10. WEEK

PARTICLE SIZE DETERMINATION METHODS

METHODS	METHODOLOGY PRINCIPLES	PARAMETER / DISTRIBUTION	LOWER LIMIT (μm)
Sieve Analysis Optical Microscope	Geometric basis	Sieve Diameter/Mass Martin, Feret and Projection area Diameter / Number	20.0 - 75.0 1.0
Sedimentation	Hydrodynamics	Stokes diameter / Mass	2.0
Current detection methods	Volume	Volume / Number	0.6 - 0.8
Field scanning methods	Light scattering	Volume / Mass	0.05
Permeability Adsorption	Surface properties	Specific surface	0.1 - 1.0
Photon correlation spectroscopy	Brown motion	Stokes diameter	<1.0

OPTICAL METHODS

- Optical microscope **(1.0 – 150 μm)**
- Electron microscope
  - *SEM (Scanning elektron microscopy)
  - *TEM (Transmission elektron microscopy)
  - *AFM (Atomic force microscopy)

Disadvantages of Optical Microscope:

- It is unclear which dimension the diameter of the particle to measure will be accepted,
- It is a time consuming and exhausting analysis,
- Two dimensionality is a matter and requires very particle counting,
- Reproducibility is poor due to these reasons.

SIEVE ANALYSIS

Sieve analysis is the most commonly used particle size measurement method, but reproducibility is poor. Since the sieve openings (meshes) are square, the particles passing through this opening are reproducible only every time the spherical sands are made.

SEDIMENTATION TECHNIQUE

The behaviors of the particles in the collapse sequence in a liquid are used to determine the particle size. In this method, the velocity of sedimentation under gravity of a single turbine in the liquid is measured. Suspensions with a concentration of 0.2-0.5% are used as the liquid.

A particle that falls on a liquid stream reaches a velocity depending on the "Stokes" law. It is assumed that all particles falling in the liquid according to the "Stokes" law are spherical.

Current Detection -COULTER COUNTER

The conductivity change in an electrolyte solution is used to calculate the particle volume.

Working Principle:

It is based on the fact that the volume change of the particulate passing through the gap is directly equal to the volume.

Current Detection-Light Blockage Method

Particles block the light as the liquid through which the sample is dispensed passes through the window cut by a light source. This is detected by a photo detector.

The sensor area must be absolutely clean, particulate adhesion is affected. It is an expensive method.

HIAC-Royco

LOW-ANGLE LASER LIGHT SCATTERING (LALLS)

The system includes a laser light source with a fixed wavelength and a detector. As the laser beam passes through, the light of the particles is collected. The diffraction (light diffraction) angle is inversely proportional to the particle size.

PHOTON CORRELATİON SPECTROSCOPY

It utilizes the Brownian motion among the particles to measure the particle size. This is the Stokes diameter measured in this technique, which is usually the ideal method for measuring the size of particles in the 5-5000 nm dimension.

Malvern Mastersizer Nano ZS

SURFACE METHODS - PERMEABILITY METHOD

- ✓ Surface methods do not measure particle size distribution.
- ✓The specific surface, i.e. the surface per unit volume (Sv) or weight (Sw), is measured.
- ✓With this method, average size measurement can be performed in dust.

$$Sv = \frac{\text{Surface area of particles}}{\text{Volume of particles}}$$

$$Sw = \frac{Sv}{\rho}$$

The resistance of the bed of powder to the passage of gas flow is a function of surface measurements of powders. The relationship between the gas flow rate and the specific surface is denoted by Kozeny Equation.

SURFACE METHODS-ADSORPTION METHOD

- ✓ In this method, it is a method which does not measure the particle size distribution but is used only to measure the specific surface of the powders.
- ✓ The method is the physical adsorption of a single layer to the solid surface of the gas.
- ✓ The instruments used depend on volumetric and gravimetric principles.