BACHELOR OF ENGINEERING IN CHEMICAL ENGINEERING EXAMINATION, 2018

(4th Year, 1st Semester)

INDUSTRIAL POLLUTION CONTROL ENGINEERING

Time : Three hours | Full Marks : 100

(50 marks for each part)

Use a separate answerscript for each part.

PART I

Answer any **5** questions

1. a) Explain the parallel plate precipitator.
   b) Before the installation of an electrostatic precipitator, the stack gas of a power plant contained 10.0 g particulates per m^3 of gas. The gas flow rate is 400 m^3/min and the new precipitator can remove 3000 kg particulates/day.
   1. What is the emission rate of particulates before and after pollution control in kg/day?
   2. What is the efficiency of the electrostatic precipitator?
   3. Will the new system meet an emission standard of 0.9 g/m^3? **5+5=10**

2. a) Explain four major classes of anthropogenic air pollutant emission sources.
   b) A 700 MW power plant of 55% thermal efficiency burns coal (carbon=72%) in a power plant. Because of the potential threat of global warming, it was decided to reduce the amount of carbon emissions into the atmosphere by scrubbing CO_2 using NaOH solution. An efficiency of 95% is desired. Calculate the amount of sodium carbonate produced (in kgs) per kg of coal used. The heating value of coal is 29, 00 kJ/ kg. **5+5=10**

3. a) Explain with suitable sketches the DuPont's powdered activated carbon process in advanced waste water treatment
   b) A conventional cyclone with diameter 1.0 m, air entrance height 0.5 m and width 0.25 m, handles 3.0 m^3/s of standard air of viscosity 1.81x 10^{-5} kg/m-s. Using, effective number of turns a gas makes in traversing the cyclone, Ne=6, determine the cut-size and the collection efficiency as a function of particle diameter for particles of density 2000 kg/m^3. **5+5=10**

4. a) Describe the microflocculation and macroflocculation.
   b) Assume that 40 kg of a) alum (mol. wt. 666.5) and b) ferrous sulfate and lime as $Ca(OH)_2$ is added per 4000 m^3 of waste water. Also assume that all insoluble and very slightly soluble products of the reactions, with the exception of 15 g/m^3 $CaCO_3$, are precipitated as sludge. How many kg of sludge/1000 m^3 will result in each case? **5+5=10**

5. a) Describe with suitable sketches the aerobic and aerated ponds.
   b) The 5-day 20°C BOD of waste water is 185 mg/l. What will be the ultimate BOD (UBOD)? What will be the 10-day demand? If the bottle had been incubated at 33°C, what would the 5-day BOD have been? (Given, k=0.23 d^{-1}) **5+5=10**

6. a) Classify the disposal methods of solid waste.
   b) Briefly explain the Indore and Nusoil processes for composting of solid waste.
   c) Describe with suitable sketches the different phases of refuse stabilization. **1+4+5=10**

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B.E. CHEMICAL ENGINEERING FOURTH YEAR FIRST SEMESTER - 2018

INDUSTRIAL POLLUTION CONTROL ENGINEERING

Time : Three hours Full Marks : 100

Use separate answerscript for Part I and Part II

Part II

Answer any two questions

1. Prove that for electrostatic precipitator $\eta = 1 - \exp(-(v_{pm} P L)/Q)$. **[10]**

   Briefly describe cyclone separators and its application in air pollution controlling.

   A plate type electrostatic precipitator for use in a cement plant for removing dust particles consists of 10 equal channels. The spacing between the plates is 0.15 m, and the plates are 2 m high and 2 m long. The unit handles 10,000 m^3/hr of gas. What is the efficiency of collection? What should be the length of the plates for achieving 95% collection efficiency if other condition are the same. v_{pm} is 0.10. **[15]**

2. Assuming the food to micro-organism ratio equal to 0.25 and hydraulic residence time (Volume/wastewater flow) of 6 hours, compute a) volume of reactor, b) daily amount of BOD_5 fed to the reactor, c) the value of MLVSS (mg/L) to be maintained in the reactor of a conventional activated sludge plant designed to treat 5 MLD settled wastewater with 200 mg/L of BOD_5. **[10]**

   Briefly describe oxidation ponds and its application for wastewater treatment. **[10]**

   Write down the factors affecting biodegradation. **[5]**

3. i) Write down the difference between aerobic and anaerobic process. **[6]**

   ii) 1st stage of BOD of a sample is 50 ppm. 5 day BOD at 20C is 41 ppm. What will be the reaction rate constant if the sample temperature is at 30C? **[9]**

   iii) Design a conventional activated sludge plant to treat 20000 kl/d of settled sewage of BOD is 200 mg/l. The effluent BOD is 20 mg/l. F/M ratio is 0.22, MLSS is 3000 mg/l. Adopt diffusion aeration system SVI = 90. Air required is 100 m^3/d/kg of BOD removed. Standard diffusion plates of 0.3 m x 0.3 m x 25 mm and pore size is 0.3 mm. **[10]**