

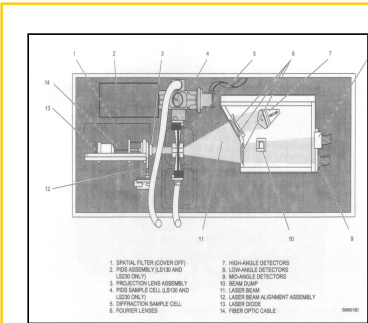
Particle Size Analysis Comparison of Sedimentation and Laser Scattering Method



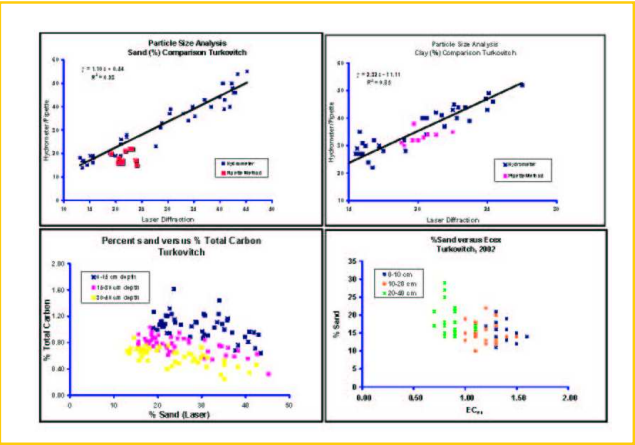
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Among the most versatile soil attributes that can describe soil spatial variation is soil texture or soil particle size distribution (PSD). Traditional measurement techniques for soil particle size distribution are based on the sedimentation method (Pipette and Hydrometer methods) and are time-consuming, thereby limiting the number of soil samples to be analyzed. In contrast, modern techniques such as the laser scattering or diffraction method are relatively quick, allowing many samples to be analyzed in a short time frame. In this study we compared the two particle size distribution methods for 50 samples collected at a 70-acre experimental field of Button and Turkovitch Farms. Whereas there was an excellent correlation between the two methods, absolute values in clay and silt content were systematically different. Soil texture was well correlated with soil saturation extract salinity and total soil carbon and nitrogen. PSD can be related to a wide range of soil physical and chemical properties, such as soil water retention and hydraulic conductivity, gaseous diffusion, and chemical adsorption.

Comparison	Sedimentation Method	Laser Diffraction Method
Ø	Large samples and time-consuming	Small samples and quick
Ø	Relatively low precision	High precision
Ø	Simple	More complex
Ø	Relatively cheap investment	Expensive instrument
Ø	Limited to not smaller than 2 µm	Detection limit is about 0.05 µm, using PIDS
Ø	Produces % sand, silt and clay	Produces continuous PSD
Ø	Established reference method	New method; no correlations available
Ø	Assume particles are spherical	Particle shape affects results
Ø	Overestimation of fine fraction	Underestimation of fine size fraction
Ø	Assumes soil particle density value	Independent of particle density
Ø	PSD by mass fraction	PSD by volume fraction



Diffraction angle is inversely proportional to particle size. The intensity of diffracted beam is a measure of the number of particles of specific size.



Results of Laser Diffraction:

- High correlation between sedimentation and laser diffraction method;
- PSD can be related to other soil properties;
- Very quick method;
- Very promising when used as a new standard.

Instrument: Beckman-Coulter LS-230 with 750 nm laser beam;
Diffraction model: Mie theory;
Required parameters: Refractive Index (RI): $n_{real} = 1.50$ and $n_{imaginary} = 0.2$;
Solution: 0.1 to 0.5 g soil in 50 g L⁻¹ hexamethaphosphate;
Treatment: Mixed with 1.7 L DI water in fluid module for ultra-sonication;
Pump speed: 8-12 L/min for 1 minute runs

Key references:
 Gee, G.W., and D. Or. 2002 Particle size analysis. IN: Methods of Soil Analysis, Part 4-Physical Methods. Soil Science Society of America. Book Series: 5. Pages 255-293. SSSA, Inc. Madison, Wisconsin.
 Eshel, G., G.J. Levy, U. Mingelgrin, and M.J. Singer. 2003. Critical evaluation of the use of laser light scattering for particle size distribution analysis. Submitted. SSSAJ.