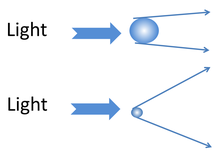
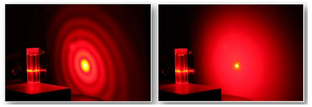
DETERMINATION OF PARTICLE SIZE BY LASER DIFFRACTION

Introduction

Particle size distributions can be determined by measuring the angular variation in intensity of light scattered as a laser beam passes through a dispersion of particles. This is a widely used particle sizing technique for materials ranging from hundreds of nanometers up to several millimeters in size.





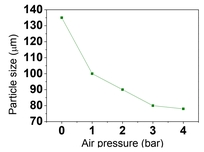
Three crucial aspects of laser-diffraction analysis:

✓ Sampling ✓ Dispersion ✓ Measurement conditions

Sample preparation

DRY MEASUREMENT

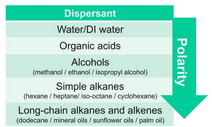
Optimize dry dispersion by carrying out a pressure titration.



WET DISPERSION

Achieving reproducible results from a wet measurement depends on:

1 Choosing an optimal dispersant



Sample must be **completely dispersed**

2 Establishing a stable dispersion

Stabilization	Examples
Steric	Non ionic surfactants and/ or particles
Electrosteric	Ionic surfactants and/or particles

3 Measuring at a suitable sample concentration

Obscuration correlates with sample concentration

Plotting measured particle size as a function of obscuration

Dispersions solid in liquid

Ultrasound if necessary

Particle imaging for detecting agglomerates

Dispersions liquid in liquid

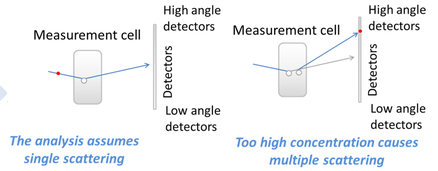
No ultrasound

Diluent should be a surfactant solution at the cmc concentration to avoid instability process

Measurement conditions

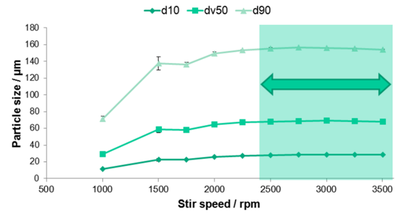
Obscuration

- Good signal to noise ratio
- Avoid multiple scattering effects



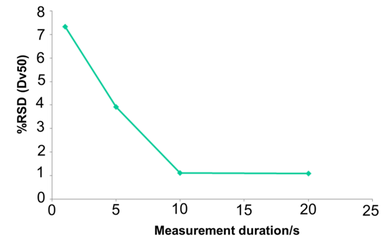
Stir speed

- Prevent sedimentation of large particles
- Excessive shear might affect samples



Measurement duration

- Measure all particles in the dispersion unit

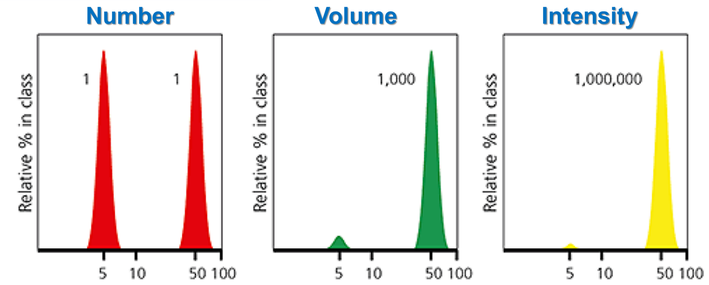


Laser diffraction uses **Mie theory** of light scattering to calculate the particle size distribution, assuming a **volume equivalent sphere model**.

Mie theory requires optical properties

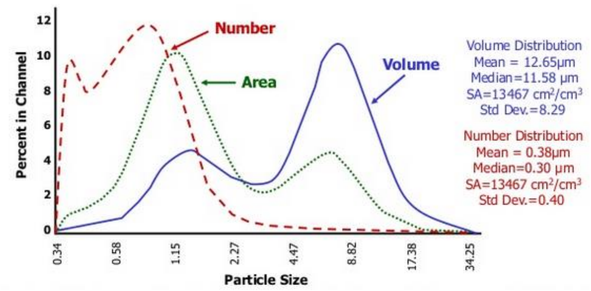
PARTICLE	SOLVENT
Refractive index	**Refractive index**
Absorption (refractive index imaginary component)	

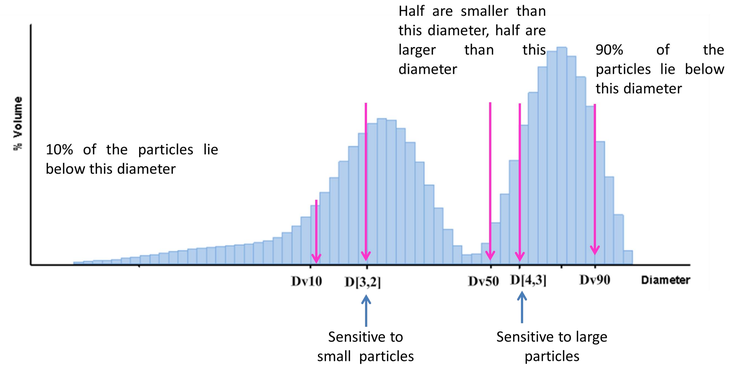
Data analysis



Example of number, volume and intensity weighted particle size distributions for the same sample.

Volume, number and area distribution of the same sample





References

ISO 13320:2009 Particle Size Analysis-Laser Diffraction Methods. Part 1: General Principles (2009). .

Virden, Anne, Method Development for Laser-Diffraction Particle-Size Analysis, Malvern Instruments.