



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)
19ASE304/ Heat Transfer



Unit -1/ Critical thickness of insulation /Lesson plan No (LP-7/10)

The concept of critical thickness of insulation is important in heat transfer, especially in applications where insulation is used to minimize heat loss or gain.

Understanding Critical Thickness of Insulation

Insulation and Heat Transfer:

- Insulation is typically applied to pipes, walls, and other surfaces to reduce the rate of heat transfer between a system and its surroundings.
- The effectiveness of insulation depends on its thickness. Adding more insulation usually decreases the rate of heat transfer.

Critical Thickness:

- The "critical thickness" of insulation refers to the point at which adding more insulation actually begins to **increase** the rate of heat transfer instead of decreasing it.
- This phenomenon occurs because of the balance between the conductive resistance (which increases with thickness) and the convective resistance (which decreases with the increased surface area of the insulation).

Mathematical Explanation:

- Consider a cylindrical pipe with insulation of thickness r_i (where r_i is the outer radius of the insulation). The rate of heat transfer by conduction through the insulation can be calculated using Fourier's law.
- On the other hand, the heat transfer from the outer surface of the insulation to the surroundings occurs through convection, which depends on the surface area (which increases with r_i and the convective heat transfer coefficient).

$$r_{cr} = \frac{k}{h}$$

$$r_{cr} = \frac{2k}{h}$$