SOPHIE: Harmonization of PSD properties through international collaboration.

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Lublin, Poland, January 16th, 2019

Dr R. Hessel, researcher EU project:
"The urgency of harmonization can also be derived from the amount of time needed to compare results (DESIRE en SoilCare) due to different expertise, different equipment in use, and lack of money."

Particle Size Distribution (PSD): important property in Soil Hydro-Physics

The PSD (with others) partly determines the soil-water interactions, and thus the transport of dissolved compounds (Nutrients, Pesticides, Antibiotics, Organics)

In SHP it is used for:

- Derivation of water retention and conductivity curves
- Soil swelling and shrinking
- Calculation of soil bulk density
- CEC (cation exchange capacity) – salinization & sodification issues as a result of water movement
- Soil sealing
- Soil compaction

Volume% or mass% needed?

This depends on the application of PSD:

- Construction of water retention and conductivity curves. PSD determines pore sizes and contact areas for adhesion of water → volume% or specific surface area
- Soil swelling and shrinking (clay surface area * charge) → volume% or surface area
- Soil bulk density → mass%, or volume% with particle density
- CEC (clay surface area * charge) → volume%

Conclusion: **Volume% seems preferred**. It look as if mass% is evolved as a proximate for the preferred volume%, instead of the other way around.

PSD methods 1/3

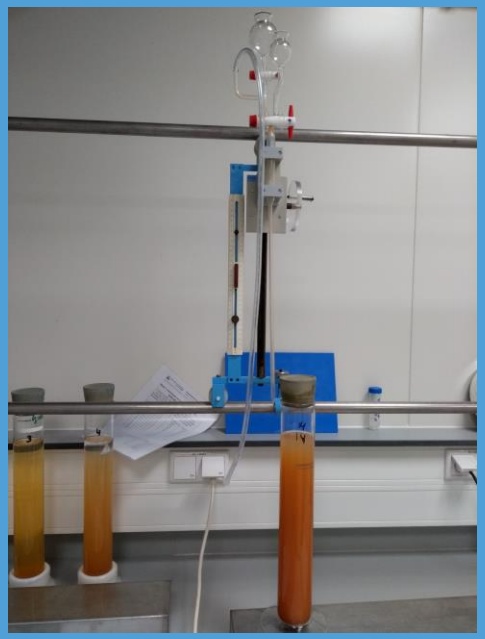
(source Wikipedia)

- **Sieve:** *Mass based*, suitable for large amounts, only determination of large particles, difficult break down of aggregates
- **Air elutriation:** *Mass based*, separation by overflow in upward adjustable air stream, time consuming, not longer used
- **Photoanalysis:** *Volume based*, analysis of a photo with software, volume based, fast
- **Optical counting: (**0.2 - 100 um): *Volume based*

PSD methods 2/3

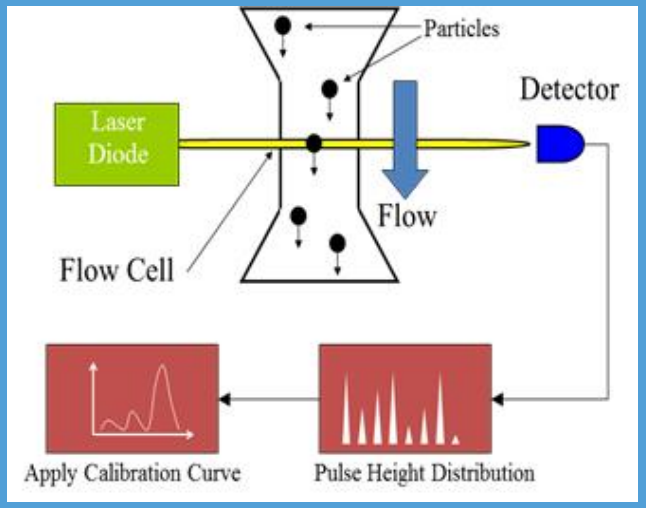
(source Wikipedia)

- **Electroresistance counting (e.g. Coulter counter):** *Volume based*, changes in electrical resistance of a liquid passing an orifice when individual non-conducting particles pass through. Result related to particle cross-section during orifice passing.
- **Sedimentation:** *Mass or Volume based,* disperse sample in liquid, then measure liquid mass density (pipette method<50um or hydrometer<200um) or volume density (X-ray or optical methods) at timed intervals, highly temperature dependent, X-Rays don't count carbon particles



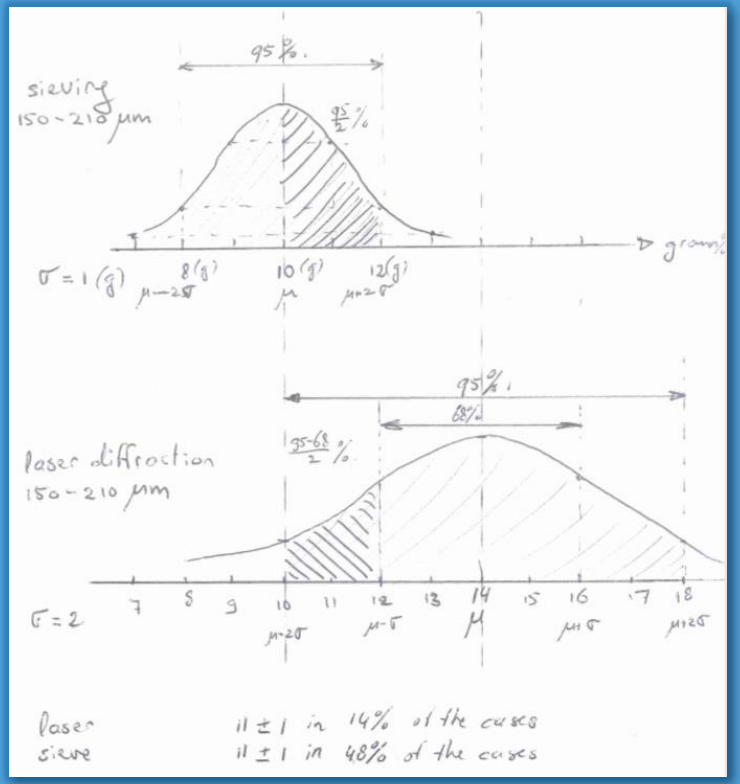
PSD methods 3/3

(source Wikipedia)



- **Laser diffraction:** *Volume based*, large particles scatter light at small angles relative to the laser beam and small particles scatter light at large angles, 0.1 and 3,000 µm, fast
- **Laser Obscuration Time (LOT) / Time Of Transition (TOT):** *Volume based,* time of laser beam obscuration directly relates to the particle's diameter
- **Acoustic (ultrasound attenuation) spectroscopy:** *Volume based,* measuring transmitted energy versus frequency, for any fluid with no dilution or preparation. i.e. big advantage, micron-nanometer scales

SOPHIE has to come with an answer on Harmonization of PSD :



1. What to do with the very valuable (!) history data in mass% if we are going to use volume% instead.
2. Can we use frequency analysis with normal or log-normal distributed variables to combine both?
3. Can we advise a golden, silver and bronze standard that each differs in M% or V%?
4. Focus on EU research alone, or should it be 'common practice' in most of the labs whatever research is done?
5. What first step should we take to harmonize?

What methods are preferred?

For the choice of preferred methods (golden, silver, bronze), we need to know:

1. If a volume% (optical) or mass% (weight) PSD is preferred
2. The cost-effectiveness of the available methods
3. The accuracy of the methods
4. How methods correlate to each other, and whether they can be compared and interchangeably used
5. What methods are most widely used

Basic Development Agenda – Harmonization

- Set Current Situation in Harmonization topic for
  - Field
  - Laboratory

Choose Output Parameter	Inventory of Methods & Standards	Without adjustments choose Golden, Silver, Bronze Method & Standard	Determine Bottlenecks (quality, efficiency, other) Improvements later

- Put outcome on SOPHIE-website and/or in paper with
  - Version number
  - Date
  - Supporting entities

Basic Development Agenda - Innovation

- Use bottlenecks of Harmonization for
  - Field
  - Laboratory

Regulator panel for pressure plate setup

Per Bottleneck	Define (A4) Innovation proposals For Engineers, Researchers, Policy makers PhD's, Students	Prioritize proposals & Share proposals on website	Find collaboration and fund

- Check (intermediate) results with SOPHIE-members
- Share results on SOPHIE-website and/or in paper

Basic Development Agenda - Standardization

- Use inventory of Harmonization for
  - Field
  - Laboratory

Per method/standard define Time Consumption (no costs)	Put Standard Content (or standard number with exceptions) on SOPHIE website	Discuss and improve contents per standard	Update Harmonization "Current situation"

- Share results on SOPHIE-website and/or in paper

Thank you

https://www.wur.nl/en/article/Soil-Program-on-Hydro-Physics-via-International-Engagement-SOPHIE.htm