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Air Pollution Control Technology

Air Pollution Modelling

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Chapter Description

- Aims
  - To promote air monitoring procedure and guidelines required by Malaysia's government

- Expected Outcomes
  - Students are able to explain the aim and classification of air pollution model (APM)
  - Students are able to predict the ambient air concentration using a fixed box mode

- References
  - Valerro, Daniel A. 2008. Fundamentals of air pollution. 4th edition. Elsevier.

Approaches of modelling

Physical model

- meteorological around source
- time consuming and difficult to conduct

Mathematical model

- transport of pollutant
- law of conservation of mass
- tools for formulating rational AQM

Air Quality Model

- **Air Quality Models are mathematical formulations that include parameters that affect pollutant concentrations.**
- **They are used to**
  - **Evaluate compliance with NAAQS and other regulatory requirements**
  - **Determine extent of emission reductions required**
  - **Evaluate sources in permit applications**

Types of Air Quality Model

Meteorological Model

Emission Model

Chemical Model

Temporal and spatial emission rates
Topography
Chemical Transformation
Pollutant Transport
Equilibrium between Particles and gases
Vertical Mixing

Source Dispersion Model

Receptor Model

Atmospheric stability

Table: Key to stability category

Surface wind speed (at 10 m) m/s	Day			Night	
	Incoming solar energy			Thinly overcast or > 4/8 cloud	Clear or < 3/8 cloud
	Strong	Moderate	Slight		
0-2	A	A-B	B	-	-
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

Source: Handbook of Environmental engineering , 4th edition

Example 6.3

Q = 20 g/s of SO_2 at Height H

u = 3 m/s,

At a distance of 1 km, σ_y = 30 m, σ_z = 20 m (given)

Required: *(at x = 1 km)*

a) SO_2 concentration at the center line of the plume

b) SO_2 concentration at a point 60 m to the side of and 20 m below the centerline

… solution of example 6.4

$$c = \frac{Q}{2\pi u \sigma_y \sigma_z} \exp\left[-\left(\frac{y^2}{2\sigma^2_y} + \frac{(z-H)^2}{2\sigma^2_z}\right)\right]$$

a) At the centerline

$$y = 0, \quad z - H = 0 \Rightarrow e^0 = 1$$

$$c = \frac{Q}{2\pi u \sigma_y \sigma_z} = \frac{20\ \text{(g/s)}}{2\pi(3\ \text{m/s})(30\ \text{m})(20\ \text{m})} = .00177\ \text{g/m}^3 = 1770\ \mu\text{g/m}^3$$

… solution of example 6.4

b) At a point 60m to the side and 20 m below the CL

$$y = 60 \text{ m}, \quad z - H = -20 \text{ m}$$

$$c = \frac{20 \text{ (g/s)}}{2\pi(3 \text{ m/s})(30 \text{ m})(20 \text{ m})} \exp\left[-\left(\frac{60^2}{2(30)^2} + \frac{(-20)^2}{2(20)^2}\right)\right]$$

$$= (1770\ \mu\text{g/m}^3)(0.0818) = 145\ \mu\text{g/m}^3$$

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