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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

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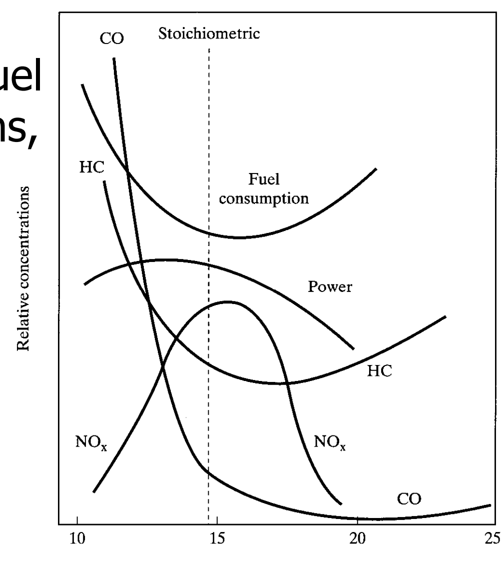
Gasoline Combustion Engine

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



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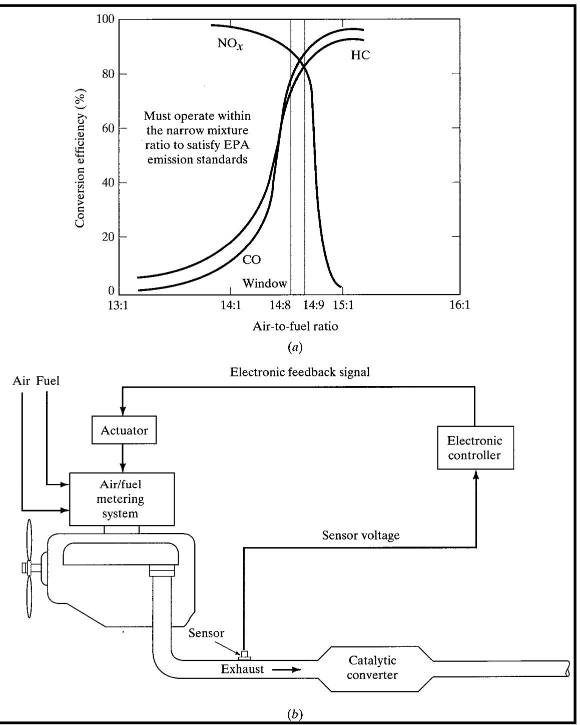
- Catalytic Converter



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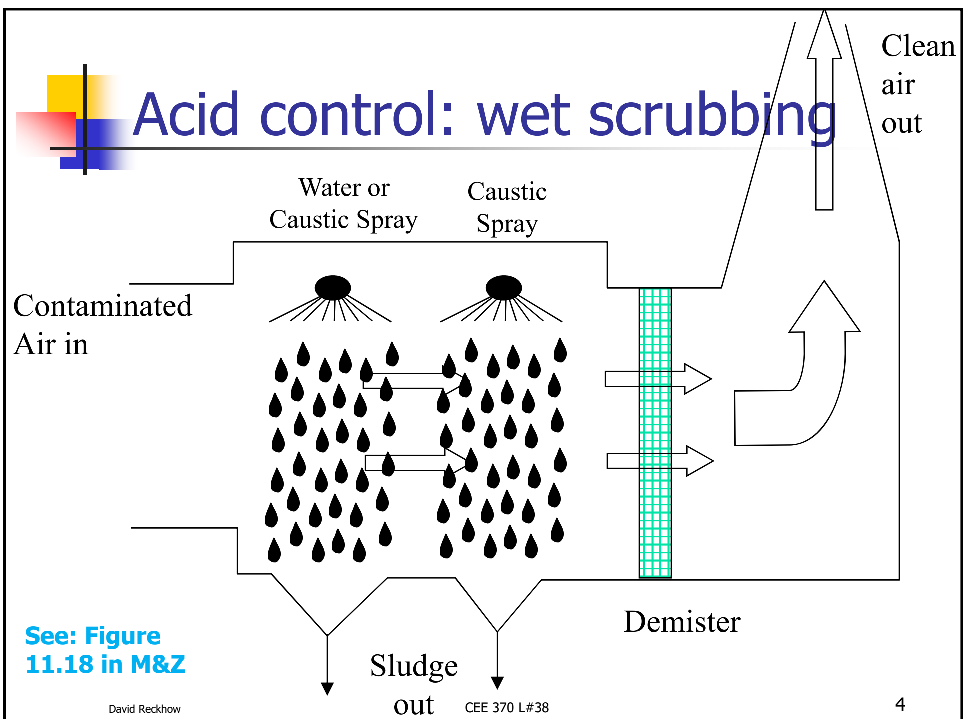
Acid control: wet scrubbing



See: Figure 11.18 in M&Z

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Example

Estimate the amount of calcium oxide required per 1000 ft^3 of exhaust gas to neutralize 2000 ppm of sulfur dioxide at 20°C.

$$M_{SO_2} = CV$$

$$M_{SO_2} = 2000 \frac{m^3\ SO_2}{10^6\ m^3\ air} \times \frac{Mole\ SO_2}{22.4\ L\ SO_2} \times \frac{10^3\ L\ SO_2}{m^3\ SO_2} \times \frac{m^3\ air}{35.3\ ft^3\ air}$$

$$M_{SO_2} = 2.53 \frac{Mole\ SO_2}{10^3\ ft^3\ air}$$

$$H_2SO_3 + CaO = CaSO_3 + H_2O$$

1mole 1mole

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Example (cont.)

$$M_{CaO} = 2.53 \frac{Mole\ SO_2}{10^3\ ft^3\ air} \times \frac{1\ Mole\ CaO}{1\ Mole\ SO_2} \times \frac{56\ g\ CaO}{1\ Mole\ CaO}$$

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

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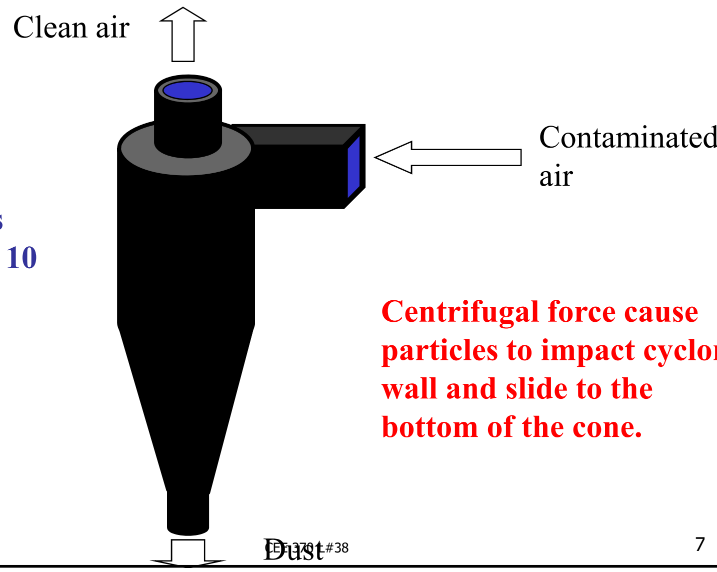
Particulate Control: Cyclones



Especially effective for particle sizes greater than 10 µm.

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

See: Figure 11.18 in M&Z

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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

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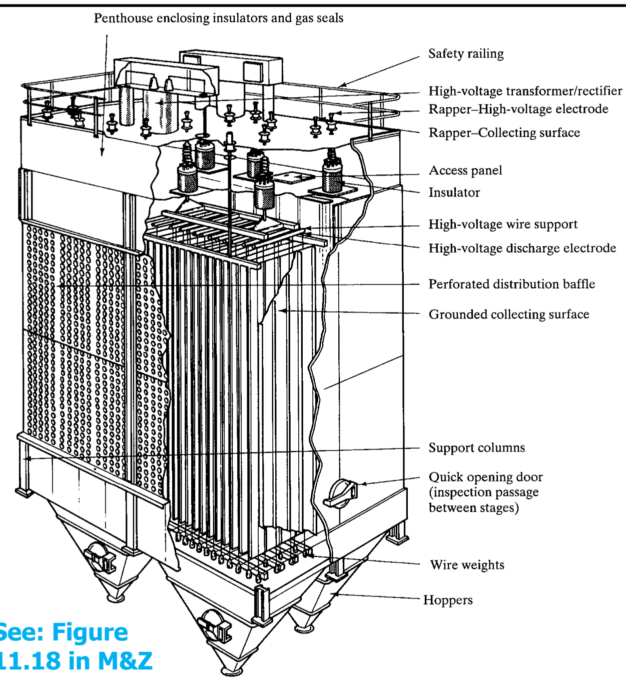

Electrostatic Precipitator

- 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)

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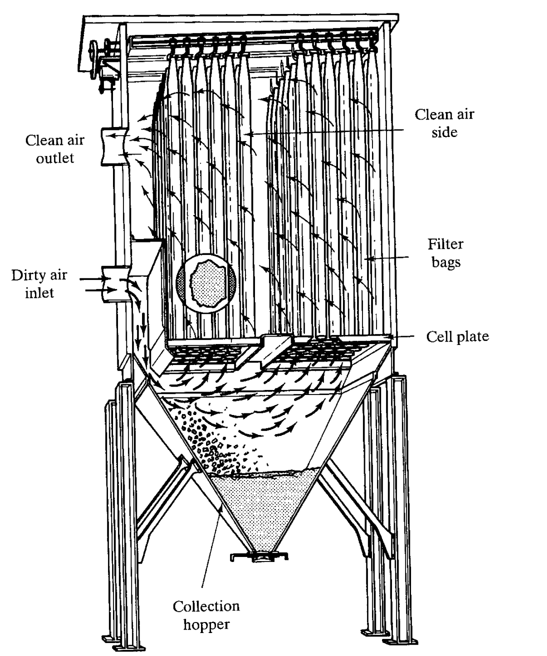
Baghouse

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



See: Figure 11.18 in M&Z

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FIGURE 7.33 Typical simple fabric filter baghouse. (*Source*: Courtesy Wheelabrator Air Pollution C

- To next lecture