Doc: MED 17 (27270)wc
January 2025

BUREAU OF INDIAN STANDARDS

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भारतीय मानक **मसौदा**

पीसने की क्षमता की इंडेक्स— परीक्षण पद्धति

Draft *Indian Standard*

GRINDABILITY INDEX — METHOD OF TEST

ICS 25.080.50

Chemical Engineering Plants and Related Equipment Sectional Committee, MED 17	Last date for receipt of comments is **28 February 2025**

FOREWORD
(*Formal clause would be added later on*)

This standard provides a method for determining grindability index of particular materials which are subjected to shear force during their size reduction process. In a large number of size reduction units, the materials are ground by shear force applied between two surfaces. In such cases the strength of the material under shear is an important criteria.

The grindability of a material is a measure of the ease with which it can be ground and as such it reflects some of the physical properties of the material like hardness, strength, tenacity and fracture.

In reporting the result of a test or analysis made in accordance with this standard, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft *Indian Standard*

GRINDABILITY INDEX — METHODS OF TEST

1 SCOPE

The standard covers a test method for determining grindability index for materials subjected which are subjected to shear for size reduction.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

IS No.	*Title*
IS 4642 : 2024	Ball, Pebble and Tube Mills - Code of Practice (*first revision*)
IS 460 (Part 2) : 2020	Test Sieves — Specification Part 2 Perforated Plate Test Sieves (*fourth revision*)

3 DEFINITION

Grindability — It is the resistance of a material to communition.

NOTE — The absolute grindability cannot be measured. However, relative grindability can be measured either by direct or indirect measurement.

4 METHOD FOR DETERMINING GRINDABILITY INDEX

4.1 Test Equipment

The components and details of test equipment shall be as follows:

a) Ball mill;
b) Balls of standard sizes and weights;
c) Vibrating sieve shaker;
d) Standard sieves as per IS 460 (Part 2);
e) Balances with weight boxes — 2 (one analytical and one up to 2 000 g);
f) Trays for sampling — 1 m × 1 m; and
g) Measuring cylinder.

4.1.1 *Ball Mill*
The ball mill used shall be as per IS 4642, cylindrical in shape with smooth inside surface and with round corners. The mill shall have the following internal dimensions:

Diameter : 30.5 cm
Length : 30.5 cm

The mill shall be provided with a mechanical revolution counter and shall be rotated at a constant speed of 70 rev/min.

4.1.2 The balls shall be of forged alloy steel with mirror finish. The ball charge shall consist of 285 balls with total weight 20 125 g ± 25 g. The size distribution of the ball charge shall be:

Nominal Size mm	*No. of Balls*	*Weight* g
38.0	43	8 730
31.5	67	7 197
25.0	10	705
19.0	71	2 085
12.5	94	1 441

4.2 Test Procedure

4.2.1 About 25 kg of the representative sample shall be sufficient to carry out grindability test. The sample shall first be crushed to 6 mm in jaw crusher. The 6 mm crushed sample shall then be crushed through rolls and screened through 2.8 mm sieve. Crushing and sieving of the oversize shall be continued until the whole sample passes through the 2.8 mm sieve. A screen analysis of 2.8 mm size sample shall be made using a sieve set in the range of 2.36 mm to 150 microns sieves.

NOTE — For taking samples from the 25 kg lot, standard sampling procedure like coning and quartering shall be used.

4.2.2 The 80 percent passing size of test sample (*F*) shall be determined by plotting cumulative weight passing against size in microns.

4.2.3 700 ml of the 2.8 mm size sample shall be weighed and placed in the ball mill. To take 700 ml of the sample, the material 2.8 mm size shall be placed in a 1 000 ml measuring cylinder, 50 mm diameter, and compacted by shaking to yield a volume of 700 ml. The measuring cylinder shall be placed on a vibrating sieve shaker for 30 s.

4.2.4 The sample shall be grounded for a known number of revolutions (*N*) say 100. The grounded sample shall be removed and screened through a specific sieve of (P_1) microns.

4.2.5 The screened undersize produce shall be weighed, from which the quantity finer than (P_1) size (undersize) originally present in the test sample shall be deducted so as to get the net undersize produce due to grinding for (*N*) revolutions. From this, the net weight grinded per revolution shall be calculated (G_{op}).

4.2.6 A second feed sample for the ball mill shall be prepared by mixing the screen oversize with a fresh test sample from the stock so as to get the total weight of the same as in **4.2.3**.

4.2.7 The grinding and screening as given in **4.2.3** to **4.2.5** shall be repeated until a circulating load of 25 percent is achieved, which is equivalent to 28.6 percent of the mill discharge (finer than P_1 size) at equilibrium under standard conditions. The average quantity of finer produce per revolution (G_{op}) shall be calculated from the last two or three grinds.

4.2.8 The final produce obtained shall be screen analyzed, so that the sieve size in microns (P) through which 80 percent of the produce passes shall be determined.

5 CALCULATION OF GRINDABILITY UNDER CIRCULATING LOAD

The following equation shall be used for calculating grindability index (G_i) in kWh/tonne.

$$G_i = \frac{44.5 \times 1.1}{(P_1)^{0.23} \times \left(G_{op}\right)^{0.82} \times [\frac{10}{\sqrt{P}} \times \frac{10}{\sqrt{F}}]}$$

where

P_1 = Screen size in microns;
G_{op} = Net weight grinded per revolution;
P = Sieve size in micron through which 80 percent produce passes; and
F = Sieve size in micron through which 80 percent feed passes.

NOTES
1 As already mentioned, different sizes of sieves may be used in **4.2.4** (P_1). However, by using fine sieves, the sieving is inaccurate and takes long time. Normally 150 µm size sieve shall serve the purpose but sieving has to be done twice.
2 1 tonne = 1 000 kg.