



SOIL TEXTURE: Some methods and problems

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Dias 1



Why texture analysis?

Soil texture affects several important soil functions in relation to plant growth and environmental protection:

- **Plant available water capacity (PAW)**
- **Plant nutrition (CEC, sorption, weatherability)**
- **Water and wind erodibility**
- **Buffer properties (acidification, retention, vulnerability, resilience)**
- **Hydraulic properties.**

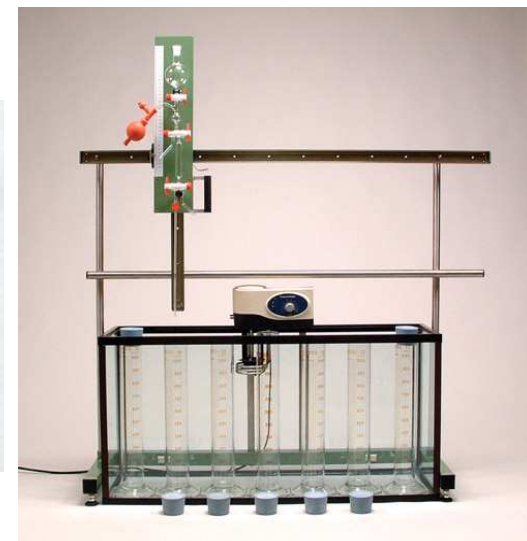


Standard (reference) texture analysis

The combined sieve and sediment (S/S) analysis is the standard method in Denmark and elsewhere.



Sand fraction (20-2000 μm DK) is analyzed by sieving



Silt (2-20 μm i DK) and clay (<2 μm) is determined by sedimentation (Stoke's law)



This sieve/sediment (S/S) analysis has advantages and disadvantages

Advantages:

- **The method is well known(standard)**
- **Simple procedure and equipment.**

Disadvantages:

- **Time and labour demanding**
- **Only $>1 \mu\text{m}$ particles are measured**
- **Normally only few fractions are obtained (clay, silt, sand)**
- **Problems with dispersion due to SOM.**



Influence of SOM on S/S texture analysis.

Measurements before ($-H_2O_2$) and after hydrogen peroxide ($+H_2O_2$) treatment to remove SOM.

Jord nr	Ler (%)		Silt (%)		Sand (%)	
	$+H_2O_2$	$-H_2O_2$	$+H_2O_2$	$-H_2O_2$	$+H_2O_2$	$-H_2O_2$
140134	9,21	4,68	37,55	25,85	53,24	69,47
140135	6,03	4,04	5,15	18,60	88,83	77,36
140136	12,28	7,70	13,66	14,76	74,06	77,54
140137	14,65	12,13	14,46	16,57	70,90	71,30
140138	9,82	6,54	10,99	14,45	79,20	79,00
140139	14,71	11,33	16,71	17,04	68,57	71,62
140140	8,43	4,53	1,34	13,46	90,23	82,01
140141	4,90	3,48	4,25	3,75	90,85	92,76
140142	3,96	2,13	5,91	7,92	90,13	89,95
140143	7,19	3,99	7,56	11,62	85,24	84,39
140573	10,30	10,61	15,99	20,40	73,71	69,00
B24	10,24	9,36	-	-	-	-
Middel	9,31	6,71	12,14	14,95	78,63	78,58



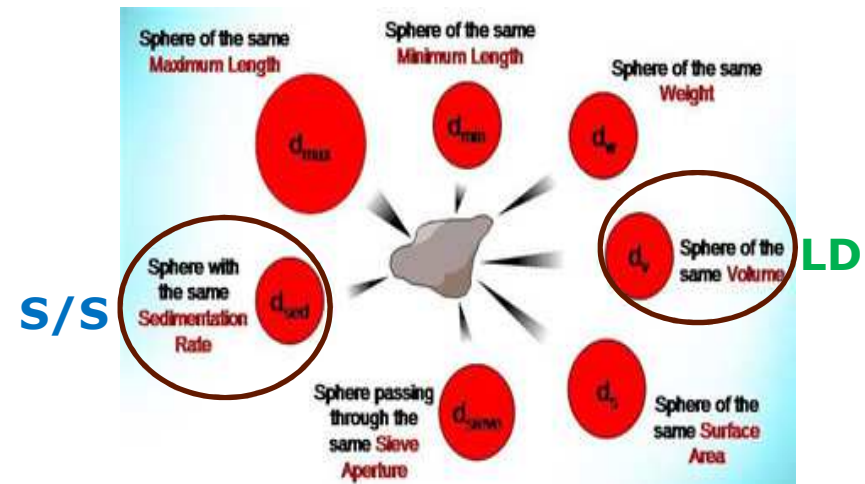
Effects of SOM removal

- Generally the clay content increases and the silt content decreases after H_2O_2 treatment, while the sand content seems unaffected.
- However, no simple relationship seems to exist. Thus, soil 100134 shows doubling of clay content and soil 140140 ten times decrease in silt after H_2O_2 treatment.
- In contrast, the clay content of soil 140573 and silt content of 140139 seem almost unaffected by the H_2O_2 treatment.

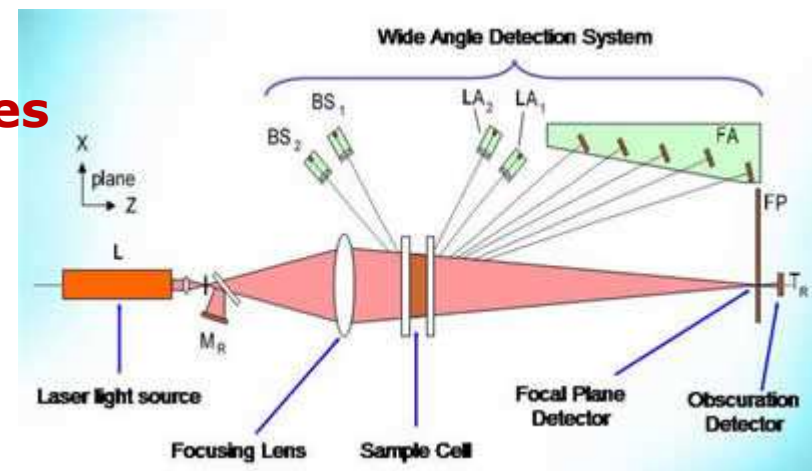


Laser diffraction (LD) analysis

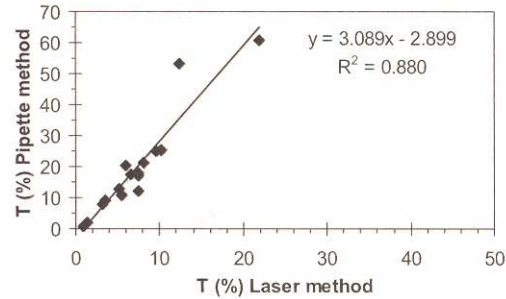
**Particle size:
What is it??**



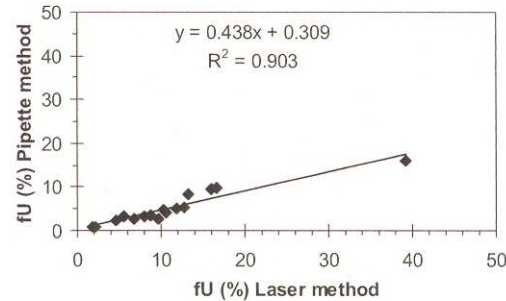
**Diffraction of the laser beam increases
with decreasing particle size:
Diffraction angle \sim particle size
Beam intensity \sim fraction volume.**



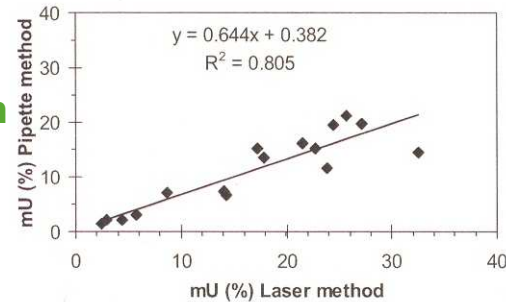
Clay



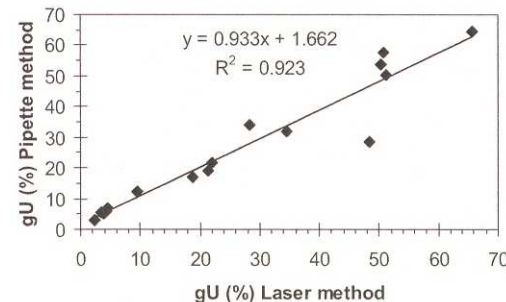
Silt, fine
(2-6 μm)



Silt, medium
(6-20 μm)



Silt, coarse
(20-63 μm)



Comparison of laser (LD) and traditional S/S methods:

Method difference increases with decreasing particle size, ie. great difference between clay contents but little or no difference between sand contents (63-2000 μm).

Fra Taubner et al., 2010



Laser-Diffraction method: +/-

Compared with traditional sieve/sedimentation (S/S) method, Laser Diffraction (LD) method has some advantages :

- LD is fast – a typical analysis takes 5-15 min. (after dispersion)
- LD can give a detailed analysis of particle size distribution in the range 0.02-2000 μm
- The method is volume based, ie. it is independent of particle density.

Disadvantages:

- Compared with S/S method, the LD generally underestimates clay content and overestimates silt content.
- Difficult/impossible to calibrate as there seems to be no unique comparison between clay and silt contents determined by LD and S/S methods!

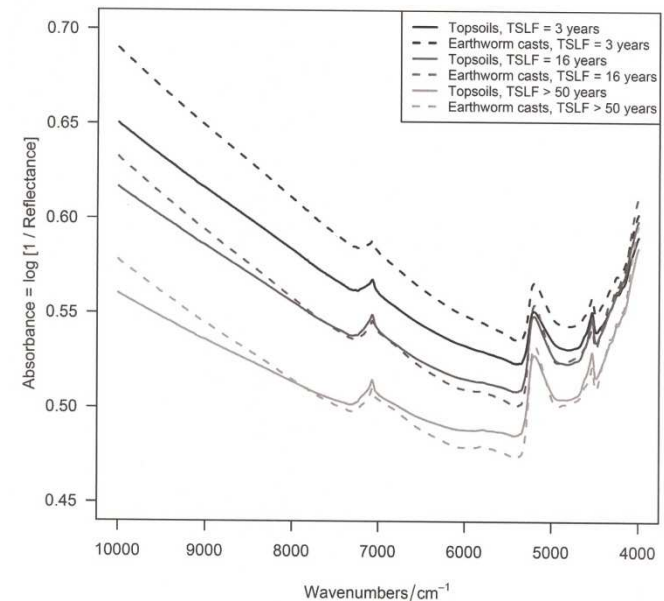


Near Infrared Reflectance Spectroscopy (NIRS)

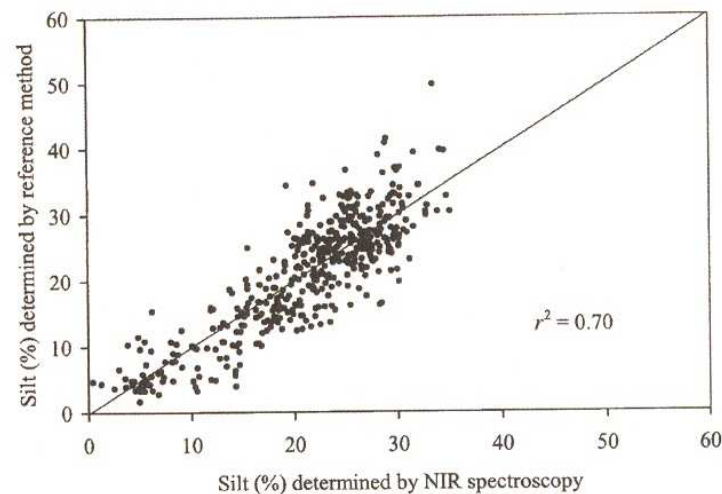
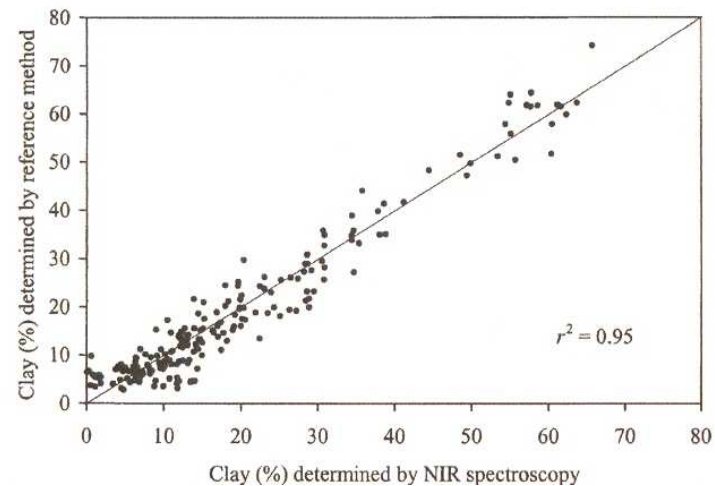
Radiation of samples containing O-H, C-H, N-H bonds with near infrared radiation, weak reflection is emitted:

In NIRS the whole spectrum is used/analyzed:

- Calibration by means of chemometrics using results for many soils obtained by NIRS and standard (S/S) method
- Validation of results by means of other soils.



Comparison: NIRS vs S/S



Fra Sørensen & Dalsgaard, 2005

An investigation of Danish soils gave good results for clay content but less good results for silt and sand contents (but the method was mainly developed for clay content determination).



NIRS: +/-

NIRS offers several advantages:

- **Fast analysis (within a few minutes)**
- **The method is non-destructive with no pretreatment (can be done with a lump of soil)**
- **NIRS seems to be cost-effective**
- **Give 'same' results as S/S method!**
- **Can assess more soil characteristics (texture, %C, %N etc.).**

Main disadvantages by NIRS:

- **Needs calibration with similar soils**
- **Calibration must be validated.**



What to do?

Soil texture can be assessed by more methods but the result depends on the method. A certain method is necessarily not much better than other methods.

We must make our choice:

- **Do we still need to use the S/S as standard (reference) method or maybe only for special analyses (classification, pedotransfer function etc.)?**
- **Are we going to replace S/S by the faster LD or NIRS, and why?**
- **LD results cannot be converted to S/S results. Is it a problem?**
- **????**

