This is the last lecture! ☺ **Today, we will**:

- Continue our discussion of **impaction between moving particles** (spray chambers, scrubbers, etc.) in **Section 9.3**
- Discuss **filtration** in **Section 9.4**
- ~~If time, discuss **electrostatic precipitators** in **Section 9.5**~~
- ~~Do Candy Questions for Candy Friday~~

No Time!

Section 9.3 – Spray Chambers (continued from the end of the previous lecture):

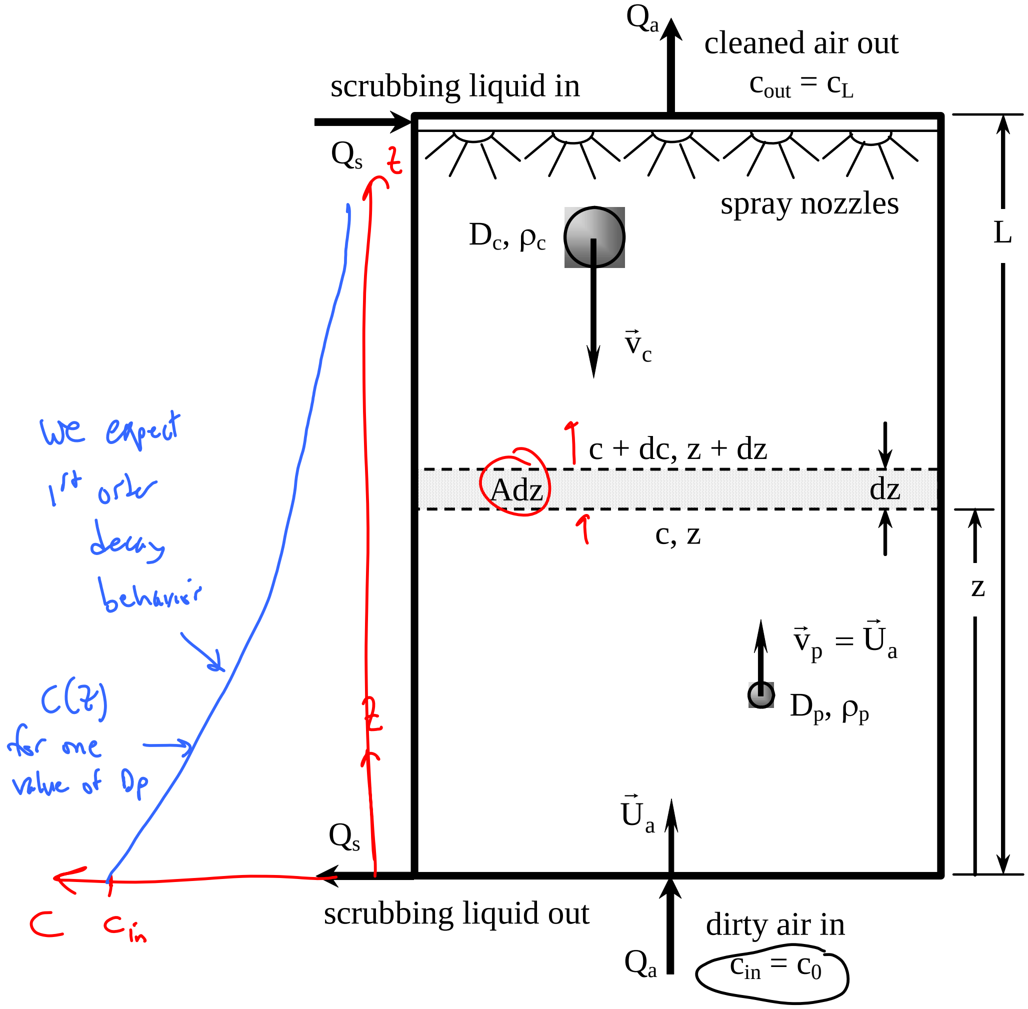
Collector drop: diameter = D_c, velocity = v_c (downward)

let $V_{t,c}$ = settling speed of coll. drop

$V_c = V_{t,c} - U_a$ down since $V_{t,c} > U_a$

$\uparrow U_a$ = air speed

Aerosol particles: diameter = D_p, velocity = v_p (upward)



let $V_{t,p}$ = settling vel. of aerosol particles

$V_{t,p} \ll U_a$ (tiny particles)

$\therefore$ $V_p \approx U_a$ up

See text for details → 1^{st}-order ODE for $c(z)$

At any z-location,

$$\eta(D_p, z) = 1 - \frac{c(D_p, z)}{c(D_p)_{in}} = 1 - \exp\left[-\eta_d(D_p)\frac{V_{t,c}}{V_c}\frac{3}{2}\frac{Q_s}{Q_a}\frac{z}{D_c}\right]$$

↑ grade efficiency @ any z location

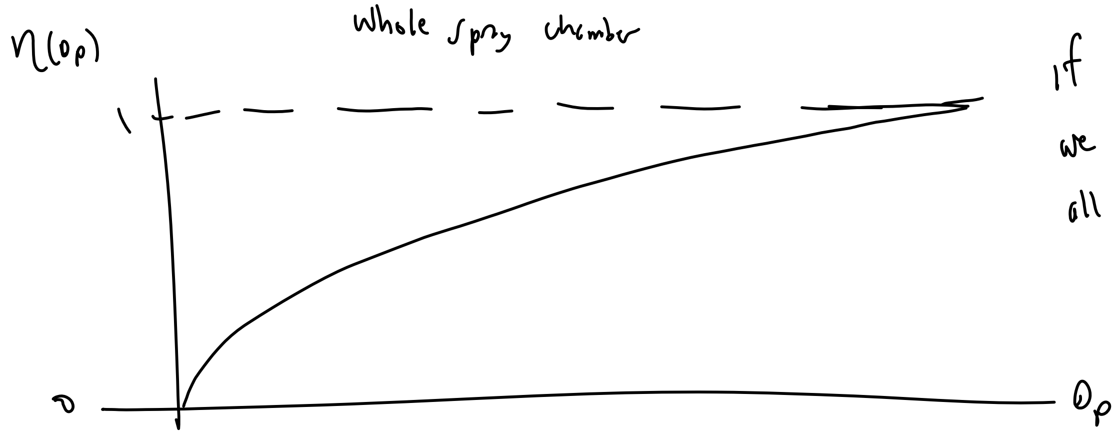
$\eta_d(D_p)\frac{V_{t,c}}{V_c}\frac{3}{2}\frac{Q_s}{Q_a}\frac{1}{D_c}$ ↔ Call this L_c = critical length

$$\therefore \quad \boxed{\eta(D_p, z) = 1 - \exp\left(\frac{-z}{L_c}\right)}$$

@ $z = L$ (end of chamber) →

$$\boxed{\eta(D_p) = 1 - \frac{c(D_p)_{out}}{c(D_p)_{in}} = 1 - e^{-\frac{L}{L_c}}}$$

↖ grade eff. of the whole spray chamber

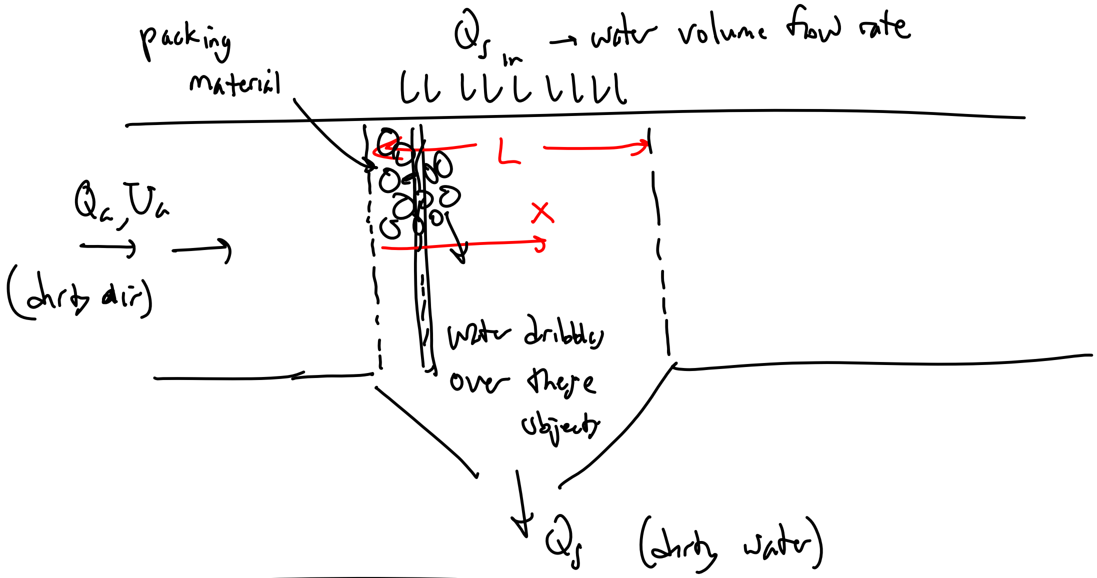


if $L \gg L_c$ we clean up all the particles

Sec 9.3.3 Transverse Packed Bed Scrubber

Main disadvantage of spray chamber → needs to be high (tall)
→ requires lots of water

A compact design is a <u>transverse packed bed scrubber</u>



Analysis

$$\eta(D_p) = 1 - \exp\left(-\frac{L}{L_c}\right)$$

L_c is different

☆ In these cleaners, we clean the air, but now we have contaminated water to dispose of.

Sec. 9.3.4 – 9.3.5 – skim

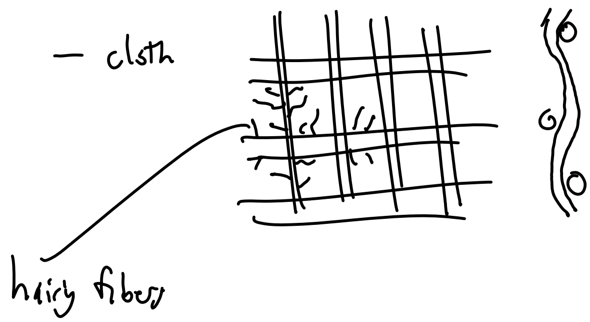
Sec. 9.4 FILTRATION (read)

Filters are most useful for collecting <u>very small particles</u>

Two types:

- **Woven fabric** — cloth

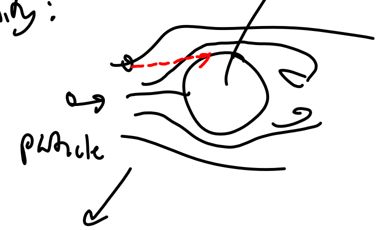
  e.g. vacuum cleaner bags



Inertial separation

dirty air →

Magnify:



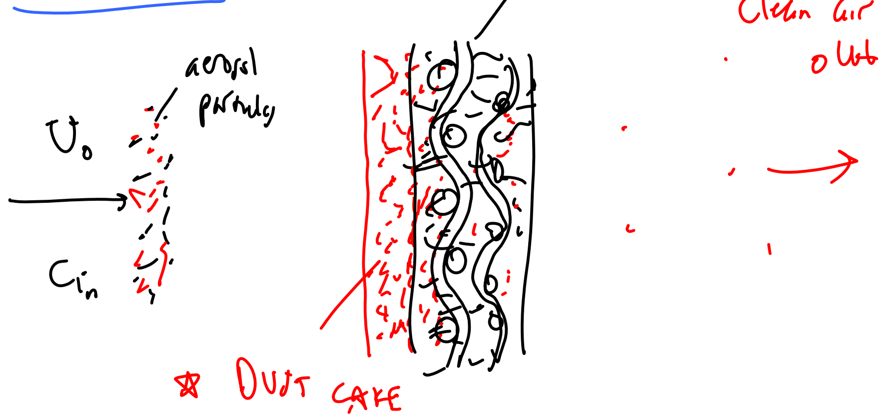
Collection efficiency just as we had with collector drops

Static electricity typically makes aerosol particles stick to the fibers

- **felt** → a collection of tiny fibers, not woven, but glued together

  e.g. <u>cigarette filter</u>

Dust Cakes



Dust cake leads to significant pressure drop through the filter

↓ requires more fan power OR, slows down flow

But → Dust cake is "good" because the dust cake acts like a filter itself.

↓

See text for various designs of cleaning systems that use filters

e.g. Bag houses

THE END