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Solid fertilizers — Method of checking the performance of mechanical devices for sampling of product moving in bulk

Matières fertilisantes solides — Méthode de contrôle des performances des appareils mécaniques d'échantillonnage du produit en vrac en mouvement

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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 5308 was prepared by Technical Committee ISO/TC 134, *Fertilizers and soil conditioners*, Sub-Committee SC 2, *Sampling*.

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Solid fertilizers — Method of checking the performance of mechanical devices for sampling of product moving in bulk

1 Scope

This International Standard specifies a method of checking the performance of mechanical devices for sampling fertilizers moving in bulk by comparison of particle size distribution with that obtained by a reference method.

It is applicable to any form of mechanical sampling device installed at some point in a bulk-handling system, providing that either the fertilizer passes along a conveyor belt, before or after the device, or it is subsequently packed in bags in order that a reference collection can be made.

NOTE 1 Although the mechanical sampling may be used for the collection of samples for chemical analysis instead of or as well as for physical testing, any bias will be more easily and economically found by size analysis than by chemical analysis of the nutrients.

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 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval.*

ISO 3301:1975, *Statistical interpretation of data — Comparison of two means in the case of paired observations.*

ISO 3310-1:1990, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth.*

ISO 3534:1977, *Statistics — Vocabulary and symbols.*

ISO 3963:1977, *Fertilizers — Sampling from a conveyor by stopping the belt.*

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

ISO 8397:1988, *Solid fertilizers and soil conditioners — Test sieving.*

3 Principle

Collection of two series of increments, one using a mechanical device and one using a reference method, from a quantity of fertilizer passing through a bulk-handling system, and comparison of the means and variances of the particle size distribution of the two samples.

4 Apparatus

4.1 Rotary sample divider, complying with the requirements of ISO 7742.

4.2 Sample containers

4.3 Set of sieves, complying with the requirements of ISO 3310-1, of nominal aperture sizes 4,00 mm, 3,35 mm, 2,80 mm, 2,36 mm, 2,00 mm, 1,40 mm, 1,00 mm and 0,50 mm.

4.4 Sieve-shaking machine

5 General conditions

The method of test specified in this International Standard should be carried out using a granular fertilizer. The use of a blended product may introduce additional sources of variation.

If only blended fertilizer is available for this test, increments of at least 200 g shall be collected (see 6.1.1).

It may be necessary to check the variability of the product before carrying out this test method in order to decide whether to take more increments than are specified, or to be able to conduct the test over a shorter period of time. A statistician should be consulted on the most efficient and economical method of carrying out such a check.

The test shall be carried out while at least 20 t (and preferably not more than 100 t) of fertilizer passes through the mechanical sampling device.

6 Procedure

6.1 Collection of increments

Carry out the operations described in 6.1.1 and 6.1.2 concurrently.

6.1.1 Using the mechanical sampling device under test, collect at least 50 increments of a suitable size[1] and label them from A_1 to A_{50}, etc.

6.1.2 Carry out one of the following reference collections.

a) If the fertilizer is conveyed by a conveyor belt feeding to, or extracting from, the mechanical sampling device, collect the same number of increments as collected in accordance with 6.1.1 by stopping the conveyor belt as specified in ISO 3963. If possible, synchronize the taking of the increments by the device under test with the taking of increments by the reference method, so that corresponding increments are taken from the same part of the fertilizer bed (see 7.2). For example, if the reference sample is taken after the sample taken by the mechanical sampling device, it may be possible to see the gap in the fertilizer bed on the conveyor belt.

b) Collect the same number of full bags as the number of increments specified in 6.1.1, from the same tonnage of fertilizer, at intervals corresponding as closely as possible to the time-intervals at which increments are taken in accordance with 6.1.1.

Label the reference increments or bags R_1 to R_{50}, etc.

If necessary, reduce the size of the increments, or the quantities of fertilizers taken in bags, to approximately the same size as those collected in 6.1.1, by the method specified in ISO 7742.

6.2 Preparation of samples

Combine the increments into equal groups to give at least 10 individual samples taken by the same method (6.1.1 and 6.1.2). The groups shall be formed of consecutive increments, for example A_1 to A_5, A_6 to A_{10}, . . ., A_{46} to A_{50}, etc.

Mix each of the individual samples thoroughly, then, proceeding in accordance with ISO 7742 using the rotary sample divider (4.1), reduce each sample to a suitable mass (200 g to 250 g) for particle-size analysis.

6.3 Analysis of samples

Carry out a particle-size analysis on each of the reduced samples, obtained as described in 6.2, by the method described in ISO 8397 using four or five sieves from the set (4.3), chosen to suit the fertilizer used in the test. Use the same sieves for the analysis of each reduced sample. Record the percentages of fertilizer retained on each sieve and the percentage passing through the sieve with the smallest aperture.

7 Expression of results

7.1 General case where the increments taken by the two methods do not correspond exactly to each other

For each series of n reduced samples, calculate the mean and the standard deviation for the percentage of fertilizer retained successively on each of the sieves and the percentage passing through the sieve with the smallest aperture size used.

For each successive test sieve, calculate the value of the statistic t by means of the formula

$$t = \frac{\sqrt{n}(\bar{x}_A - \bar{x}_R)}{\sqrt{s_A^2 + s_R^2}}$$

where

$\bar{x}_A$ and s_A are the mean and the standard deviation for the reduced samples obtained using the device (6.1.1);

1) Information on the minimum mass of an increment is given in ISO/TR 7553:1987, *Fertilizers — Sampling — Minimum mass of increment to be taken to be representative of the total sampling unit.*

$\bar{x}_R$ and s_R are the mean and the standard deviation for the reduced samples obtained using the reference method (6.1.2).

Refer to the statistical tables in ISO 2602 for the significance of the values of t obtained with $2(n-1)$ degrees of freedom.

7.2 Special cases where the increments taken by the two methods correspond exactly to each other

For each pair of reduced samples, calculate the difference between the percentages of fertilizer retained on each sieve in turn and the percentage passing through the sieve of smallest aperture size used. Calculate the mean $\bar{d}$ and the standard deviation s_d of these differences for each test sieve in turn and for the undersize fraction, and calculate the value of the statistic t by means of the formula

$$t = \frac{\sqrt{n \cdot \bar{d}}}{s_d}$$

Refer to the statistical tables in ISO 3301 for the significance of the values of t obtained with $(n-1)$ degrees of freedom.

8 Interpretation of results

The interpretation of the individual results depends on the precision that is both acceptable and practically feasible. It is to be expected that the most significant bias will be shown by the results for the percentages of fertilizer retained on the sieve of largest aperture size and passing through the sieve of smallest aperture size used for the test, and the least significant bias by the results for the intermediate sieves.

A mechanical sampling device shall be rejected if any of the values of t for the percentages of fertilizer retained on the sieve of largest aperture size and the percentages of fertilizer passing through the sieve of smallest aperture size are significant at the 95 % confidence level.

The device shall be accepted as being without bias if all the values of t are not significant at the 95 % confidence level.

In other cases, e.g. where one of the values of t is significant at the 95 % confidence level, indicating the possibility of bias, the tests should be repeated on a larger number of samples.

NOTE 2 As tests of this sort, requiring larger numbers of samples, are tedious and costly to carry out, it is recommended that a statistician be consulted before further tests are carried out.

Additional information on the performance of the tested device can be obtained by comparing the variances s_A^2 and s_R^2 obtained in 7.1 using the F-test as defined in ISO 3534.

In the special case (7.2), s_A^2 and s_R^2 may be calculated in the normal way from the individual results.

If a significantly larger variance is obtained for the tested mechanical device than for the reference method, this implies that the device is not reliable.