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Copper, lead, and zinc sulfide concentrates — Determination of transportable moisture limits — Flow-table method

Concentrés sulfurés de cuivre, de plomb et de zinc — Détermination des limites d'humidité transportable — Méthode de la table d'écoulement

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12742 was prepared by Technical Committee ISO/TC 183, *Copper, lead, zinc and nickel ores and concentrates*.

This second edition cancels and replaces the first edition (ISO 12742:2000), which has been technically revised.

Introduction

ISO 12742:2000 was published as a guidance document because there had been insufficient test programme participants to allow precision data to be derived. However, it had been agreed that ISO/TC 183/WG 11 be kept in existence, as there was likelihood that a precision test programme could be held at a later time.

Revision of ISO 12742 was commenced in 2005, on the basis that changes to the procedure were necessary, and there were then sufficient participants to allow a test programme to be conducted.

In the final analysis, insufficient participants were identified. However, the International Standard has been revised for a further edition as a guidance document.

Copper, lead, and zinc sulfide concentrates — Determination of transportable moisture limits — Flow-table method

WARNING — This International Standard may involve hazardous materials, operations and equipment. It is the responsibility of the user of this International Standard to establish appropriate health and safety practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies a flow-table method for the determination of the transportable moisture limit (TML) of copper, lead and zinc sulfide concentrates, which may liquefy during transport.

This International Standard is applicable to the determination of the TML of concentrates containing 10 % to 80 % (mass fraction) of lead, or 10 % to 65 % (mass fraction) of zinc, or 10 % to 55 % (mass fraction) of copper. It is applicable to TMLs in the range 3 % to 28 % (mass fraction).

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 10251, *Copper, lead, zinc and nickel concentrates — Determination of mass loss of bulk material on drying*

ISO 12743, *Copper, lead, zinc and nickel concentrates — Sampling procedures for determination of metal and moisture content*

3 Principle

The moisture content of the sample is adjusted by mixing with water. The mixture is converted to a conical shape using a mould and tamper. The sample is placed on the flow table and the mould is removed. The flow characteristics are determined by repeated dropping of the flow table, while observing the behaviour of the sample. When sufficient water has been added to the sample so that plastic deformation occurs during the dropping of the flow table, the sample is considered to be at its flow moisture point.

The TML is calculated as 90 % of the flow moisture point.

4 Apparatus

Copper, lead and zinc concentrates may gain or lose moisture rapidly when exposed to air. The laboratory should be designed so that excessive temperatures, direct sunlight, air currents and humidity variations are avoided.

4.1 Flow table and frame, as specified in Annex A.

The flow-table mounting shall be as specified in Figure A.1.

4.2 Mould, as specified in Figure A.1.

4.3 Tamper.

The required tamping pressure may be achieved by using calibrated, spring-loaded tampers or some other suitable design of tamper that allows a controlled pressure to be applied via a 30 mm diameter tamper head as specified in Figure A.2.

4.4 Calliper ruler.

4.5 Balance, top loading, having the sensitivity specified in Table 1.

Table 1 — Sensitivity of balance and precision of weighing

Mass of sample plus tray g	Precision of balance and weighing g
100	0,01
200	0,02
300	0,03
400	0,04
500	0,05

4.6 Measuring cylinder, of capacity 50 ml to 200 ml.

4.7 Burette, of capacity 10 ml.

4.8 Mixing bowl, hemispherical, of diameter approximately 30 cm.

NOTE It is advisable to use an automatic mechanical mixer having a mixing bowl as described, as this leads to improved precision.

4.9 Rubber gloves.

4.10 Drying trays or pans, having dimensions that permit the sample to be spread to a thickness of less than 30 mm.

The trays shall be made of corrosion-resistant and heat-resistant material, such as stainless steel, glass or enamel plate.

4.11 Drying oven, ventilated, with forced circulation of air or inert gas, regulated at a temperature of 105 °C ± 5 °C.

4.12 Airtight containers.

5 Sampling and sample preparation

5.1 General

TML figures are required to be updated on a periodic basis, usually six monthly, or when there is a known change to the process used to produce the material. The reported figure should be the mean of samples taken during the period.

To ensure that the TML result is representative, increments of the material shall be taken either

a) while a stockpile is being built up or broken down, or

b) while loading or discharging a vessel.

These increments are combined to form the sample used to determine TML.

The sample used to determine TML should not be used to determine moisture.

Stationary sampling of stockpiles should never be used for the determination of TML. This method of sampling can only be used to provide an indicative moisture value for use during the planning of shipping schedules.

5.2 Laboratory sample

Samples for the determination of TML shall be taken in accordance with ISO 12743. The laboratory sample shall not weigh less than 12 kg. To minimize changes to the flow characteristics of the sample, it shall not be oven dried or ground during its preparation.

5.3 Sample preparation

Homogenize the laboratory sample as quickly as possible to prevent losses. Take nine test samples as follows:

a) Sample 1

Take not less than 1 kg, which is to be used for determining the moisture content of the sample "as received", from the laboratory sample and place on a drying tray or pan.

b) Sample 2

Take approximately 1,2 kg from the laboratory sample. This sample is to be used for the preliminary TML test. Store this sample in an appropriately labelled airtight container.

c) Samples 3 to 6

Take four samples of approximately 1,2 kg from the laboratory sample. These samples are to be used for the main TML test. Store these samples in appropriately labelled airtight containers.

d) Samples 7 to 9

Take three samples of approximately 1,2 kg from the laboratory sample. These samples are to be used for confirmation of TML by the graphical method. Store these samples in appropriately labelled airtight containers.

6 Procedure

6.1 General

Copper, lead and zinc concentrates may undergo rapid changes in moisture when exposed to air, so all stages of the test should be accomplished in the shortest time period and shall definitely be completed within the day of commencement. Where possible, sample containers should be covered with plastic film or any other suitable airtight cover.

The moisture result from Sample 1 provides information about how far the material under test is from the flow moisture point.

As more accurate results are obtained when the moisture of the test portion is close to the flow moisture point, a preliminary test is carried out (Sample 2). The result of this test is used to adjust the moisture of the final test portion to 1 % to 2 % below (Samples 3 and 4) and above (Samples 5 and 6) the flow moisture point.

To check the main flow moisture point graphically, three more samples (Samples 7 to 9), having moisture values higher than the flow moisture point, are tested. The flow moisture point is the extrapolation to zero of the linear adjustment of the seven test portions. The value obtained this way will be used to validate the main flow moisture point.

6.2 Preparation of test portions

6.2.1 General

Sample 1 is prepared in accordance with ISO 10251. Proceed to 6.7.

Samples 2 to 9 are prepared in accordance with 6.2.2 to 6.2.6.

6.2.2 Filling the mould

Place the mould on the centre of the flow table and fill it in three stages with the test portion as follows:

a) the first charge, after tamping, shall aim to fill the mould to approximately one-third of its depth;

b) the second charge, after tamping, shall fill the mould to about two-thirds of its depth;

c) the third and final charge, after tamping, shall reach to just below the top of the mould (see Figure 1).

The quantity of test portion required to achieve each of these stages will vary from one material to another, but is readily established after experience has been gained on the packing characteristics of the material being tested.

6.2.3 Tamping pressure

The aim of tamping is to simulate the amount of compaction prevailing at the bottom of a shipboard cargo for the material being tested. The correct pressure to be applied via the tamper is calculated as follows:

$$p_T = \rho_D \times d_{max} \times g \quad (1)$$

where

p_T is the tamping pressure, in pascals;

ρ_D is the bulk density, in kilograms per cubic metre;

d_{max} is the maximum depth of the cargo, in metres;

g is the acceleration due to gravity (= 9,81 m/s^2).

If, when calculating the tamping pressure, there is no information available concerning the cargo depth, use the maximum likely depth.

Alternatively, the pressure may be estimated from Table 2.

Table 2 — Tamping pressures (kPa) for selected concentrates[a]

Typical concentrate type	Bulk density kg/m^3	Maximum cargo depth			
		2 m	5 m	10 m	20 m
Copper	2 000	39 [2,8]	98 [6,9]	196 [13,9]	392 [27,7]
Lead	2 100	41 [2,9]	103 [7,3]	206 [14,6]	412 [29,1]
Zinc	1 950	38 [2,7]	96 [6,8]	192 [13,5]	384 [27,1]

[a] Values in square brackets are equivalent kilogram-force (kgf) when applied via a 30 mm diameter tamper head.

6.2.4 Tamping procedure

The number of tamping actions (applying the correct, steady pressure each time) should be about 35 for the bottom layer, 25 for the middle layer and 20 for the top layer. Tamping shall be performed successively over the complete area, including the edges of the sample, to form a uniform surface for each layer (see Figure 1).

6.2.5 Removal of the mould

Tap the mould on its side until it becomes loose, leaving the material in the shape of a truncated cone on the flow table. Clean the surface of the table around the cone. Measure the size of the cone in the three directions marked on the table. The average of these readings will be equivalent to zero displacement.

6.2.6 Dropping the flow table

Immediately after removing the mould, raise and drop the flow table up to 50 times through a height of 12,5 mm ± 0,13 mm at a rate of 25 times per minute. While the flow table is going through these cycles, observe the behaviour of the material using the information provided in 6.3 as a guide for determining the flow state.

6.3 Identification of the flow state

The impacting action of the flow table causes the grains of the material to rearrange themselves to produce compaction of the mass. As a result, the fixed volume of moisture contained in the material at any given level increases as a percentage of the total volume. A flow state is considered to have been reached when the moisture content and compaction of the material produce such a level of saturation that plastic deformation occurs. At this stage, the moulded sides of the cone may deform, giving a convex or concave profile (see Figure 2). With repeated action of the flow table, the cone continues to slump and to flow outwards. In certain materials, cracks may also develop on the top surface.