

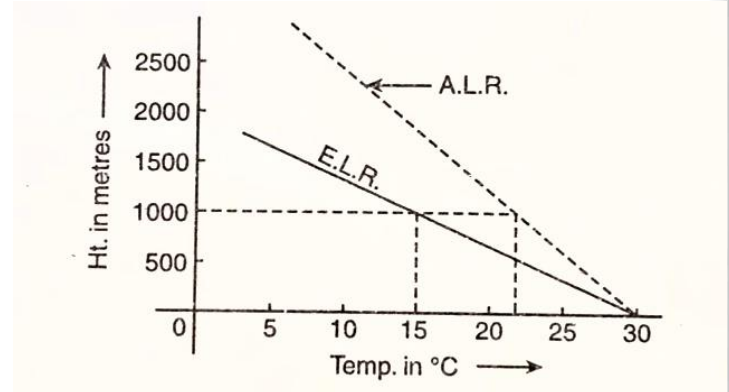
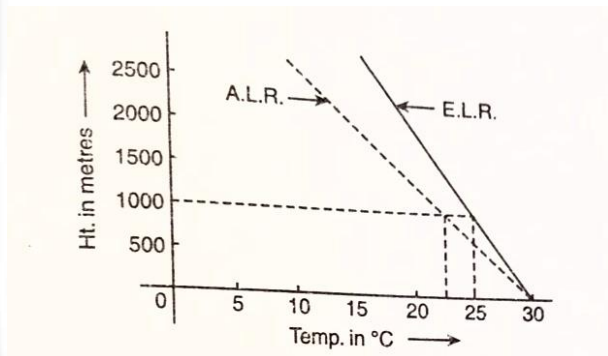
Atmospheric Stability

Lapse Rate:

Lapse rate is the rate of change of temperature with height

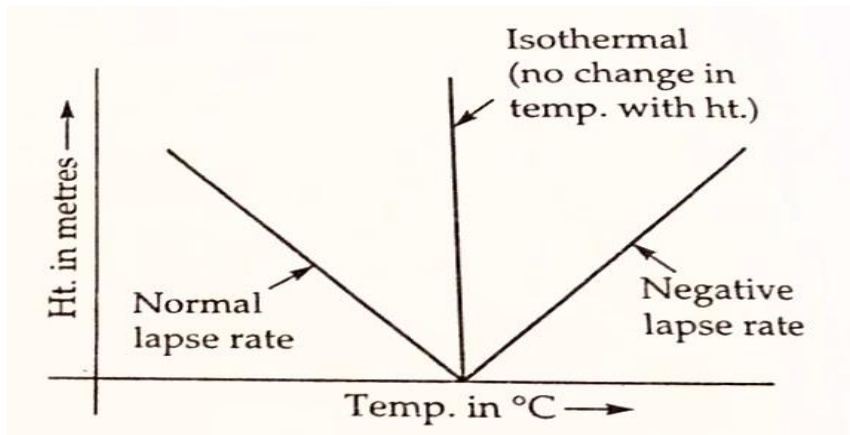
Lapse rate is defined as $\Gamma = -\frac{\delta T}{\delta z}$

Stable condition ($ELR < ALR$) Unstable Condition ($ELR > ALR$)



○ Neutral Condition

○ Inversion



• **Radiation Inversion** It usually occurs at night, When earth loses heat by radiation and cools the air in contact with it.

• **Subsidence Inversion** It is caused by sinking of air in anti cyclones (high pressure area surrounded by low pressure area)

✓ It occurs at modest altitude and often remains for several days

Mixing Height

- The height above which the earth surface to which related pollutants will extend, primarily through the action of atmospheric turbulence.
- It may be related to one or more of the following factors
 - wind direction
 - wind speed
 - wind turbulence

Meteorological Parameter:

Secondary Parameter

○ Precipitation

- It accelerates the deposition of particular matter on the ground and removed from the atmosphere.

○ Humidity

- Influence the corrosive action of the air pollutants.
- Relative humidity is most frequently used to represent humidity.

○ Solar Radiation

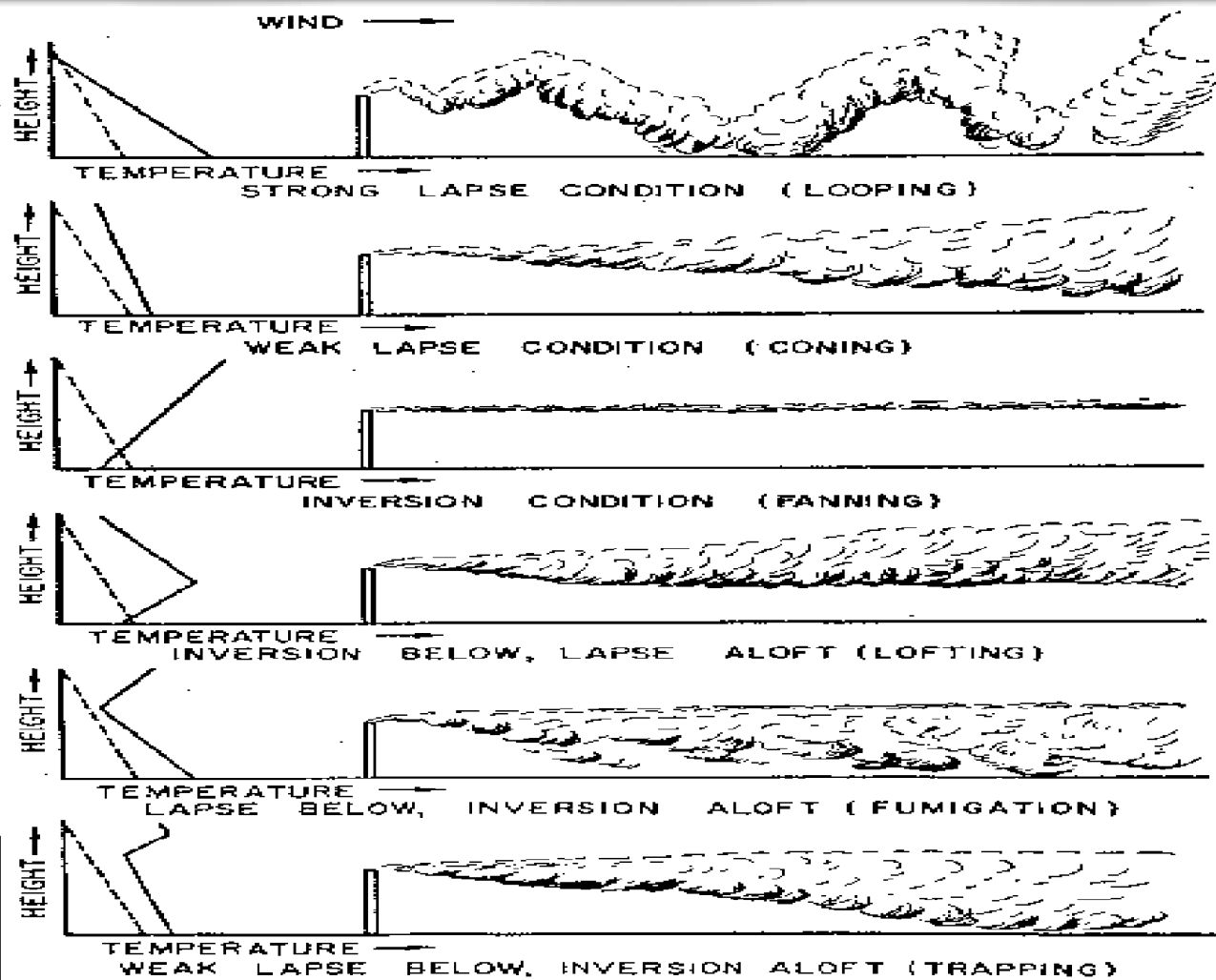
- Depending on the location, solar radiation can have effect on the type and rate of chemical reactions in the atmosphere.

Plume Behaviour

- Dispersion of pollutants
 - Wind – carries pollution downstream from source
 - Atmospheric turbulence – causes pollutants to fluctuate from mainstream in vertical and cross-wind directions.

•Plume behaviour

- The mixing or dispersion of the waste gases and products into the atmosphere is called plume behaviour.
- Depending on the conditions close to the plume source, the plume may acquire shapes very different from the regular diffusion shape.



Plume Behaviour

• Various plume shapes and associated phenomena are described below.

a. Looping plume:

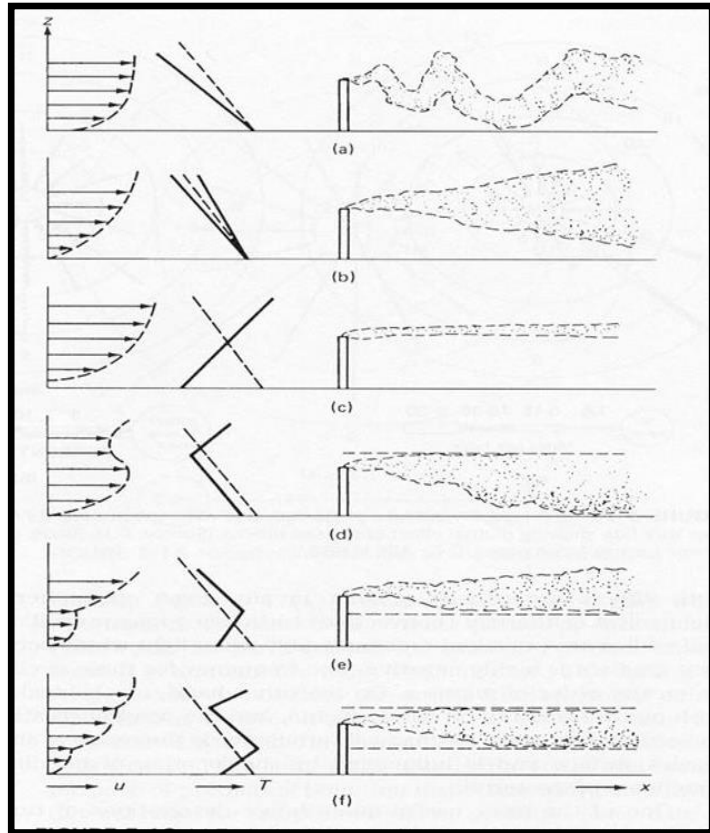
b. Conning plume

c. fanning plume;

d. Fumigation;

e. Lofting

f. Trapped plume



Six Classes of Plume Behavior

Looping:

- Plume has wavy character.
- Occurs in highly unstable conditions because of rapid mixing.
- High turbulence helps dispersing plume rapidly.
- High conc. may occur close to stack if plume touches ground.

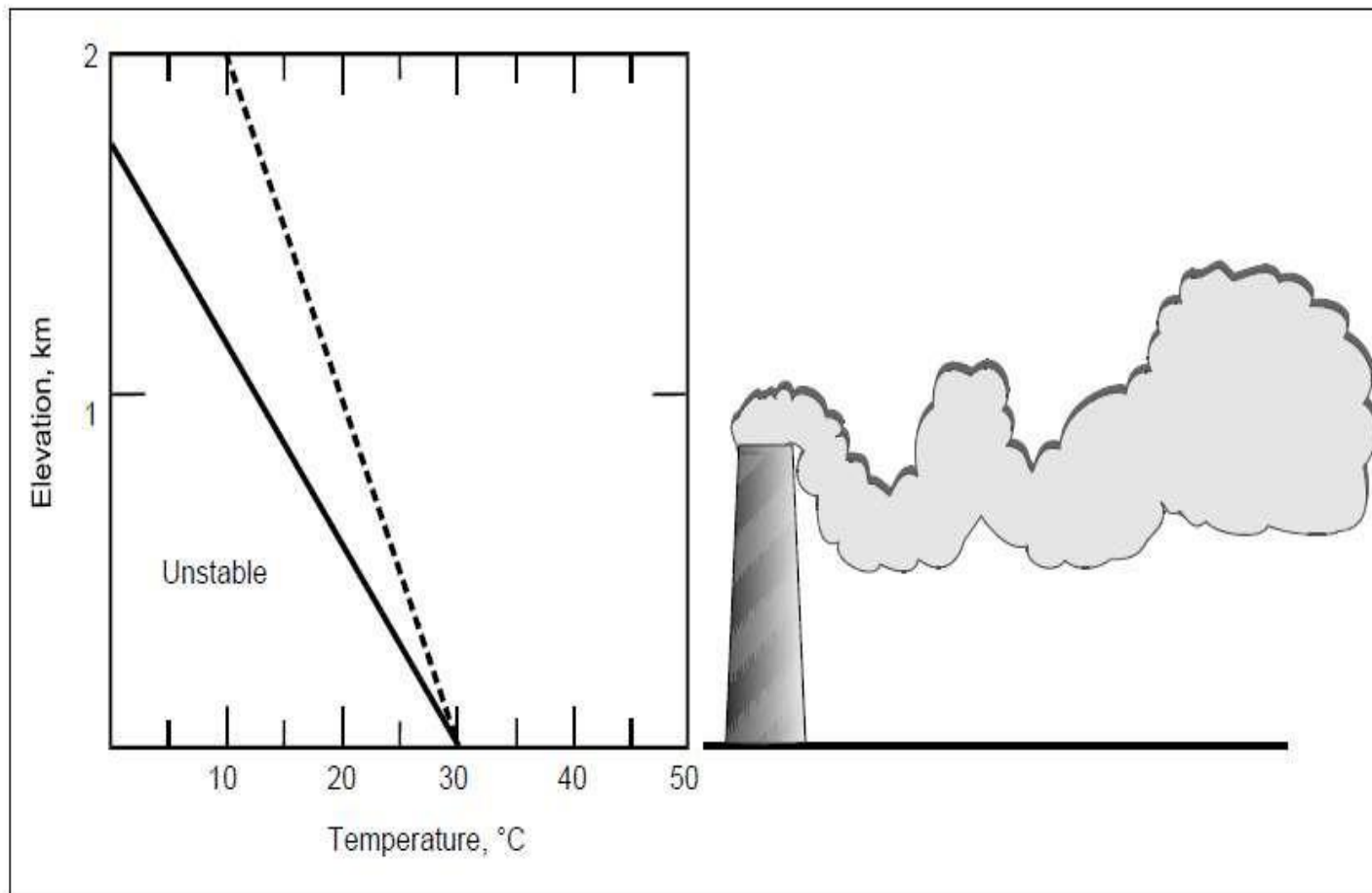


Figure 4-19. Looping plume

Coning:

- Plume shaped like a cone
- Takes place in neutral atmosphere, when wind velocity > 32 km/hr.
- Plume reaches ground at greater distance than looping.

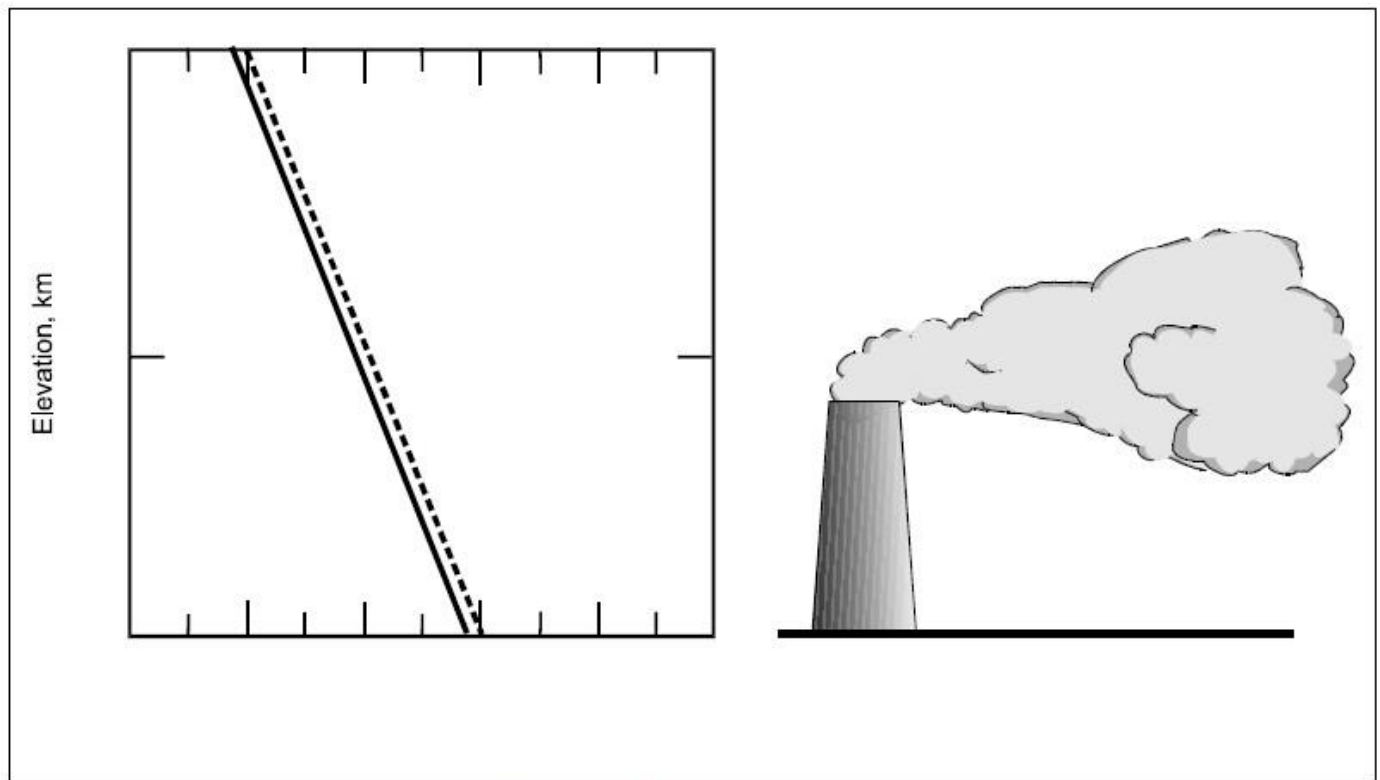


Figure 4-21. Coning plume

Fanning:

- In stable air, and where the vertical movement of the plume is slow, a fanning plume is produced.
- This wide, shallow, spreading plume is very common after calm clear nights.
- A layer of warm air limits the rise of the plume into the upper atmosphere, and creates a higher concentration of polluted air at lower levels. This plume exists for several hours.

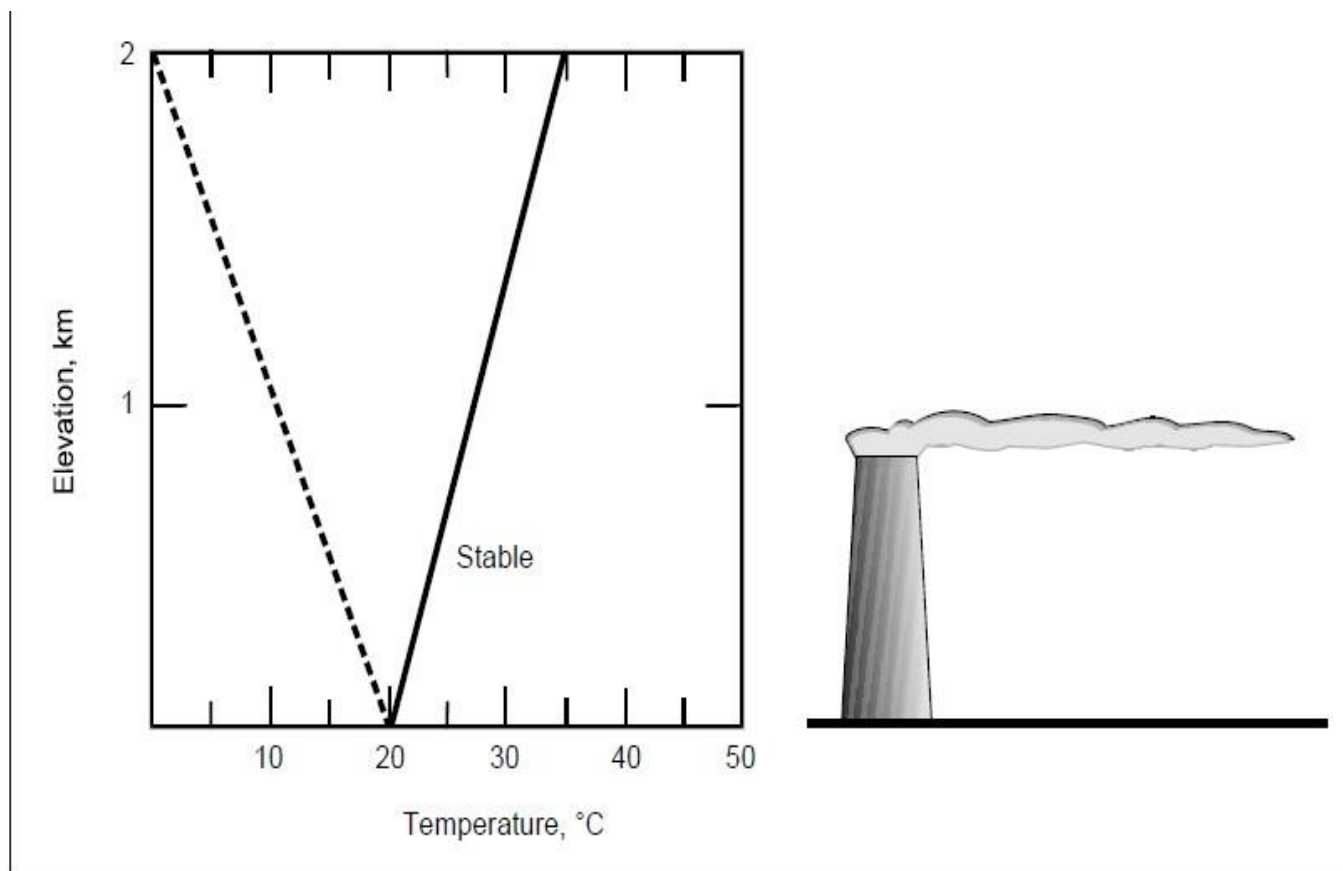


Figure 4-20. Fanning plume

Fumigation:

- Fan or cone with well defined cone.
- Pollutants are loft in air are brought rapidly to ground level when air destabilizes.
- Little turbulence in upper layer.
- Large probability of ground contact.

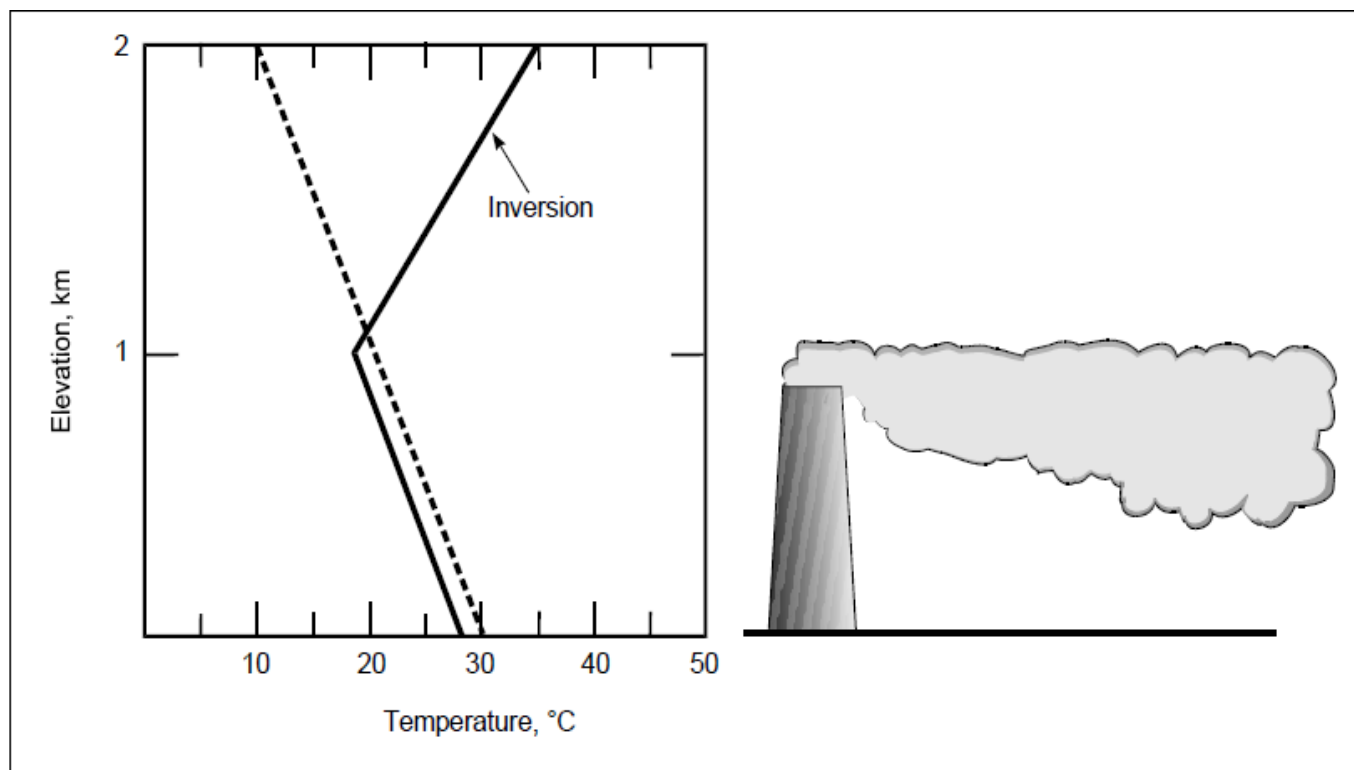


Figure 4-23 Fumigation

Lofting:

- Loops or cone with well defined bottom.
- Occurs when strong lapse rate above surface inversion.
- Moderate winds.
- Ground contact small.
- Best condition for pollutant dispersion.

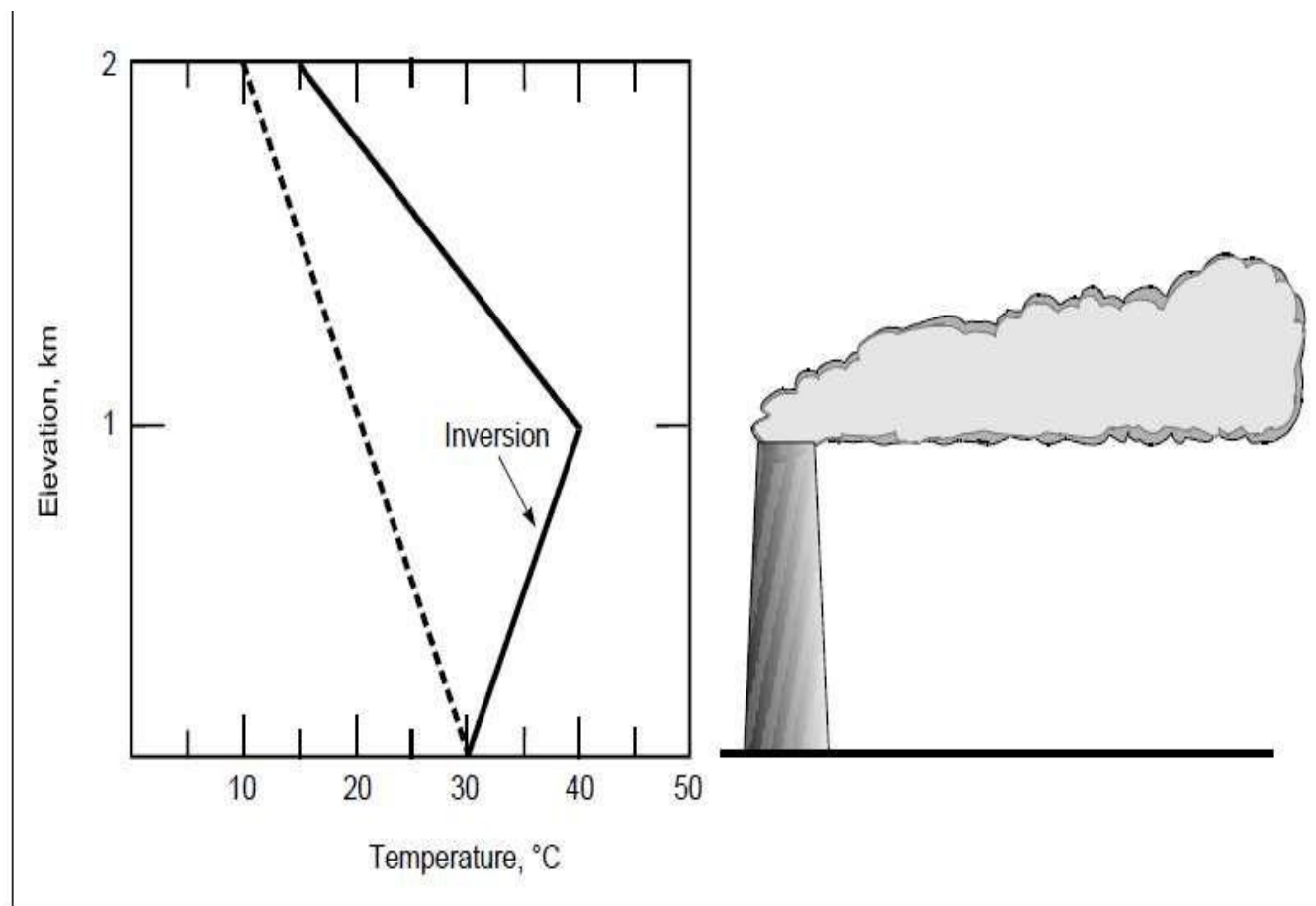


Figure 4-22. Lofting plume

Trapping:

- Inversion above and below stack
- Diffusion of pollutants is limited to layer between inversions
- Very critical from point of ground level pollutant.

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