

# Indian Institute of Technology Kharagpur

## Department of Chemical Engineering

### CLASS TEST-3

TIME: 90 MINS

FULL MARKS - 40

#### Industrial Pollution Control (CH 62007)

*Answer all the questions*

(Open Book, Open Note examination. Assume suitable data whenever necessary with justification)

**Write your name and Roll No on front page of answer script.**

**Upload neat and clean hand-written answer script only in A-4 size paper by using MS Team**

1

A horizontal parallel plate ESP having dimension as 3m high, 4m depth with spacing between the plates as 25 cm. Flow rate of gas is 60000 m<sup>3</sup>/hr. Inlet and outlet loadings are 27 gm/ m<sup>3</sup> and 40 mg/ m<sup>3</sup>. Determine

(i) Efficiency of collection

(ii) Particle migration velocity

(iii) Efficiency when flow rate is changed to four times the original flow rate

(iv) Change in efficiency when spacing is increased 5 cm keeping all other parameters constant

[ 10 ]

2.

Dust emitted from a cement plant is controlled by a conventional cyclone with a cyclone diameter of 90 cm. For air with a flow rate of 180 m<sup>3</sup>/min at  $T = 375$  K and 1 atm, containing particles with a density of 2.4 gm/cc and a size distribution as given below, calculate the overall collection efficiency and cut size particle diameter. The gas viscosity equal to 0.017 CP. The number of complete turns by the entering air within the cyclone is 5.

Particle Size Range, $\mu\text{m}$	Mass Percent in Size Range
0 – 2	1.0
2 – 4	9.0
4 – 6	10.0
6 – 10	30.0
10 – 18	30.0
18 – 30	14.0
30 – 50	5.0
50 – 100	1.0

[ 10 ]

3

A bag filter is operating at constant rate on an optimum cycle. The filtration equation is

$$V_G^2 = 2.2 \times 10^6 \times t \times P^{0.62}$$

Where  $V_G$  = volume filtered,  $m^3$ ;  $t$  = time, min and  $P$  = pressure, cm of water

The filtering time is 30 min with a maximum allowable pressure of 100 mm of water.

Calculate

i) Maximum overall capacity

ii) It is necessary to increase the capacity of the filter. It has been suggested that two additional unit identical to the present one be installed. All units would work from the same compressor, which have ample capacity, and filtration would be carried out to the same maximum pressure as at present. The total time required to shake and clean three units is estimated as 20 min. What is the maximum percentage increase in the overall capacity that could be attained by adopting this suggestion?

[ 10 ]

4. A  $H_2SO_4$  acid plant emitting  $SO_2$  at  $800 \mu g/m^3$  in a flue gas at 450 K and 756 mm of Hg with a flow rate of  $80000 m^3/hr$ . This is to be scrubbed with water as a solvent in an absorber. It is required to be maintained below  $80 \mu g/m^3$ . Design a wet scrubber of your choice to meet the above requirements.

[ 10 ]