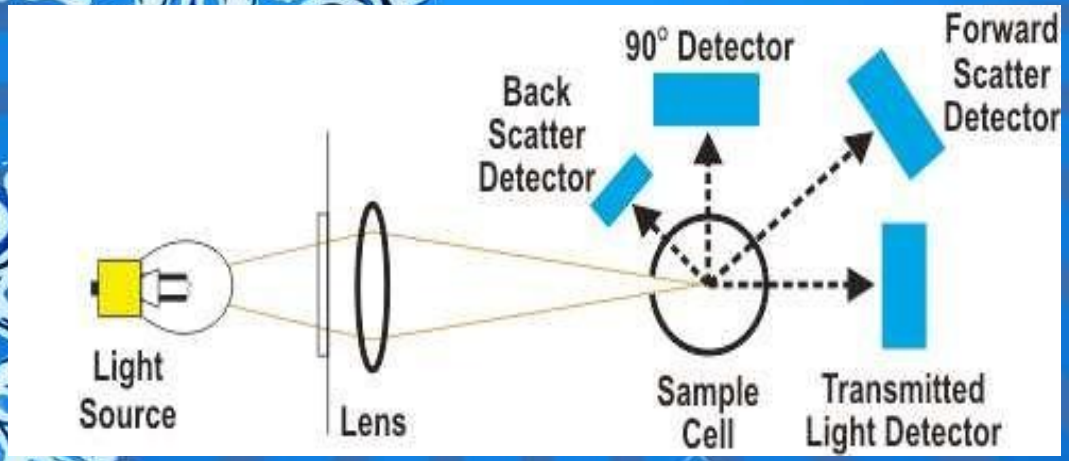
NEPHELOMETRY AND TURBIDIMETRY



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INTRODUCTION

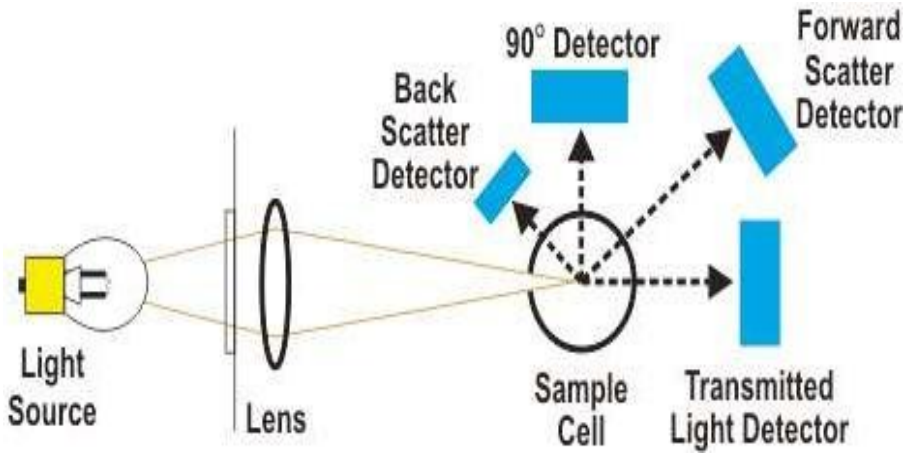
- When electromagnetic radiation (light) strikes a particle in solution, some of the light will be absorbed by the particle, some will be transmitted through the solution and some of the light will be scattered or reflected.

- The amount of light scattered is proportional to the concentration of insoluble particle. We will focus on the concept of light scatter

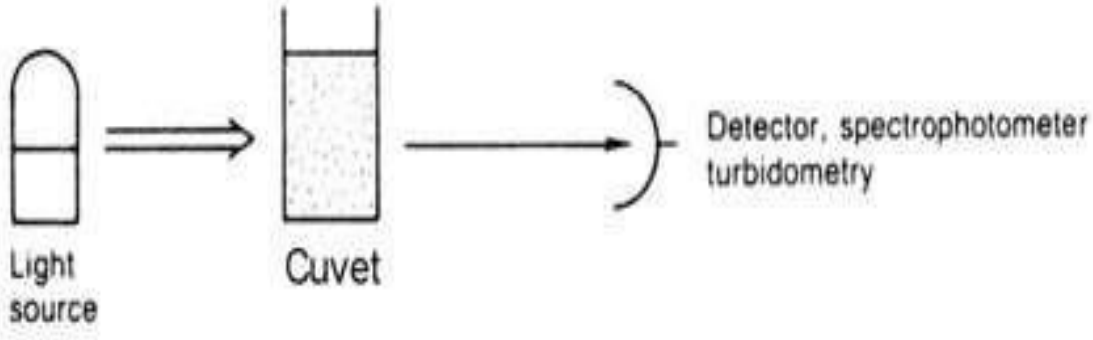
THEORY

Scattered light may be measured by

- Turbidimetry
- Nephelometry
- In turbidimetry, the intensity of light transmitted through the medium, the unscattered light, is measured.

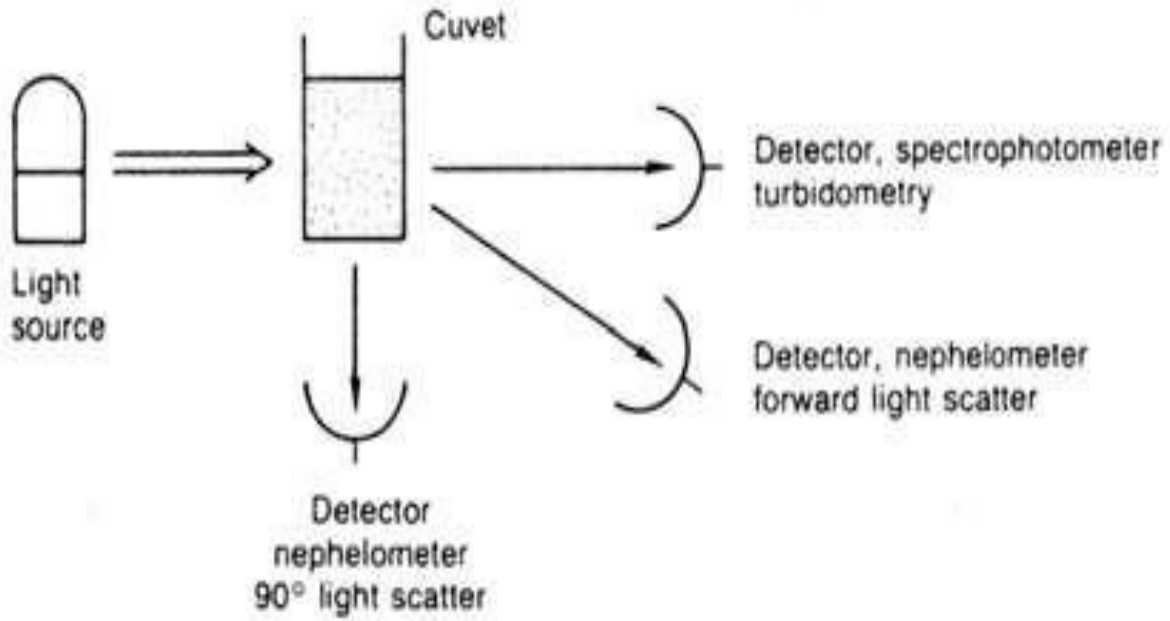


- Turbidometric measurements are made at 180^{o} from the incident light beam.



- In Nephelometry, the intensity of the scattered light is measured, usually, but not necessarily, at right angles to the incident light beam.

- The two techniques differs only in the mannerof measuring the scattered radiation.



Nephelometry

- Turbidity can be measured on most routine analysers by a spectrophotometer (absorbed light)
  - Reduced sensitivity and precision.
  - Extent of light scattering increases as wavelength increases
- The intensity of scattered light is normally measured by Nephelometer.

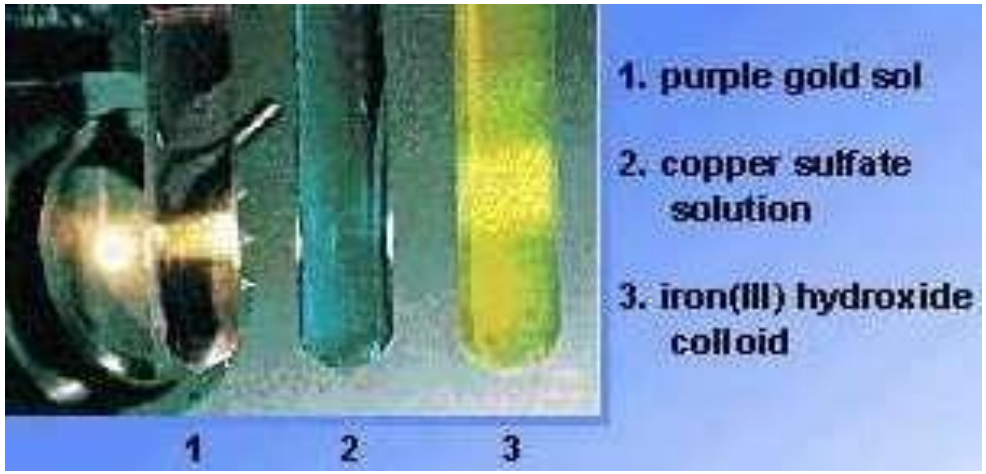
- Light scattering is the physical phenomenon resulting from the interaction of light with a particles in solution.

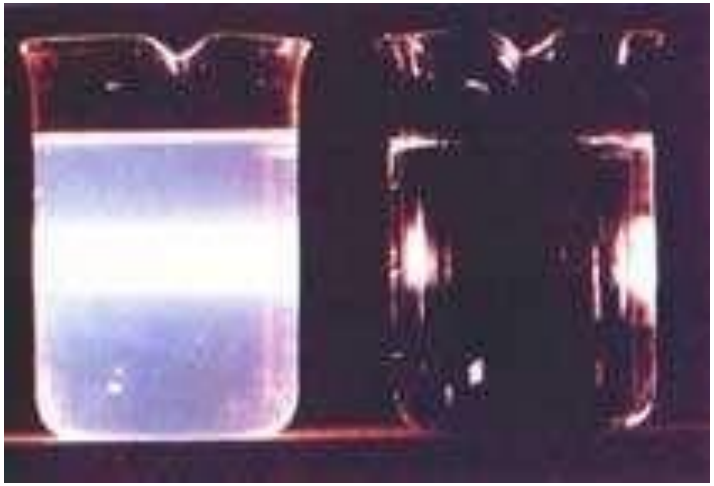
Dependent on :

- Particle size
- Wavelength
- Distance of observation,
- Concentration of particles
- MW of particles

Tyndall Effect

- Scattering of light- by particles in a colloid or suspension.
- the longer-wavelength light is more transmitted while the shorter-wavelength light is more reflected via scattering.





Light Scattering Phenomenon

- The blue color of the sky and the red color of the sun at sunset result from scattering of light of small dust particles, H_2O molecules and other gases in the atmosphere.
- The efficiency with which light is scattered depends on its wavelength, λ. The sky is blue because violet and blue light are scattered to a greater extent than other longer wavelengths.

- **NEPHELOMETRY**

- ↓ concentration, uniform scattering, intensity of scatted light proportional to conc. measured at 90^0

- **TURBIDIMETRY**

- ↑ concentration, scattering not uniform, intensity of transmitted light measured at 180^0

Turbidimetry

↕

Colorimetry

- Measurement of the intensity of light transmitted through a medium, light intensity is decreased.

Nephelometry

↕

Fluorimetry

- Measurement of scattered light at 90^0

COLORIMETER

Similarity:

- transmitted light measured
- measured at 180^0

Difference:

- Absorption of radiation

TURBIDIMETER

Similarity:

- transmitted light measured
- measured at 180^0

Difference:

- Scattering of radiation

FLOURIMETRY

Similarity:

- Emergent radiation measured at 90^0

Difference:

» emitted radiation measured

» emitted radiation – longer WL than incident light

NEPHELOMETRY

Similarity:

- Emergent radiation measured at 90^0

Difference:

» Scattered radiation measured

» emitted radiation – same WL as that of incident light

CHOICE OF THE METHOD

- depends upon the amount of light scattered by suspended particles present in solution.

- **TURBIDIMETRY** - high concentrated suspensions
- **NEPHELOMETRY** - low concentrated suspensions
  - more accurate results

INSTRUMENTATION

- The basic instrument contains
- Light Source:Tungsten lamp,
  White light - nephelometers
- Filters - Turbidimeter (blue filter or 530 nm)
  Nephelometer (visible filter)
- Sample cells
- Detectors (photometric)

- CELLS
- cylindrical cells - flat faces to minimize reflections & multiple scatterings

FACTORS AFFECTING MEASUREMENTS

- The amount of radiation removed or deviated from the primary radiation beam depends on the following factors

1.Concentration

- Turbidimetry: S= log I/Io= kbc
- T=Transmittance = I/Io
- S= turbidence due to scattering
- k = turbidity constant
- b= path length
- c = concentration of suspended material

- Nephelometry:
- Is = Ks Io C
- Is = scattered intensity
- Ks = empirical constant
- Io = Incident intensity
- c = concentration of suspended material

2. Effect of Particle Size on Scattering

- Size and the shape of the particles responsible for the scattering.
- Because most analytical applications involve the generation of a colloidally dispersed phase in a solution, those variables that influence particle size during precipitation also affect both turbidimetric and nephelometric measurements.

- Turbidimetry-Practical Considerations
- Selecting λ: Important. It is necessary to avoid radiation that is absorbed by the sample.

Sample Preparation

- Scattering is related to:
- 1.Concentration of the scattering particles
- 2.Particle size
- 3.Particle shape

APPLICATIONS

1. Analysis of water

   clarity, conc. of ions

2. Determination of CO_2
3. Determination of inorganic substances

   Sulphate – barium chloride

   Ammonia – Nesslers reagent

   Phosphorus – Strychine molybedate
4. Biochemical Analysis
5. Quantitative Analysis – (ppm level)

6. Miscellaneous

Water treatment plants, sewage work, refineries, paper industry

7. Atmospheric pollution

smokes & fogs

8. Determination of mole. Wt of high polymers

9. Phase titration

NEPHLOTURBIDIMETER

Two detectors


Thank
You