LDA METHODOLOGY AND CHARACTERISTICS OF THE GRAIN SIZE CURVE OF SVITAVA FLOODPLAIN ALLUVIAL SOILS

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Laser diffraction analysis (LDA) is a modern method that can be used to determine soil texture.
Soil texture is an elemental parameter for naming soils and it allows soils mechanical behaviour determination. Grain size indicates the share of individual grain fractions in the soil composition. Coarse-grained and fine-grained (under 0.2 mm) soils are classified. The grain size proportions are graphically represented in *the grain size curve*. The grain size curve expresses *the cumulative frequency of individual fractions*, which is given by their share in the total soil weight (Rejšek, Vácha, 2018).

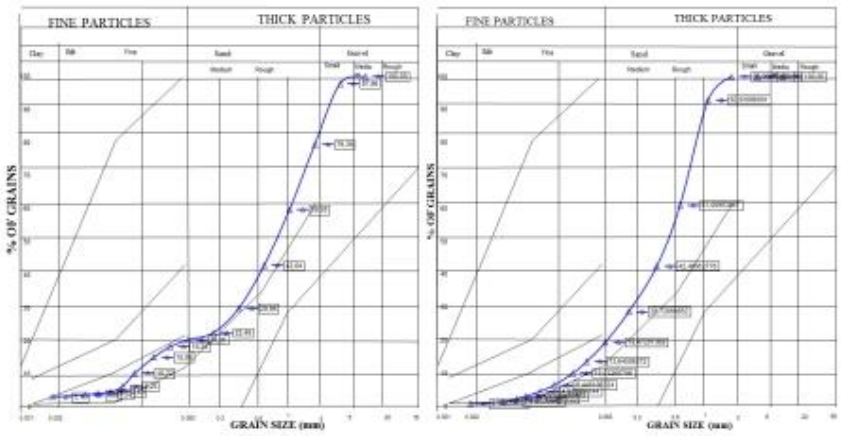

Fig. 1 Grain size curve. Sample 8 measured by a densitometer (left) and LDA (right).

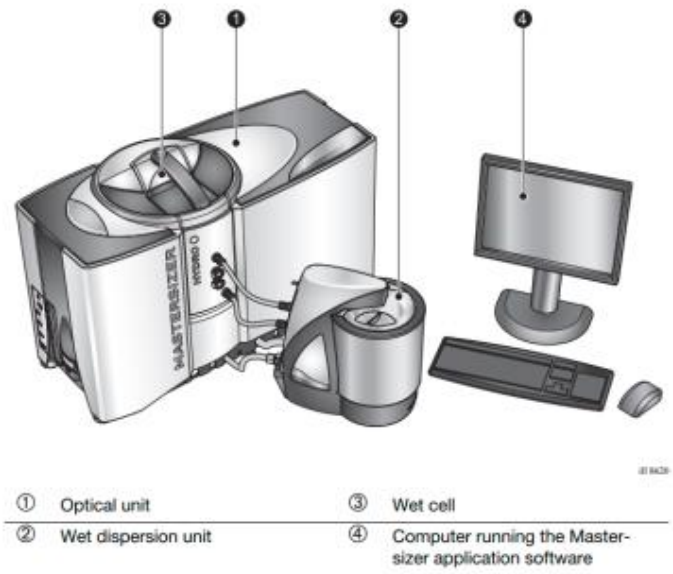

Fig. 2 Laser analyzer Mastersizer 3000 by MALVERN (Malvern, 2020)

The first method is used to determine soil mechanical properties. The grain size curve is created by a combination of sieve analysis and aerometric (densitometer) test. The densitometer test deals with a smaller fraction (under 4 mm) and with cohesive soils, sieve analysis deals with fractions larger than 0, 36 mm and with incoherent soils. *Sieve analysis* (gradation test) consists in sieving the sample through a system of sieves with different meshes. Sieves are sized from 63 mm to 0.63 mm. The sample on each sieve is weighed and a percentage of each fraction is calculated. *Aerometric* (densitometer) test is based on free sedimentation of the suspension (Stoke's law). With the data from these two tests was created the grain size curve (Hanák, 2001).

The second method, *LDA*, is used to measure the particle size in the soil sample. The principle of laser diffraction consists in irradiating the sample particles with a laser beam. Sample particles bend light (diffraction). The angle of light refraction is inversely proportional to the measured particles size – large particles scatter light at a small angle, but with low intensity and vice versa. The light amount that is determined in different directions is used to calculate the particle size and the calculation depends on the sample refractive index and the medium in which it is dispersed. LDA deals with fractions under 2 mm (Šulcová, Beneš, 2008). LDA is used for smaller soil particles as well as another method, the pipette method (Taubner, Roth and Tippkötter, 2009).
Laser analyzer Mastersizer 3000 (Malvern Instruments), which was used in the Department of Landscape Management laboratory, is comprised of the optical unit, dispersion unit and a measurement cell. The wet dispersion was used.
A part of each sample was prepared for sieve analysis and aerometric test and another part was sieved at 2 mm mesh size. From this amount was measured about 20 g and quartering was performed. All samples preparation was the same, without the use of chemicals. Some samples were dried at room temperature and some were dried at 105°C, but all samples were fully dry when the measurement was performed (the samples were dried for practical reasons because the dry soil is better sieved through a sieve with small meshes). After quartering, a small amount of soil (about 1-2 g) was inserted into the laser analyzer. Three measurements were performed, first with no specification, second with entered sieves and third with SOP (SOP is predefined measurement sequence). The second measurement was used for comparison with the aerometric test. The fictitious sieve sizes were entered into the device (fictitious sieves are imaginary sieves calculated from the aerometric test). These data were obtained during the previous measurement with a densitometer. The grain size curve is formed by the cumulative volume in percentage. Laser analyzer processed the specified sieves, but only for the histogram (percentage of individual sizes). For cumulative volume, the two closest sieves had to be selected.
The measurement results differed, in some samples case significantly. There can be several causes, most likely a human error. The first measurements had to be repeated because the method was not stable. Another significant problem is the shape of the grains. Some irregular grains can cause instability in sieve analysis and LDA. Also, the same procedure must always be followed for all compared samples. Further data processing and measurement should be focused on creating a uniform method to prevent these errors.

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