IS 13001 (1991): Guidelines for manufacture of gypsum plaster in Mechanized pan system [CED 4: Building Limes and Gypsum Products]

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(Reaffirmed 2002)

Indian Standard

GUIDELINES FOR MANUFACTURE OF GYPSUM PLASTER IN MECHANIZED PAN SYSTEM

भारतीय मानक

यांत्रिक स्थाली प्रणाली में जिप्सम प्लस्टर निर्माण के लिए मार्ग दर्शिका

UDC 666·913·02

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

March 1991

Price Group 2

Gypsum and Gypsum Based Products for Buildings Sectional Committee, CED 21

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Gypsum and Gypsum Based Products for Buildings Sectional Committee had been approved by the Civil Engineering Division Council.

Gypsum finds its importance usually in the form of plaster of Paris or calcined material. So the dehydration of gypsum is an important operation. Manufacture of gypsum plaster of various grades for use in buildings, ceramics, surgical or dental purposes requires that the mineral should be calcined to hemihydrate or plaster of Paris.

Manufacture of plaster of Paris is mostly done by calcination in open pan, rotary drum and kettle calciners. Agitation of the material during calcination is done manually in open pan process. As such, not only lot of heat is wasted in this process, but also the plaster produced is not of uniform quality, being under-calcined and over-calcined in different portions of the material. The dust losses during such open pan calcination are as high as 15 to 20 percent. Also precise control of calcination temperature is not possible in such open pans.

It was, therefore, felt necessary to develop an equipment with efficient system of simultaneous agitation and calcination of raw gypsum in order to get a uniform quality plaster suitable for various applications with lower energy consumption.

This standard, based on the research work carried out at CBRI, Roorkee, lays down the details of mechanized pan system for calcination of gypsum.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GUIDELINES FOR MANUFACTURE OF GYPSUM PLASTER IN MECHANIZED PAN SYSTEM

1 SCOPE

1.1 This standard covers the mechanized pan system for calcination of natural or by-product gypsum up to a capacity of one tonne per charge including manufacture of plaster and precautions to be taken during calcination process.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
1288 : 1982	Methods of test for mineral gypsum (*second revision*)
2469 : 1976	Glossary of terms relating to gypsum (*first revision*)
2542 (Part 1) : 1978	Methods of test for gypsum plaster, concrete and products: Part 1 Plaster and concrete (*first revision*)

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 2469 : 1976 shall apply.

4 GENERAL INFORMATION

4.1 For efficient manufacture of gypsum plaster, detailed information with regard to the chemical composition of the gypsum and the fuel will be necessary.

5 EQUIPMENT

5.1 The mechanized pan system (*see* Fig. 1) has two main components, namely, the mechanized churning system and the furnace. The mechanized churning system comprises of a mild steel pan, a vertical power shaft, number of churning blades rigidly connected to the vertical power shaft at two levels, a sweeping chain attached at the bottom of the lower set of the churning blades and a removable lid to cover the pan and allow churning of the gypsum charge without any dust loss, and finally a prime mover alongwith appropriate power transmission mechanism.

5.1.1 The pan has a diameter of 1·25 m and a depth of 0·7 m. The bottom of the pan is typically bulging at the centre towards inside of the pan. This design of the bottom of the pan helps in easy discharge of the calcined gypsum beside effective heating of the pan from below.

5.1.2 Two churning blades, made of mild steel angle iron section, are welded opposite to each other directly with the vertical shaft. A chain is attached to the lower set of the blades which sweeps the material at the bottom so that over calcination of gypsum may be avoided.

5.1.3 The vertical shaft, located centrally inside the pan, rotates for agitation of the mass. The bearing housing is located centrally on top of the pan and other power transmission mechanism arranged for rotation of the churning blades. The bevel gear of the vertical power shaft is driven by a bevel pinion. A clutch is however arranged in between the bevel pinion and the output shaft of the speed reducer.

5.2 One set of calciner comprises of two pans and two vertical power shafts with churning blades, one shaft for each pan. Both the pans get power from a single prime mover through a speed reducer to two output shafts. Facility is provided so that both the shafts may be actuated simultaneously or when required, only one shaft be kept in operation. To protect the gypsum charge against overburning, in situations when electric power gets suddenly off, manually operated cranking system has to be provided so that two persons may easily rotate the churning blades simultaneously in both the pans.

Necessary provision is made in the pans for charging of material and letting out the steam.

5.3 Other important component of the mechanised pan system is the furnace. The furnace is a vertical cylindrical shaft furnace. The pan is directly placed at the bevelled-out top of the furnace. Two furnaces are required for one set of calciner. The furnace is made of ordinary burnt clay bricks, where only the inner side lining is cladded with fire bricks. A small flue ring is provided around each pan, so that even the sides of the pan may be heated and maximum heat be derived from the flue gases leading to the chimney. The furnaces shall be fired separately. The flue gases from both the pans meet at entry point to

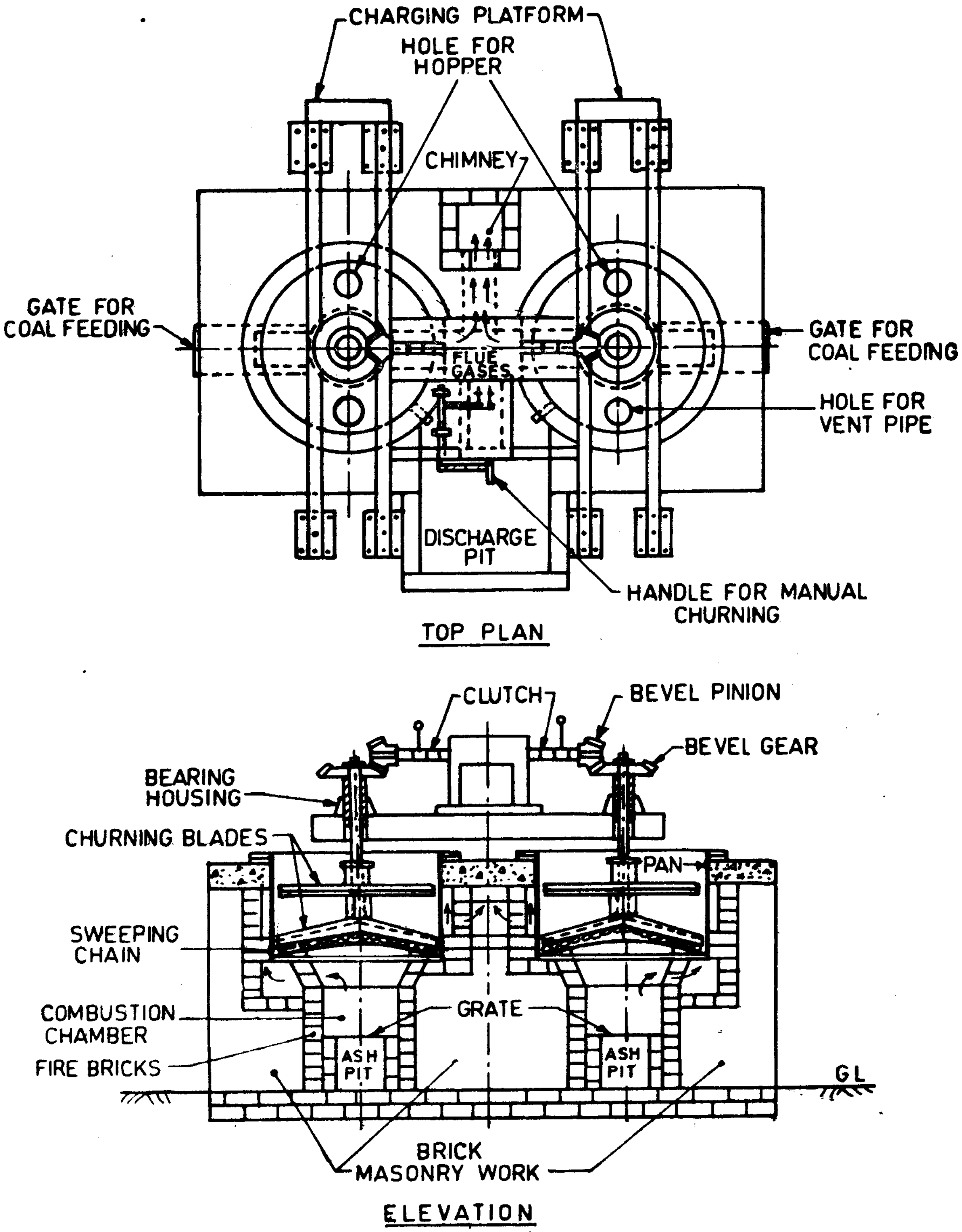

FIG. 1 MECHANIZED PAN FOR CALCINATION OF GYPSUM

the chimney. A chimney of 6 m height helps in getting the flue gases out into the atmosphere and also in securing the required draft for efficient burning of the fuel in the furnace.

5.4 A spout is provided with each pan to discharge hot calcined gypsum from the pan. During calcination the spouts are kept closed to avoid release of gypsum through the spouts. Only at the time of discharging calcined gypsum, the spout is opened.

6 MANUFACTURE

6.1 Chemically, gypsum plaster is $CaSO_4 \cdot \frac{1}{2} H_2O$. It is manufactured by heating ground gypsum at 120 to 170°C in the calcining plant where it loses one and half molecules of water of crystallisation in the form of steam. As a result, gypsum plaster with half molecule of water is produced.

6.2 Preparation of Gypsum

Natural or marine gypsum shall be crushed to about 25 to 30 mm size and then ground to pass 60 percent through 150 micron IS sieve.

By-product gypsum shall be dried to 2 percent moisture content before calcination.

6.3 Preparation of Fuel

Steam coal should be crushed to about 50 mm size before feeding in the furnace. Alternatively, dried fire wood may also be used.

6.4 Reserve Storage

Sufficient quantity of properly sized gypsum and fuel should be kept in reserve at the site ready for loading.

6.5 Charging and Discharging of Pans

First of all both the furnaces shall be lighted. When the temperature inside the pans is 115±5°C, gypsum is fed through the charging hole into the hot pans with the churning mechanism already on, so that the material remains in agitation from the very beginning. When the temperature rises to 130°C, the charge boils vigorously and gives out water of crystallisation as steam. This temperature remains constant for some time depending upon the purity of gypsum. When the boiling subdues, the temperature starts rising quickly and reaches 160 to 170°C. When boiling ceases, the plaster starts settling indicating completion of calcination process. The hot calcined gypsum is discharged immediately in the pit covered with a lid to avoid dusting. The system is again ready for next charge.

6.5.1 The temperature of charge during calcination shall be controlled by adjusting the rate of feed of fuel and use of dampers in the furnace. The optimum and completion temperature of calcination shall be noticed with the help of thermocouples and pyrometers. Separate thermocouples and pyrometers shall be fitted for each pan.

NOTES

1 The operation cycle, temperature of calcination and rate of heating are dependent on the quality of gypsum and fuel, and hence are to be optimised for a particular raw material.

2 By-product gypsum is normally available in superfine powders and, therefore, care should be taken during calcination to avoid scale formation inside the pans and choking of charging and vent hole.

7 QUALITY OF PLASTER PRODUCED

7.1 The calcined material after grinding to the desired fineness shall be tested for chemical and physical requirements according to the methods laid down in IS 1288 : 1982 and IS 2542 (Part 1) : 1978.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Revision of Indian Standards

Indian Standards are reviewed periodically and revised, when necessary and amendments, if any, are issued from time to time. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition. Comments on this Indian Standard may be sent to BIS giving the following reference:

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