Industrial Pollution Control

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ASSIGNMENT

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1). A stack in an urban area is emitting 80 g/s of NOx. It has an effective stack height of 200 m the wind speed is 4 m/s at 10 m. It is a clear summer day with the sun nearly overhead. Estimate the ground level concentration at

a) 2 km downwind on the centreline and
b) 2 km downwind, 100 m off the centreline.

2) An industrial boiler is burning at 12 tons of 2.5% sulphur coal/hr with an emission rate of 151 g/s. the following exist: H=220m, u=2 m/s, y=0. It is one hour before sunrise and the sky is clear. Find the downwind ground level SO_2 concentration at x= 2 km, y= 0, z= 0.

3) A 500MW thermal power plant burns 18000 tons of coal per day containing 0.58% sulphur. The plant emits the flue gasses into the atmosphere through a stack of inside diameter of 1.5 m and height of 60m. the velocity and the temperature of the plume at the exit are 5m/s and 1550C respectively. The ambient air temperature is 28 C and the wind speed at the stack altitude is 7m/s. the barometric pressure is 825 mbar at the top of the stack. Assume a moderately stable plume.

a) calculate the effective height of stack.
b) what is the downwind SO_2 concentration in the plume centreline at a distance of 2 km in the day time?
c) calculate the maximum concentration of SO_2 along the centreline of the plume and at what downwind distance it will occur.
d) Show a concentration profile of SO_2 upto 10km downwind distance and 800m along the crosswind distance.

4) A stack gas from a cement clinker emits dusts at the rate of 115.0 gm/s at a temperature of 175 ^{O}C, velocity 8 m/s and barometric pressure of 977 millibars. A slightly unstable plume is found at the exit of the chimney. The ambient air temperature is 30 ^{O}C and wind velocity is 4 m/s. A chimney of 96 cm diameter may be used for dispersion. Under slightly unstable conditions Calculate:

a) Effective stack height
b) The concentration of dust at a distance of 6 km downwind along the central line of the plume.
c) Maximum ground level concentration of dust and at which it will occur.

5) A coal burning plant burns 24000 tons of coal/day. The coal has a Sulphur content of 1.7%. The physical stack height, h is 200 ft, inside diameter of stack at exit is 0.8m, stack gas exit velocity is 18.3m/s which leaves the chimney at a temperature of 140^{0}C. Ambient air temperature is 28^{0}C. The atmospheric pressure is 1000mbar and prevailing wind speed is 4.5m/s.

a) Calculate the effective stack height.

b)What is the maximum concentration of SO_2 at the ground level? Use moderately unstable condition of the plume.

c) Calculate the concentration of SO_2 at a distance of 5km away from the plant. Also show the concentration profile of SO_2upto 3km from the chimney.

6). A 100 MW power plant burns 10000 tons of 1.5% S containing coal/day. The flue gases are emitted into the atmosphere through a stack of height 200m and the diameter of stack at the plume exit is 0.5 m. The velocity and temperature of the plume is 10m/s and 120^{0}C respectively at the exit. What is the downwind concentration of SO_2 in the plume central line at a distance of 5km for class D plume (neutral)? Assume the ambient temperature is 15 ^{0}C and wind velocity is 6m/s.

7) SO_2 is emitted through a stack 50m height and 2m diameter at the exit at a temperature of 120 ^{O}C, with a velocity of 10 m/s .the SO_2 emission rate is 200g/s. Show how the ground level concentration at a down level distance of 1Km varies with wind speed for stability category D when the pressure is 100millibar and ambient temperature is 25 ^{o}C

8) A smelting plant emits SO_2 at the rate of 100Kg/s and as per stringent central control board norms the maximum permissible concentration at a distance of 500m from the stack is 80µgm/m^3 wind velocity at the top of chimney is 7.5m/s and the stability coefficient (downwind and cross wind) σ_y=35m, σz=20m respectively. A) Calculate the effective stack height if a particulate emission from the same smelter plant is at the rate of $3x10^{-3}$ tons/hr. Calculate the minimum stack height?