

# L-17

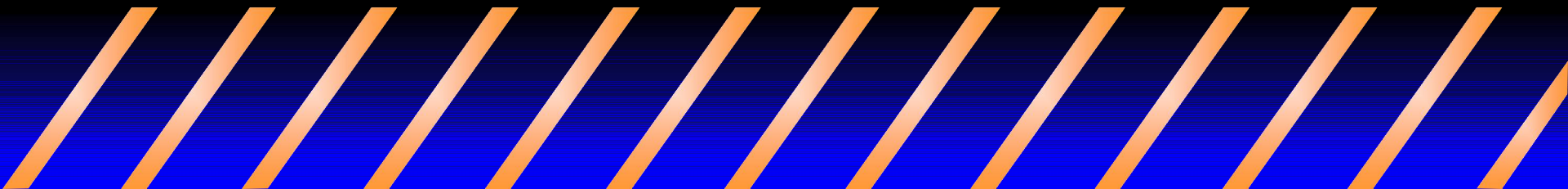
## Problems

Air Pollution and control  
Elective -I



# Problem-1

An oil pipeline leak results in emission of 100g/h of  $\text{H}_2\text{S}$ . On a very sunny summer day, with a wind speed of 3.0 m/s, what will be the concentration of  $\text{H}_2\text{S}$  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,  $\sigma_y$  is approximately 210m and, from Fig. 16,  $\sigma_z$  is approximately 160m, and

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

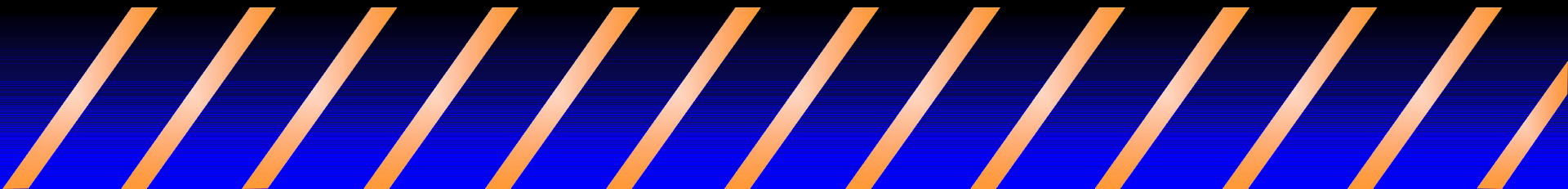
Applying the Eq., we have

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

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

## Problem-2

A coal-burning electric generating plant emits 1.1 kg/min of  $\text{SO}_2$  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  $\text{SO}_2$  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,  $\sigma_y$  is approximately 35 m and  $\sigma_z$  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,  $\sigma_y$  and  $\sigma_z$ , 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  $y = 0$ ,

$$\begin{aligned} C(500, 0, 0) &= \frac{160 \times 10^6}{\pi(6)(36)(18.5)} \exp\left[-0.5\left(\frac{60}{18.5}\right)^2\right] \\ &= 12.7 \times 10^3 (5.25 \times 10^{-3}) \\ &= 66.0 \mu\text{g}/\text{m}^3 \text{ of SO}_2 \end{aligned}$$

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