

Effluent Treatment Processes for Energy Industry (10626584)

Review: Concepts and Problems

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The chemical composition of wastewater naturally reflects the origin from which it came.

a) True

b) False

Answer: a

Explanation:

Wastewater is the liquid end-product, or by-product, of municipal, agricultural, and industrial activity. As such, the chemical composition of wastewater naturally reflects the origin from which it came.

The world's available fresh water supply is about _____ percent of that total water supply.

- a) 10
- b) 4
- c) 3
- d) 7

Answer: c

Explanation: The world's available fresh water supply is about 3 percent of that total water supply. Only 20 percent of this amount is available for use in drinking water supplies. The remainder of the world water is salt water, which is costly to desalinate for drinking water purposes.

_____ tend to resist conventional methods of wastewater treatment.

- a) Suspended solids
- b) Nutrients
- c) Refractory organics
- d) Priority pollutants

Answer: c

Explanation: Refractory organics tend to resist conventional methods of wastewater treatment. Typical examples include surfactants, phenols, and agricultural pesticides.

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Organic matter + nutrients + $O_2 \rightarrow CO_2 + H_2O +$

a) Biomass

b) O_2

c) Nutrients

d) Organic matter

Answer: a

Explanation: This is the general form of the equation for decomposition of organic matter during the BOD test. It should be noted that oxygen is consumed in the reaction and biomass is the catalyst for the reaction.

What is stoichiometry?

- a) A quantitative relationship between reactants and products
- b) Defines a qualitative value of the reactants and products
- c) Defines the quantity of reactants and products upon reaching equilibrium
- d) It defines quantity of only reactants

Answer: a

Explanation: Stoichiometry is a quantitative relationship between reactants and products. This is arrived only after balancing a chemical equation. This is required to calculate the rate of a reaction.

What is the rate of a chemical reaction not dependent on?

- a) Stoichiometry
- b) Surface area of reactants
- c) Temperature
- d) Pressure

Answer: d

Explanation: The rate of a reaction is independent of the pressure. Stoichiometry is the basis on which the rate of a reaction is defined. Greater the surface area of the reactants, greater is the rate of a reaction.

The degradation of **BOD** is classified as what type of reaction?

- a) First Order Reaction
- b) Zero Order Reaction
- c) Second Order Reaction
- d) Third Order Reaction

Answer: a

Explanation: The degradation of Biological Oxygen Demand is classified as First Order Reaction. $r = -kC$. This is the equation that depicts the degradation of BOD. Here r represents the rate of reaction, k represents coefficient of rate of degradation of BOD and C represents the BOD concentration.

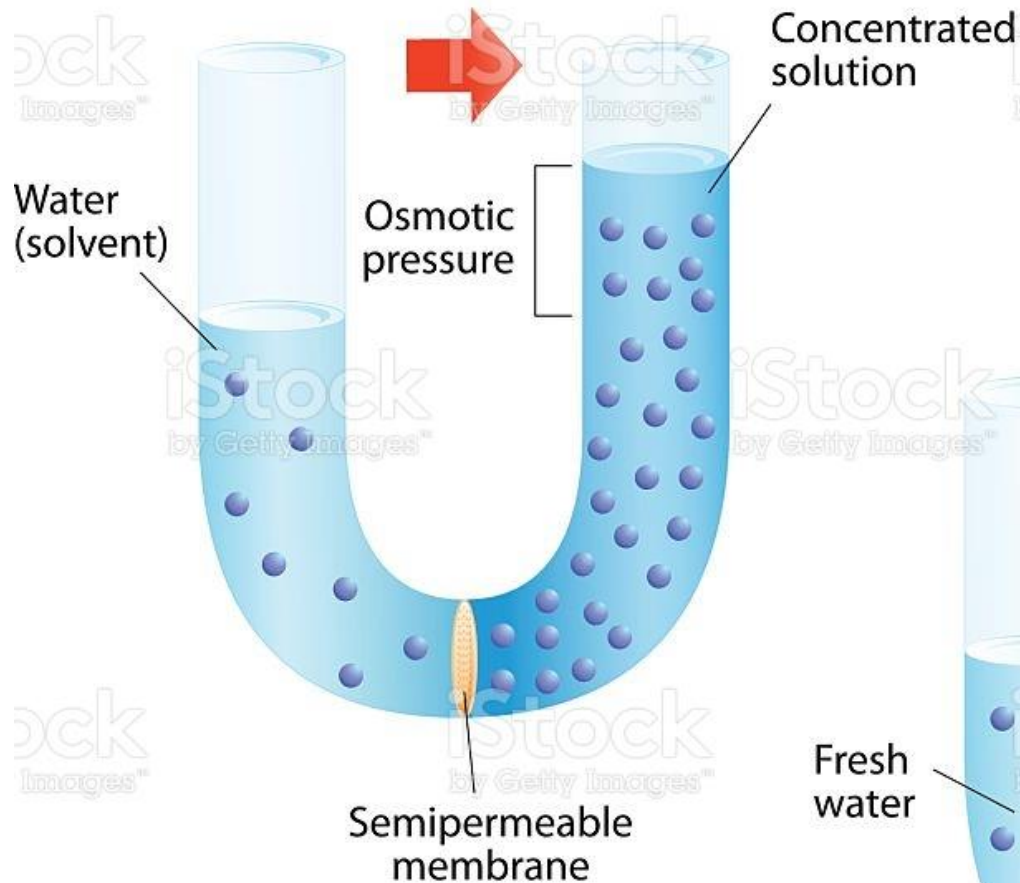
_____ is the net movement of mass from one location or component to another.

- a) Osmosis
- b) Mass transfer
- c) Dilution
- d) Reverse osmosis

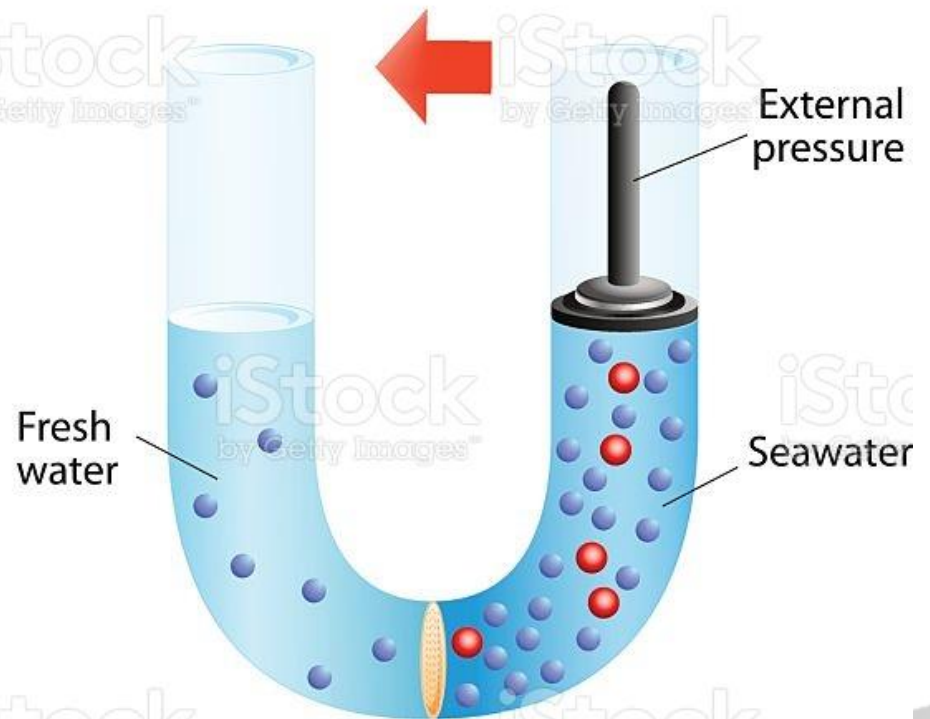
Answer: b

Explanation: Mass transfer is the net movement of mass from one location, usually meaning stream, phase, fraction or component, to another. In processes like precipitation, membrane filtration, and distillation mass transfer takes place.

Osmosis



Reverse osmosis



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Which of the following do not involve mass transfer in terms of water treatment?

- a) Clarification
- b) Aeration
- c) Air Stripping
- d) Adsorption

Answer: a

Explanation: Clarification is the process in which the suspended solids are removed. This is done by sedimentation. Coagulants such as alum are added to obtain flocs. Then this settles down. The clear supernatant flows into the next treatment channel.

What is the flux not dependent on?

- a) Pressure
- b) Mass solute
- c) Area
- d) Time

Answer: a

Explanation: The flux is not dependent on the pressure. Flux is defined as the mass of solute transported through an area per unit time. Mass flow is the product of flux multiplied by area.

In water treatment what is the driving force due to which mass transfer occurs?

- a) Concentration gradient
- b) Electric potential
- c) Gravity
- d) Pressure

Answer: a

Explanation: Gibbs Energy is the cause due to which the mass transfer occurs. The Gibbs Energy is also known as the concentration gradient. When there is a concentration gradient present between the phases there will be mass transfer from a higher concentration gradient to a lower one.

In _____ reactor the bed is filled with a packing material that expands when wastewater moves upwards.

- a) Fluidized bed reactor
- b) Packed bed reactor
- c) Plug flow reactor
- d) Mix batch reactor

Answer: a

Explanation: Fluid particles pass through the tank and are discharged in the same sequence in which they enter in plug flow reactor. The packing material that expands and gets fluidized when wastewater moves upward in the reactor is provided in fluidized bed reactor.

Which process is employed to gain sufficient head for the wastewater?

- a) Screening
- b) Pumping
- c) Oxidation
- d) Fermentation

Answer: b

Explanation: Pumping facilities may be employed to gain sufficient head for the wastewater to flow through the treatment works to the point of final disposal. Pumping is also generally required for recirculation of all or part of the flow around certain units within the plant. Pumping facilities are classified as influent, effluent, or recirculation stations and perform a critical function.

What is the most common used coagulant?

- a) Alum
- b) Ferric sulphate
- c) Limestone
- d) Coal

Answer: a

Explanation: Sedimentation using chemical coagulation has been implied mainly to pre-treatment of industrial or process wastewaters and removal of phosphorus from domestic wastewaters. Alum is mostly used as it is cheap and easily available.

A process of contact and adhesion whereby the particles of a dispersion form larger-size clusters is called _____

- a) Coagulation
- b) Flocculation
- c) Suspension
- d) Sedimentation

Answer: b

Explanation: According to the IUPAC definition, flocculation is “a process of contact and adhesion whereby the particles of dispersion form larger-size clusters”. Agglomeration and coagulation lead to flocculation.

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How many types of solids are present in water?

a) 2

b) 4

c) 6

d) 8

Answer: a

Explanation: Settling and non-settling are two major types of solids found in water. The combination of these two types makes up the total suspended solids found in water. Larger visible particles are called settling particles and are generally bigger than 1 micrometer.

What is the movement of solids in water called?

- a) Motion
- b) Brownian motion
- c) Horizontal motion
- d) Viscous motion

Answer: b

Explanation: The random movement of these solids (colloids) in water is called Brownian motion. It is the Brownian motion of the solids that keep them suspended in water for so long.

What is the detention time assumed while designing a flocculator?

- a) 10 mins
- b) 20 mins
- c) 45 mins
- d) 60 mins

Answer: b

Explanation: The detention time for a flocculator is assumed as 20 mins. Flocculation is usually followed by clarification. This process is very vital in removing the TSS.

Calculate the volume of flocculator for the following data:

Flow rate: $2200 \text{ m}^3/\text{h}$

a) 733 m^3

b) 855 m^3

c) 933 m^3

d) 785 m^3

Answer: a

Explanation: The volume of the flocculator is calculated as 733 m^3 . This is calculated by assuming the detention time as 20 mins. Thus volume = $2200 \times (20 / 60) = 733 \text{ m}^3$.

What power input in (kW) is required to achieve a mixing intensity (G) of 850 s^{-1} in a mechanical rapid mixing tank with a mean hydraulic detention time of 60 s at a water flow of $8000 \text{ m}^3/\text{day}$? Assume a water viscosity of $1.3 \times 10^{-3} \text{ Pa.s}$.

Answer:

$$P = \mu V G^2$$

so first we need to calculate the tank volume from the flow and detention time.

$$V = QT = \frac{8000 \text{ m}^3}{\text{d}} \times 60 \text{ s} \times \frac{1 \text{ d}}{(24 \times 60 \times 60) \text{ s}} = 5.56 \text{ m}^3$$

Now plug into the power eqn:

$$P = 1.3 \times 10^{-3} \times 5.56 \times (850)^2 = \underline{\underline{5222.2 \text{ Watts}}}$$
$$= \underline{\underline{5.2 \text{ kW}}}$$

Experimental Design Thinking

Someone proposed adsorbents a, b, and c for the organics removal from wastewater effluent at your facility.

1. What approach would you use to choose the best adsorbent among these options.
2. Describe the experimental work that you will do for such a purpose.

Ideas Initiation for the Course Project

1. Describe various steps of cleaning wastewater in a wastewater treatment plant.
2. Think and suggest some ways to minimize waste and pollutants at their source, taking your home as an example.