SLOVENSKI STANDARD
SIST ISO 11508:2002

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Kakovost tal - Določevanje gostote delcev

Soil quality - Determination of particle density

Qualité du sol - Détermination de la masse volumique des particules

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Soil quality — Determination of particle density

Qualité du sol — Détermination de la masse volumique des particules

ISO 11508:1998(E)

Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11508 was prepared by Technical Committee ISO/TC 190, *Soil quality,* Subcommittee SC 5, *Physical methods.*

Introduction

The particle density (ρ_s) is used together with the dry bulk density (${}^{b}\rho_s$, see ISO 11272) for the calculation of the pore volume of a soil layer.

Soil quality — Determination of particle density

1 Scope

This International Standard describes two methods for the determination of particle density of soils calculated from the mass and the volume of soil particles.

The first method (4.1) is applicable to fine soil (< 2 mm diameter) and the second method (4.2) is applicable to both porous and nonporous gravel and stones (> 2 mm diameter).

The particle density may be used for the calculation of the proportion of solids and of the porosity of soil layers in combination with the procedure given in ISO 11272.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 565:1990, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings.*

ISO 10381-1:—[1)], *Soil quality — Sampling — Part 1: Guidance on the design of sampling programmes.*

ISO 11272:—[1)], *Soil quality — Determination of dry bulk density.*

ISO 11461:—[1)], *Soil quality — Determination of soil water content on a volume basis — Gravimetric method.*

3 Definition

For the purposes of this International Standard, the following definition applies.

3.1 particle density: Ratio of the total mass of oven-dry solid particles (minerals, organic matter) to the volume of these particles.

NOTE 1 The volume comprises internal pores of soil particles but pore spaces between particles are excluded.

NOTE 2 The preferred SI unit of measurement is kilograms per cubic metre ($kg \cdot m^{-3}$) but grams per cubic centimetre ($g \cdot cm^{-3}$) is also very common. Note that x $g \cdot cm^{-3} = 1000$ x $kg \cdot m^{-3}$

[1)] To be published.

4 Procedure

4.1 Fine soil (< 2 mm diameter)

4.1.1 Principle

The mass of a portion of soil is determined by weighing. The volume of the soil is calculated from the mass and the density of water displaced by the sample in a pyknometer.

4.1.2 Apparatus

4.1.2.1 Pyknometer (20 cm^3 to 50 cm^3): a glass flask fitted with a ground-glass stopper which is pierced lengthways by a capillary opening, and which has a built-in thermometer.

4.1.2.2 Vacuum desiccator.

4.1.2.3 Laboratory balance, capable of weighing to an accuracy of 0,1 mg.

4.1.2.4 Sieve, conforming to ISO 565, aperture size 2 mm.

4.1.3 Sampling

For general information on sampling soils, reference shall be made to ISO 10381-1.

Take a disturbed representative sample from the soil, pass it through a sieve (4.1.2.4) and dry it at room temperature. Determine the reference water content, w, of the air-dried soil in a subsample in accordance with ISO 11461.

4.1.4 Density determination

Weigh a clean, dry pyknometer in air (m_0). Add 10 g to 25 g of air-dried soil (4.1.3) and weigh the pyknometer with the soil (m_S). Add distilled water to the pyknometer to approximately the half-full mark.

Wet and then de-aerate the soil sample in the pyknometer in a vacuum desiccator until there is no further escape of air. Fill the pyknometer completely with distilled, boiled and cooled (de-aerated) water in a weighing room maintained at constant temperature, and insert the stopper so that no air bubbles remain under the stopper and the capillary tube in the stopper is completely filled with water (hold the pyknometer at the neck only during this operation). Then carefully dry the pyknometer without warming it, using filter paper, and weigh it (m_{SW}).

During the procedure, take care to ensure that the capillary tube remains filled with water, and that the temperature does not change.

After weighing, read the temperature of the water to the nearest 0,1 °C and determine its density (ρ_W) from table 1.

Table 1 — Density of water, in grams per cubic centimetre, at different temperatures

°C	ρ_w	°C	ρ_w	°C	ρ_w	°C	ρ_w	°C	ρ_w
10,0	0,999 7	15,0	0,999 1	20,0	0,998 2	25,0	0,997 0	30,0	0,995 7
11,0	0,999 6	16,0	0,998 9	21,0	0,998 0	26,0	0,996 8	31,0	0,995 3
12,0	0,999 5	17,0	0,998 8	22,0	0,997 8	27,0	0,996 5	32,0	0,995 0
13,0	0,999 4	18,0	0,998 6	23,0	0,997 5	28,0	0,996 2	33,0	0,994 7
14,0	0,999 2	19,0	0,998 4	24,0	0,997 3	29,0	0,995 9	34,0	0,994 4

Finally, remove the soil sample from the pyknometer and refill with distilled boiled and cooled water of the same temperature as before, insert the stopper, thoroughly dry the outside with filter paper, and weigh it (m_w), taking care that the temperature remains the same as before.

4.1.5 Calculation

a) Calculate the oven-dry mass of soil (m_d) from equation (1):

$$m_d = \frac{m_s - m_0}{1 + w} \tag{1}$$

where

m_s is the mass, in grams, of pyknometer plus soil sample;

m_0 is the mass, in grams, of the empty pyknometer (pyknometer filled with air);

w is the water content of the air-dried soil sample.

b) Calculate the soil particle density, ρ_s, in grams per cubic centimetre, using equation (2):

$$\rho_s = \frac{\text{mass}}{\text{volume}} = \frac{\rho_w \cdot m_d}{m_d - (m_{sw} - m_w)} = \frac{\rho_w \cdot m_d}{m_d + m_w - m_{sw}} \tag{2}$$

where:

m_d is the oven-dried mass, in grams, of the soil sample;

ρ_w is the density of water, in grams per cubic centimetre, at the temperature observed (see table 1);

m_{sw} is the mass, in grams, of pyknometer filled with soil and water;

m_w is the mass, in grams, of pyknometer filled with water at the temperature observed.

4.2 Gravel and stones (> 2 mm diameter)

4.2.1 Apparatus

4.2.1.1 Laboratory balance, with thin wire attached to the weighing beam, from which a light frame can be suspended. The frame serves as a platform for a weighing dish with a small container so that both frame and dish can be immersed in a large container of water during weighing (see figure 1).

4.2.1.2 Vacuum desiccator with self-indicating desiccant.

4.2.1.3 Thermometer.

4.2.2 Density determination

Weigh the weighing dish of the balance (m_0). Clean the gravel and stones (for example by shaking them with sodium hexametaphosphate solution), wash in water, and dry them at (105 ± 2) °C.

Place the gravel and stones in the small container of the dish and weigh them (m_s). Then fill the small container with distilled, boiled and cooled water. Put this container in a vacuum desiccator and de-aerate twice for 10 min, allowing air to enter the desiccator between evacuations. Then put this container on the weighing dish and submerge dish with the container in a large container containing distilled, boiled and cooled water and carefully reweigh while the stones and gravel are suspended in the water (m_{sw}). Remove and discard the sample, clean the weighing dish with its container, and weigh it while it is submerged in water (m_w). Measure the temperature of the water, and from table 1, determine its density (ρ_w).