)_3 + 2H^+ + 2HSO_4^-$.
(pyrite)

→ obtains energy through the oxdn of ferrous iron.

pH of streams receiving this drainage can be as low as 3.0.

- organic waste from industries.
- Tanneries.
- Textile & dyestuff industry.
- Food processing plants
- cosmetic industry.

	ZnO, TiO_2 (100%)	white
Cobalt Blues,	Co_3O_4 - 30-35%	
	Al_2O_3 65-70%	Blue
Red Lead	Pb_3O_4 + PbO	
Synthetic Iron	Fe_3O_4	Red
Chrome Green	Co_2O_3	Green
Ochre	Naturally occuring Fe_2O_3 (30-35%)	Yellow

Teacher's Signature

Surprise Quiz : 3rd week Aug, last week Aug.

- Agricultural Runoffs : Phosphates & Nitrates.
- Sources of W. Pollu :
  point sources
  non-point / diffused sources.
- Categories : Ground water pollu.
  Surface water pollu
- Anaerobic Decom. Reacti : slower than aerobic pollu.
- Groundw. if polluted, diff. to regenerate.

$C_6H_6 + 9O_2 \rightarrow 6CO_2 + 3H_2O$

Ls Benzene very easily decomposes to CO_2.

$C_6H_6(aq) + 6NO^- + 6H^- \rightarrow 6CO_2(aq) + 3N_2 + 6H_2O$.

- Inorganic species as pollutants
  (i) Cyanide.

22-August-2017

Persistent Organic Pollutants (POPs) (10+2) 12

our main concern : non-biodegradable ones. mostly non-naturally occurring.

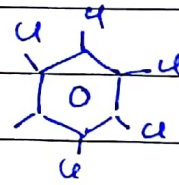
3 main points about the POPs :

(b) very stable, resist any decay. - poorly biodegradable. → Though they stay for long.

(a) Mostly are chlorinated aromatic compounds.

(c) Soluble in fat, hence bioaccumulative. ie. accumulate in the fatty issues of the orgs.

- Why do industr. produce such comps ?.
  PAH, PCB, DDT.
  Eg : Insecticides (DDT, etc.).



1,1,1,2,3,4 - Hexachloro Benzene (Raw mat. for pesticides)

- 10 intentionally produced.
- 2 unintentionally prod : (i) Polychlorinated Dioxins
  (ii) Polychlorinated dibenzofurans (PCDF).
- Toxic Effects of POPs.
  hormonal probs.
  cancer, immunitycts.

Polynuclear Aromatic Hydrocarbons PAHs.

Eg : Napthalene, Anthracene, Phenanthrene, Chrysene.
All have no substituent in their rings.

- produced by incomplete combustion of org. comps.
- natural : forest fire, petroleum, volcanic eruption
- man-made : vehicle exhaust.

Teacher's Signature

- Uses: dyes, plastics, pharmaceuticals.
- Mixture of phenanthrene & Anthracene: used to coat water storage tanks to prevent rust.
- Anthracene, phenanthrene, used as fast dyes.
  Al^{3+} → red
  Sn^{2+} → pink
  Fe^{2+} → brown.
- Health problems of PAH.

▷ **Polychlorinated Biphenyls**
having 1 to 10 Cl atoms.

- formula:

$$C_{12}H_{10-x}Cl_x$$

Sources: byproduct of coke production. Synthesised also.
Uses: insulating materials etc.
additives to epoxy paints.
Toxic effects: endocrine system, reproductions & fetal development
birds also

▷ **DDTs**: contributing to heavy crop loss every year.
Pesticides: categories: insec.
fungii. etc.
effec. against malaria.
learn structure of DDT.

Octanol-water partition coefficient (K_{ow})

$$K_{ow} = \frac{C_{octanol}}{C_{water}}$$

- indicates the tendency of fat solubility of a contaminant.
- used to calculate K_{ow} of other structurally similar contaminants

$$(\log K_{ow})_2 = (\log K_{ow})_1 + \pi_i \text{ value}$$

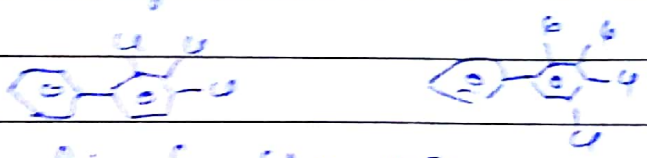
↳ also called reference index.

π_i describes lipophilic nature of a substituent.

- +ve value: preferred by octanol.
- -ve value: preference for aqueous medium.

Q) $\log K_{ow}$ of 4,4'-biphenyl = 6.19. What is $\log K_{ow}$ of 3,3',5,5'-biphenyl

Sol: structurally similar.



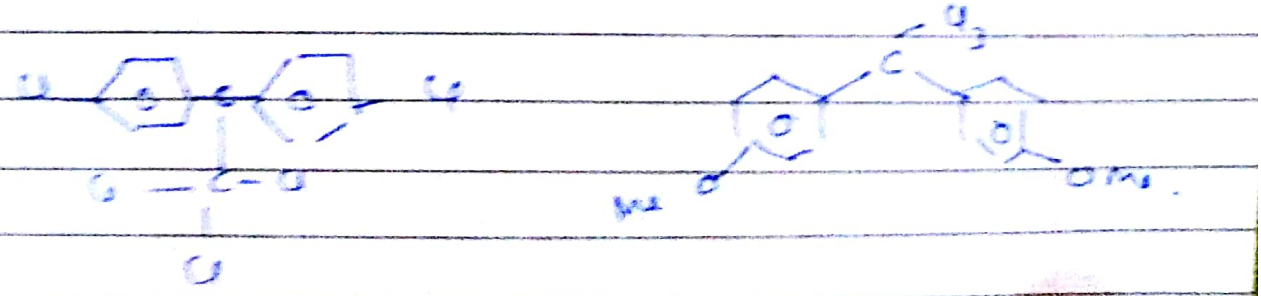
Given π_i for Cl = 0.71.

$\therefore \log K_{ow_2} = 6.19 + 0.71 = 6.90$.

$\therefore K_{ow_2} = 7.94 \times 10^6$

Compound with more K_{ow} is more lipophilic.

Q) $\log K_{ow}$ of DDT = 5.87. What is for metoxychlor.



Compare structure: 2 chlor. atoms are extra in DDT.

$\therefore \quad \log(K_{ow_2}) = (\log K_{ow_1}) - 2\,\pi_i(Cl) + 2\,\pi_i(OH)$

$= 5.87 - 2(0.71) + 2(-0.02)$

$= 5.87 - 1.42 - 0.04$

$= 5.87 - 1.46$

$= 4.41$

$\therefore \quad (K_{ow})_2 = 2.57 \times 10^4.$

$\therefore$ DDT is more toxic.

as $(K_{ow})_1 = 7.41 \times 10^5.$

$\therefore$ 29 times more toxic.

- Water contamination.
- effects of Arsenic.
- Hydrogeology.
- Green Revolu. in Rajasthan

24- August- 2017

Alternative for pesticides : Biopesticides.

~~Ferromones~~ Pheromones : organic subs. released by some insects/ their means of communication.

But this process is expensive. Time Consuming. Extract, identify.

ht readsht

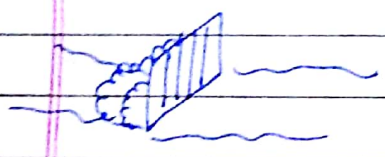
Hussainiwala Ferozepur
Jalalabad Bathinda
Thoke Fazilka
Faridkot

Waste Water Treatment :

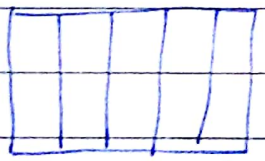
↳ defn: used water.

- multistage process
- Preliminary Treatment (physical) method : bulky mat. removed (comminutor)
  - ↓ Primary Tr. (phys. & chemical). → primary sedimentation Tank (suspended solids removed)
    - ↓ Secondary Tr. (Biological method) → Trickling Filter (biodegradable micro. orgs. removed.)
      - ↓ Tertiary (all phy, bio, chem) or Advanced
        - ↳ disease causing ~~sub~~ subs.

- Screening → Comminutor → Grit Chamber → Primary Sedimentation Tank (Primary) → Aeration Tank / Trickling Filter
  (Prelim. Treat. ⟶)



Q. Design a screen chamber with max. flow (Q) of 0.15 m^3/s of domestic wastewater. Given width : depth ratio is 1.5 : 1.



You need to calculate no. of bars.

Given: veloc. of wastewater = 0.75 m/s
clear opening of the chamber, given: 25 mm & diameter of each bar = 10 mm.

Say,
(if no. of bars = 4, no. of c. openings = 5)

- Calculate no. of bars.
- Exact. area through which water can pass.
- effective [illegible]

Cross sectional Area

$A_x = \frac{\text{Rate of flow } (Q_{max})}{\text{Velocity of waste water}}$

$\therefore A_x = \frac{0.15}{0.75} = \frac{1}{5} m^2 =$ [redacted]

$\therefore h \times \frac{3}{2}h = \frac{1}{5}$

$\Rightarrow h^2 = \frac{2}{15} \Rightarrow h = \sqrt{\frac{2}{15}}$ m. (Teachy's ↓ 0.4m)

$w = \frac{3}{2}\sqrt{\frac{2}{15}}$ m. (Teach's : 0.6 m).

$\therefore$ Let no. of bars $= n$

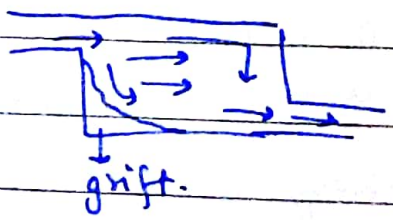
$\therefore$ no. of openings $= n+1$.

$\therefore n \times \frac{10}{1000} m + (n+1)\frac{25}{1000} m = \frac{3}{2}\sqrt{\frac{2}{15}}$ m.

(Teachy's : $n = 16$)

Effective width $= 0.6 - (0.01 \times 16) = 0.44$ m.

o Grift Removal



particles are slowed down & settled.

Q A ww plant recieves flow of 35,000 m³/day. Calculate particle settling velocity (V_s), surface area, volume & retention time of a 3m deep horizontal flow grift chamber which removes grift with specific gravity of 1.9 & size of 0.2 mm at temp 22°c, viscosity of water = 1.002×10^{-3} kg.

Use Stoke's law:

$$V_s = \frac{g\,(\rho_{Particle} - \rho_{water}) \times (\text{diameter of particle})^2}{18\,\mu}$$

g → gravitational force ($9.81\ m/s^2$)

μ → viscosity of water.

$$\therefore V_s = 9.81 \times \frac{(1900\ kg/m^3 - 1000\ kg/m^3) \times (0.2 \times 10^{-3})^2}{18 \times 1.002 \times 10^{-3}}$$

Given, specific gravity = $\frac{\text{density of part.}}{\text{density of water}}$ = 1728 m/d

$\therefore$ density of part: 1.9×1000

Also, settling velocity = $\frac{\text{Flow Rate}}{\text{Area}}$

$\therefore$ Area = $\frac{35000}{1728\ m/d} = 20.25\ m^2$.

$\therefore$ Volume = $20.25 \times 3m = 60.75\ m^3$

Retention Time (t) = $\frac{\text{vol. of grift chamber}}{\text{flow rate}} = \frac{\text{depth of tank}}{\text{settling velocity}}$

$= \frac{60.75\ m^3}{35000} = 0.017$ day.

Teacher's Signature

- Role of chem. in daily life :
- Oil Refining : Distillation.
- Alkali refining method

29-August-2017

How to design a PCB.

Easy EDA / Eagle

Primary Sedimentation Tank (in Primary)

E we add Alum: $Al_2(SO_4)_3 + 3\,Ca(OH)_2 \rightarrow 2Al(OH)_3 + 3\,CaSO_4$.

Sludges

Q Determine quantity & volume of sludge produced in 10 days in the treatment of 10 MLD of domestic wastewater with following condition:

(i) suspended solid in wastewater = 250 g/m^3.

(ii) SS removal efficiency of prim. tank = 60%

(iii) Conc. of solids in sludge = 6%

(iv) Solids conc. per capita = ~~1.03~~ 75 g/d (specific gravity of sludge) = 1.03

(v) Dens. of water = 1000 kg/m^3.

Also calculate volume of sedimentation tank & no. of people residing in that locality.

Teacher's Signature

10 MLD = 10×10^3 m³/d = $10 \times 10^3 \times 10^3$ L/d = 10^7 L/d.

quant. of sludge = SS removal effic. x SS in water x vol. of ww per day.

$= \frac{60}{100} \times 250\ g/m^3 \times 10 \times 10^3\ m^3/d.$

$= 1500\ kg/d.$

Now

Volume of sludge = $\frac{\text{quant. of sludge produced}}{\text{Dens. of water} \times \text{spec. grav. of sludge} \times \text{per. of solids in sludge.}}$

In exam, perc. of moisture content in sludge also say, 90% then per. of solids = 10%.

V. of Sld. = $\frac{1500\ kg/d}{1000 \times 1.03 \times 0.06} = 25 m^3/d.$

∴ Retention time = $\frac{\text{Vol. of prim. tank}}{\text{vol. of sludge produced per day.}}$

From this, calculate Vol. of prim. tank.

$= 25 m^3/d \times 10\ d = 250 m^3.$

∴ Total persons : total sluge = 1500 kg/d ~~x~~ NA

= 20000

Secondary Treatment

Trickling Filter method

Q A wastewater treatment plant receives a flow of 35000 m^3/d containing BOD of 250 mg/L. Primary treat. removed 25% of organic matter. Calculate no. of trickling filters with diam. of 60 m which would accomodate an organic load (conc. of microbes) of 250 g/m^2/d.

Total amt of organic matter entering the filter =

$= 250 mg/L \times 0.75 \times 35000$

$= 6562500 g/d$

~~$n \times \pi r^2 = 6562500$~~

$\therefore$ Total area of each filter $= \pi r^2$

$= 900\pi \ m^2$.

Total area required $= \frac{\text{Total org. matter}}{\text{org. load} \equiv \text{microbes}}$

$= \frac{6562500}{250} = 26250 \ m^2$

$\therefore$ n can be calculated. $= \frac{26250 \times 7}{900 \times 22} \simeq 9.\overline{09}$

$= 10.$

DATE : / /
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- $K_T = K_{20} \times \theta^{(T-20)}$
  (°C)

  K_{20} = rate const. at std. of 20°c.

  θ = const. has value 1.135 for temp: 4→20°c
  & 1.047 for 20→30°c.

- $BOD_{time} = L_o (L - e^{-kt})$

  L_o = ultimate BOD

  K = rate of biod——— / rate const.

- F/M = Rate of flow × Conc. of org matter in ww / vol. of aeration tank × conc. of biological mass

  = wight of the sludges

31-August-2017

Sludge Treatment

Appl. of microbiology.

Anaerobic digestion : sludge generated at prim. & second. treatm. are pumped to anaerobic digesters.

Digester: air tight container, substrates are heated & fermentation takes place.

(Anaerobic digestion takes place).

$\{CH_2O\} \rightarrow CH_4 + CO_2$

Differences b/w secondary treatment & anaerobic digestion.

• carried out under ambient temp. No heat is required	• Heat required
• Microbial reacn. in presence of O_2	• absence of O_2.

Teacher's Signature

- Mesophillic : orgs. whose growth is optimum at 30-45
- Thermophillic : 45-70°c.

- End prods. of anaerobic diges:
  (i) Biogas (50 to 75 % CH_4 & 25 to 45°)
  (ii) sludge cakes, used as fertilizers.

- Tertiary treatment: :

Reverse Osmosis

Removing Nitrogen (actually Ammonia)

- Ammonia striping (physical).
- nitration followed by denitrification. (Biological process)

$NH_3 \rightarrow NH_4 \xrightarrow[\text{bakteria}]{\text{Nitrosomonas}} NO_2 \xrightarrow[\text{bacter}]{\text{Nitro}} NO_3 \xrightarrow[\text{Agent}]{\text{Red.}} N_2$

↳ methanol + H^+ etc. (denitrifying bacteria)

- chlorination for removing NH_3 :

In water Cl_2 rapidly hydrolyzes.

$$Cl_2 + H_2O \rightarrow H^+ + Cl^- + HOCl$$

↳ reacts with NH_3.

$$NH_4^+ + HOCl \rightarrow NH_2Cl + H_2O + H^+$$

(mono chloramine)

$$NH_2Cl + HOCl \rightarrow NHCl_2 + H_2O$$

(dichloramine)

Teacher's Signature

$NHCl_2 + HOCl \rightarrow NCl_3 + H_2O$

(trichloramine) → unstable, converts to N_2.

- Chloramines cause the chlorine smell.

Overall reaction:

$$2NH_3 + 3HOCl \rightarrow N_2 + 3HCl + 3H_2O$$

↳ gallon per day

Q. A flow of 850,000 gpd requires a dose of 25 mg/L chlorine. If sodium hypochlorite is 15% available Cl, how many pounds per day are needed?

Sod. Hypo. is actually the source of Cl.

$$\underset{\text{(pound per day)}}{\text{lbs/day}} = \text{conc.}\ (\text{mg/L}) \times \text{flow (MGD)} \times \frac{8.34\ \text{lbs}}{\text{gal}}$$

$$= 25\ \text{mg/L} \times 0.855\ \text{mgd} \times \frac{8.34}{0.15} = 1.181\ \text{lb/d}$$

(million gallon per day)

- Water disinfection :

Common agents:

- Cl, chloramines : also kills pathogens. (free avl. chlor) (HOCl and OCl^-) : called Free Available Chlorine

Q. What'll be the amt. of Cl. required to pass. Express Cl : N ratio

$$2NH_3 + 3HOCl \longrightarrow N_2 + 3HCl + 3H_2O.$$

$$2NH_3 + 3Cl_2 \longrightarrow N_2(g) + 6H^- + 6Cl^-.$$

Teacher's Signature

35.5 / 16 / 52.5

218 / 5

Q Calculate the weight ratio of Cl:N (molar ratio 3:2).

$3Cl_2 \rightarrow 71 \times 3 = 213\ g$

$N_2 \rightarrow 28\ g.$

$\therefore$

$\frac{213}{28} = 7.6\ g\ Cl_2$ per gram of N (as ammonia).

Q A. w.w.T. plant handles 1,500,00 L/day of sewage that contains an avg. of 50 mg/L of NH_3-N. How many gms of Cl_2 (aq) must be required daily to remove all of ammonia?

Total NH_3: 50×1500000 mg.

1 gm NH_3 require 7.6 g Cl_2

$\therefore \frac{50 \times 1500000 \times 7.6}{1000} =$

$= \frac{7.6 \times 50 \times 1500 \times 2}{2}$

$= \frac{7.6 \times 1500 \times 100}{2}$

$= 360 \times 1500$

$= 540,000\ g$

Amount of NH_3 =

$\frac{54 \times 14}{17}$

54 / ×14 / 216 / 54 / 75 6

14 / 17 44 / 17) 752 / 68 / 76 / 68

3 / 36 / ×15 / 180 / 36 / 540

Teach's: One mole NH_3 → 14 g of N

∴ 50 mg/L of NH_3 → $\frac{14}{17} \times 50 = 41.2$ mg/L of N.

∴ In 1500000 L → 1500000 × 41.2 = 61800000 mg N.
= 61800 g/day

∴ Amt. of Cl required is : 61800 × 7.6
= 470 kg Cl_2/day
= 1036 lb/day

- Removal of NH_3 by Stripping method
- Removal of impurities by adsorption of activated charcoal.

- Risks due to chemicals in food.
  MSG (Monosodium Glutamate).

- Genetically modified Foods:

05-September-2017

Atmosphere & Air Pollution

- Importance of atmosphere.
- physical charac: of atmosphere:
  (i) major constituents.
  why N_2: 78% & O_2: 21% only. Because it is inert in nature, stable,
  (ii) water vapour: colourless, clouds are visible. why?
- ~ 99% of atmosphere mass is found within 30 km of atmosphere.
- Major regions: Tropo, Strato, Meso, Iono
- Why in tropo, temp. ↑es with altitude & opposite in stratosphere?

  Sun rays ~~rays~~ falls. Ground absorbs.
- Remember data for Tropo & Strato.
- Tropo-Strato interface: -56°C. helps in sustaining water on earth.
- Calculate mean molecular weight of air.

N_2, O_2 : $\frac{(78)(28) + (21)(32) + (0.934)(40)}{100}$

Ar, : $\frac{100}{3}$

0.934% ↵

Teacher's Signature

$M_a = C_{N_2} M_{N_2} + C_{O_2} M_{O_2} + C_{Ar} M_{Ar}$

~~$= 0.78 \times 28$~~

$= \left((0.78) \times \frac{28}{1000} \right) + \frac{0.21 \times 32 \times 10^{-3}}{2} + \left(0.01 \times \frac{40}{1000} \right)$

$= 28.96 \times 10^{-3}$ kg/mol.

Air Pollution

- Stationary vs Mobile sources.
- Primary vs Secondary pollutants.

↓ NO, CO_2, CO, NO, NO_2. Most hydro carbons

↳ SO_2, HNO_3 PANS, H_2O_2, H_2SO_4, O_3

- National Ambient Air Quality Standards. (NAAQS).

Regulates :

- CO : formed by incomplete combustion

Q Atmospheric CO_2 concentrations have increased from 280 ppm to 365 ppm today. What is the corresponding increase in mass of atmospheric C?

Given: mass of atmosphere : 5.2×10^{18} kg. $= m_a$

mean. molec. Mass. : 29×10^{-3} kg/mol. $= M_a$

Sol, Conc. of CO_2, C_{CO_2}, in atmosphere in terms of moles $=$ no. of moles of CO_2 / no. of moles of air.

$$C_{CO_2} = \frac{n_{CO_2}}{n_a} = \frac{M_a}{m_a} \cdot \frac{m_c}{M_c} \Rightarrow \frac{5.2 \times 10^{18} \times 10^3 \times 10^3 \times m_c}{29 \times 44} = 291 \text{ ppm.}$$

$$281\ ppm = \frac{5.2\times10^{18}\times10^{-3}}{1g} * \frac{29\times10^{-3}}{5.2\times10^{18}} * \frac{m_{c_1}\times10^{3}}{44}$$

$$\Rightarrow C_{co_2} = \frac{M_a}{M_c}\cdot\frac{m_c}{m_a} \qquad M_c = 12g.$$

$$\Rightarrow \Delta C_{co_2} = \frac{M_c}{M_a}\cdot\frac{1}{m_a}\cdot\Delta m_c.$$

$$\Rightarrow \Delta m_c = \Delta C_{co_2} \times \frac{M_a}{M_c}\cdot m_a$$

$$= \frac{85}{10^6}\times\frac{29}{10^3}\times\frac{5.2\times10^{18}\times10^3}{44} \qquad (10^{12})$$

$$= \frac{85\times29\times5.2\times10^{11}}{44}$$

$$= 1.8\times10^{14}\ kg = 180 \text{ billion tons.}$$

$$= 180\times10^{12}\ kg$$

EO AIR QUALITY INDEX

ratio of measured to accepted $\times 100\%$.

Q Avg. CO conc. in JPR air yesterday = 3 ppm. Is this high & unhealthy or air quality was ok.
Given: acceptable is 9 ppm.

Air is unhealthy, if AQI value exceeds 100%.

- Harmful & benificial M. organisms.
- Citizens Group & Action Groups.

07-September-2017

Q Calculate conc. of CO_2 in the room, after fire extinguisher is emptied.

Amt. of CO_2 measured is 10 lb. Dimensions of room = 10 ft x 10 ft x 10 ft. Temp. in the room is fed to 30°C (earlier - 20°C) & that the ambient pressure is 1 atm.

All these Based on $PV = nRT$.

You use $C_{CO_2} = \frac{\text{no. of moles of } CO_2}{\text{no. of moles of air in atmosphere.}}$

Weight = 10 lb, m.mass = 44 g./mole.

$\therefore n_{CO_2} = 10 \times 454\ g/lb \times \frac{1}{44}$

$= \frac{4540}{44}$ moles. $= 103$ gmol of CO_2.
↳ or ↳

No. of moles of air in atmosphere: g moles of gas

$(PV = nRT) \rightarrow n = \frac{PV}{RT}$.

$n = \frac{1 \times 10 \times 10 \times 10 \times (28.3\ L/ft^3)}{0.082\ \frac{lb\text{-}atm}{gmol\text{-}K} \times (30 + 273)}$ ($ft^3 \rightarrow$ Litre)

$= 1138$ gmol of gas.

∴ Conc. of $CO_2 = C_{CO_2} = \frac{103}{1138} = 9.05\%$.

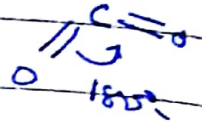
Greenhouse gases & its effect

CO_2, water vapour, methane, ozone etc.

Q N_2, O_2 are not G.H. They don't have heat holding capacity? Why?

Though biatomic, but atoms are different. Thus the bonds are stable.

$N \equiv N$ $O = O$



Because of presence of hetroatoms, they are IR active. Able to trap heat. And heat we receive lies in IR region.

Q Given: flow of O_2 into and out of earth's atmosphere is 3×10^{14} Kg/year, what is the residence time in the earth's atmosphere?

Input: photosyn. output many ways.

Given: At 15°c & 1 atm, vol. of atmosphere = 4.3×10^{21} L.

At NTP (0°c & 1 atm), 1 mol of gas occupy 22.4 l.

$\therefore$ Vol. of O_2 in atmosphere = $0.21 \times 4.3 \times 10^{21}$

32g → 22.4 l.

1g =

$\therefore \frac{0.21 \times 4.3 \times 10^{21}}{\text{[illegible]}} \times \frac{273}{288} \times \frac{32 \times 10^{-3}}{22.4}$

{ 22.4 l is at 0°c, not 15°c. } Temp. factor. Mass factor. (vol. to mass)

$= 1.2 \times 10^{18}$ Kg.

Teacher's Signature

∴ Time of residence : $\frac{\text{Mass}}{\text{Flow rate}}$

$$= \frac{1.2 \times 10^{18}}{3 \times 10^{14}} \text{ kg} \quad \begin{matrix} 0.4 \\ 10^4 \end{matrix} = 4000 \text{ years.}$$

- Major air pollutants
- Ozone (second. pollutant) :

  reacts with NOX_s etc. ~~VOC_s etc~~

  ↳ volatile org. comp. (VOC_s).

  Prim. pollutant + org. molecules (VOC_s).

  Nitrous oxides + VOC_s → photo chemical smog.