L-17
Problems

Air Pollution and control

Elective -I

Problem-1

An oil pipeline leak results in emission of 100g/h of H_2S. On a very sunny summer day, with a wind speed of 3.0 m/s, what will be the concentration of H_2S 1.5 km directly downwind from the leak?

Solution:

From Table 1, we may assume Class B stability. Then, from Fig. 15, at x = 1.5 km, σ_y is approximately 210m and, from Fig. 16, σ_z is approximately 160m, and

$$Q = 100 \text{ g/h} = 0.0278 \text{ g/s}.$$

Applying the Eq., we have

$$C(x, 0, 0) = \frac{Q}{\pi u \sigma_y \sigma_z}$$

$$C(1500, 0, 0) = \frac{0.0278 \text{ g/s}}{\pi (3.0 \text{ m/s})(210 \text{ m})(160 \text{ m})} = 8.77 \times 10^{-8} \text{ g/m}^3 = 0.088 \mu\text{g/m}^3$$

Problem-2

A coal-burning electric generating plant emits 1.1 kg/min of SO_2 from a stack with an effective height of 60m. On a thinly overcast evening, with a wind speed of 5.0 m/s , what will be the ground level concentration of SO_2 500 m directly downwind from the stack?

Solution:

From Table 1, we may assume Class D stability. Then, from Fig. 15, at x = 0.5 km, σ_y is approximately 35 m and σ_z, is approximately 19 m, and

$$Q = 1.10 \text{ kg/min} = 18 \text{ g/s}.$$

In this problem, the release is elevated, and H = 60 m.

Applying the Eq., we have

$$C(x,0,0) = \frac{Q}{\pi u \sigma_y \sigma_z} \exp\left(\frac{-H^2}{2\sigma_z^2}\right)$$

$$C(0.5,0,0) = \frac{18\,\text{g/s}}{\pi(5\,\text{m/s})(35\,\text{m})(19\,\text{m})} \exp\left(\frac{-(60)^2}{2(19)^2}\right) = 11.8 \times 10^{-6}\,\text{g/m}^3,$$

Problem-3

Sulfur dioxide is emitted at a rate of 160 g/s from a stack with an effective height H of 60 m. The wind speed at stack height is 6 m/s, and the atmospheric stability class is D for the overcast day. Determine the ground-level concentration along the center line at a distance of 500 m from the stack, in micrograms per cubic meter for a rural area.

Solution:

From Figures 4-6 and 4-7 the horizontal and vertical standard deviations, σ_y and σ_z, at 500 m for stability class *D* are 36 m and 18.5 m, respectively. Substitution of these values and other given data into Equation (4-9) yields, for $y = 0$,

$$C(500, 0, 0) = \frac{160 \times 10^6}{\pi(6)(36)(18.5)} \exp\left[-0.5\left(\frac{60}{18.5}\right)^2\right]$$

$$= 12.7 \times 10^3 (5.25 \times 10^{-3})$$

$$= 66.0\ \mu g/m^3 \text{ of } SO_2$$

It is interesting to note that this value is just within the primary air quality standards of 80 $\mu g/m^3$ listed in Table 2-1. Equation (4-9) has been used since considerable reflection occurs at 500 m downwind.