

Lecture 13

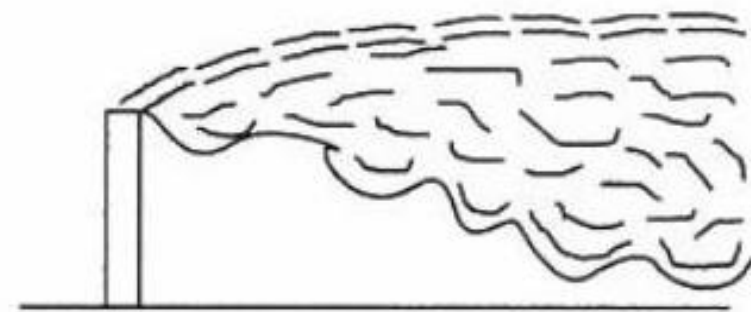
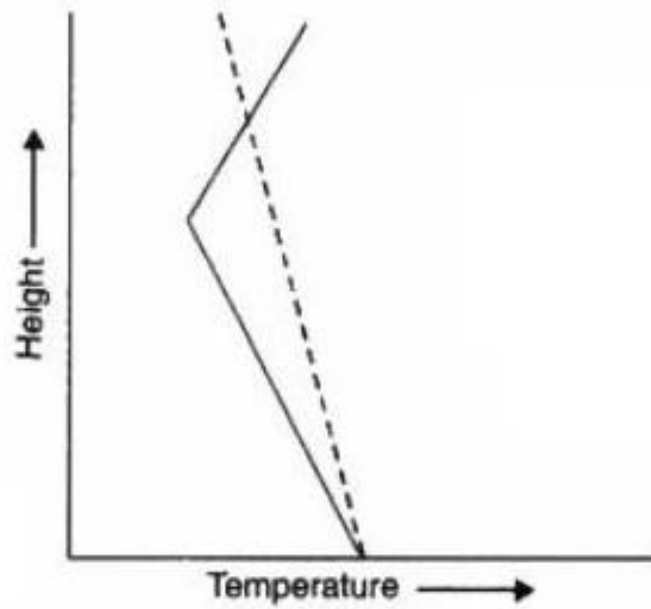
Plume Behaviour

Fumigation



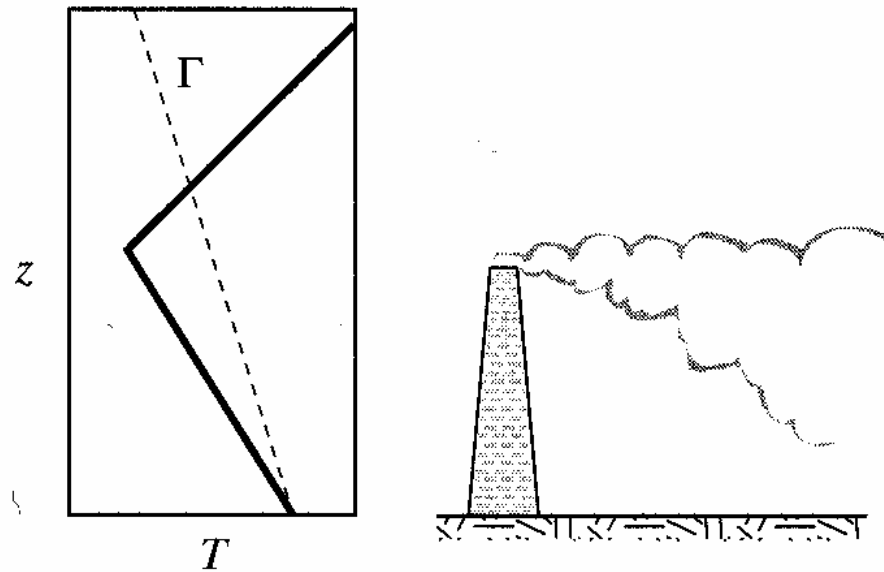
- “ The preceding three types of plume behavior are observed under conditions of uniform lapse rate but when the lapse rate changes from stable to unstable
- “ a situation usually arising when an inversion is breaking up in early morning when the sun comes up – a condition is called as Fumigation

(dry adiabatic lapse rate - - -, ambient lapse rate —)



Aloft inversion (fumigation)

- “ Most dangerous plume: contaminants are all coming down to ground level.
- “ They are created when atmospheric conditions are stable above the plume and unstable below.
- “ This happens most often after the daylight sun has warmed the atmosphere, which turns a night time fanning plume into fumigation for about a half an hour.
- “ Fumigation is favored by Clean skies, light wind and is more common in the summer season



Fumigation



Fumigation:

Most dangerous plume: contaminants are all coming down to ground level. They are created when atmospheric conditions are inversion stable above the plume and unstable below. This happens most often after the daylight sun has warmed the atmosphere, which turns a night time fanning plume into fumigation for about a half an hour.

“ Why can’t the pollutants be dispersed upward?

Plume trapped by inversion above stack height.

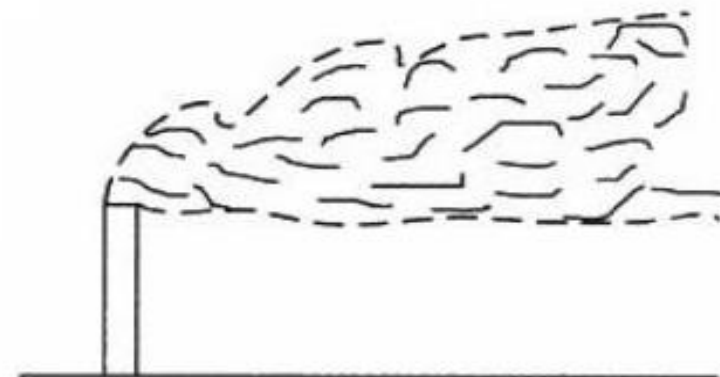
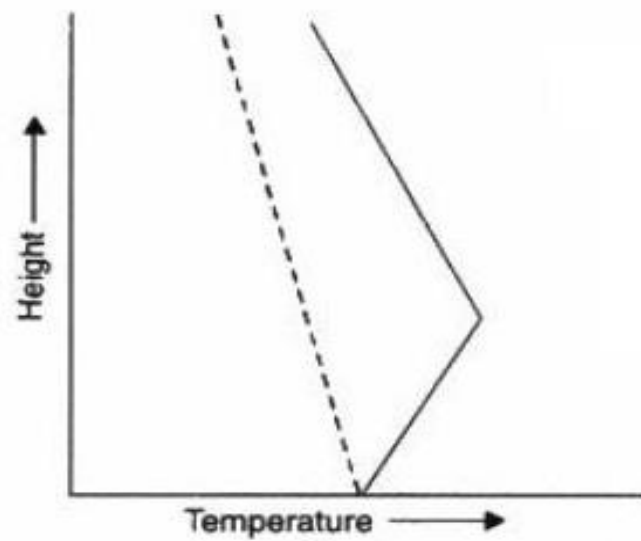
“ Does it happen during the day or night? **Morning**

Lofting Plume

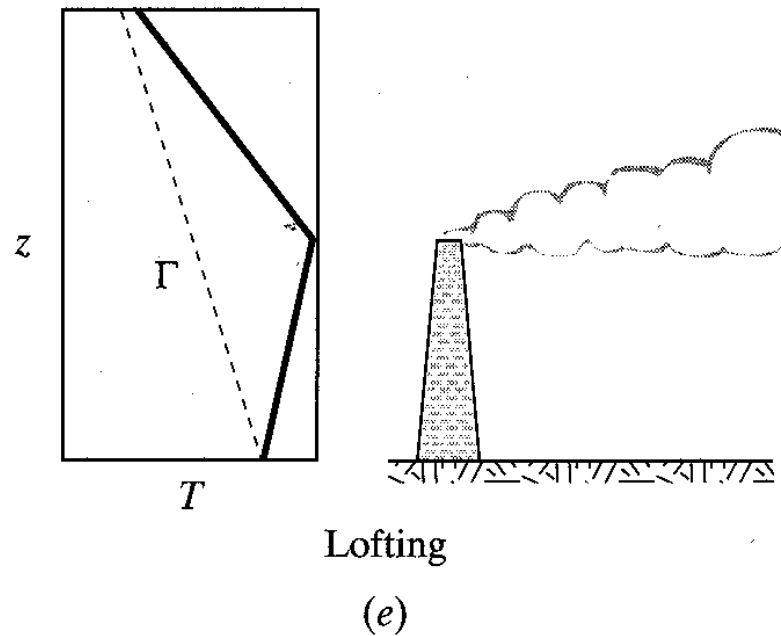
- “ Inverse of the Fumigation
- “ Lapse rate in the upper part of the plume is unstable and that in the lower portion stable.
- “ Favorable in the sense that fewer impacts at ground level.
- “ Pollutants go up into environment.



(dry adiabatic lapse rate ---, ambient lapse rate —)



Inversion below stack (lofting)



Lofting Plume: favorable in the sense that fewer impacts at ground level. Pollutants go up into environment. They are created when atmospheric conditions are unstable above the plume



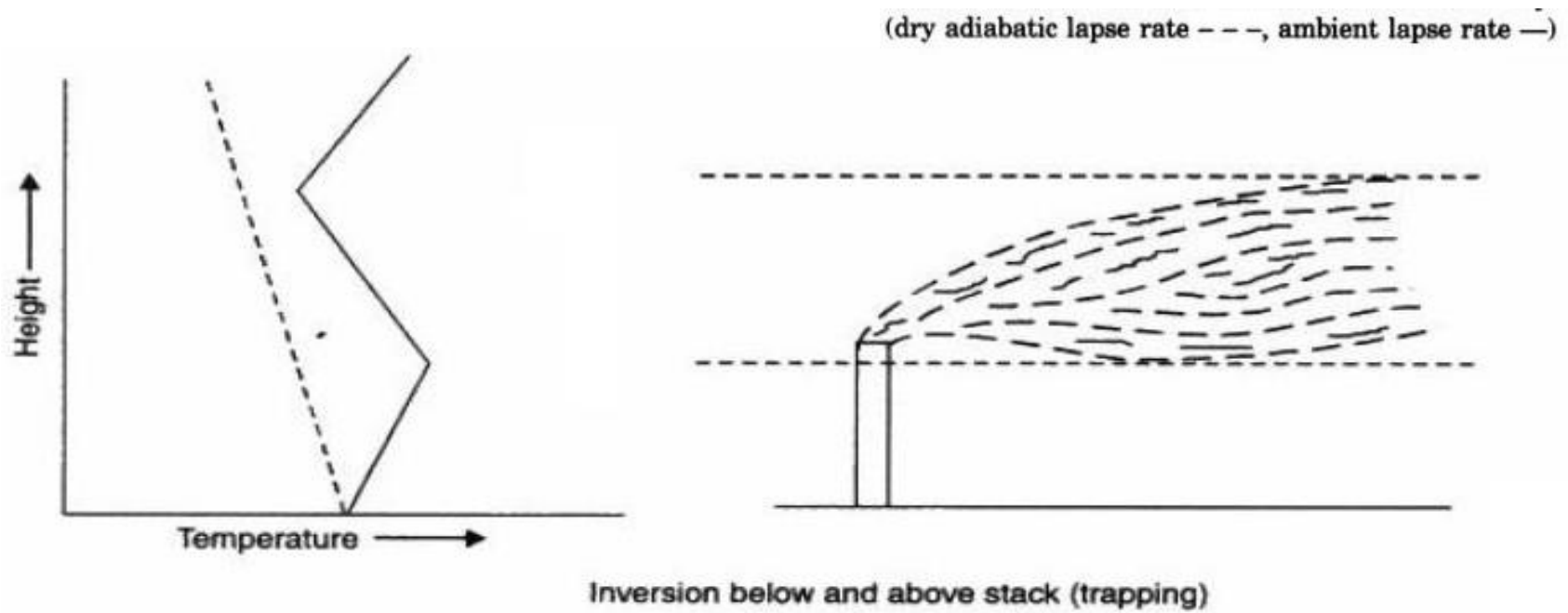
” Why can’t the pollutants be dispersed downward?

” What time of the day or night does this happen?

Evening –night as radiation inversion forms

Trapping

- “ Occurs when the plume is trapped in between two layers
- “ Only vertical mixing and that too very slowly
- “ Diffusion of effluent is severely restricted to the unstable layer between stable layer
- “ It is usually associated with subsidence inversion lasting for several days, where almost all emissions are trapped below the inversion layers thus creating one of the worst pollution situations

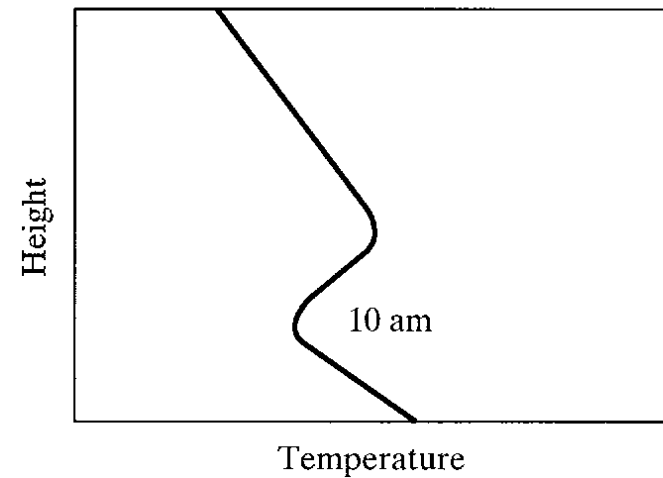
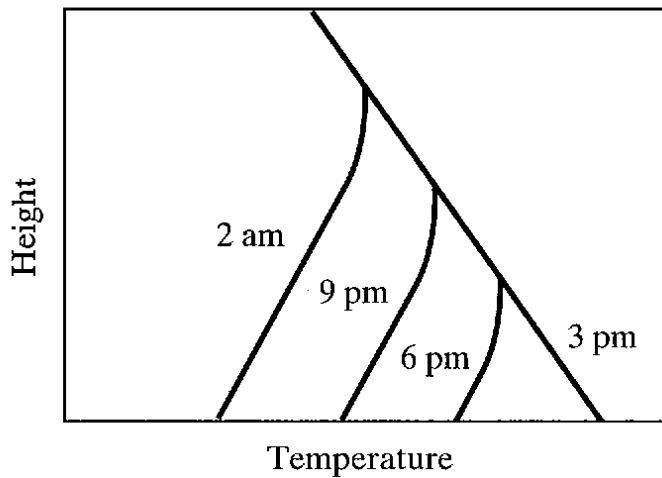


“ What weather conditions cause plume trapping?

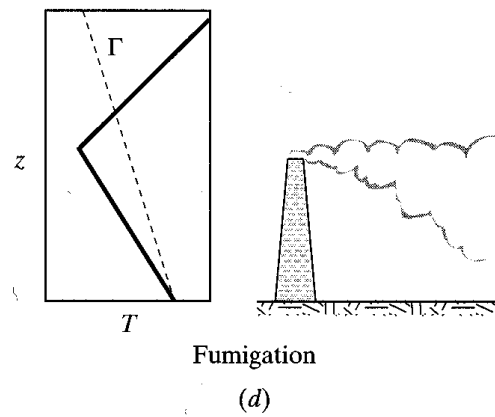
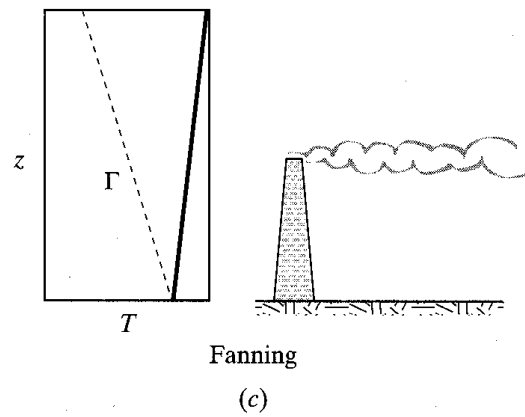
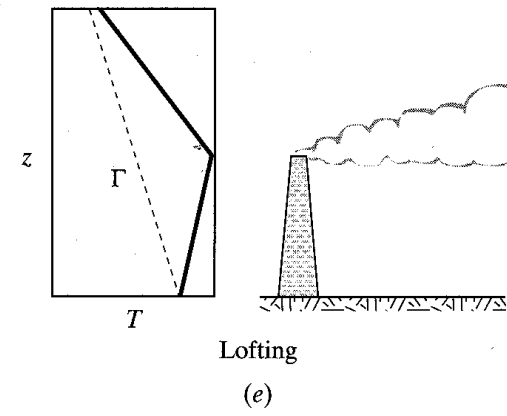
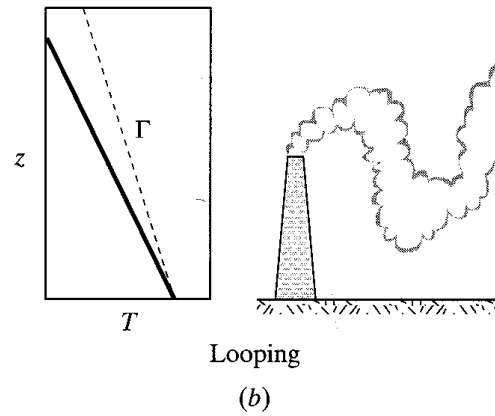
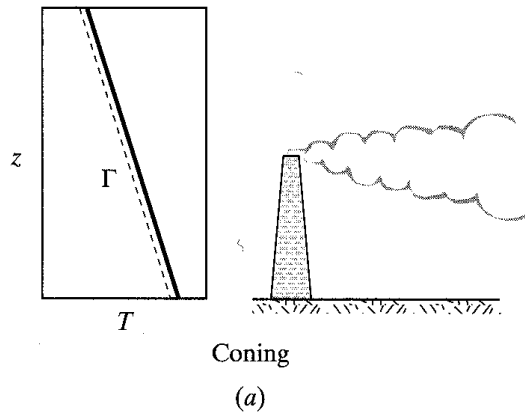
“ Radiation inversion at ground level, subsidence inversion at higher altitude (evening –night)

Temperature Inversions

- “ Extreme case of stability when lapse rate is actually positive, i.e. temperature increases with altitude
- “ Resulting temperature inversion prevents nearly all upward mixing



Effect of Lapse Rate on Plumes



POINT SOURCE GAUSSIAN PLUME MODEL

