

CEE 370

Environmental Engineering Principles



Lecture #38

Air Pollution III:

Air Pollution Control

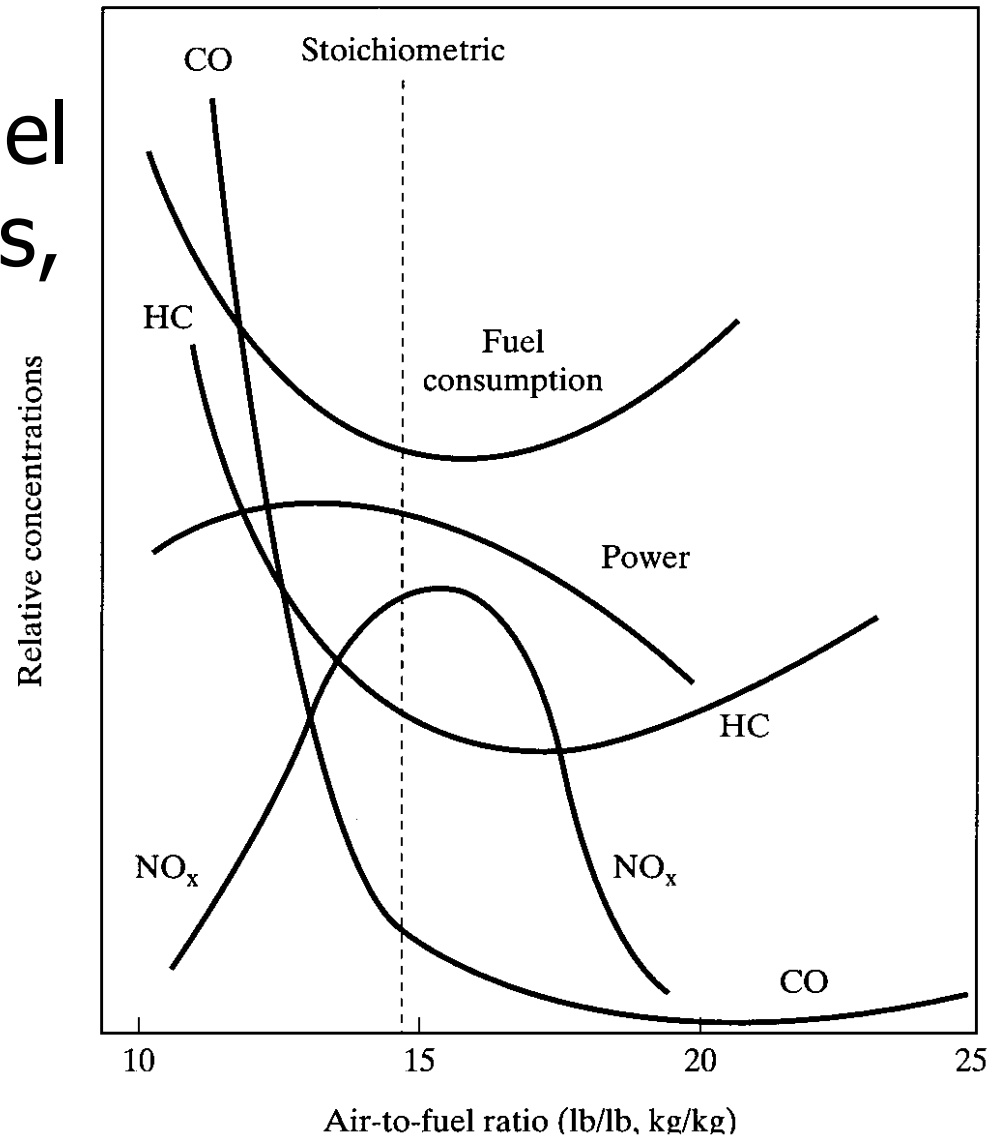
[Reading: Mihelcic & Zimmerman, Chapt 11](#)

[Reading: Davis & Cornwall, Chapt 7-10 to 7-12](#)

[Reading: Davis & Masten, Chapter 12-10 to 12-12](#)

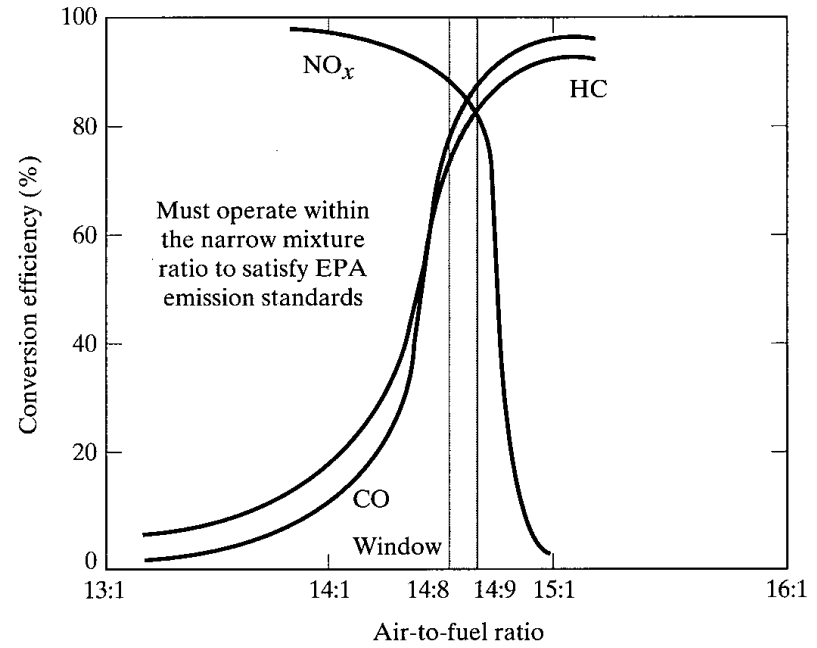
Gasoline Combustion Engine

- Effect of air-to-fuel ratio on emissions, power, and fuel economy

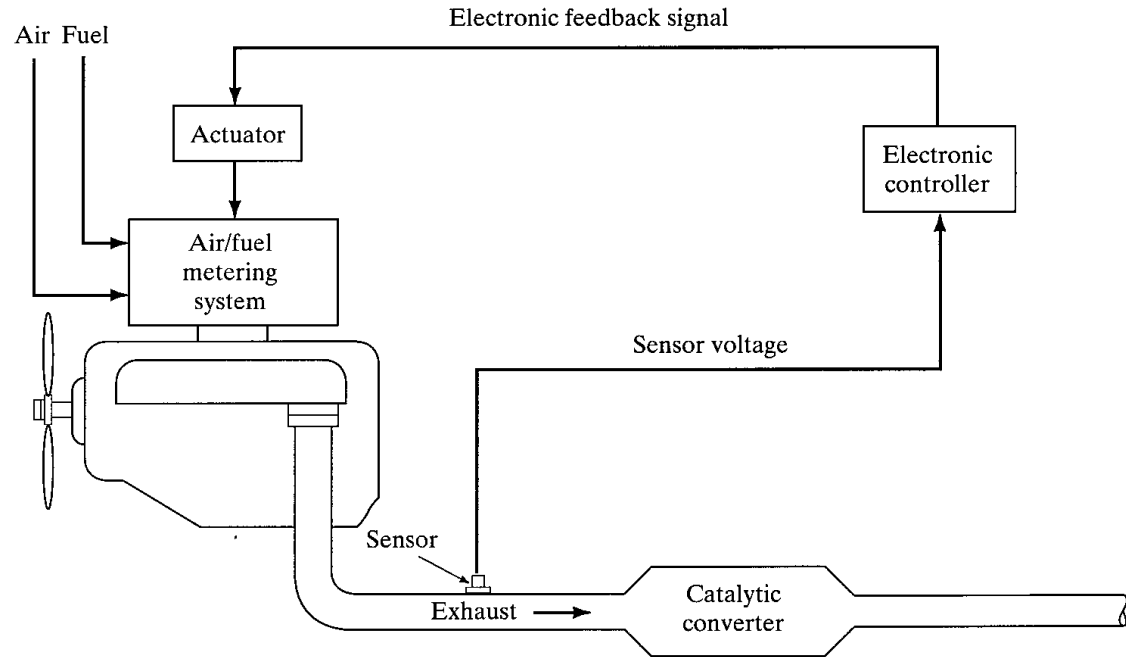




■ Catalytic Converter

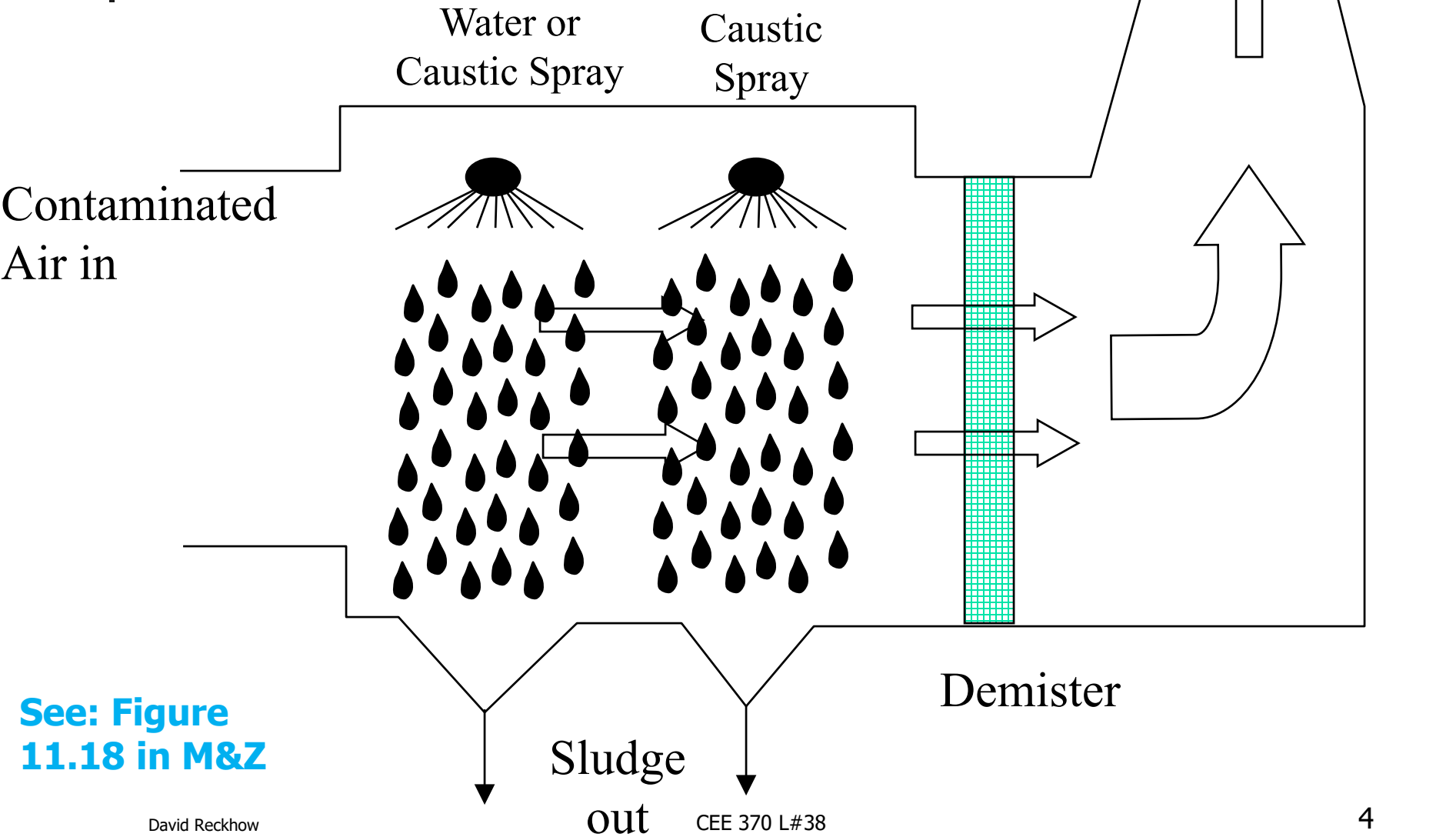


(a)



(b)

Acid control: wet scrubbing



See: Figure 11.18 in M&Z



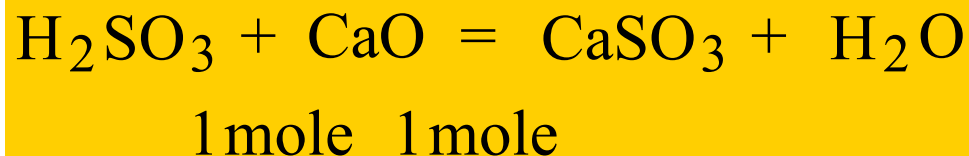
Example

Estimate the amount of calcium oxide required per 1000 ft³ of exhaust gas to neutralize 2000 ppm of sulfur dioxide at 20°C.

$$M_{\text{SO}_2} = CV$$

$$M_{\text{SO}_2} = 2000 \frac{\text{m}^3 \text{ SO}_2}{10^6 \text{ m}^3 \text{ air}} \times \frac{\text{Mole SO}_2}{22.4 \text{ L SO}_2} \times \frac{10^3 \text{ L SO}_2}{\text{m}^3 \text{ SO}_2} \times \frac{\text{m}^3 \text{ air}}{35.3 \text{ ft}^3 \text{ air}}$$

$$M_{\text{SO}_2} = 2.53 \frac{\text{Mole SO}_2}{10^3 \text{ ft}^3 \text{ air}}$$





Example (cont.)

$$M_{\text{CaO}} = 2.53 \frac{\text{Mole SO}_2}{10^3 \text{ ft}^3 \text{ air}} \times \frac{1 \text{ Mole CaO}}{1 \text{ Mole SO}_2} \times \frac{56 \text{ g CaO}}{1 \text{ Mole CaO}}$$

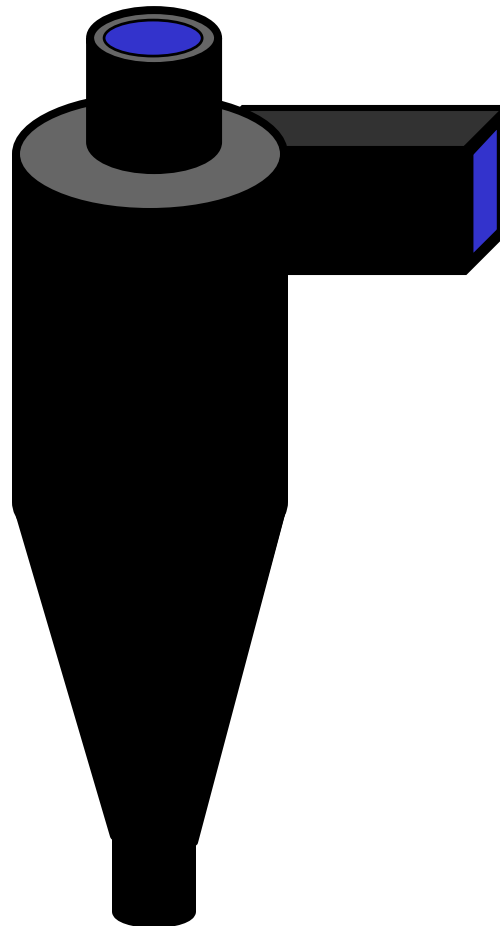
$$M_{\text{CaO}} = 142 \frac{\text{g CaO}}{10^3 \text{ ft}^3 \text{ air}} = 0.312 \frac{\text{lbs CaO}}{10^3 \text{ ft}^3 \text{ air}}$$

Particulate Control: Cyclones

Clean air



Especially effective for particle sizes greater than 10 μm .



Contaminated air

Centrifugal force cause particles to impact cyclone wall and slide to the bottom of the cone.

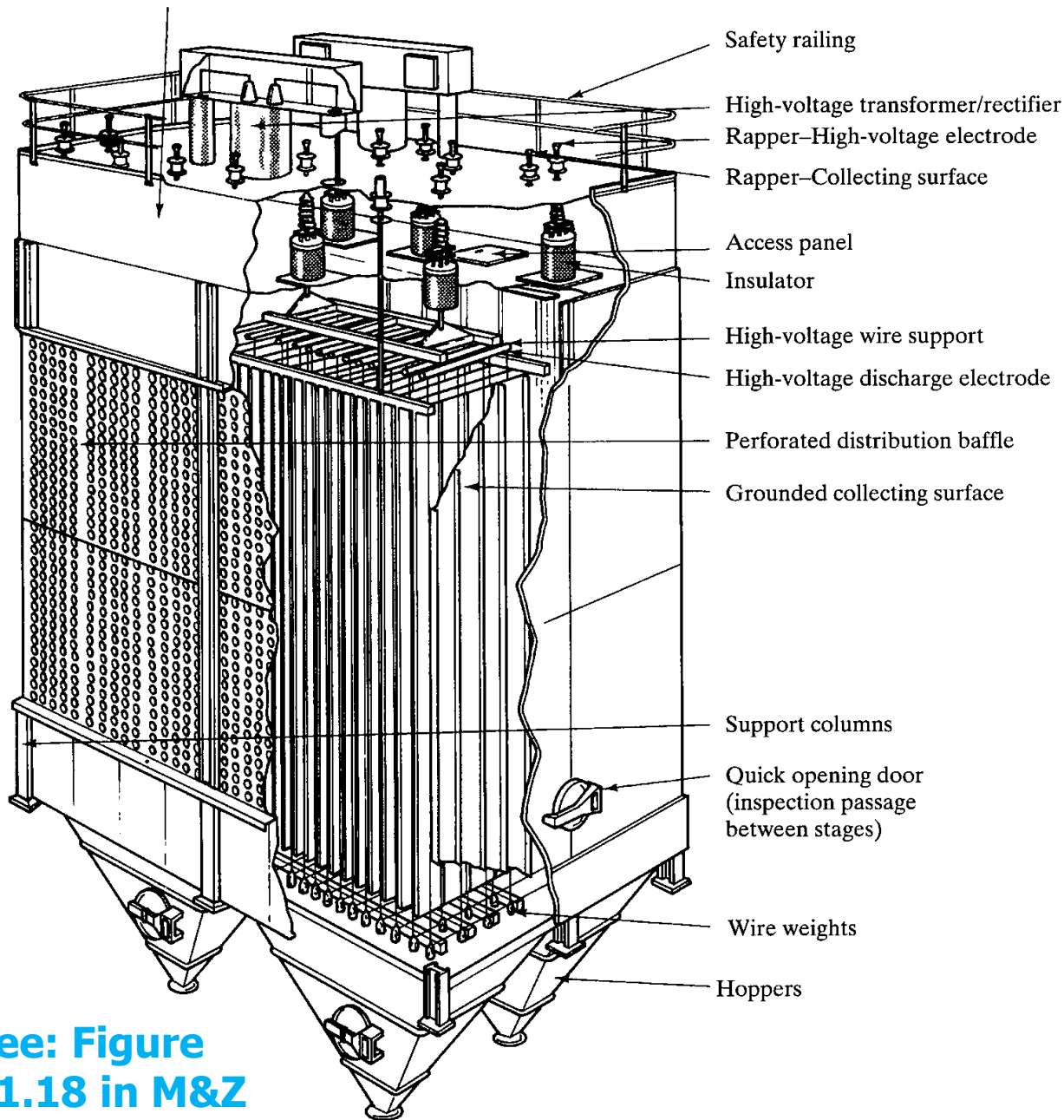
See: Figure 11.18 in M&Z



Other Particulate Control Processes

- Baghouse Filters
 - M&Z: Figure 11.18; Ray: Figure 13.8, Masters: Fig. 7.33, M&D: Figure 12-28
 - heat-resistant porous fabric
 - cleaned by vibration
- Electrostatic Precipitators (ESP)
 - M&Z: Figure 11.18; Masters: Fig. 7.32, M&D: Fig 12-30 &31
 - use high voltage electric field; particles are ionized (by negative plate) and collected on the positive plate

Penthouse enclosing insulators and gas seals



Electrostatic Precipitator

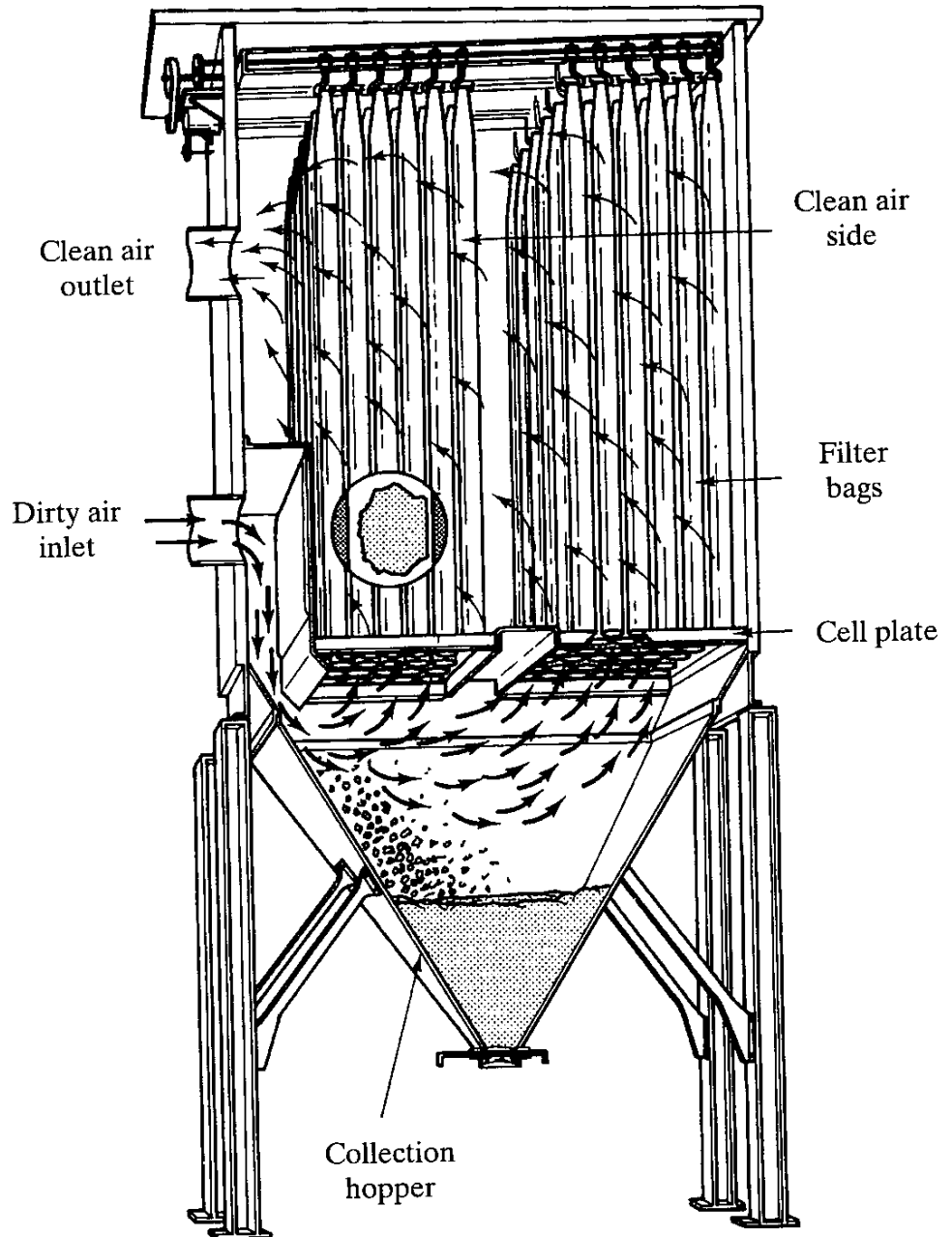
- Dry collection of particles
- Large potential between plates
 - Particles are give a negative charge
 - Then trapped on the positive plate

See: Figure 11.18 in M&Z

FIGURE 7.32 Cutaway view of a flat surface-type electrostatic precipitator. (Source: U.S. HEW, 1969)

Baghouse

- Composition
 - Natural or synthetic fibers
- Bag life
 - 1-5 years



See: Figure
11.18 in M&Z

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- To next lecture