Lecture 3

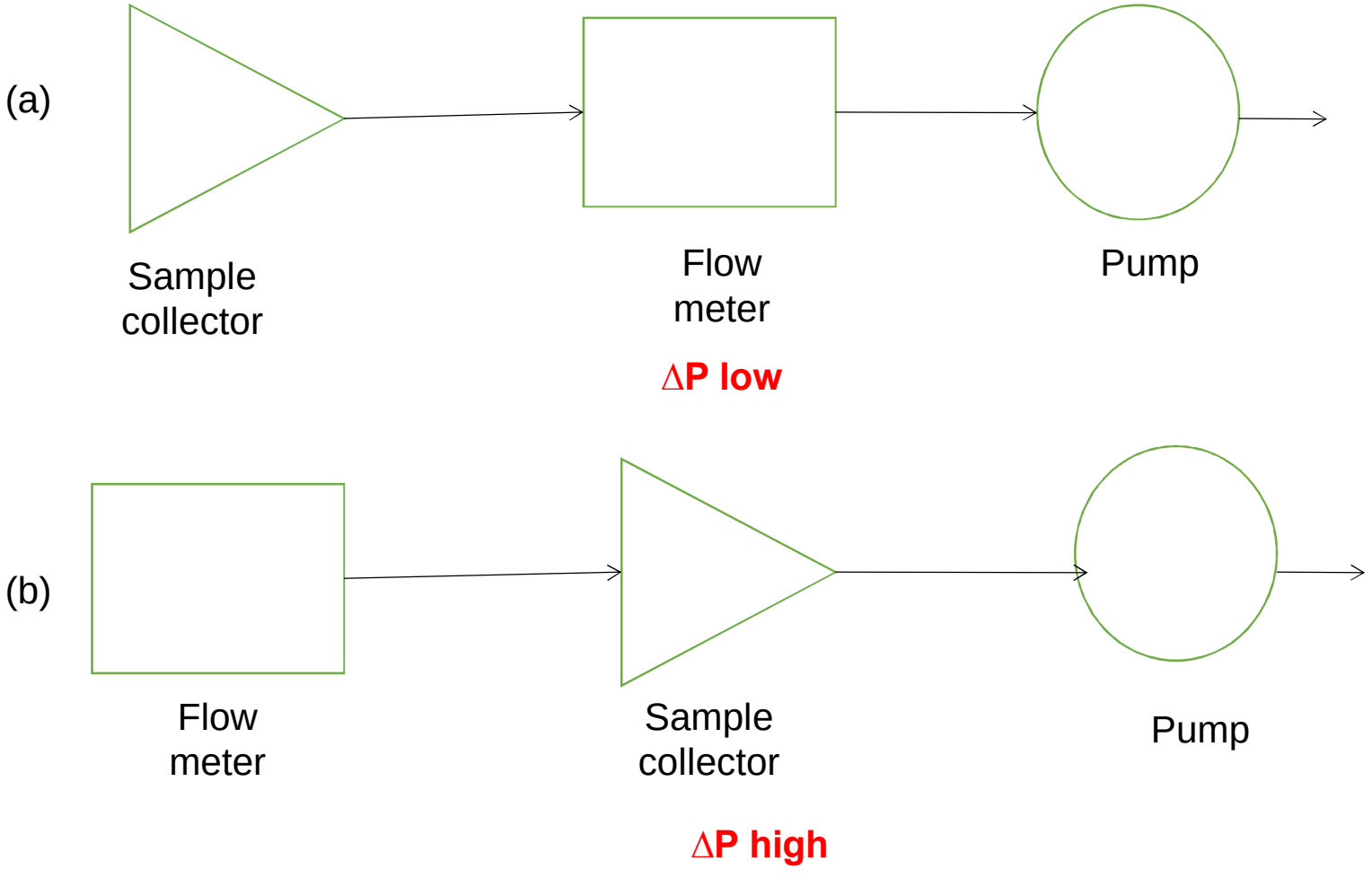
Sampling

Basic consideration of air sampling

1. The sample collected must be representative in terms of time and location
2. The sample volume should be large enough to permit accurate analysis
3. The sampling rate must be such as to provide maximum efficiency of collection
4. The duration of sampling and frequency of sampling should reflect accurately the occurrence of fluctuations in pollution level
5. The contaminants must not be modified or altered in the process of collection

Sampling

Air sampling set-up



Sampling
Sample collector

Nature of pollutants

Method of analysis to be used

Sample collector

To collect gaseous pollutants

- Grab sampling
- Absorption in liquid
- Adsorption on solids
- Freeze out sampling

To collect Particulates matter

- Sedimentation (Dust fall Jar)
- Filtration (Hi volume sampler)
- Impingement (Anderson Impactor)
- Electrostatic Precipitation (ESP)
- Centrifugal Force (Cyclone separator)
- Thermal Precipitation (Thermal

Sampling

Instruments for sampling waste gases and for atmospheric sampling

1. Devices for general use
2. Devices for sampling gases and vapors

1. Devices for general use

Meters

- They are used to determine accurately the volume of the gas collected.
- They are fitted with manometers and thermometers to indicate the pressure and temperature of the gas stream sampled.

Sampling

Probes

- They are tubes suitable for penetrating into the gas stream and should be constructed of material which are non-corrosive and which can withstand special temperature conditions.
- They should be constructed of materials (S. S, Glass or Quartz) that do not react with the substances to be sampled.
- A probe should have suitable length and diameter.
- To ensure iso-kinetic sampling condition the opening of he probe should face the gas stream to be sampled.

Sampling

Sampling probe

Sampling

Suction Devices

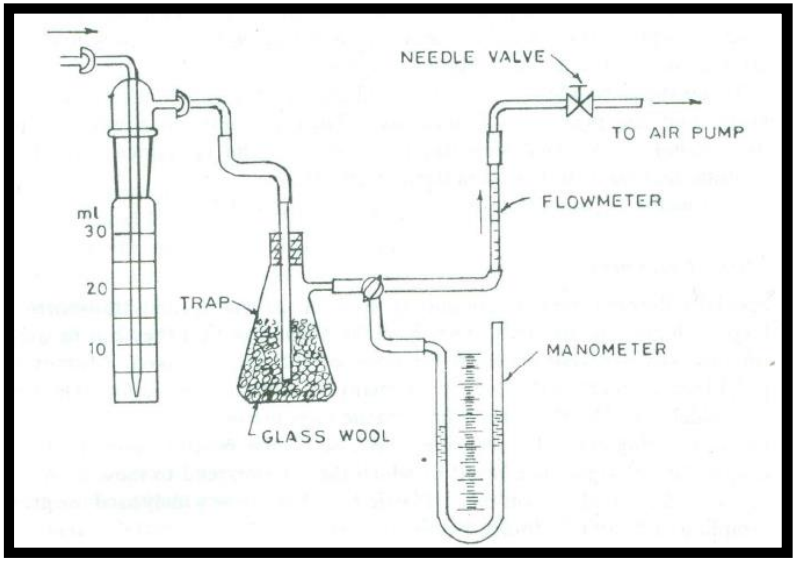
- Any suction device that has the required volumetric capacity can be used.
- Vacuum pumps driven by electric motors are very commonly used.

Sampling

2.Devices for sampling gases and vapors

Absorption in liquid:

Effluent gases are passed through absorber (scrubbers) which contains liquid absorbents that remove one or more of the pollutants in the gas stream.



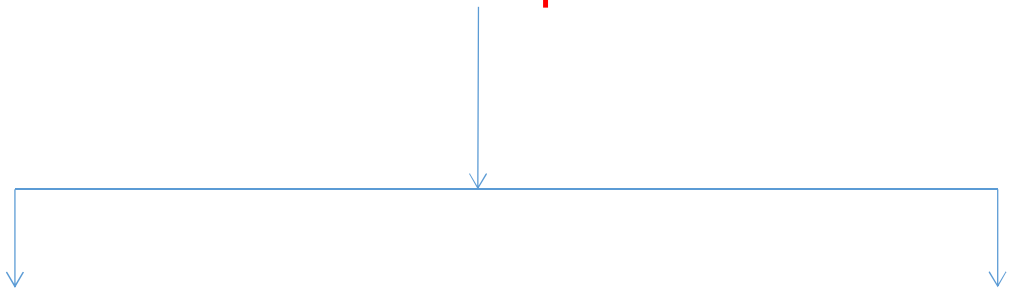
Absorption

Equipments using the principle of absorption for the removal of gaseous pollutants includes (1) Packed tower (2) Plate tower (3) bubble cap plate tower (4) Spray tower (5) Liquid jet scrubber absorber.

Oxides of sulphur, Oxides of nitrogen, Ammonia, Hydrogen sulphide, Hydrochloric acid, Hydrofluoric acid, Hydrocynic acid, ozone, H/C, organic solvent are measured (0.1 ppm by volume)

Collection of particulate pollutants:

Particulate pollutants



Settle due to the **force of gravity**

(Particle size greater than 10μm)

Sedimentation

Those that remain **suspended as aerosols**

(Smaller size)

Filtration

Impingement

Electrostatic

Thermal Precipitation

Classification of particulate matter

EPA description	Particle size
Super coarse	$d_{pa} > 10\ \mu m$
Coarse	$2.5\ \mu m < d_{pa} \leq 10\ \mu m$
Fine	$0.1\ \mu m < d_{pa} \leq 2.5\ \mu m$
Ultrafine	$d_{pa} \leq 0.1\ \mu m$

Classification of particulate matter

1. **Total suspended particulate matter (TSP)**
   Particles ranging in size from 0.1 µm to about 30 µm
   Particle sizes including : Fine, Coarse, Super coarse

2. **PM_{10}**
   Particle matter with a dia of 10 µm collected with 50 % efficiency

3. **$PM_{2.5}$**
   Particle matter with a dia of 2.5 µm collected with 50 % efficiency

4. **Particles less than 0.1 µm**
   0.01 µm to 0.1 µm

5. **Condensable particulate matter**
   Particulate matter that forms from condensing gases or vapors is referred to as Condensable particulate matter

Dust fall Jar

- Dust fall is the **fraction of particulates** which settles down **quickly by virtue of their larger size.**
- Simple techniques for **collection of particulate matter**.
- Suitable for **larger particles having a size more than 10 μm.**
- The jar method for dust fall is **based on sedimentation**.

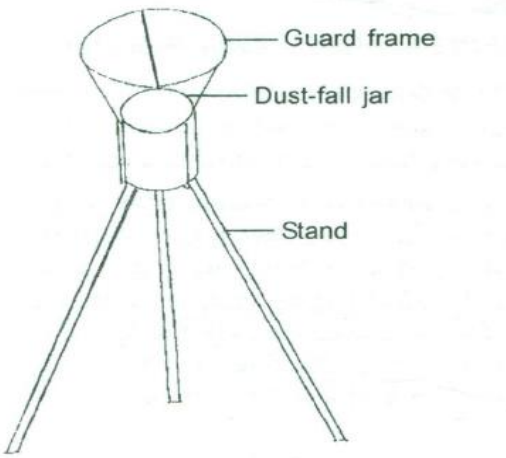
Dust fall Jar

- Dust Fall Jar is a device which enables the user to carry out dust fall monitoring in high dust areas such as **open mining, excavations, constructions etc.**

- It is a form of **gravitational sampling** system.
- It utilizes the principle that dust particles are usually coarse in size and that they settle slowly under the influence of gravity. It continues to be in use because of its inherent simplicity and low cost.

Dust fall Jar

- Simple open top cylindrical container having a flat bottom.
- $d_{cylinder}$: more than 15 cm
- Height: 2 to 3 times of diameter
- Container made up of glass or plastic.
- It is kept little above the ground on a stand with a protection provided by a guard frame.
- Greasy slides can also be used for trapping the sedimented particles.



Dust fall Jar

General considerations in site selections are:

1. The site should be **free from overhead obstructions** and **away from** inference by local sources such as **an incinerator or chimney**.
2. The **mouth** of the dust fall collector should be **no less than 2.5 m and no more than 16 m above ground level**, with a **standard height of 6 m as recommended elevation**
3. When sampling in urban areas, the dust fall collector should be set no less than 10 stack lengths from an operating smoke stack

Dust fall Jar

Advantages:

- Ease of procurement of 1-5 gram of weightable sample, on which a number of chemical and physical analyses can be performed.

- The method is simple and inexpensive and required no electrical power or moving parts.

Dust fall Jar

Disadvantages:

- Lack of precision and inability to distinguish episode of peak dust fall due to integration of the total sample weight over the entire sampling period (up to 30 days)

- Particles collected are more less agglomerated and may not be representative of the original from and size of particulate matter suspended

Dust fall Jar

Applications:

- Monitoring in urban areas
- Monitoring of open spaces like forests and national park air monitoring.
- Monitoring of ecologically sensitive monuments
- Short Time Surveys
- Mining Industry
- Waste Disposal and Burning sites
- Construction and Infrastructure Sites
- Data Collection and Reporting