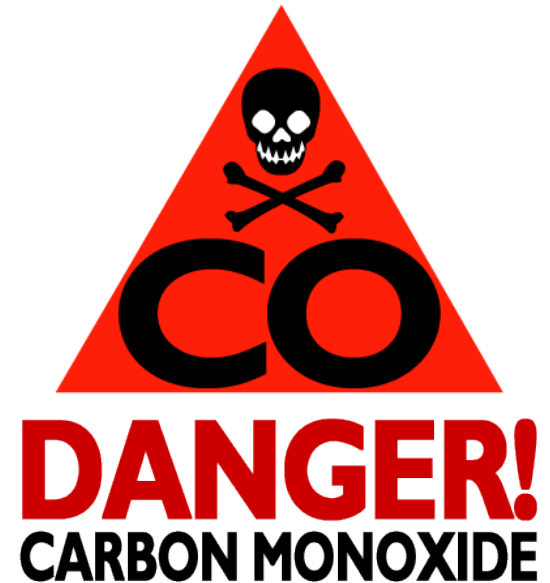
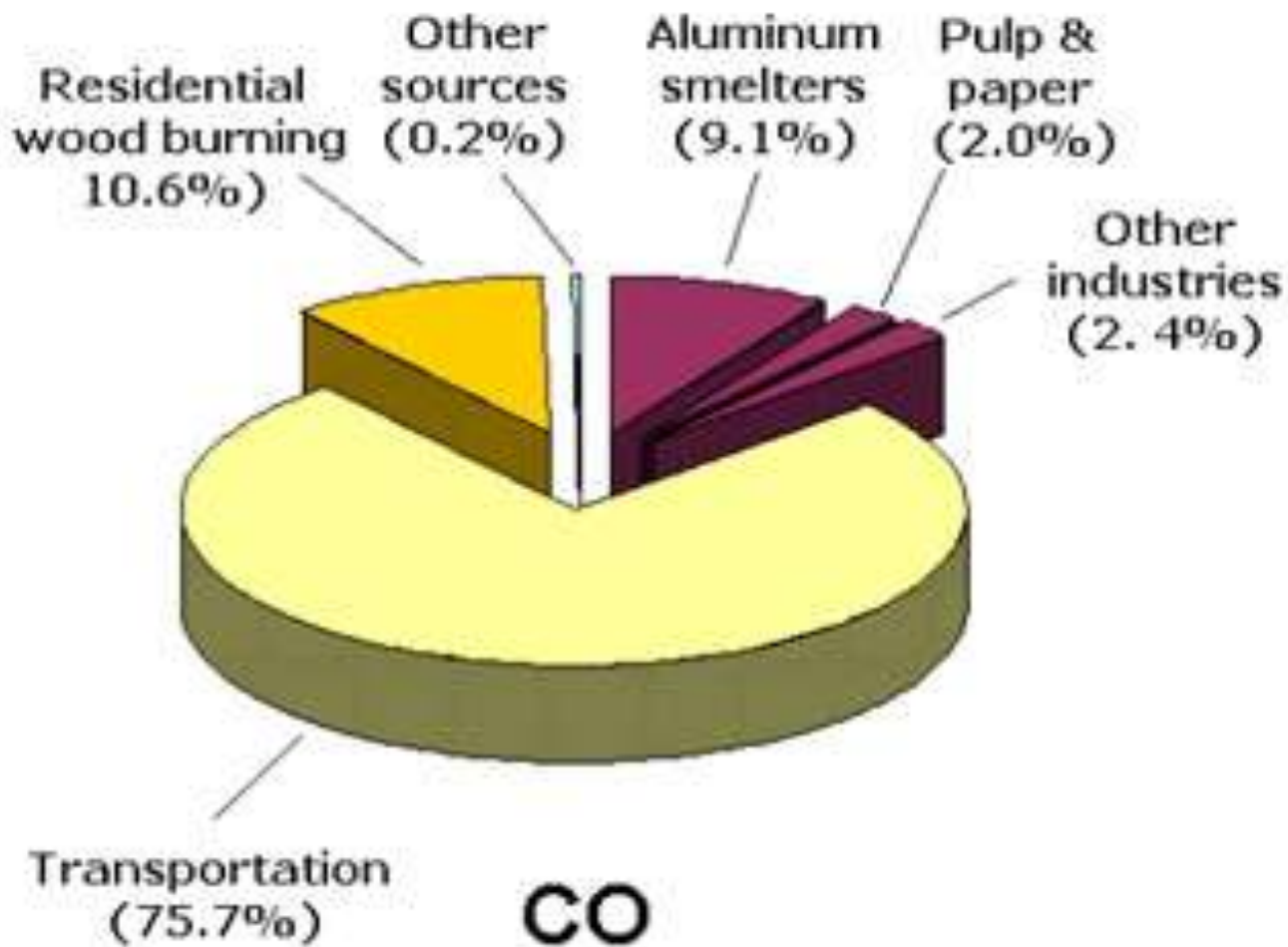


# MAJOR POLLUTANTS SOURCES AND EFFECTS

- Carbon monoxide (CO)- colorless, odorless, tasteless gas.
- No effect at normal conc. (0.1ppm) but higher conc. seriously affect.
- Volcanoes, natural gas emissions, seed germination contribute to CO.
- Transport sector contribute 75% CO.
- Residential wood burning 10%, industrial process 15% CO.





## Effects:

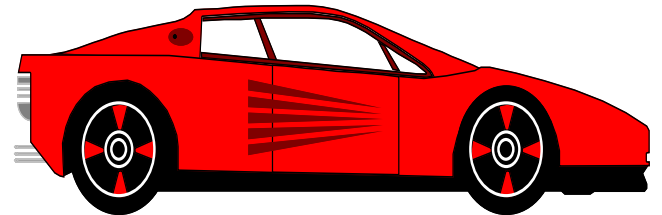
- Reduce oxygen carrying capacity of blood.
- Decrease in vision and causes cardio vascular disorders.
- Carbon dioxide ( $\text{CO}_2$ )- Fossil fuel combustion.
- Jet plane use  $\text{O}_2$  and release  $\text{CO}_2$ .
- Burning

## Effects:

- Causes headache and nausea.
- Effect on climate, increase global temp.

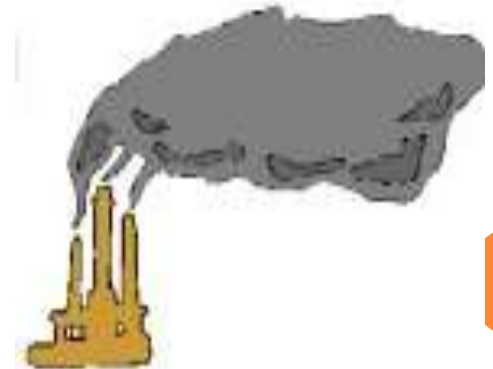


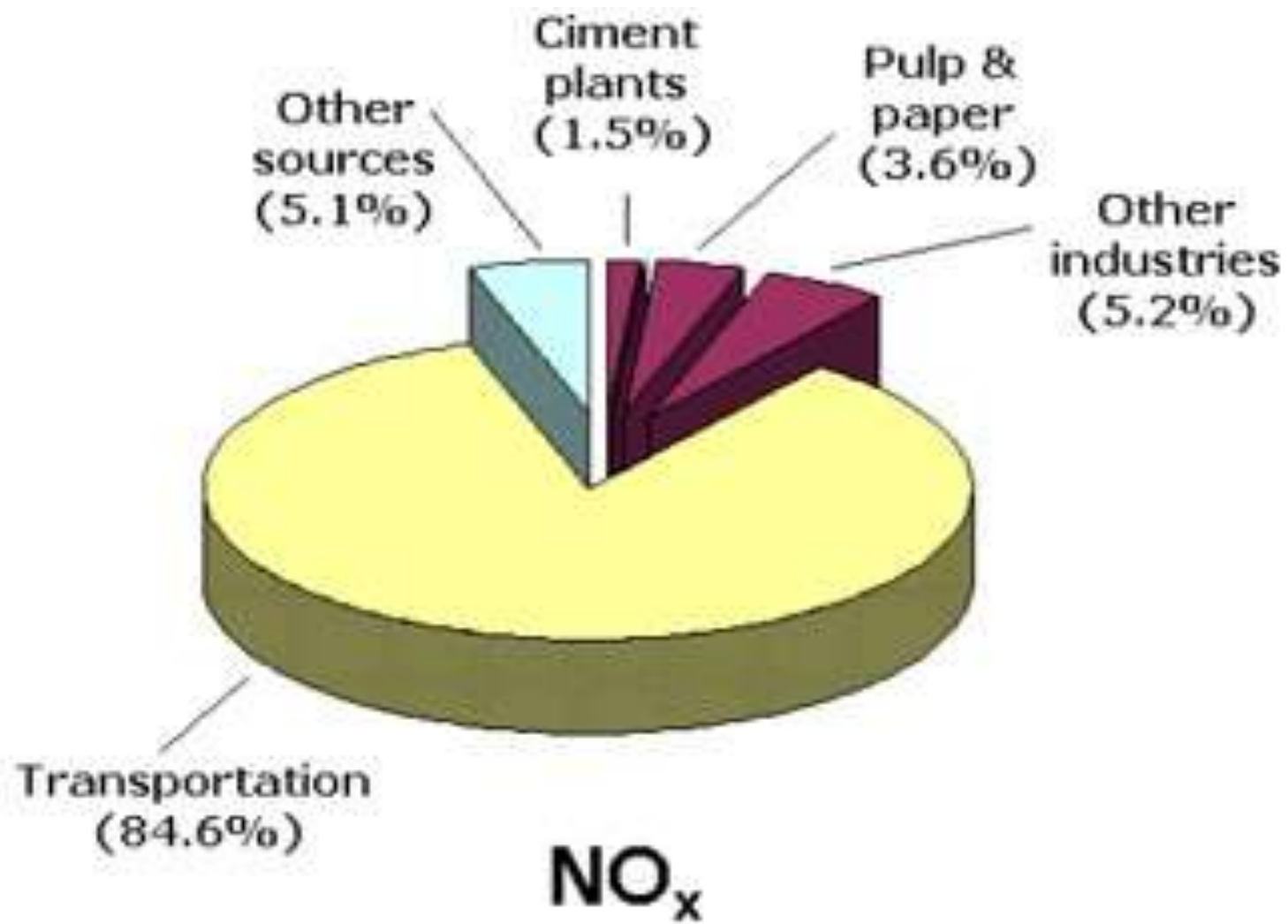
- Oxides of nitrogen – NO<sub>x</sub> group contains NO, NO<sub>2</sub>, N<sub>2</sub>O.
- Fuel combustion in automobiles and industries.
- Lightening.
- Forest fires.
- Natural ionizing radiations.



### Effects:

- Reduce blood carrying capacity.
- Causes lung problems.



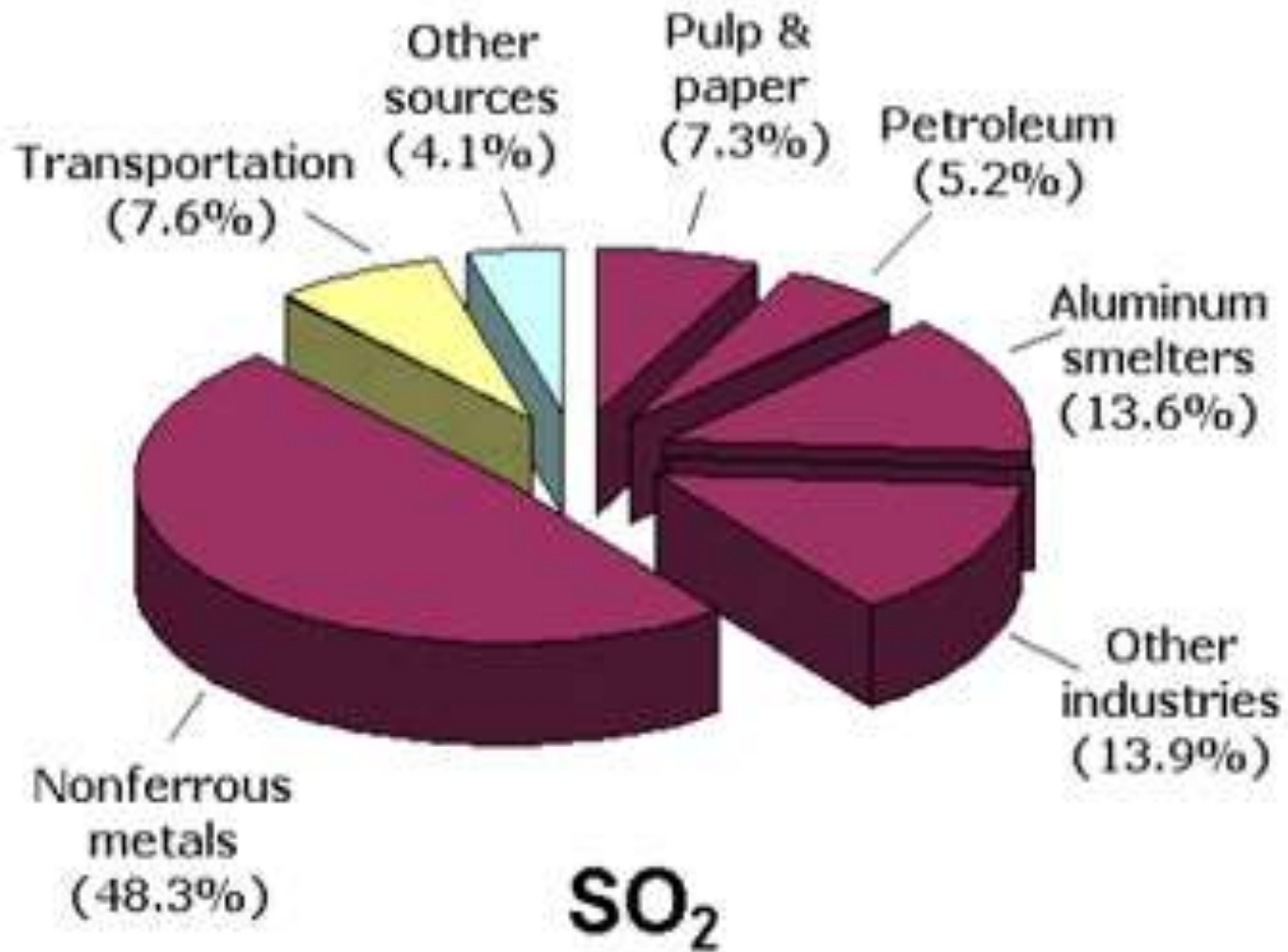


- Oxides of sulphur – generally called SO<sub>x</sub>, include SO<sub>2</sub>, SO<sub>3</sub>.
- 67% SO<sub>x</sub> pollution due to volcanic activities and other natural sources.
- Remaining due to fossil fuel burning, transportation.
- Industrial activities.

### Effects:

- Respiratory problems
- Marbles, clothes, paper, leather also affected.
- Plants also heavily affected.





- Hydrocarbons (HC) – these include methane, ethylene, acetylene, terpenes etc.
- Sources include coal fields, natural fires.
- Incomplete combustion
- Forest fires
- Agricultural burning



### Effects:

- Carcinogenic effect
- Form ozone and PAN which are harmful.
- Damage plants, rubber materials, fabric and paints.





# PARTICULATE MATERIALS

- Particles of different substances suspended in the air
- In the form of solid particles and liquid droplets
- Particles vary widely in size
- Different particulate materials are aerosols, dust, smoke, fumes, mist, fog, fly ash etc.



- Fine particles come from a variety of sources:

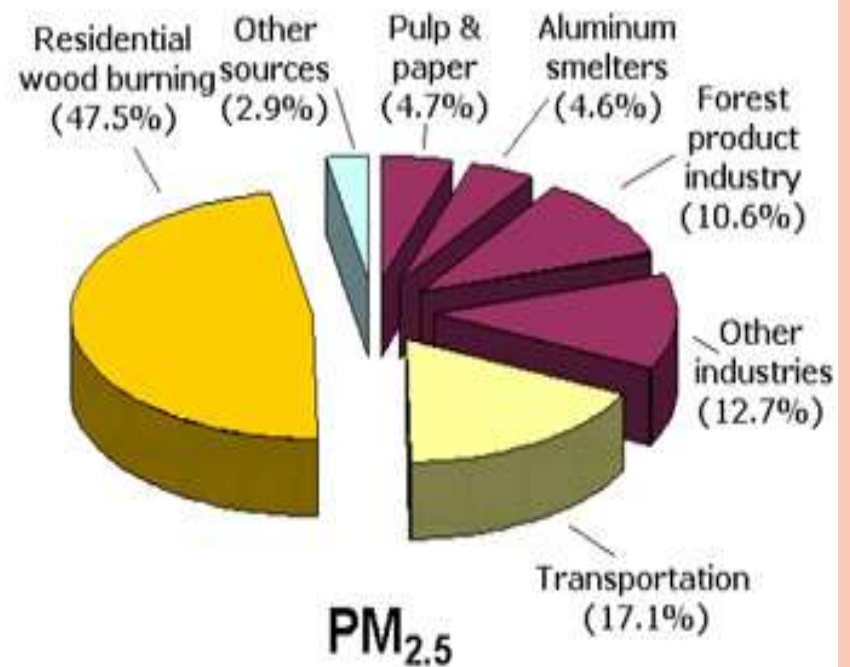
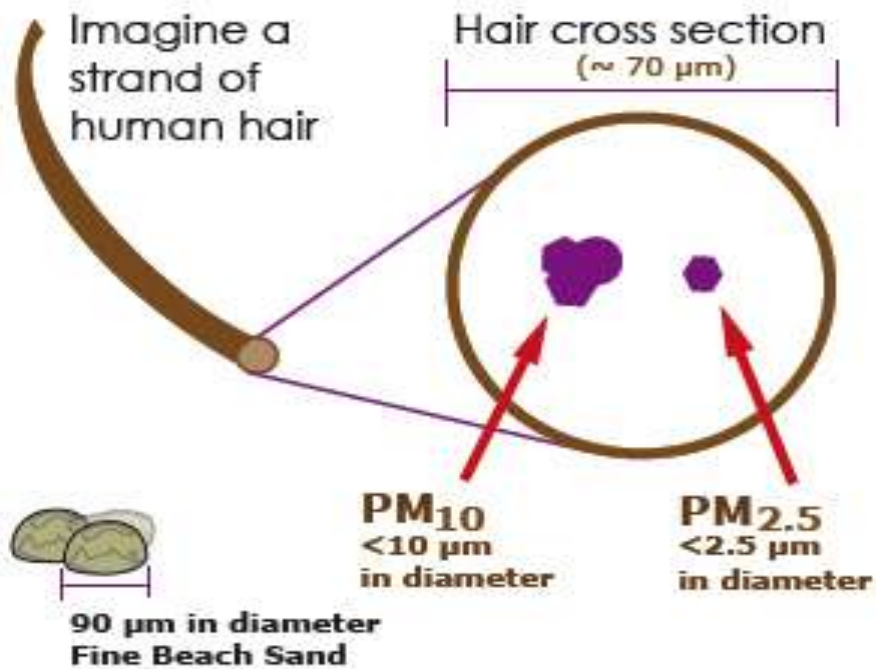
- diesel trucks and buses
- construction equipment
- power plants
- woodstoves
- wildfires



- Also, Chemical reactions in the atmosphere can transform gases into fine particles.



# How small is PM?

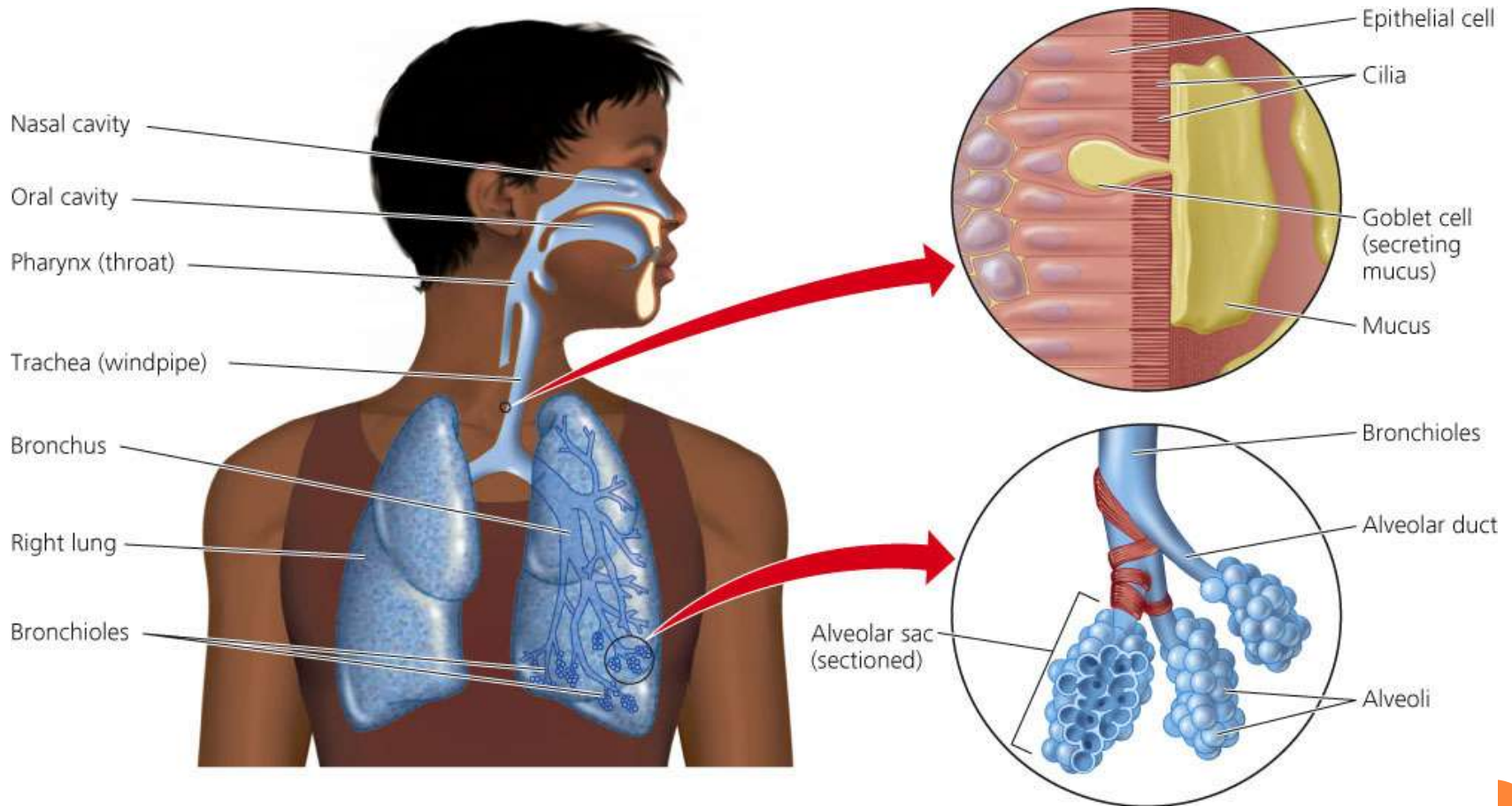


## Effects:

- Premature death
- Aggravated asthma
- Acute respiratory symptoms
- Chronic bronchitis
- Decreased lung function (shortness of breath)
- People with existing heart and lung disease, as well as the elderly and children, are particularly at risk



# EFFECTS OF AIR POLLUTION ON HUMAN



- around 30-40% of cases of asthma and 20-30% of all respiratory disease.
- effect our health in many ways with both short term and long term effect.
- Short term effect are: irritation to nose, eye, throat, bronchitis, headache etc.
- Long term affect are: lung disease, chronic respiratory problem, damage to heart, brain, eyes etc.
- Eye irritation due to NO<sub>x</sub>, O<sub>3</sub>, PAN, particulates.
- Nose and throat due to SO<sub>2</sub>, NO<sub>x</sub> etc.



- Gaseous pollutants like  $\text{H}_2\text{S}$ ,  $\text{SO}_2$ ,  $\text{NO}_2$  and hydrocarbons cause odor nuisance.
- Irritation of respiration tract caused by  $\text{SO}_x$ ,  $\text{NO}_x$ ,  $\text{CO}$ ,  $\text{O}_3$ .
- Increase in mortality.
- High conc. of  $\text{SO}_2$ ,  $\text{NO}_2$  and SPM causes bronchitis and asthma.
- $\text{CO}$  and  $\text{NO}$  react with haemoglobin and reduce  $\text{O}_2$  carrying capacity of blood.
- Heavy metals like lead can cause poisoning. High conc. cause damage to liver and kidney.



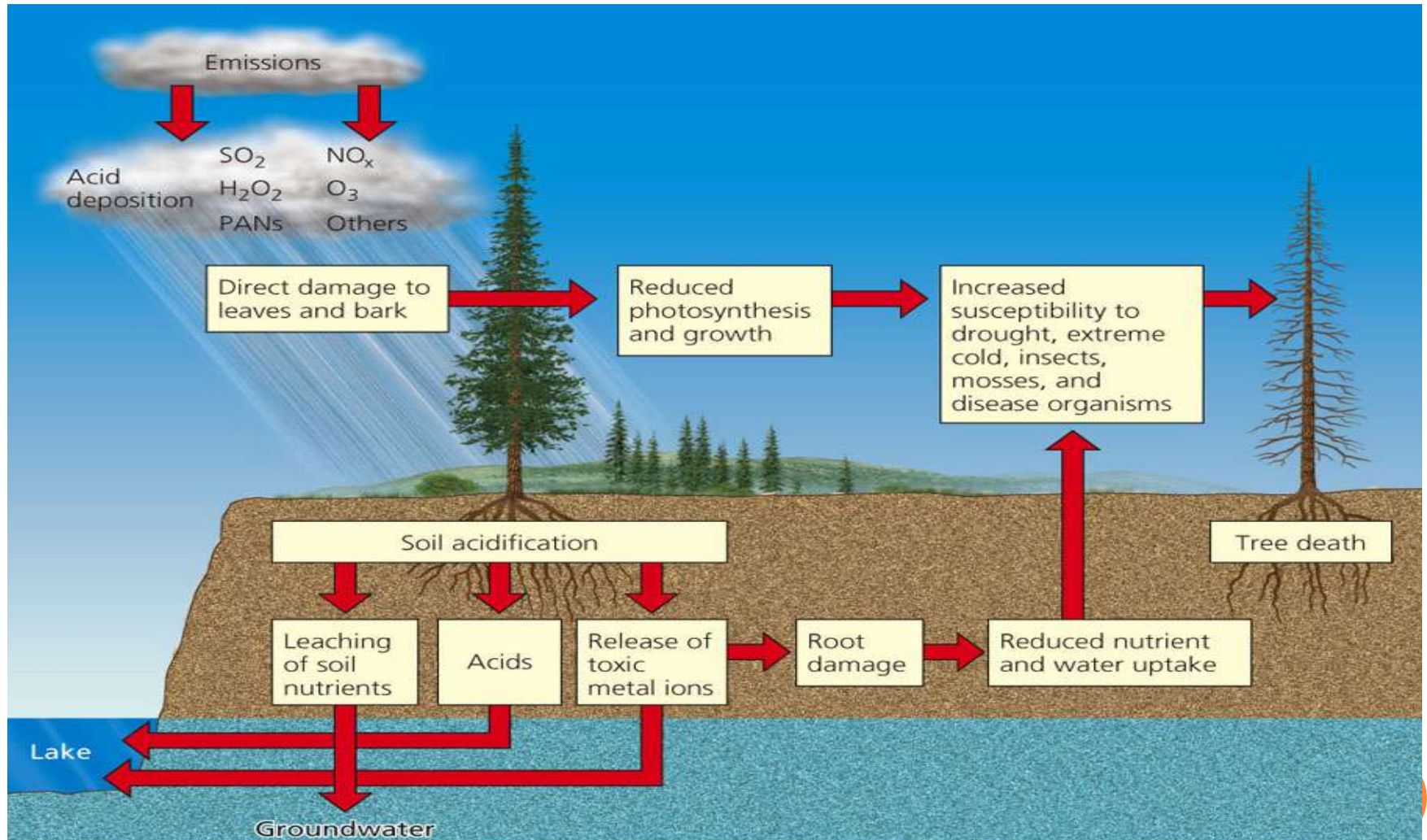
# FACTORS AFFECTING HUMAN HEALTH

- Nature of the pollutants
- Concentration of the pollutants
- Duration of exposure
- State of health of receptor
- Age group of the receptor





# EFFECTS OF AIR POLLUTION ON PLANT



- Decrease yield in agriculture.
- Suppressed growth of vegetables.
- Leaf injury and damage to young plants.
- Decreased growth rate and increased death rate.



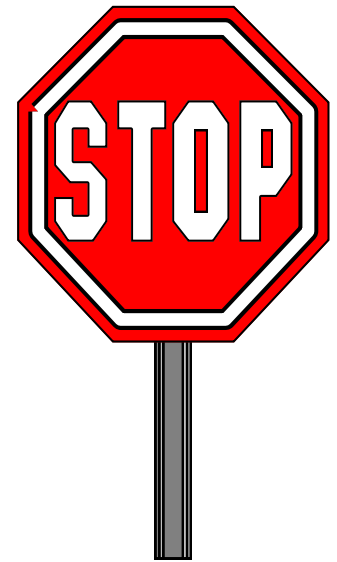
# EFFECTS OF AIR POLLUTION ON MATERIALS

- Corrosion of metals due to  $\text{SO}_2$  in presence of oxygen and moisture is converted into  $\text{H}_2\text{SO}_4$  acid.
- $\text{H}_2\text{SO}_4$  acid react with limestone, marble and other building materials to cause deterioration.
- Soiling and eroding of building materials.
- $\text{SO}_2$ ,  $\text{O}_3$ ,  $\text{H}_2\text{S}$  and aerosols damage protective coating and paints of the surface.
- $\text{O}_3$  and PAN causes cracking of rubber and various electrical insulations.
- Deterioration of art work due to SPM.



# AIR POLLUTION CONTROL

- Cannot be fully prevented but can be controlled.
  1. Preventative measures
  2. Control measures using equipments.



## Preventative measures (~~source control~~)

- Selection of suitable fuel. (Low sulphur coal in power plant, using of CNG)
- Modification in industrial process.
- Selection of suitable site and zoning for industrial unit.



## Control measures

- ~~When source control not possible~~ some measures taken to prevent pollution.
- Collecting pollutants by using equipments.
- Destroying the pollutants by thermal or catalytic combustion.
- Changing the pollutants to less toxic form.
- By releasing the pollutants through tall chimneys for greater dispersion.



# PREVENTATION BY LAWS

- Various laws has been established for the menace of air pollution.
- Air (Prevention & control of pollution ) Act,1981.
- Air (Prevention & control of pollution ) Amendment Act,1987.
- Motor vehicle Act, 1988.
- Air (Prevention & control of pollution) Union Territories Rules, 1983.
- Environment Protection Act, 1986.



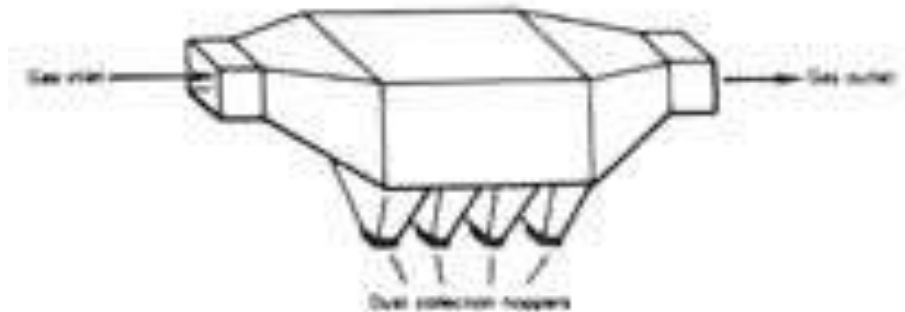
The government is trying to

- remove the use of leaded petrol, a major cause of air pollution.
- the industrial acts are implemented to control the harmful emission of gases.
- the natural management team work to minimize the effect of various natural disaster like forest fire, volcanic eruption that are causes of air pollution.



# AIR POLLUTION CONTROLLING EQUIPMENTS

- Gravitational settling chamber



**Settling Chamber**

- Used to remove particles with size greater than 50  $\mu\text{m}$ .
- Velocity of flue gas reduced in large chamber.
- Particles settle under gravitational force.





## Advantages

- Low initial cost.
- Easy to design.
- Low pressure drop.
- Low maintenance cost.
- Dry and continuous disposal of solid particulates.

## Disadvantages

- Require large space.
- Less collection efficiency.
- Only larger size particles can be collected.



## Cyclone separator

- Centrifugal force is utilized to separate the particulate matter.
- It can remove 10 to 50  $\mu\text{m}$  particle size.
- Used mostly in industries.



## Advantages

- Low initial cost.
- Require less floor area.
- Simple construction and maintenance.
- Can handle large volume of gas at high temp.

## Disadvantages

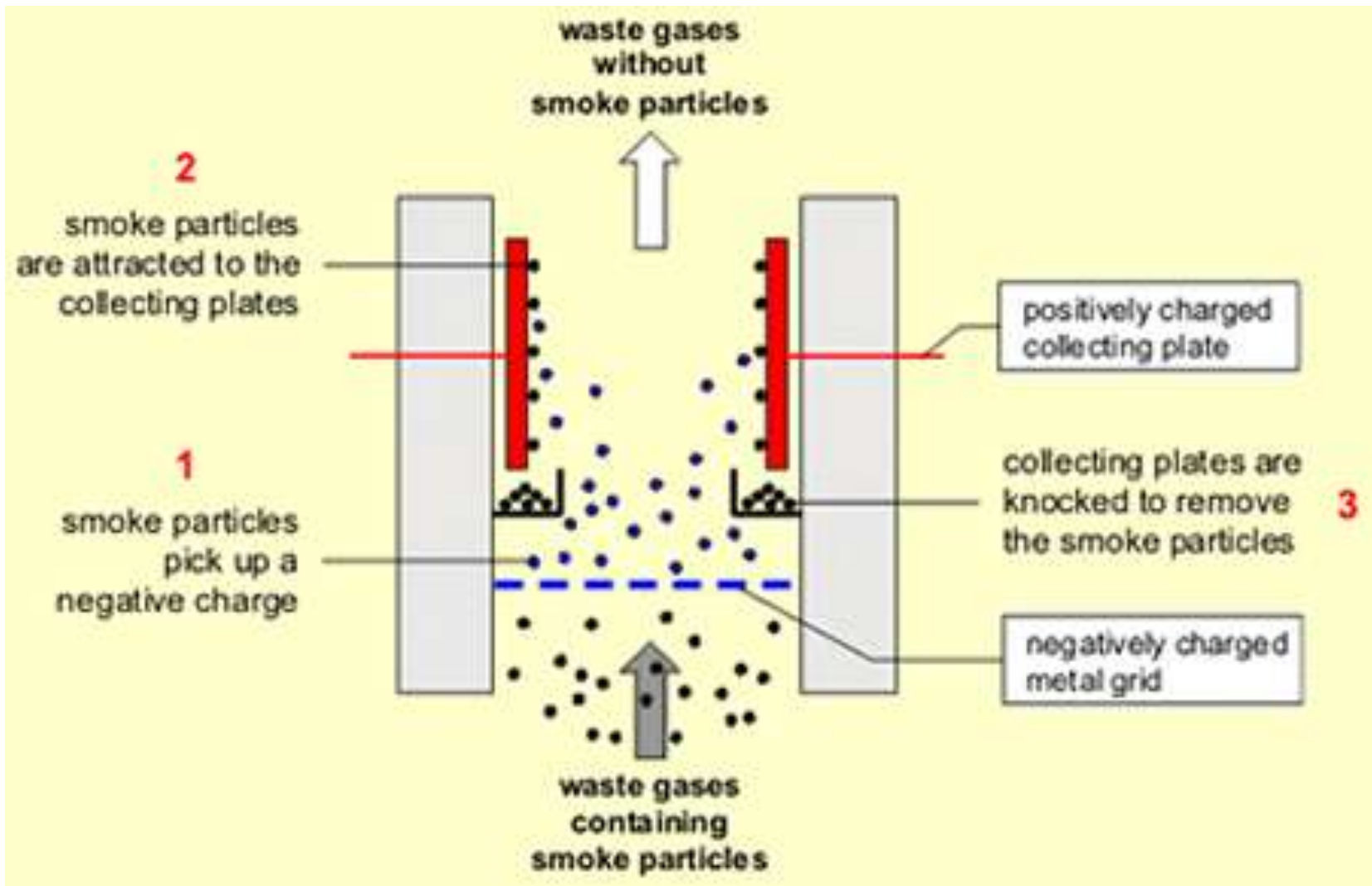
- Requires large head room.
- Less efficiency for smaller particles ( $<10\mu\text{m}$ ).
- Sensitive to variable dust load and flow rate.



## Electrostatic precipitators

- Works on the principle of electrical charging of particulate Matter (-ve) and collecting it in a +ve charged surface.
- 99% efficiency.
- Can remove particle size range of 0.1  $\mu\text{m}$  to 1  $\mu\text{m}$ .





## Advantages

- High collection efficiency.
- Particles may be collected dry or wet.
- Can be operated at high temp. (300-450°c).
- Maintenance is normal.
- Few moving parts.

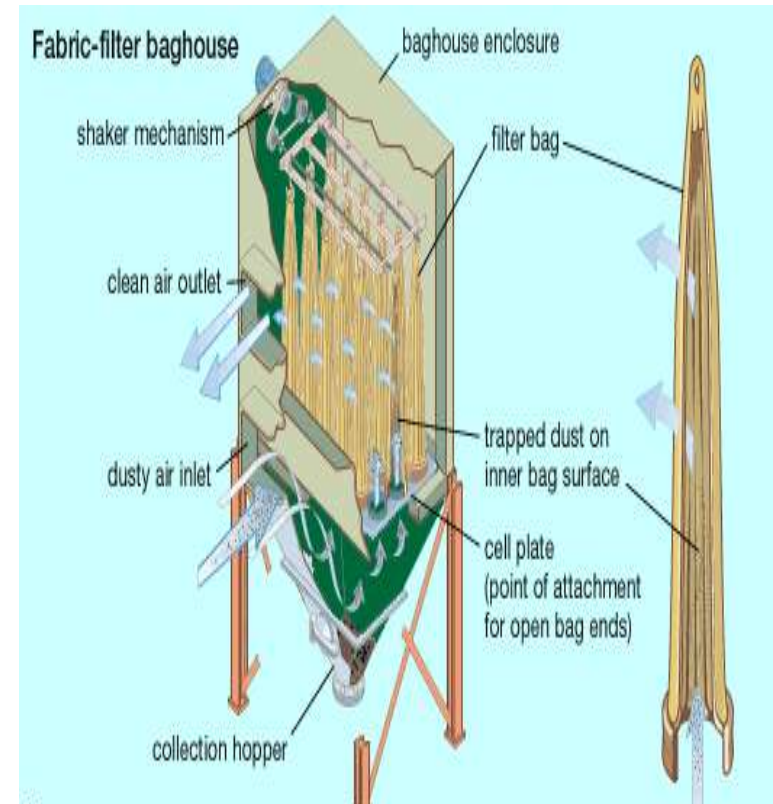
## Disadvantages

- High initial cost.
- Require high voltage.
- Collection efficiency reduce with time.
- Space requirement is more.
- Possible of explosion during collection of combustible gases or particulates.



## Fabric filters

- Flue gas is allowed to pass through a woven Fabric, which filters out Particulate matter.
- Small particles are retained on the fabric.
- Remove particles up to  $1\ \mu\text{m}$ .
- Its efficiency up to 99%.



## Advantages

- Higher collection efficiency for smaller than 10  $\mu\text{m}$  particle size.
- Performance decrease becomes visible, giving prewarning.
- Normal power consumption.

## Disadvantages

- High temp. gases need to be cooled.
- High maintenance and fabric replacement cost.
- Large size equipment.
- Fabric is liable to chemical attack.



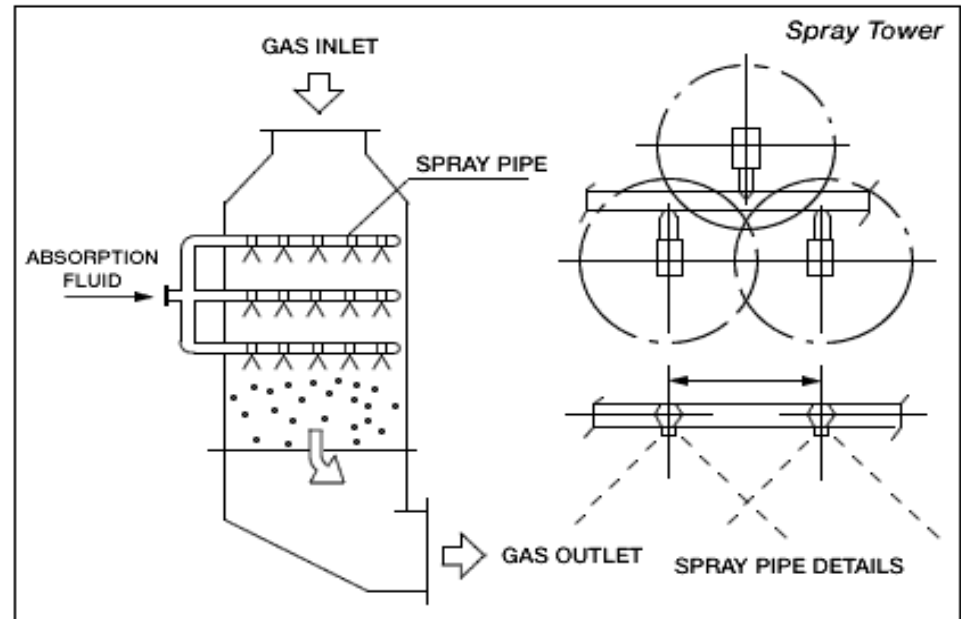


## Scrubbers

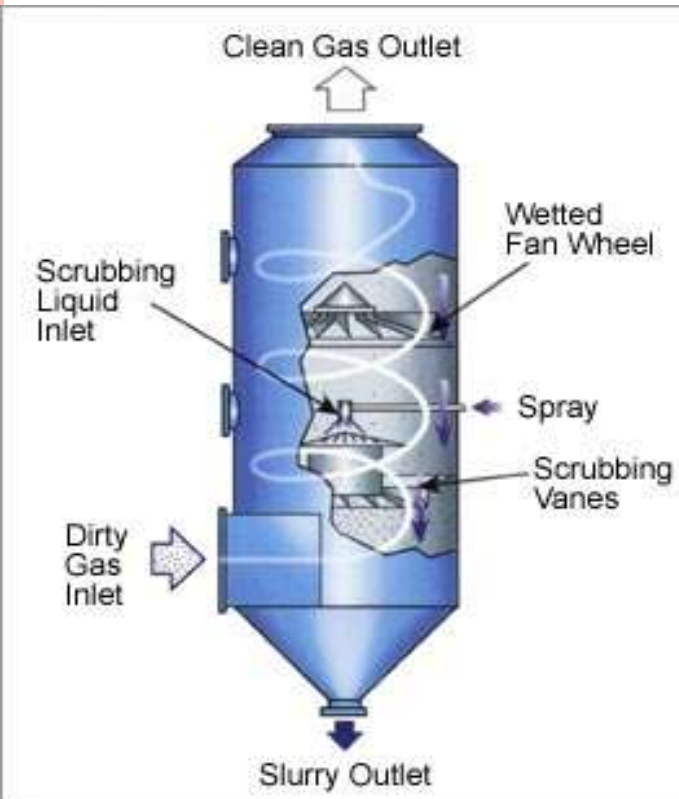
- Particulate matters are incorporated into liquid droplets and removed from the gas stream.
- Different types of scrubbers are-
  - Spray tower
  - Venturi scrubber
  - Cyclone scrubber
- Flue gas made to push up against a down falling water current.
- Particulate matter mix up with water thus falls down and gets removed.



## Spray tower



## Cyclone scrubber



## Advantages

- Simultaneously remove particulates and gaseous pollutants.
- Hot gases can be cooled down.
- Corrosive gases can be recovered and neutralize.

## Disadvantages

- Lot of waste waters produced.
- Poses freezing problem in cold countries.
- Maintenance cost is high when corrosive materials are collected.

