

Appendix

Problems for Practice

Thoroughly examine the following figure (Figure 1) of Agra-Mathura region. The wind direction is from Mathura refinery is directly towards Tajmahal. In the upwind of the Tajmahal there are two industrial areas and a national highway (see the emission and meteorological details on the figure). Under the atmospheric conditions E, estimate the following:

- (i) 1-hr-SO₂ concentration contributed by Mathura Refinery;
- (ii) 1-hr-SO₂ concentration contributed by Industrial area; and
- (iii) 1-hr-SO₂ concentration contributed by National highway.

Under the given conditions of emission and meteorology, will the one-hr air quality standard of 30µg/m³ be met at Tajmahal? If not in your opinion what would be your priority in terms of pollution control strategy, which may include: cutting down the emissions from (i) Mathura refinery, (ii) industrial source, (iii) relocating the highway. (It is only a simulated case for academic learning).

For any other distance, you are allowed to linearly interpolate the value of σ_y and σ_z

$$\Delta h = \frac{v_s d}{u} \left[1.5 + \left(2.68 \times 10^{-2} (P) \left(\frac{T_s - T_a}{T_s} \right) d \right) \right]$$

Where v_s = stack velocity, m/s

d = stack diameter, m

u = wind speed, m/s

P = pressure, kPa

T_s = stack temperature, K

T_a = air temperature, K

$$C(x, y, z; H) = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right] \left\{ \exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right] \right\}$$

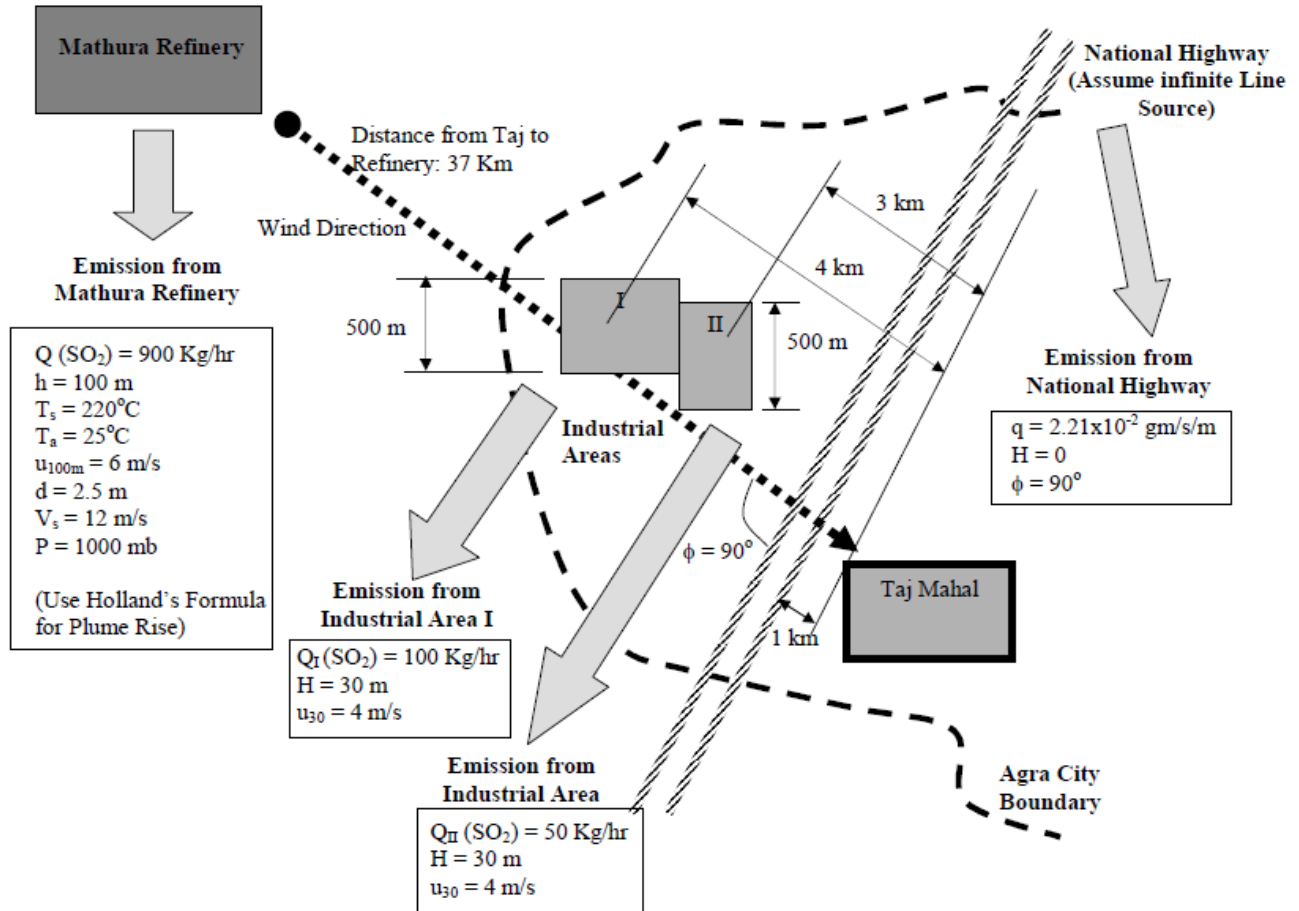


Figure 1. Air Pollution in Agra-Mathura Region in the Vicinity of Taj Mahal

Problem 1: Highways are normally modeled as a line source (as opposed to point or area sources). The highway is aligned on the y axis, and the wind blows in the x direction. For ground-level highways, $H=0$. For elevated highways the effects of source height must be included in the model.

- (A) For a line source spreading is one-dimensional in the vertical direction. Show why. A simple sketch and a few words will do.
- (B) Suggest what modification of your answer in (b) would be needed if the wind is not blowing at a 90° angle to the highway.

Problem 2: A large, poorly controlled copper smelter has a stack 150 m high and a plume rise of 75 m. It is currently emitting 1000 g/s of SO_2 . Estimate the ground-level concentration of SO_2 from this source at a distance 5 km directly downwind when the wind speed is 3 m/s and the stability class is C.