INTERNATIONAL STANDARD

ISO 8398

Solid fertilizers — Measurement of static angle of repose

Engrais solides — Mesurage de l'angle du talus d'éboulement

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 approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8398 was prepared by Technical Committee ISO/TC 134, *Fertilizers and soil conditioners*.

Solid fertilizers — Measurement of static angle of repose

1 Scope

This International Standard specifies a method for the measurement of the static angle of repose of solid fertilizers. The method is applicable to free flowing fertilizers and is suitable for measuring static angles of repose greater than 20°; the method is not suitable for materials which contain a large proportion of particles exceeding 5 mm in diameter.

NOTE — The measurement of the static angle of repose is of importance for the calculation of storage capacities. The angle measured according to this method is normally the maximum value resulting in practice. For the determination of the dynamic angle of repose (angle of slide) other methods (e.g. a tilting box method) are available.

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 listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3944 : 1980, *Fertilizers — Determination of bulk density (loose)*.

ISO 5725 : 1986, *Precision of test method — Determination of repeatability and reproducibility for a standard test method by inter-laboratory tests*.

3 Definition

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

static angle of repose : The angle at the base of the cone of fertilizer obtained by allowing a sample to fall onto a horizontal base-plate under specified conditions.

4 Principle

Measurement of the height and diameter of the base of the cone of fertilizer obtained by allowing a sample to fall through a fixed distance from a defined funnel onto a horizontal base-plate. Calculation of the angle of repose.

5 Apparatus

Only the dimensions given in the text are mandatory.

The apparatus (see figure 1) shall be composed of the following parts:

5.1 Funnel, of rigid plastics or stainless steel, having a spout of internal diameter 25 mm and fitted with a slide.

NOTE — The funnel illustrated in figure 1 is identical to that specified in ISO 3944.

5.2 Square base-plate, 750 mm × 750 mm, of rigid construction, made of metal, plastic or wood. The base-plate shall be plain, undeformable and damp-proof. Its surface shall not be polished but shall be matt; if necessary, this condition can be achieved by fixing a suitable filter paper on the surface of the base-plate. Four straight lines shall be drawn at angles of 45° to each other, intersecting at the centre of the plate.

5.3 Funnel support, comprising a frame of substantial construction to support the funnel (5.1) so that the axis of the funnel passes through the centre of the base-plate and the tip of the funnel spout is 120 mm above the surface of the base-plate.

6 Procedure

6.1 Test sample

Take a test sample of appropriate size.

NOTE — Usually 10 kg will be sufficient.

6.2 Determination

6.2.1 Carry out the determination at ambient temperature.

6.2.2 Check that the base-plate (5.2) is level and that the funnel (5.1) is properly located and fixed in the support (5.3).

6.2.3 Pour the test sample (6.1) into the funnel (5.1) with the slide closed. Then open the slide and allow the fertilizer to discharge in a steady stream, taking care not to vibrate the apparatus. If the amount of fertilizer is not sufficient, i.e. if the top of the cone which is formed on the base-plate does not

reach the tip of the funnel spout, pour an additional amount of the test sample into the funnel in a steady stream with the slide still open until the top of the cone reaches the tip of the funnel spout.

Mark the circumference of the base of the cone on the eight radii drawn on the base-plate, ignoring any grains which form only a single layer around the base of the cone. Remove the fertilizer from the base-plate and measure the four marked diameters.

7 Expression of results

The angle of repose, α, expressed in degrees, is given by the equation

$$\alpha = \arctan\left(\frac{240}{\bar{d}-25}\right)$$

or

$$\alpha = \arctan\left(\frac{2h}{\bar{d}-d_i}\right)$$

where

h is the height of the cone, in millimetres;

$\bar{d}$ is the arithmetic mean of the four diameters measured as specified in 6.2.3, in millimetres;

d_i is the internal diameter of the funnel spout, in millimetres.

8 Precision

The precision of the method was established by an inter-laboratory test carried out in accordance with ISO 5725. For the obtained repeatability limit and reproducibility limit a probability level of 95 % holds.

8.1 Repeatability

The absolute difference between two single test results, obtained under repeatability conditions, will exceed 1° on average not more than once in 20 cases. Both results should be considered suspect if this limit is exceeded.

NOTE — repeatability conditions: Conditions where mutually independent test results are obtained with the same method on identical test material in the same laboratory by the same operator using the same equipment under the same conditions within short intervals of time.

8.2 Reproducibility

The absolute difference between two single test results, obtained under reproducibility conditions, will exceed by more than 2° on average not more than once in 20 cases. Both results should be considered suspect if this limit is exceeded.

NOTE — reproducibility conditions: Conditions where test results are obtained with the same method on identical test material in different laboratories with different operators using different equipment under different conditions.

9 Test report

The test report shall include the following particulars:

a) the reference of the method used, i.e. ISO 8398;

b) the results and the method of expression used;

c) details of any unusual features noted during the determination;

d) details of any operations not specified in this International Standard, or in the International Standard to which reference is made, or regarded as optional.