Today, we will:

- “Skim” Bulk Materials Handling in Section 6.4
- “Skim” Canopy Hoods in Section 6.5
- “Skim” Air Curtains for Buoyant Hoods in Section 6.6
- Discuss Unsatisfactory Performance in Section 6.9
- Discuss Exhaust Duct System Design in Section 6.10

Sec. 6.3 → Design Plates → Design for hood of various kinds

ACGIH vent. manual is the “bible” of HVAC engineers

Sec. 6.4 → Bulk Materials Handling

Terminology → Point Source Emission → Emission from a well-defined location

Fugitive emission → Emission from vaguely defined location

Eg conveyor belt in a quarry

How to control?
- Add a cover
- Spray with water

Tank filling:

Emission of dust

Dust is “splashed” up

Acts as a buffer, pushing the dusty air out
Analyze is same as with filling tank with liquid.

**Namely - Displacement effect**

Control it with a vacuum system

\[ Q_w = \text{withdrawal volume flow rate} \]

See book for semi-empirical eqs for \( Q_w \), etc.

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**Sec. 6.5** - Canopy hood is: buoyant plume

Calc. \( Q_w \) based on semi-empirical eqs

Surges sometimes occur \( \rightarrow \) how to handle

If we design the hood with a large volume, we can handle surges.

Idea is to have a large enough \( V \) to hold all the smoke from a surge.

Then - slowly remove it.
Sec. 6.6 - Air curtain for buoyant plumes

→ Similar to the “push-pull” system discussed previously

Sec. 6.7 i.e. 6.8 - Skip

Sec. 6.9 - Mostly qualitative - Unsatisfactory performance

Real world problem - hoods do not always work the way they are designed

- Stagnant air currents
- Blocked inlets or blocked ducts
- Leaks
- Inadequate make-up air (as previously
- etc.
Sec. 6.10 Exhaust Duct System Design

Typical System:

Just as in ME 33, there are major losses and minor losses:

- due to long, straight section of duct
  - (use Moody chart or Colebrook eq.)
- due to everything else
  - (elbows, drop-out boxes, transition, valves, etc.)
  - (we lose coefficients)

Additional problems when we have dusty (particle-laden) flow:

- Dust particles settling in the duct
- Buildup of particles on the floor of the duct

Thus, a minimum duct transport velocity to keep particles from settling.
Particle buildup in duct is bad because:

1) Can clog the duct → if restrict the flow area, it slow down the flow!
   [eg. dryer hose] (acts like a valve)

2) Structural problems (too much weight)
3) Possibility of explosion

For vapors in duct — also can cause problem

1) Usually vapors are generated hot, then condense on the cold duct walls
2) conc. usually high in duct → can have explosion
   etc.

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**EQUATIONS**: Energy eq. for a control volume from an inlet to an outlet

Inlet is taken as “far away” from the hood face itself.

@0 → V=0, P = P_{room}
Head form of the energy eq. for Steady-State, Steady Flow (SSSF)

\[
\left( \frac{P_1}{\rho g} + \alpha_1 \frac{V_1^2}{2g} + z_1 \right)_{\text{inlet}} = \left( \frac{P_2}{\rho g} + \alpha_2 \frac{V_2^2}{2g} + z_2 \right)_{\text{outlet}} + h_{\text{turbine}} - h_{\text{pump}} + \sum h_{\text{loss}}
\]

Generally, kinetic energy factor are ignored (set \( \alpha_1 = \alpha_2 = 1 \))

Notation:

\[
\delta P_{\text{fan}} = \rho g h_{\text{fan}}
\]

But, \( \delta P \) is usually listed in catalogs as "inch of water"

Be careful not to confuse Pa \( \equiv \) in.

Pa \( \equiv \) in. of water