AIR POLLUTION METROLOGY

Fundamentals of Metrology – Wind Roses- Atmospheric Stability – Atmospheric Diffusion Theories – Plume rise – Gaussian Diffusion Model.

Fundamentals of Metrology

Meteorology is the science of the atmosphere. The atmosphere is the media into which all air pollution is emitted. Atmospheric processes, such as the movement of air (wind) and the exchange of heat i.e. convection and radiation describes the fate of pollutants. Air pollution meteorology is the study of atmospheric processes namely, transport, dispersion, transformation and removal that affect the fate of air pollutants. Therefore, knowledge of air pollution meteorology is used to manage and control the release of pollutants into the ambient air.

Important meteorological parameters that influence air pollution

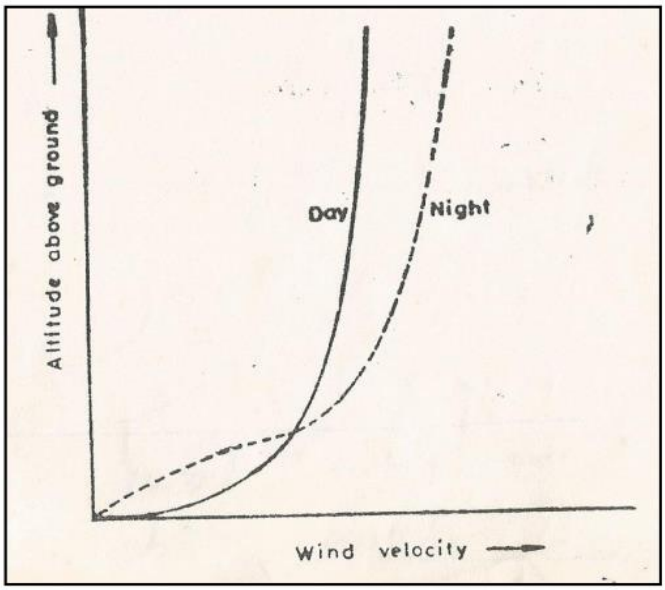
Primary parameters	secondary parameters
Wind direction and speed	Precipitation
Temperature	Humidity
Atmospheric stability	Solar radiation
Mixing height	Visibility

Wind Direction and Speed

1. Pollutants are dissipated in the atmosphere by both horizontal and vertical moments of the Wind
2. during the day

(a) Solar heating causes thermal turbulent or eddies and these eddies set up convective currents, so that turbulent mixing is increased.

(b)This results in a more flat velocity profile in the day than that at night.



Wind velocity profiles during day and night

3. The mean wind speed variation with altitude in the planetary boundary layer can be represented by a simple empirical power law.

$$U/U_1 = (Z/Z1) \propto \text{ ---------- (1)}$$

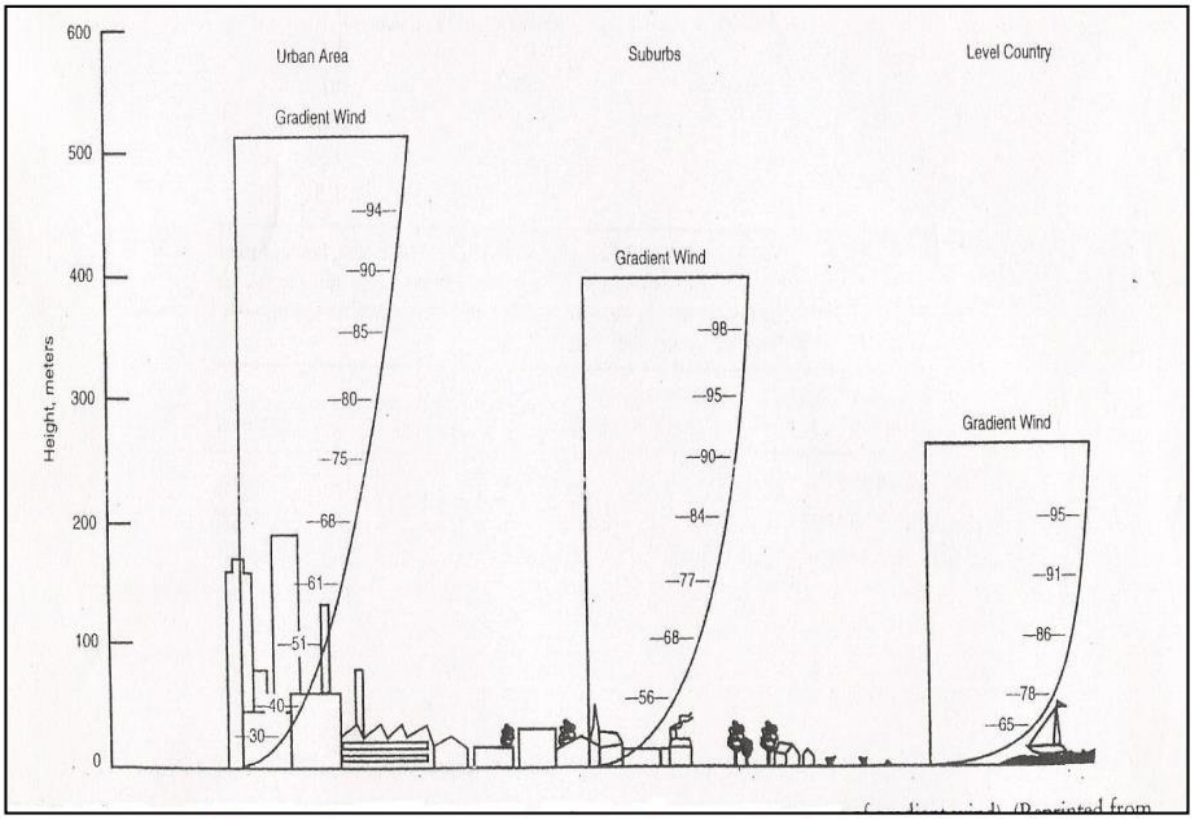
Where, U = Wind speed at altitude Z

U_1 = Wind speed at altitude Z1

$\propto$ = varies between 0.14 to 0.4 depending on the roughness of the ground surface and as well as on the temperature stability of the atmosphere.

Values of exponent $\propto$

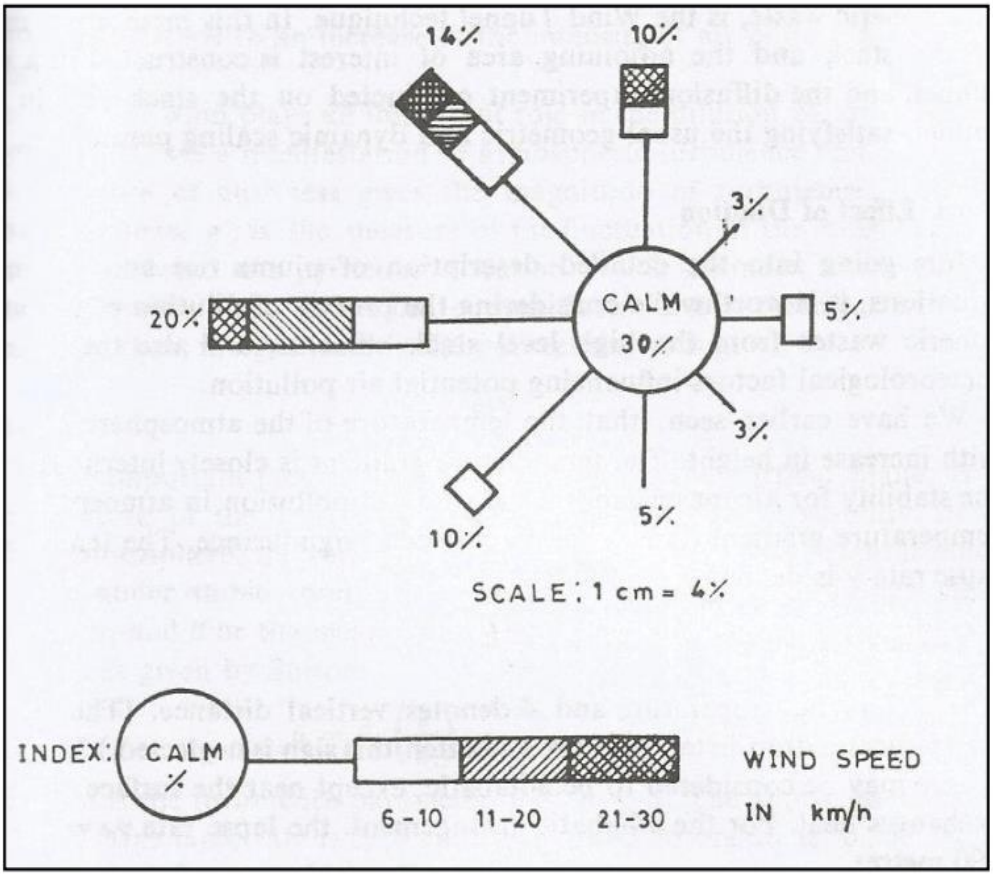
Surface configuration	Stability	$\propto$
Smooth open country	Unstable Neutral Moderate stability Large stability	0.11 0.14 0.20 0.33
Flat open country	Neutral	0.16
Suburbs	Neutral	0.28
Urban area	Neutral	0.40



Effects of terrain roughness on the wind velocity profile.

Wind Roses

- Wind direction is normally defined by a wind rose in a graphical display of the distribution of wind direction at a location during a defined period.
- Wind speed measured by anemometers.
- Wind rose is a set of wind statistics that describes frequency. In other words, the wind rose shows the prevailing direction of wind.
- Wind roses may be constructed form the data obtained over a given time period such as a particular month or season or a year.
- In constructing or interpreting wind roses, it is necessary to keep in mind the meteorological convention that wind direction refers to the north or the wind rose indicates the frequency of winds blowing from the north.
- Wind rose diagram is prepared using an appropriate scale to represent percentage frequencies of wind directions and appropriate index shades; lines etc., to represent various wind speeds.
- Observations corresponding to wind speed below 1 Km/h are recorded as calm



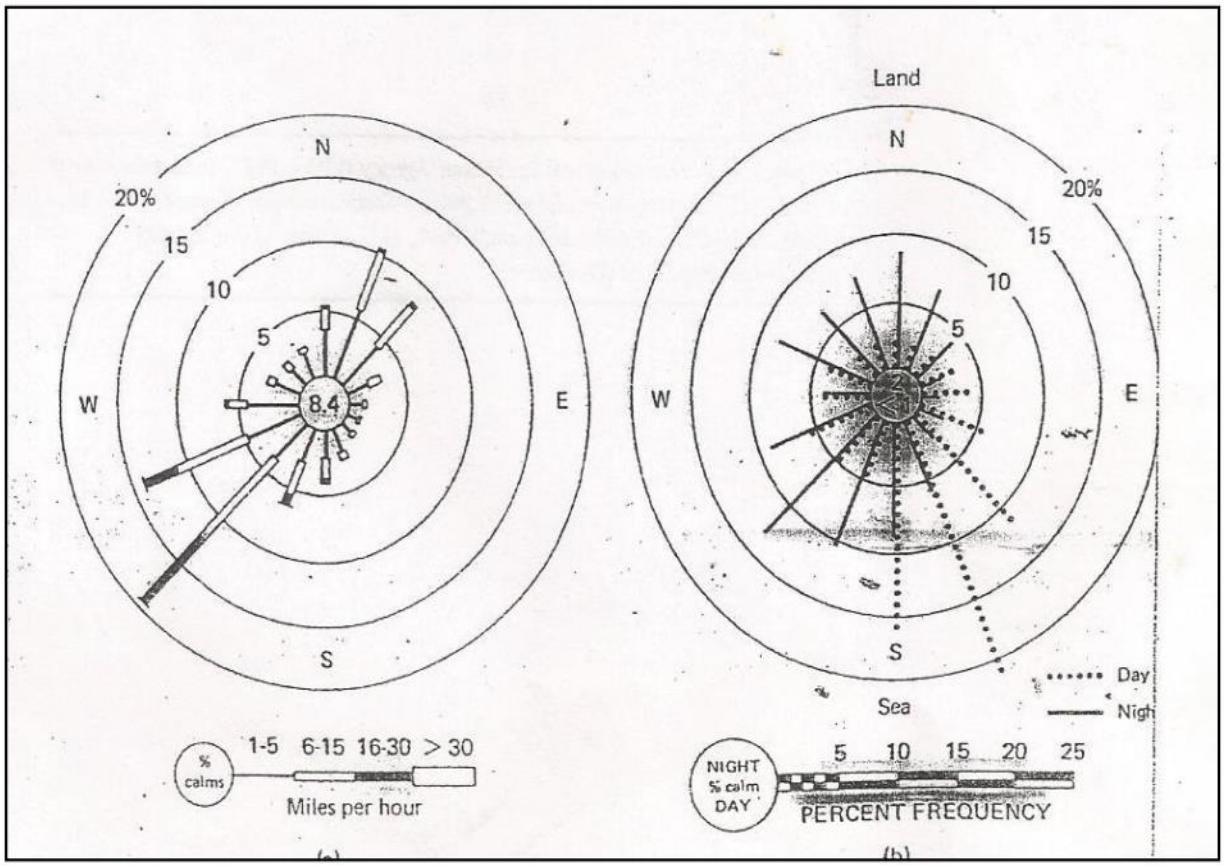
Wind rose construction

Special wind roses are sometimes constructed like:

- Precipitation wind rose
- Smoke wind rose
- Sulphur dioxide wind rose
- Hydrocarbons wind rose

Pollution Roses

Instead of wind speed the parameters of precipitation, smoke, sulphur dioxide, hydro carbons etc., are attached to the wind direction.



(a)A typical wind rose presentation of wind speed data. (b) A day –night wind rose showing the diurnal effect of the see breeze.