Today, we will:

- Continue our discussion about **hood suction velocities** and **isopleths**
- Discuss **capture velocity** and **capture of particles** in Section 6.1
- Do some example problems – capture velocity
- Do Candy Questions for Candy Friday

Example: Circular inlet without a flange (plain circular inlet:

![Diagram of hood suction velocities and isopleths](image_url)

**Figure 6.9** Velocity isopleths (curves of constant $U/U_{face}$, %) and decay of $U(x,0)/U_{face}$ (along the centerline, %) for a plain circular opening (adapted from ASHRAE HVAC Applications Handbook, 1995).
Example: Circular inlet with a flange (flanged inlet):

Figure 6.10 Velocity isopleths (curves of constant $U/U_{face}$, %) for a flanged circular opening (adapted from ASHRAE HVAC Applications Handbook, 1995).

Capture Velocity $= V_c =$ velocity magnitude required to "capture" a contaminant particle so that it enters the hood.

There is a range of $V_c$ for various activities that produce particles. See Table 6.1.
**Table 6.1** Capture velocities (abstracted from ACGIH, 2001).

<table>
<thead>
<tr>
<th>characteristics of contaminant emission</th>
<th>examples</th>
<th>capture velocity (FPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. contaminant enters quiescent air with negligible velocity</td>
<td>degreasing tank, evaporation</td>
<td>50-100</td>
</tr>
<tr>
<td>2. contaminant enters slightly moving air with a low velocity</td>
<td>welding, vessel filling</td>
<td>100-200</td>
</tr>
<tr>
<td>3. contaminant actively generated and enters rapidly moving air</td>
<td>spray painting, stone crushers</td>
<td>200-500 ft/min</td>
</tr>
<tr>
<td>4. contaminant air enters rapidly at high velocity</td>
<td>grinding, abrasive blasting</td>
<td>500-2000</td>
</tr>
</tbody>
</table>

**Lower values of capture velocity:**
- room air movement minimal or conducive to capture
- contaminants of low toxicity
- intermittent use or low production rates
- large hood and large mass of air moved

**Upper values of capture velocity:**
- adverse room air movement
- contaminants of high toxicity
- heavy use and high production rates
- small hood and small mass of air moved
Given: A flanged round inlet is used as a hood to capture overspray particles from spray painting. The hood inlet (face) diameter is 0.50 m. The spray paint region of concern extends to $x = 0.50$ m (axially) and $r = 0.25$ m (radially) as sketched.

To do: Calculate the range of required volume flow rate through the hood.

Solution:

Capture velocity

| Table 6.1 | $V_c = 200 \text{ ft/min}$ |

Set $Q = V_c$, $V_c = 200 \text{ ft/min}$ to $500 \text{ ft/min}$

Air velocity at the location of interest

Fig. 6.10 - $\frac{x}{D} = \frac{0.5}{0.5} = 1.0$; $\frac{r}{D} = \frac{0.25}{0.5} = 0.5$

$\frac{x}{D} = 1.0$; $\frac{r}{D} = 0.5$ → $\frac{U}{U_{face}} = 7.5\% = 0.075$

$Q = U_{face} \cdot A_{face}$

$= \frac{U}{U/U_{face}} \cdot \left( \frac{\pi}{4} D^2 \right)$

$= \frac{V_c}{U/U_{face}} \cdot \frac{\pi}{4} \left( \frac{0.5}{0.3048} \right)^2$

Range from $V_c = 200$ to $500 \text{ ft/min}$

$Q = \frac{200 \text{ ft/min}}{0.075} = \frac{\frac{4}{\pi} (0.5 \text{ m})^2 \left( \frac{1 \text{ ft}}{0.3048 \text{ m}} \right)^2}{\left( \frac{4}{\pi} \right)}$

$= 5676 \text{ ft}^3/\text{min}$

$= 5600 \text{ CFM}$ Range of $Q$ required

$Q = 14000 \text{ CFM}$
Fundamental Problem with This Technique

We are using only the magnitude of parabolic velocity (speed) / nothing is said about direction of parabolic motion.

Ve value are conservative — worst case scenario

Reach \[ \rightarrow \] The size of the region in front of an inlet that is capable of drawing contaminants into the inlet.

Problem with inlet & hood \[ \rightarrow \] Reach is much smaller than we desire

"Candle problem"

If the contaminant is buoyant, we put the hood on top & it helps tremendously

Aabog inlet \[ \rightarrow \] see text

END OF EXAM 2 MATERIAL