INTERNATIONAL STANDARD

ISO 5311

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Fertilizers — Determination of bulk density (tapped)

Engrais — Détermination de la masse volumique après tassement

Reference number
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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 5311 was prepared by Technical Committee ISO/TC 134, *Fertilizers and soil conditioners*, Sub-Committee SC 3, *Physical properties*.

This third edition cancels and replaces the second edition (ISO 5311:1983), which has been technically revised.

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Introduction

The bulk densities (loose and tapped) of a fertilizer provide information relative to the required size of packaging materials, store-houses, stock-rooms, etc. Generally, the bulk density (tapped) is up to 10 % greater than the bulk density (loose), and sometimes it may exceed this value. Both bulk densities depend on the actual density, surface form and particle size of the fertilizers.

The bulk density (loose) can be used to calculate the maximum volume of a given weight of fertilizer which may be expected in practice. The actual volume occupied by a given weight of fertilizer will normally be within the range calculated from the bulk density (loose) and the bulk density (tapped).

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Fertilizers — Determination of bulk density (tapped)

1 Scope

This International Standard specifies two methods for the determination of the bulk density (tapped) of solid fertilizers:

- the machine-tapping method (method 1);
- the hand-tapping method (method 2).

These methods are applicable to dry fertilizers only. If the fertilizer has absorbed moisture during transport or storage, it is necessary to dry it in an environmental chamber, with constant low humidity, prior to the determination.

Neither method is suitable for materials which contain a large proportion of particles exceeding 5 mm in diameter.

Method 2 is applicable only to spherical granules and to prills. It is not applicable to sharp-edged grains.

NOTE 1 Because of the differences in tapping technique, the two methods will not necessarily give the same value for the bulk density (tapped).

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 3944:1992, *Fertilizers — Determination of bulk density (loose).*

ISO 7742:1988, *Solid fertilizers — Reduction of samples.*

ISO 8358:1991, *Solid fertilizers — Preparation of samples for chemical and physical analysis.*

3 Definition

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

3.1 bulk density (tapped) of a fertilizer: The mass per volume of a material tipped into a container and then compacted under clearly specified conditions.

The bulk density (tapped) is expressed in grams per cubic centimetre (g/cm^3).

4 Preparation of test sample

Prepare the test sample by the methods given in ISO 7742 and ISO 8358, ensuring that the sample is sufficient to carry out two separate determinations.

5 Method 1 — Machine-tapping method

5.1 Principle

Pouring of the fertilizer from a specified funnel into a specified measuring cylinder of known volume, tapping by means of a tapping machine, and weighing of the contents of the cylinder.

5.2 Apparatus

5.2.1 Balance, capable of weighing to the nearest 1 g.

5.2.2 Apparatus for determination of bulk density (loose), according to ISO 3944, with a collar of transparent plastic and a measuring-cylinder holder with guide clamp (see figure 1).

5.2.3 Tapping machine, having a camshaft the cams of which lift the guide clamp, measuring-cylinder holder and measuring cylinder once per revolution. The rotational frequency of the camshaft shall be 250 $\text{min}^{-1} \pm 15\ \text{min}^{-1}$. (See figure 1.)

5.2.4 Spatula, approximately 120 mm × 20 mm, or other suitable scraper.

5.3 Procedure

Pour into the closed funnel of the apparatus (5.2.2) a quantity of the fertilizer greater than that needed to fill the measuring cylinder.

Fully open the slide of the funnel so that the contents discharge into the measuring cylinder in 6 s to 12 s.

If the fertilizer does not flow freely, keep the outlet clear by inserting a rod of 3 mm to 4 mm diameter into the opening.

Remove the measuring cylinder from its holder, slip on the plastic collar and add by hand a quantity of fertilizer such that, after tapping, the fertilizer still remains several centimetres above the top of the measuring cylinder.

Place the measuring cylinder firmly in its holder in the tapping machine, and tap 2 500 times.

Remove the measuring cylinder from the tapping machine, remove the collar, and scrape away the surplus fertilizer heaped on the measuring cylinder by means of the spatula (5.2.4).

Weigh the contents of the measuring cylinder to the nearest 1 g of the total mass.

Carry out two determinations, in rapid succession, on separate test portions taken from the same test sample.

6 Method 2 — Hand-tapping method

6.1 Principle

Pouring of the fertilizer from a specified funnel into a specified measuring cylinder of known volume, tapping the walls of the cylinder by hand, and weighing of the contents of the cylinder.

6.2 Apparatus

6.2.1 Balance, capable of weighing to the nearest 1 g.

6.2.2 Apparatus for the determination of bulk density (loose), according to ISO 3944.

6.2.3 Spatula, approximately 120 mm × 20 mm, or other suitable scraper.

6.2.4 Rod, made of wood, plastic or similar material, about 200 mm long and about 10 mm in diameter.

6.3 Procedure

Pour into the closed funnel of the apparatus (6.2.2) a quantity of the fertilizer greater than that needed to fill the measuring cylinder.

Open the slide of the funnel so that the contents discharge into the measuring cylinder in 20 s to 25 s. During the discharge, tap the sides of the measuring cylinder gently two to three times per second with the rod (6.2.4) to ensure compaction of the material.

If the fertilizer does not flow freely, keep the outlet clear by inserting a rod of 3 mm to 4 mm diameter into the opening.

Close the slide of the funnel, then twice raise the measuring cylinder 2 mm to 3 mm and drop it to complete the compaction. Scrape away the surplus fertilizer heaped on the measuring cylinder by means of the spatula (6.2.3).

Remove the measuring cylinder from below the funnel and weigh its contents to the nearest 1 g of the total mass.

Carry out two determinations, in rapid succession, on separate test portions taken from the same test sample.

7 Expression of results

7.1 Method of calculation and formula

The bulk density (tapped), ρ_t, of the fertilizer is given, in grams per cubic centimetre, by the equation

$$\rho_t = \frac{m}{V}$$

where

m is the mass, in grams, of the test portion;

V is the volume up to the brim, in cubic centimetres, of the measuring cylinder.

Take as the result the arithmetic mean of the two determinations if the requirement concerning repeatability (see 7.2) is satisfied.

7.2 Repeatability

The difference between the results of two determinations, carried out in rapid succession by the same