SLOVENSKI STANDARD
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Kakovost tal ï Določ anje količ ine vode kot volumskega deleźa na osnovi znane volumske gostote - Gravimetrijska metoda

Soil quality -- Determination of soil water content as a volume fraction on the basis of known dry bulk density -- Gravimetric method

Qualité du sol -- Détermination de la teneur en eau volumique du sol à partir de la masse volumique apparente sèche connue -- Méthode gravimétrique

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Foreword

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ISO 16586 was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 5, *Physical methods*.

Introduction

The determination of water content volume fraction using coring sleeves, which is described in ISO 11461, is the basic method for determination of the water content volume fraction. This International Standard provides a less precise method than that given in ISO 11461.

Soil quality — Determination of soil water content as a volume fraction on the basis of known dry bulk density — Gravimetric method

1 Scope

This International Standard specifies a method for the gravimetric determination of soil water content as a volume fraction on the basis of the ratio of measured water content mass to known dry bulk density.

This International Standard is applicable to all types of non-swelling or non-shrinking soils. It is used as a reference method (e.g. the calibration of indirect methods for determination of water content).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11465:1993, *Soil quality — Determination of dry matter and water content on a mass basis — Gravimetric method*

3 Terms and definitions

3.1
water content
water content mass fraction
water content mass ratio
ratio of the mass of water evaporating from the soil when dried to constant mass at 105 °C, to the dry mass of the soil sample

NOTE For soil with high content of organic matter, drying at a temperature below 70 °C is usual practice.

3.2
dry bulk density
mass of the solid particles divided by the undisturbed bulk volume of the soil

3.3
water content volume fraction
volumetric water content
ratio of the volume of water evaporating from the soil when dried to constant mass at 105 °C, to the original bulk volume of the soil

4 Symbols

s_x sample standard deviation of variation of variable x;

w water content (mass fraction), expressed in kilograms per kilogram;

Δ_x standard deviation of the errors in variable x;

φ water content volume fraction, expressed in cubic metres per cubic metre;

ρ_b dry bulk density, expressed in kilograms per cubic metre;

ρ_w density of water, expressed in kilograms per cubic metre.

5 Principle

Soil samples are dried to constant mass at 105 °C. The difference in the mass of the soil sample, before and after the drying procedure, is taken as a measure of the water content. The water content (mass fraction) is converted to the water content (volume fraction) by using a known value for the dry bulk density. This method is inherently less accurate than ISO 11461, since the dry bulk density is not determined on the same sample.

NOTE The dry bulk density may be known from previous sampling. If the dry bulk density is not known, it can be determined in accordance with ISO 11272.

6 Apparatus

Equipment for determination of water content as a mass fraction shall be in accordance with ISO 11465.

7 Procedure

Sampling, transport and laboratory treatment of the samples shall be carried out in accordance with ISO 11465.

NOTE Usually larger samples are needed than those specified in ISO 11465. For structured soils, a sample including 20 structural elements is satisfactory for most investigations.

8 Expression of results

Calculate w in accordance with ISO 11465. Compute the water content volume fraction from:

$$\varphi = w\frac{\rho_b}{\rho_w}$$

where

w is the water content mass fraction;

φ is the water content volume fraction;

ρ_b is the dry bulk density of the sample, in kilograms per cubic metre;

ρ_w is the density of water at soil temperature, in kilograms per cubic metre (usually an approximation of 1 000 kg m^{-3} will be satisfactory for this method)

NOTE The water content (mass fraction) in accordance with ISO 11465 is expressed as a percentage. This number can be converted to a decimal fraction by dividing by 100.

9 Accuracy and precision

9.1 Various error sources influence the accuracy of the calculated water content through errors in w, ρ_b and ρ_w. The basic inaccuracies due to sampling, transport and laboratory handling have to be assessed within the procedures given in ISO 11465 (w) and ISO 11272 (ρ_b), as well as the final error in these variables. For convenience, a summary of the assessment of these errors is given in Annex A.

9.2 Temperature differences between the field and laboratory introduce a deviation in ρ_w. If this systematic error occurs, a correction shall be established for it. The uncertainty in this correction shall then be applied as the final systematic error, hence: corr. $\Delta\rho_w$.

9.3 After estimation of the standard deviation of the respective error sources in w, ρ_b and ρ_w, their propagation in the water content can be estimated with the following formula:

$$s_\varphi = \sqrt{\left(\frac{\rho_b}{\rho_w}\right)^2 s_w^2 + \left(\frac{w}{\rho_w}\right)^2 s_{\rho_b}^2 + \left(\frac{\varphi}{\rho_w}\right)^2 s_{\rho_w}^2}$$

where s_φ, s_w, $s_{\rho b}$ and $s_{\rho w}$ are the standard deviations of φ, w, ρ_b and ρ_w respectively.

In the final result one may distinguish between the (total) variable component in time and space $s_\varphi(t,x)$ and the (total) systematic component s_φ (see Annex A).

General guidelines for the actual magnitude of specific error sources cannot be given, since they fully depend on sampling and laboratory practice. Apart from the error sources in ρ_b as elaborated in Annex A, the temporal and spatial variabilities in this variable shall be taken into account, due to differences in both sampling sites and sampling times between w and ρ_b.

10 Test report

The test report shall include following information:

a) reference to this International Standard;

b) an accurate description of the sampling location and depth;

c) the date of field sampling;

d) the mass of the soil sample used for the determination;

e) the dry bulk density value(s) used, the method used to determine the dry bulk density, the time and sites used for the dry bulk density determination(s);

f) the calculated water content (volume fraction);

g) details of any operations not specified in this International Standard, or regarded as optional, as well as any other factors which may have affected the results.