21.5.14

INDIAN I NSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR
B.E. 8th SEMESTER FINAL EXAMINATIONS, 2014
Environmental Management (CE 805/10)

Full Marks: 35 **Time: 2 hrs**

Answer any 4 (four) questions
1 mark is allotted for neatness

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1. (a) The Government of India launched the eco-labelling scheme known as `Ecomark' in 1991. What are the objectives of the scheme of ecomark? Which environmental impacts of a product are considered to be the criteria for ecomark? Name another ecolabel from any other country. What is the logo for Ecomark?

   (b) Name at least four product categories for which the Government of India has notified the final criteria for the ecomark. Suggest strategies for popularizing the 'ecomark' scheme.

   (5.5+3)

2. (a) What is biomedical waste? What are the rationale and reasons for biomedical waste management?

   (b) What are the different components of biomedical waste management under the Bio-medical Waste (Management and Handling) Rules 1998?

   (c) What are the suggested treatment methods for 'human anatomical wastes' and 'microbiology and biotechnology wastes'?

   (3+3+2.5)

3. (a) What is 'carbon footprint'? What is 'carbon dioxide equivalency' for an amount of greenhouse gas? What is 'carbon credit?

   (b) What are the mechanisms suggested to achieve the goals of Kyoto protocol? Name the gases which are taken into consideration by the Kyoto Protocol.

   (4+4.5)

4. (a) Why the DO profile assumes the shape of a sag curve downstream of the point of discharge of a waste in any river? What is the self-purification capacity of a river?

   (b) A municipal wastewater treatment plant discharges secondary effluent to a surface stream. The wastewater is found to have a maximum flow rate of 15000 m^3/d, BOD_5 of 40 mg/L, a dissolved oxygen content of 2 mg/L, and a temperature of 25°C. The stream is found to have a minimum flow rate of 0.5 m3/s, a BOD_5 of 3 mg/L, a dissolved oxygen content of 8 mg/L and a temperature of 22°C. Complete mixing of the

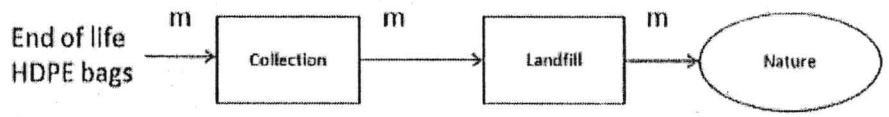
wastewater and the stream is almost instantaneous, and the velocity of the mixture is 0.2 m/s. The reaeration constant is estimated to be 0.4 d^{-1}. Find the critical oxygen concentration and the location where it occurs. Assume other data suitably.

(2.5+6)

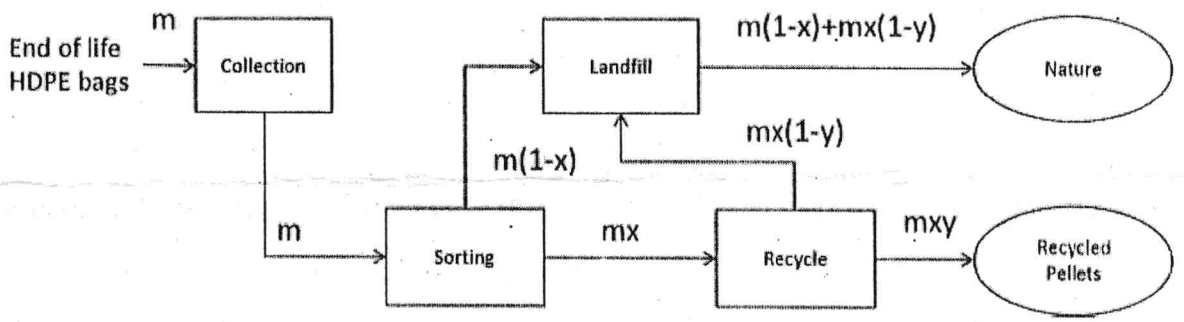
5. (a) How is the life cycle assessment of a product useful?

(b) Suppose we want to analyze the CO2 emissions of different end of life scenarios for plastic grocery bags in an urban region in an effort to inform policy makers. Two end of life processes for waste plastic bags collected in our urban region are considered: landfill and recycling. Let's assume that currently all collected mass is being sent to landfill (System1). Now suppose we wanted to evaluate changing this system by recovering some portion of the collected mass for recycling (System 2).

(1) Once-through landfill system (end of life stage only)



(2) System with plastic bag recycling (end of life stage only)



- e_c = MJ/kg input to collection
- e_l = MJ/kg input to landfill
- e_s = MJ/kg input to sorting
- e_r = MJ/kg input to recycling

} *energy intensity of each unit process*

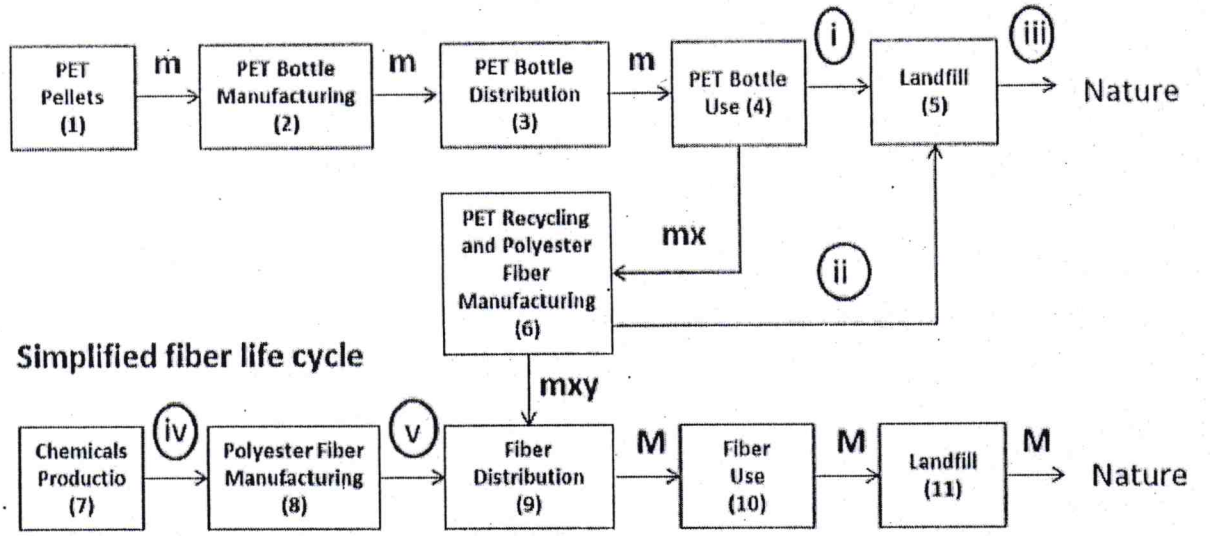
- s = MJ/kg recycled pellets -- the energy savings credit associated with the recycled pellets (i.e., the energy savings "credited" to the recycled pellets because they save energy by avoiding the production of virgin pellets in a subsequent product life cycle)

What is the maximum acceptable value of s for recycling to make sense from energy use point of view? Assume that e_c = 6 MJ/kg, e_l = 5 MJ/kg, e_s = 10 MJ/kg, e_r = 15 MJ/kg, x = 0.9, and y = 0.9.

(c) Use the CO_2 emissions intensities provided below to calculate the avoided emissions associated with the PET bottle to polyester fiber recycling system,

compared to producing and consuming those two products from independent systems. Also find out the mass quantities associated with flow i, ii, iii, iv and v?

Simplified PET bottle life cycle



$m = 5$ kg $\quad M = 6$ kg

$a_1 = 1 \quad a_3 = 2 \quad a_5 = 1 \quad a_7 = 3 \quad a_9 = 3 \quad a_{11} = 1$ kg CO_2/kg

$a_2 = 2 \quad a_4 = 1 \quad a_6 = 2 \quad a_8 = 2 \quad a_{10} = 2$

(2+3+3.5)

6. (a) The two pond system shown in figure below is fed by a stream with flow rate of 1 MGD (million gallons per day) and a BOD (a nonconservative pollutant) concentration of 20 mg/L. The rate of decay of BOD is 0.3/day. The volume of the first lake is 5.0 million gallons and the second is 3.0 million gallons. Assume complete mixing within each lake, find the BOD concentration leaving each lake.

(b) Consider the air over a city to be a box 100 km on a side that reached upto an altitude of 1.0 km. Clean air is blowing into the box along one of its sides with a speed of 4 m/s. Suppose an air pollutant with reaction rae K = 0.2/hr is emitted into the box at a total rate of 10.0 kg/s. Find the steady-state concentration if the air is assumed to be completely mixed? If the wind speed suddenly dropped to 1 m/s, estimate the concentration of pollutant 2 hr later.

(c) A lagoon with volume 1200 m^3 has been receiving a steady flow of conservative waste at the rate of 100 m^3/day for long enough time to assume that steady-stae conditions apply. The waste entering the lagoon has a concentration of 10 mg/L. If the input waste concentration suddenly increases to 100 mg/L, what would be the concentration in the effluent 7 days later? Also find the effluent concentration if the pollutant is non-conservative with reaction rate K = 0.2/day.

(2.5+3+3)

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