**OPTIONAL QUIZ QUESTIONS for Class 8: “Wastewater Treatment of Pulp & Paper Mills”**

Scroll way down to the bottom to see answers.

Session 1: Untreated effluents from pulp & paper mills

1A – What process within an integrated kraft pulp and paper mill is often the biggest source of lignin-related compounds, color, solids, and either very high or low pH values?

* Paper machines
* Bark removal operations
* Bleach plants
* Mineral additive systems

1B – Which of the following quantities is related to the solid materials suspended in wastewater, either before or after its treatment?

* BOD
* AOX
* TOC
* TSS

1C – What are the two most commonly employed stages of wastewater treatment employed at US pulp and paper mills?

* Primary (clarification by settling) and secondary (with activated sludge)
* Primary (by electrocoagulation) and secondary (by reverse osmosis)
* Preliminary (by floatation or settling) and finishing (by clarification)
* First stage (by counter-current washing) and second stage (by activated carbon)

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Session 2: Water quality evaluation and tests

2A – How many days does a standard Biological Oxygen Demand (BOD) test take?

* One
* Two
* Five
* Ten

2B – Which of the following is NOT in the category of absorbable organic halides (AOX)?

* Dioxin
* 4,5-Dichloroguaiacol
* Dichlorodiphenyltrichloroethane (DDT)
* Chloroform (CHCl3)

2C – What are the units used for standard turbidity tests?

* Total suspended solids (TSS)
* Consistency (%)
* Opacity (%)
* Nephelometric turbidity units (NTU)

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Session 3: Primary treatment: Clarification

3A – Which of the following lists is in the correct chronological order for primary wastewater treatment that is done with two chemical additives?

* Settling 🡪 Coagulation 🡪 Flocculation
* Coagulation 🡪 Flocculation 🡪 Settling
* Flocculation 🡪 Coagulation 🡪 Settling
* Coagulation 🡪 Settling 🡪 Flocculation

3B – What condition of particles in a wastewater suspension often approximately coincides with the greatest clarity (lowest turbidity) of wastewater following treatment with a coagulant?

* Near-zero biological oxygen demand
* The pH adjusted to the range 6 to 7.5
* Near-zero zeta potential
* Well dispersed, non-settling particles

3C – What three factors have a dominant effect of the rate of settling of particulates during primary wastewater treatment (according to Stokes’ law of terminal velocity)?

* Local differences in gravitational acceleration, water’s density, and particle shape
* Density difference relative to water, particle size, and water’s viscosity
* Air content of the water, surface-active agents, and thermal convection
* Feed velocity, fractional sludge flow, and fractional clarified water flow

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Session 4: Secondary treatment: Activated sludge

4A – What do bacteria and fungal microbes present in aerated wastewater treatment system release to the water phase to speed up the breakdown of various organic chemicals, ultimately resulting in their conversion to carbon dioxide and the energy needed for growth of organisms that eventually will make up the sludge?

* Enzymes
* Acidity
* Hydrogen peroxide
* Oxygen

4B – In addition to the water coming from a primary wastewater treatment stage, what else is most commonly added to a mixture for aerated treatment of wastewater (conventional secondary wastewater treatment)?

* Some of the sludge from the secondary treatment
* Some of the sludge from the primary treatment
* Activated carbon to adsorb pollutants from the solution
* A coagulant such as alum or a polyamine, and optionally a flocculant

4C – In which of the following devices is the sludge from biological treatment squeezed between two fabrics in a continuous process?

* A raking device
* Screw press
* Vacuum filter
* Belt press

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Session 5: Secondary treatment: Anaerobic options

5A – Mainly what flammable gas comes out of the top of an upflow sludge blanket reactor system during its operation?

* Methanol
* Methane
* Hydrogen
* Oxygen

5B – What two processes can tend to decrease the permeability of a membrane filter system during its continuous operation?

* Swelling of the membrane material and resulting decrease of pore sizes
* Crushing of the membrane, which pinches off the pore passages
* Cake formation and pore plugging or occlusion
* Change from hydrophobic to hydrophilic character, giving rise to biofilm

5C – What is one way that process integration between a pulp and paper mill operation and an adjacent wastewater treatment plant can help the wastewater treatment operations with a very low increase in net operating costs?

* Use biogas as the main fuel for all the electricity needed in the mill.
* Use ethanol from the pulping operation to “sweeten” the wastewater.
* Use the paper machines to dry the sludge from wastewater treatment.
* Use excess heat from the mill to warm up the wastewater.

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Session 6: Biosorption of metals, organics, and toxins

6A – Which of the following types of ions is more likely to be retained on a conventional ion-exchange material, as was discussed in the lecture (with negatively charged surface groups)?

* Calcium ions (divalent)
* Sodium ions (monovalent)
* Hydrogen ions (at near-neutral pH)
* Neutral ions (nonvalent)

6B – Why is it often challenging to remove the highly toxic hexavalent chromate ion from solution when using the kind of ion exchange material used to remove other metals?

* The chromate ion is monovalent (CrO3+).
* The chromate ion has a negative charge (CrO42-).
* The chromate ion forms a neutral complex in water.
* The chromate ion is in the form of colloidal particles.

6C – Why is activated carbon, which can be obtained by pyrolysis of plant-based materials under activating conditions, very effective for sorption of pollutants from water?

* Very high surface area within pores
* Near-ideal particle size (micrometer)
* High negative charge density (near theoretical maximum)
* Presence of a biofilm on its surface

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Session 7: Reducing fresh water used in papermaking

7A – If a paper mill system utilizes less fresh water, what will be the likely effect on wastewater treatment, and why?

* No effect on wastewater treatment because the pollutant load is not changed
* Decreased effectiveness of wastewater treatment due to higher concentrations
* Higher cost of wastewater treatment because more heating is needed
* Improved wastewater treatment due to higher retention times

7B – What is the procedure in which the cleanest water is used to clean the cleanest pulp, and then the rinse water is used to clean the next dirtier pulp, and so on?

* Displacement washing
* Stagewise cleaning
* Counter-current washing
* Saveall operation with filtrate segregation

7C – What is the technical term for the types of substances that tend to become more and more concentrated in a paper machine system as the amount of recirculation of process water is increased to a high level?

* Fines (mainly mineral and cellulosic)
* Non-substantive substances
* Multivalent metal ions
* Fibers (because they are not washed out)

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Session 8: Advanced wastewater treatment options

8A – What is the technical term meaning that a substance in wastewater is resistant to breakdown even when treated in an activated sludge system, in which there are high concentrations of enzymes?

* Aromatic
* Recalcitrant
* Noncompliant
* Regenerative

8B – What type of advanced wastewater treatment system involves iron ions and hydrogen peroxide?

* Fenton oxidation
* Electrocoagulation
* TEMPO-mediated oxidation
* Reverse osmosis

8C – Which of the following types of membrane has the largest pore sizes (on average)?

* Microfiltration
* Ultrafiltration
* Nanofiltration
* Reverse osmosis

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ANSWERS TO QUIZ QUESTIONS, COURSE 8

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2C: What are the units used for standard turbidity tests? Nephelometric turbidity units (NTU)

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4C: In which of the following devices is the sludge from biological treatment squeezed between two fabrics in a continuous process? Belt press

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