

# COLLECTION AND MEASUREMENT OF PARTICULATE POLLUTANTS

Made by: 11bme060  
11bme050  
11bme059

# COLLECTION OF PARTICULATE POLLUTANTS

- Particulate pollutants are grouped generally into those that settle out due to force of gravity and those that remain suspended as aerosols.
- 1<sup>st</sup> category consisting of large particle of size greater than 10 micrometer can be collected using sedimentation technique.
- 2<sup>nd</sup> category containing particles of smaller size more sophisticated technique like filtration, electrostatic precipitator etc are used.
- Most instruments function is to collect pollutants, the analysis of weight is done separately.

# SEDIMENTATION (DUSTFALL JAR)

- Simplest device used for sampling particles larger than 10 micrometer.
- A collector consists of a plastic jar of about 20-35cm height and 10-15cm diameter at the base with a slight inward tapering of the walls from top to bottom.
- The sample is deposited over a period of one month and the material is dried and weighed. Usually, only water insoluble dustfall reported in  $\text{mg}/\text{cm}^2$ .



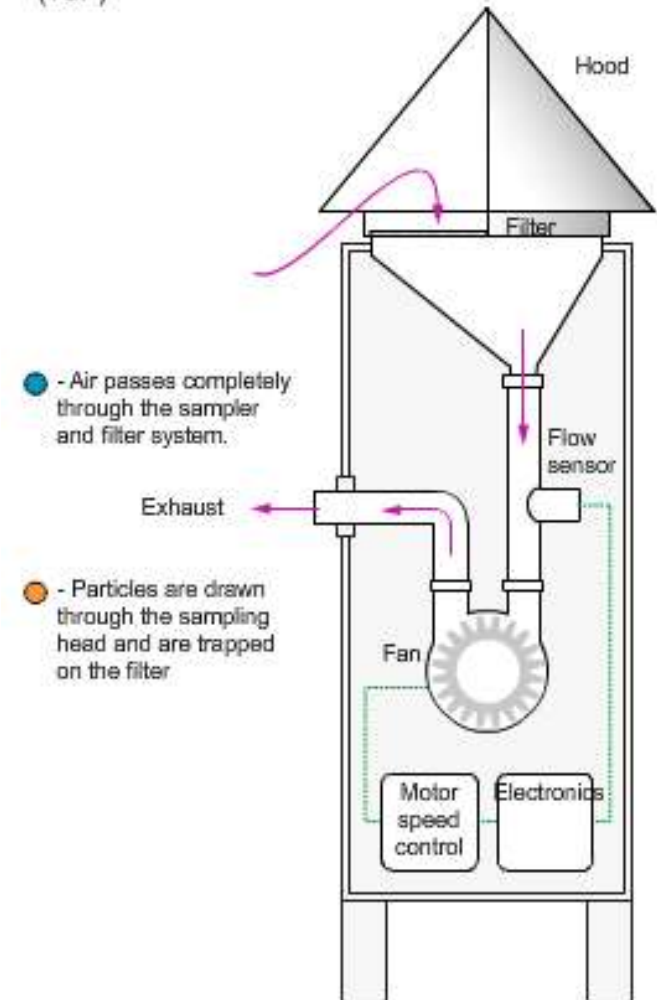
# Sedimentation

- Dust particles larger than 10 micrometer are rarely carried for distance greater than 1km, station must be closely spaced for meaningful data.
- ❖ **Advantages:**
  - The method is simple and inexpensive and requires no electrical power or moving parts.
- ❖ **Disadvantages:**
  - Method lacks precision and is selective and usually nonrepeatable.
  - Hence this method show pollution trend in a specific region over a period of time

# HIGH VOLUME FILTRATION

- Method is popular for measurement of the mass concentration of suspended particulates smaller than 10micrometer.
- In this method, a known volume of air is sucked by a high speed blower through a fine filter and the increase in weight due to trapped particles is measured.

High volume sampler  
for Total Suspended Particulates  
(TSP)



# HIGH VOLUME SAMPLER

- Filter is made of fibrous material, provide a dense porous medium through which an air stream must change direction in a random fashion, allowing the entrained particles to impact on the filter material
- A glass fiber filter used in air sampler has an efficiency of 99% for particles of size 0.3 micrometer and it is moderately effective for trapping particles of size as 0.05 micrometer.
- Sampling time is 24 hour and during this time over 2000 m<sup>3</sup> of air is sucked through filter.
- The particulate level is generally expressed in terms of microgram/m<sup>3</sup>.

# Sample calculation

- Air flow through clean filter =  $1.7 \text{ m}^3/\text{min}$
- Air flow through filter at the end of the test =  $1.4 \text{ m}^3/\text{min}$
- Average air flow =  $1.55 \text{ m}^3/\text{min} = 2232 \text{ m}^3$  in 24 hour
- Weight of the clean filter =  $5.000 \text{ gm}$
- Weight of the filter after exposure =  $5.348 \text{ gm}$
- Weight of the particulate dust =  $0.348 \text{ gm}$   
=  $0.348 \times 10^6 \text{ microgram}$
- Suspended particulate concentration =  
 $(0.348 \times 10^6) / 2232 = 156 \text{ microgram}/\text{m}^3$

# TAPE SAMPLER

- Tape sampler is also known as 'beta gauge'. It has appearance that looks like a reel to reel tape recorder.
- In this method known volume of air is passed through a paper tape which is advanced in discrete time intervals from a supply reel to take-up reel.
- During sampling tape is held stationary. Sampling time could be from 10 min to 2 hours, depending upon the amount of particulates.
- The air is passed through the nozzle and the particulates are collected on the paper tape forming a spot.





**Tape sampler**

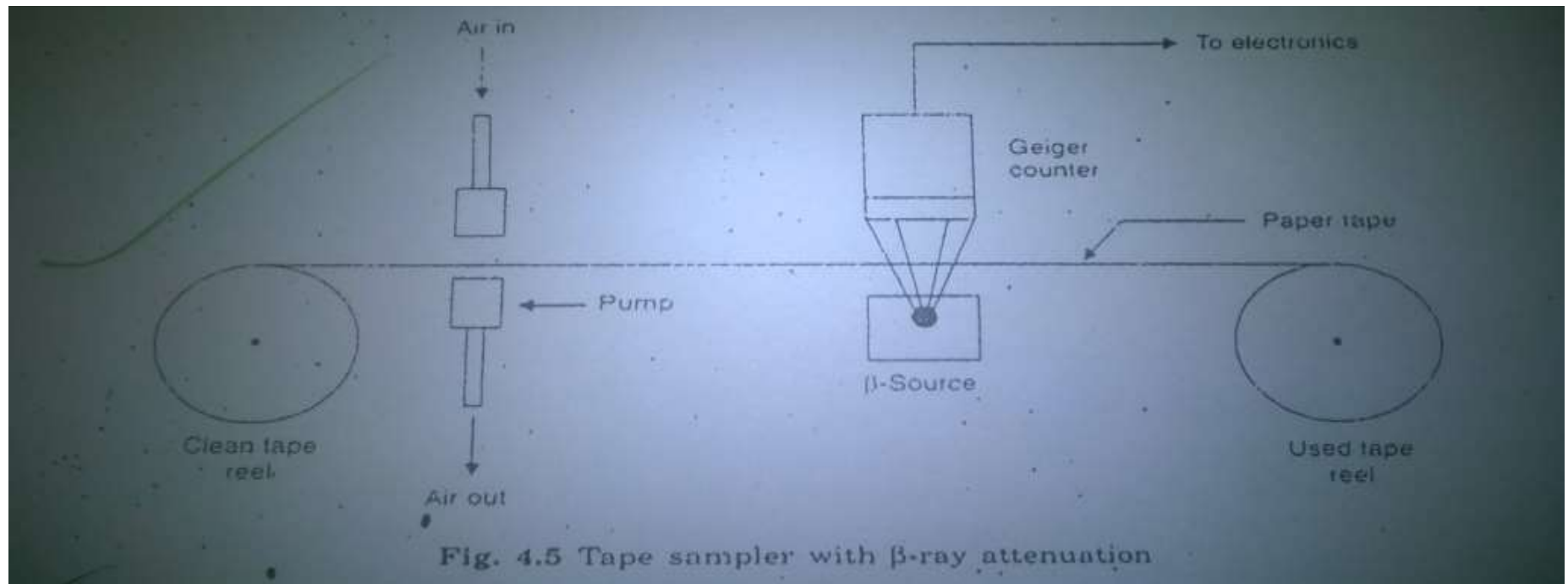
# Tape sampler

- The measurement is reported as 'CHO/1000 ft' where CHO is known as coefficient of optical haze.
- Some guidelines are required for interpreting CHO values in terms of the degree of pollution. This table provides a typical rating system for values of CHO per 1000 linear feet versus the degree of air pollution.
- Spots so obtained are evaluated by analyzing the amount of light that can be transmitted through the

CHO	Degree of Pollution
0 - 0.9	Light
1 - 1.9	Medium
2 - 2.9	Heavy
3 - 3.9	Very heavy
4 - 4.9	Extremely heavy

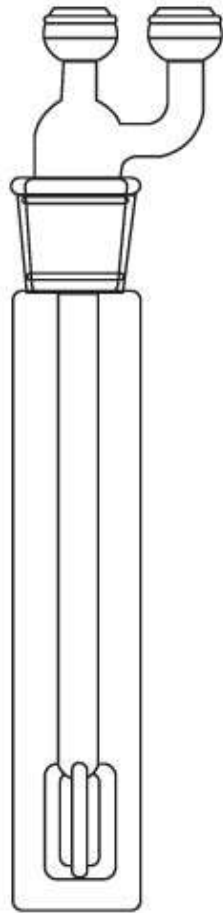
# Tape sampler

- A more realistic analysis of spot is based upon beta-ray attenuation from which the mass concentration of particulates can be estimated.
- Here a beam of beta ray of  $I_0$  intensity is passed through tape and intensity is measured.



# Impingement

- In this method separation of particulates from the air stream takes place by collision against flat surface.
- Wet impingement is used for collection of particulates in liquid phase.
- As in gas sampling the air stream containing the particulate impinges at high velocity onto a flat surface immersed in a liquid. The gas breaks up into small bubbles, particles are collected by change in the direction of gas flow and promoting their contact with the liquid.

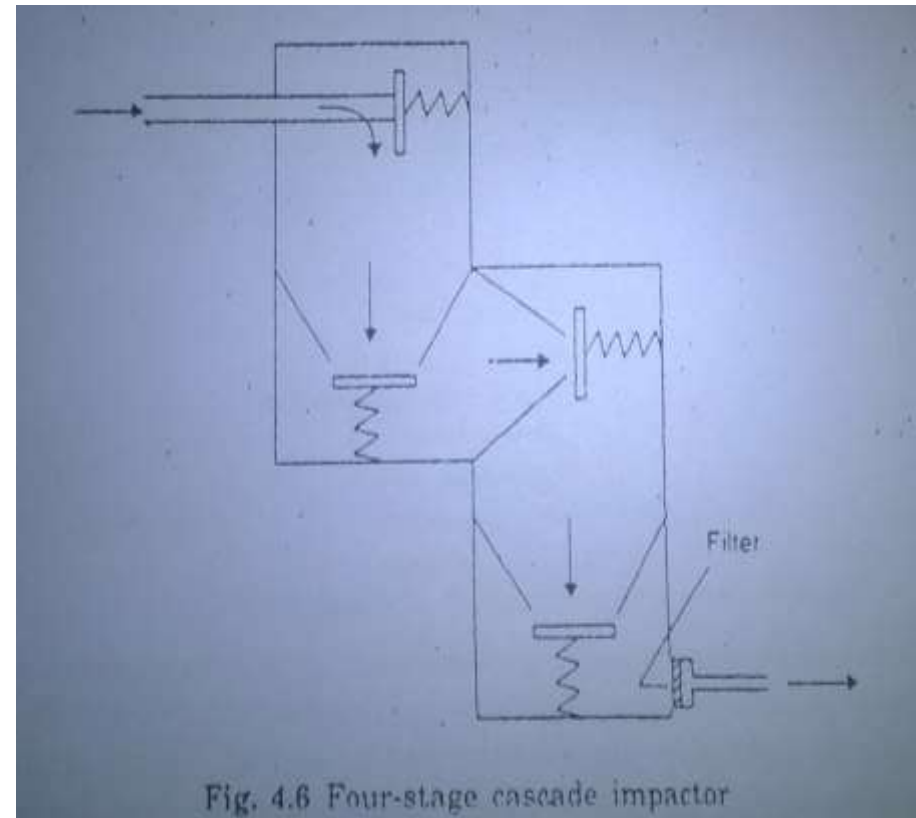


# Impingement

- Dry impingers operate on the principle of impaction on a dry surface for particle collection. These are not as efficient as wet for collecting smaller particle <2micrometer.
- The advantage of using dry impingers is that there is no need of filtration and evaporation in liquid.
- Certain dry impingers, called cascade impactors designed for making particle size measurement.
- A typical cascade consists of 5-10 collection stages in which the sample airstream is constrained to pass through a series of jets where particle are directed against collection surfaces placed normal to the jets

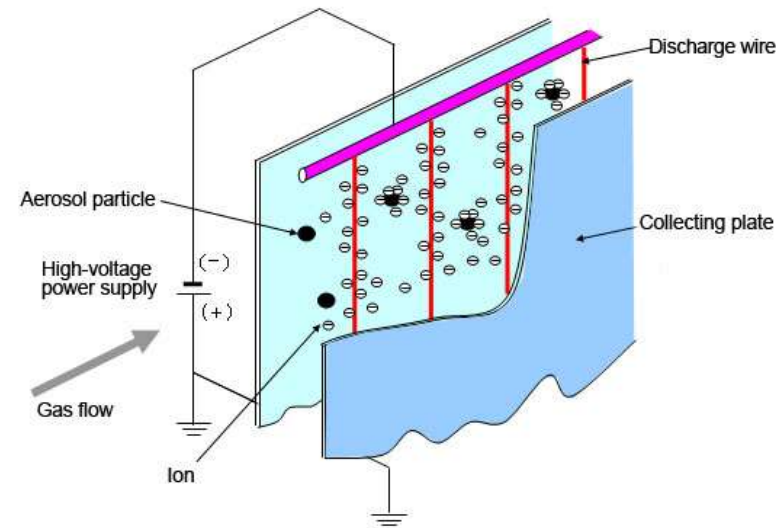
# Impingement

- Smaller particle having lower momentum, are collected in later stages, where jet velocity become progressively higher.
- In most cascade impactors a filter is placed after the last stage to collect any fine particle that might have passed through the impactor.
- After sampling, the material collected at each stage is analyzed for its weight and chemical composition.
- The impactors have efficiency of 100% for particle as small as 0.6 micrometer has been obtained.



# Electrostatic precipitation

- Air sampling could also be done by electrostatic precipitation
- During their operation negative charge is imparted on a wire placed axially inside a cylinder which is positively charged.
- When the particle laden airstream passes through the cylinder, the particles acquire negative charge from corona discharge occurring at the central wire.
- The particles migrate towards the inner surface of the cylinder and are removed by subsequent chemical analysis.



# Thermal precipitation

- Thermal precipitator works on the principle that small particles, under the influence of a strong temperature gradient between two surface, have a tendency to move towards the lower temperature and get deposited on cooler of two surfaces.
- The collection efficiency of thermal precipitators are quite high for small particle and are virtually 100% for particles in the range of 10micrometer to 0.01 micrometer. The particles are collected on a grid for further analysis.



THANK YOU

