

# CE 213A

## Introduction to Environmental Science

### **L9: Unit 2: A. Air Pollution**

### ***Air pollutants Control Techniques***

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***Schedule : LEC Mon Wed Fri 5:10 – 6 pm***

# Effects of Air Pollution on People

- Premature death
- Respiratory diseases
- Asthma
- Lung cancer
- Chronic bronchitis
- Emphysema



– *Emphysema* is a lung condition that causes shortness of breath. In people with *emphysema*, the air sacs in the lungs (alveoli) are damaged.

UNEP 2014 Report

***Air Pollution: World's Worst Environmental Health Risk***  
(Handout 6)

# Emission Reduction

## Solutions

### Stationary Source Air Pollution

#### Prevention

Burn low-sulfur coal

Remove sulfur  
from coal

Convert coal to a  
liquid or gaseous  
fuel

Shift to less  
polluting fuels



#### Dispersion or Cleanup

Disperse emissions  
above thermal  
inversion layer with  
tall smokestacks

Remove pollutants  
after combustion

Tax each unit of  
pollution produced

# Control of Air Pollution

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## 1. Prevent generation at source

- Sulfur control
  - Switch to low-sulfur fuel.
  - Remove sulfur from fuel before use.
- Lead Control
  - Switch to unleaded petrol

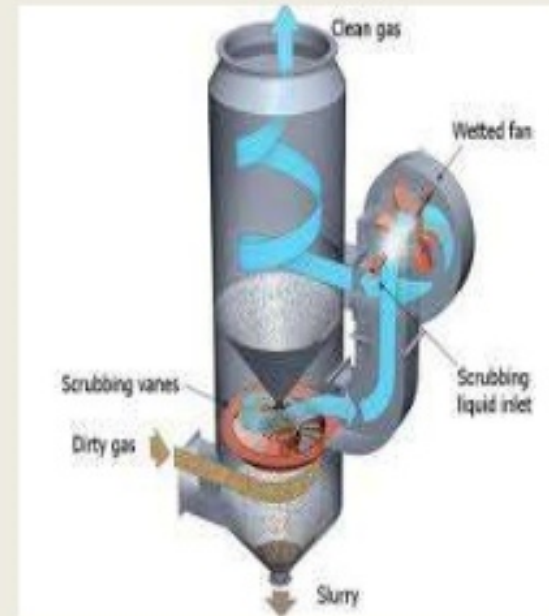
## 2. Remove pollutants after combustion

- **Point Source**  
(mainly industrial)
  - Scrubbers (remove SO<sub>2</sub>)
  - Precipitators
  - Filters
- **Mobile source**  
(mainly automobiles)
  - Use of catalytic convertors

# Removal from stationary sources:

## 1. Packed Bed Scrubber

- ❑ **Wet Scrubbers** are air [pollution control devices](#) for removing particles and gases from **industrial exhaust stream**.
- ❑ It is operated by introducing the dirty gas stream with a scrubbing liquid as water. Then gases are collected in the scrubbing [liquid](#).
- ❑ [Wet scrubbers](#) are usually the most appropriate **air pollution-control device** for collecting both, particulate and gas in a single system alone.



# Working Principle-:

All wet scrubber work on the principle of absorption technology, where the pollutant is made to come in contact with *scrubbing liquid*. The pollutant gets *absorbed* by scrubbing liquid either physical or by chemical means.

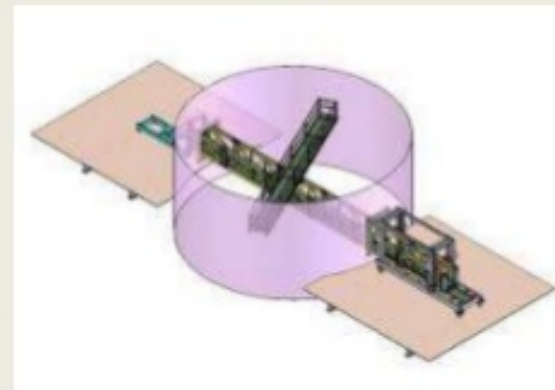
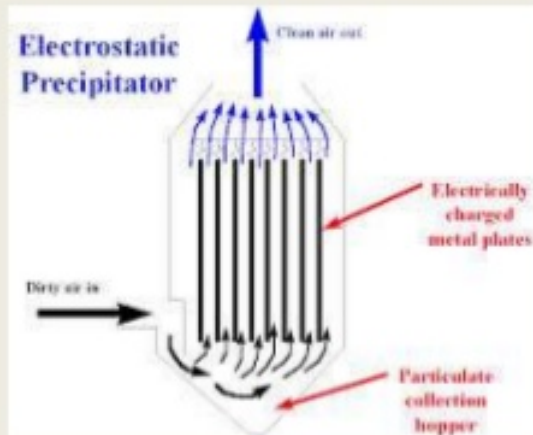
The capturing efficiency can be increased by increasing the time of contact of flue gas with scrubbing liquid.

<https://www.youtube.com/watch?v=HelaGd99HWI>

# Removal from stationary sources:

## 2. Electrostatic Precipitator

It relies on the liquid spray to remove dust particles from **gas streams**. It is also used for the fume absorption hence it is very useful in fume extraction system. It removes all air pollutants by inertia of **diffusional impaction** and reactions with absorbent.



## Working Principle of Precipitators (stationary source)-:

- Electrostatic precipitation is a method **of dust collection** that uses **electrostatic forces**, and consists of discharge wires and collecting plates. A high voltage is applied to the discharge wires to form an electrical field between the wires and the collecting plates, and also ionizes the gas around the discharge wires to supply *ions*.
- Gas that contains an aerosol (dust, mist) flows between the collecting plates and the discharge wires, the ***aerosol particles in the gas are charged by the ions***. The Coulomb force caused by the electric field causes the charged particles to be collected on the collecting plates, and the gas is purified.

<https://www.youtube.com/watch?v=AcyFY3iAdlw>



# Coulomb's law

- **Coulomb's law** states that: The magnitude of the electrostatic force of attraction or repulsion between two point charges is directly proportional to the product of the magnitudes of charges and inversely proportional to the square of the distance between them.
- The ***Coulomb force*** between two or more charged bodies is the *force* between them due to *Coulomb's* law. If the particles are both positively or negatively charged, the *force* is repulsive; if they are of opposite charge, it is attractive.

# Reducing Air Pollution from Motor Vehicle

## Solutions

### Motor Vehicle Air Pollution

#### Prevention

Mass transit

Bicycles and walking

Less polluting engines

Less polluting fuels

Improve fuel efficiency

Get older, polluting cars off the road

Give buyers large tax write-offs for buying low-polluting, energy-efficient vehicles

Restrict driving in polluted areas



#### Cleanup

Emission control devices

Car exhaust inspections twice a year

Stricter emission standards

# **Emission Control device:**

## **1. Catalytic Converter**

- A catalytic converter is an exhaust emission control device that converts toxic gases and pollutants in exhaust gas from an internal combustion engine into less-toxic pollutants by catalyzing a redox reaction

# Working Principle of Catalytic Converter -:

- Catalytic converter uses two catalysts; namely reduction and oxidation catalyst. The oxidation catalyst is made of palladium and platinum whereas reduction catalyst is of rhodium.
- Due to reduction catalyst nitrogen oxide gas breaks into nitrogen and oxygen gases whereas due to oxidation catalyst carbon monoxide convert into carbon dioxide. So it reduces the amount of harmful gases.

<https://www.youtube.com/watch?v=1e9EvrThk1Y>

# *Solution Of Acid Rain*



- *Fit scrubbers into factory's chimneys, which are chemical filters that remove impurities such as sulphur from smoke.*
- *Cars can be fitted with special converters which remove dangerous chemicals.*
- *Governments need to spend more money on pollution control.*
- *Governments need to invest in researching different ways to produce energy.*

