

* Nature of Air pollutants

1. Gaseous (SO_x , NO_x , $\text{CO} \dots$)
2. Particulate Matter

Gaseous pollutants features:

Similar sized molecules

Behaviour: Physically same and chemically different.

Particulate pollutants features:

Physics: Not the same. Size and morphology of molecules can vary.

Chemistry: Varies for different pollutants.
could be inert like dust, sand etc.
could be toxic like smoke.

Measurement of pollution on different basis:

* Concentration basis

1. mass of pollutant / Volume of air
2. number of particles / Volume of air
3. opacity: works by measuring the amount of light lost when passed through air containing pollutants.

* Duration basis: Measuring concentration over a certain time span like hours to days to years to know how long the exposure take place.

Criteria Pollutants: These pollutants forms the criteria for determining good health of air and setting ambient air quality standard.

Primary criteria pollutants:

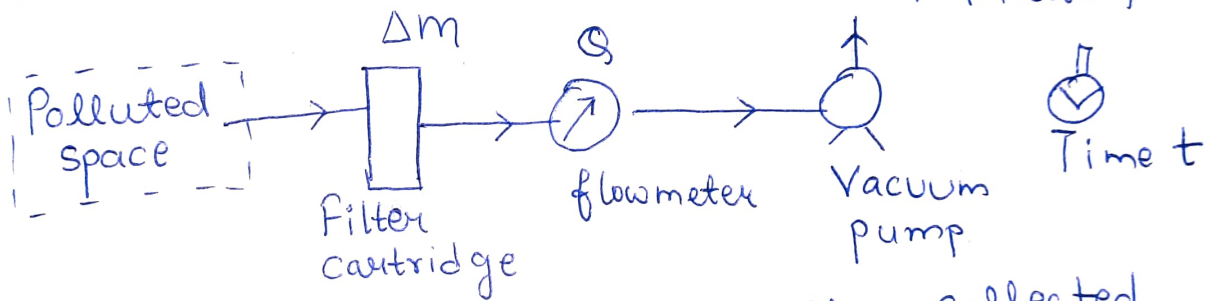
* SO_x , NO_x , CO , PM_{10} , $\text{PM}_{2.5}$

↳ (Particulate Matter)

Secondary criteria pollutant
[Not emitted directly]
from source

→ Ozone

* Measuring mass concentration of PM (particulate matter)



Δm = mass of particulate matter collected

Q = Volume flow rate

t = Measured time interval

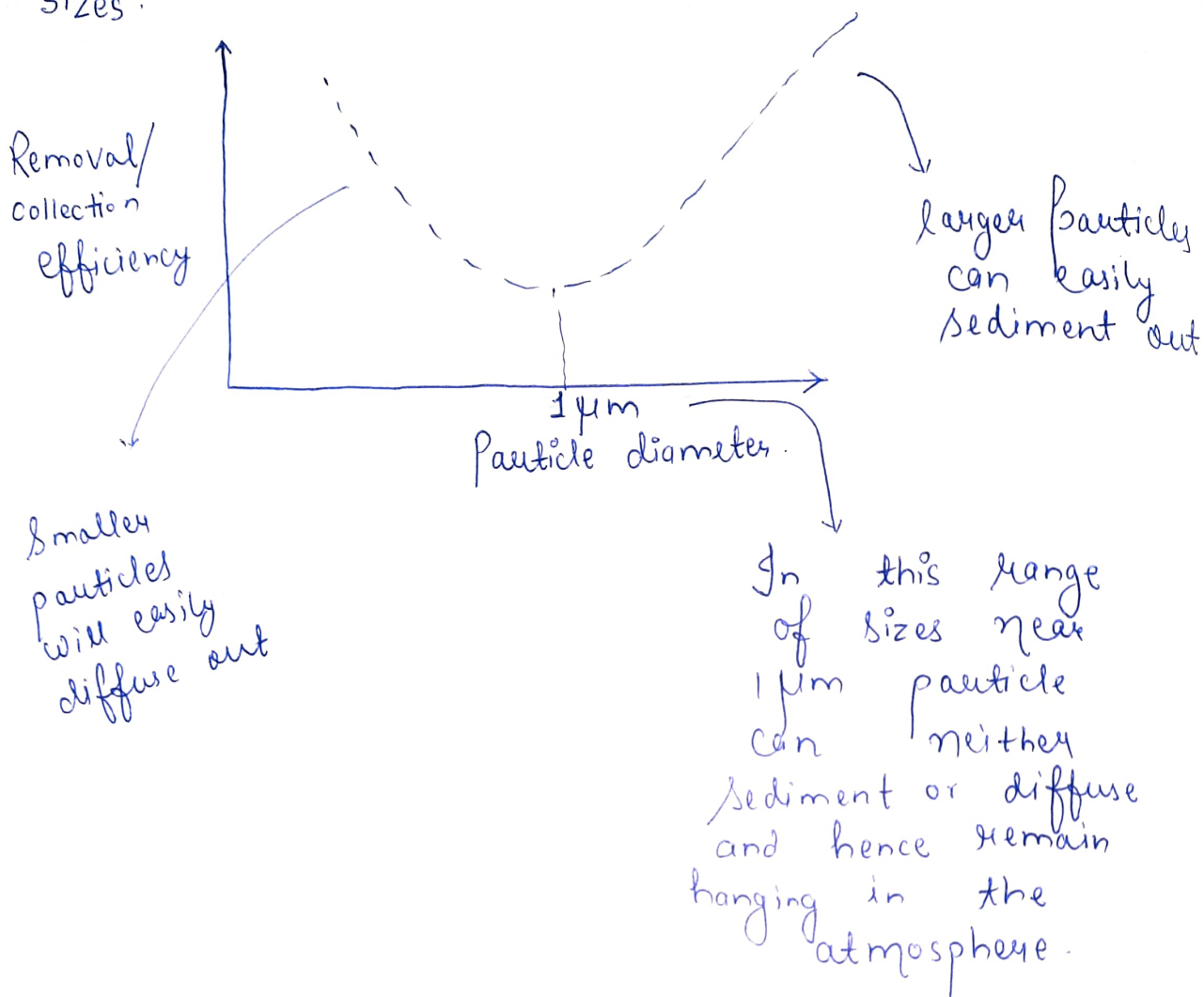
$$C_{\text{TSP}} = \text{concentration of Total suspended particulate} = \frac{\Delta m}{Q \cdot t}$$

Mass (Δm) gets collected in filter cartridge.

* Size of particulate matter \gg Size of gas molecules

Air-lecture-08

There are different-sized particles present in air. Their ease of removal depends on sizes.



- * PM_{10} → Mass concentration of particulate matter less than 10 μm expressed as $\mu\text{g}/\text{m}^3$
- * $\text{PM}_{2.5}$ → Mass concentration of particulate matter less than 2.5 μm expressed as $\mu\text{g}/\text{m}^3$
- * $\text{PM}_{2.5}$ is a subset of PM_{10}
- * < 2.5 μm sized particles is sourced by combustion and other anthropogenic activities. More toxic.

* Area under the distribution curve based on particle sizes

* 0 to 10 μm \rightarrow PM_{10}

* 0 to 2.5 μm \rightarrow $\text{PM}_{2.5}$

* Ratio of $\text{PM}_{2.5}$ to PM_{10} is indicator of anthropogenic/combustion activities.

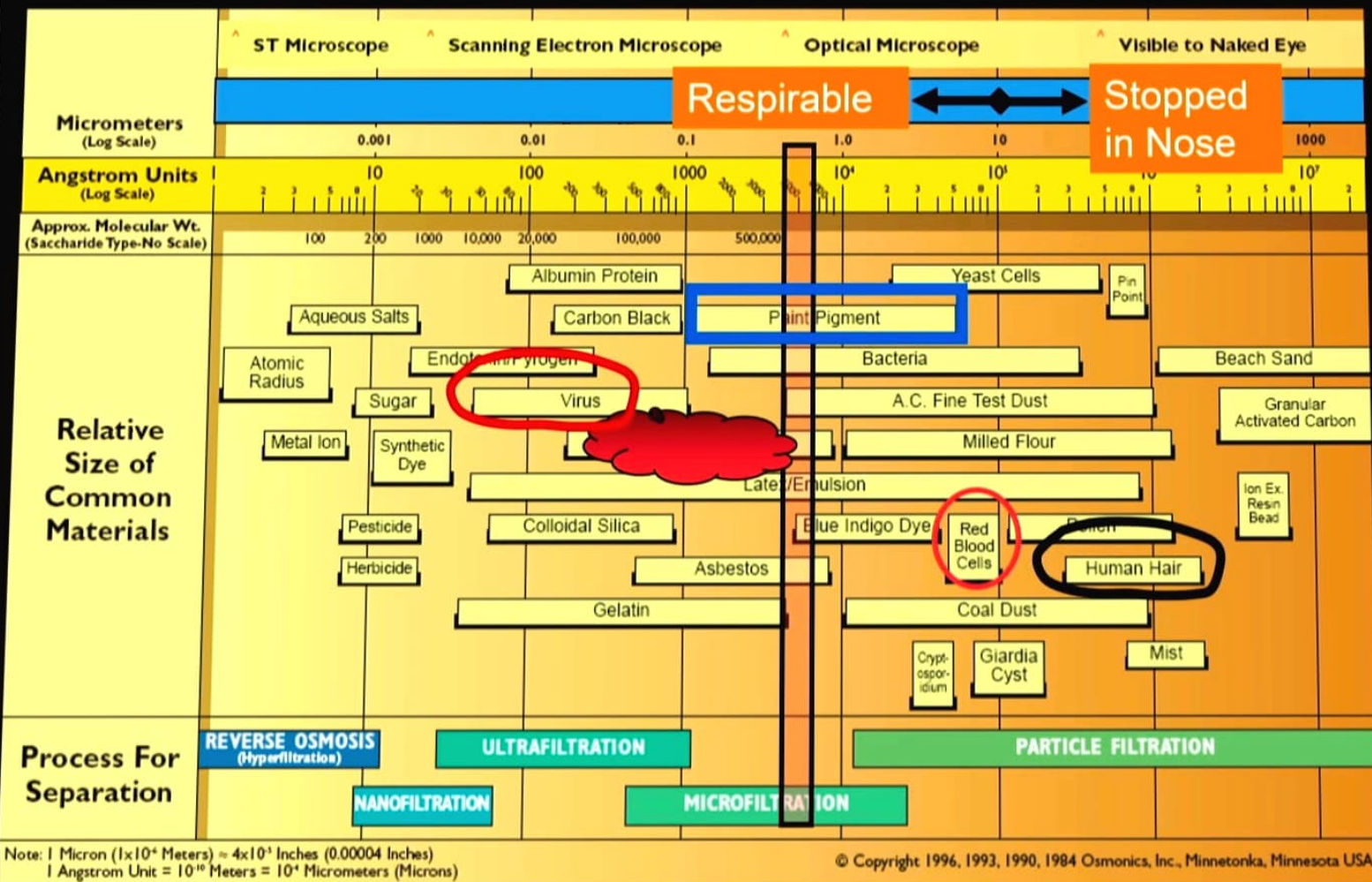
* ~~Ratio small~~ implies benign particulate.
Small ratio

* Large ratio implies most particles will reach lungs and possibly more toxic.



OSMONICS

The Filtration Spectrum



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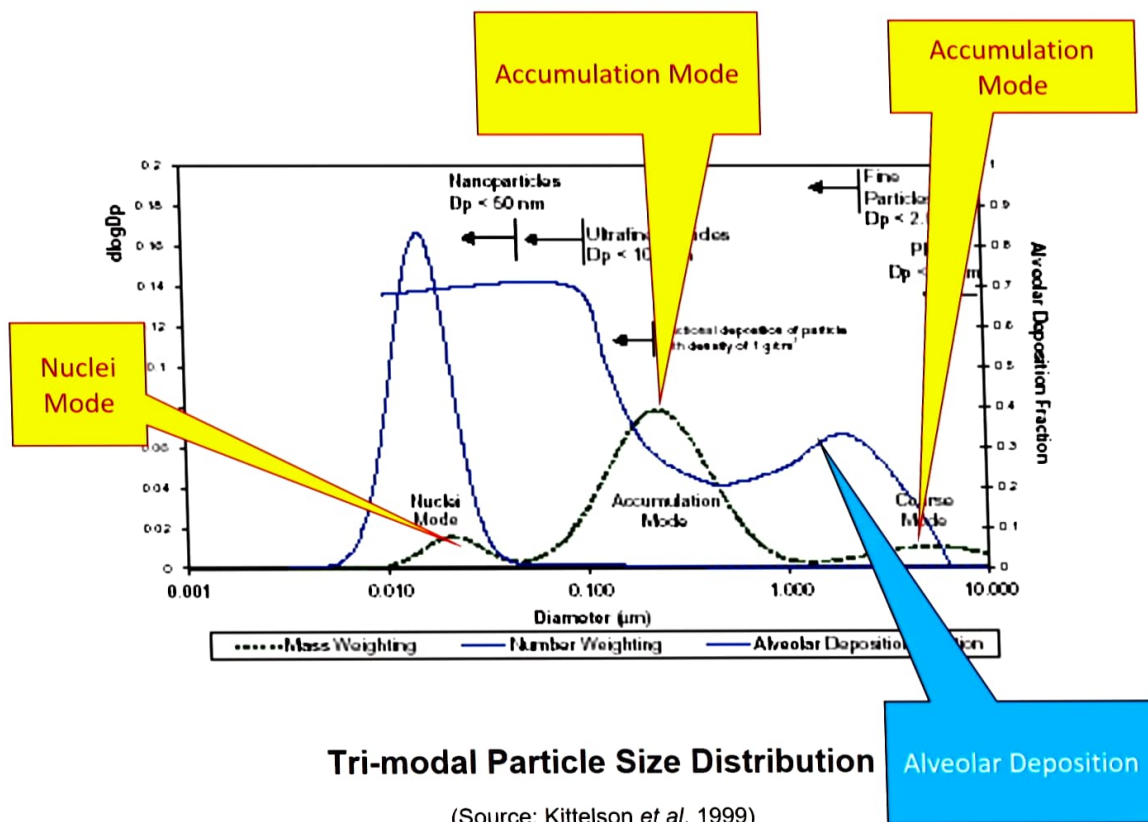
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Revised National Ambient Air Quality Standards (NAAQS)

[NAAQS Notification dated 18th November, 2009]

| S. No. | Pollutants | Time Weighted Average | Concentration in Ambient Air | | Methods of Measurement |
|--------|--|-----------------------|--|--|---|
| | | | Industrial, Residential, Rural and other Areas | Ecologically Sensitive Area (notified by Central Government) | |
| 1 | Sulphur Dioxide (SO ₂), µg/m ³ | Annual* | 50 | 20 | 1. Improved West and Gaeke 2. Ultraviolet Fluorescence |
| | | 24 Hours** | 80 | 80 | |
| 2 | Nitrogen Dioxide (NO ₂), µg/m ³ | Annual* | 40 | 30 | 1. Modified Jacob & Hochheiser 2. Chemiluminescence |
| | | 24 Hours** | 80 | 80 | |
| 3 | Particulate Matter (Size <10µm) or PM ₁₀ µg/m ³ | Annual* | 60 | 60 | 1. Gravimetric 2. TEOM 3. Beta attenuation |
| | | 24 Hours** | 100 | 100 | |
| 4 | Particulate Matter (Size <2.5 µm) or PM _{2.5} µg/m ³ | Annual* | 40 | 40 | 1. Gravimetric 2. TEOM 3. Beta attenuation |
| | | 24 Hours ** | 60 | 60 | |
| 5 | Ozone (O ₃), µg/m ³ | 8 hours** | 100 | 100 | 1. UV photometric 2. Chemiluminescence 3. Chemical Method |
| | | 1 hours ** | 180 | 180 | |
| 6 | Lead (Pb), µg/m ³ | Annual * | 0.50 | 0.50 | 1. AAS/ICP Method after sampling using EPM 2000 or equivalent filter paper 2. ED-XRF using Teflon filter |
| | | 24 Hour** | 1.0 | 1.0 | |
| 7 | Carbon Monoxide (CO), mg/m ³ | 8 Hours ** | 02 | 02 | Non dispersive Infra Red (NDIR) Spectroscopy |
| | | 1 Hour** | 04 | 04 | |
| 8 | Ammonia (NH ₃), µg/m ³ | Annual* | 100 | 100 | 1. Chemiluminescence 2. Indophenol blue method |
| | | 24 Hour** | 400 | 400 | |

| | | | | | |
|----|--|-----------|-----|-----|---|
| 8 | Ammonia (NH ₃), µg/m ³ | Annual* | 100 | 100 | 1. Chemiluminescence 2. Indophenol blue method |
| | | 24 Hour** | 400 | 400 | |
| 9 | Benzene (C ₆ H ₆) , µg/m ³ | Annual * | 05 | 05 | 1. Gas chromatography based continuous analyzer 2. Adsorption and Desorption followed by GC analysis |
| 10 | Benzo(a)Pyrene (BaP)-particulate phase only, ng/m ³ | Annual* | 01 | 01 | Solvent extraction followed by HPLC/GC analysis |
| 11 | Arsenic (As), ng/m ³ | Annual* | 06 | 06 | AAS/ICP method after sampling on EPM 2000 or equivalent filter paper |
| 12 | Nickel (Ni), ng/m ³ | Annual* | 20 | 20 | AAS/ICP method after sampling on EPM 2000 or equivalent filter paper |

* Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform interval.** 24 hourly 08 hourly or 01 hourly monitored values, as applicable shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

NOTE: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.