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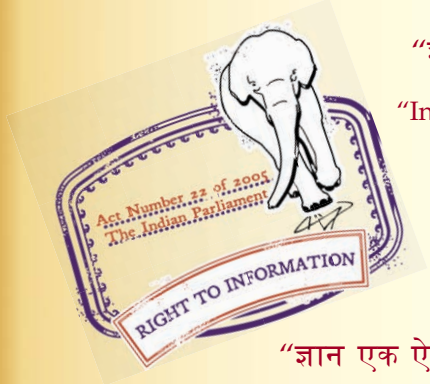
IS 1861-1 (1990): Guide for manufacture of lime in vertical mixed-feed type kiln, Part 1: From lime-stone [CED 4: Building Limes and Gypsum Products]



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"Knowledge is such a treasure which cannot be stolen"

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IS 1861 (Part 1) : 1990
(Reaffirmed 2003)

भारतीय मानक

चूने का निर्माण—ऊर्ध्व मिश्रित भरणनुमा भट्टियों द्वारा — मार्गदर्शिका

भाग 1 चूना पत्थर से

(दूसरा पुनरीक्षण)

Indian Standard

MANUFACTURE OF LIME IN VERTICAL MIXED-FEED TYPE KILNS — GUIDE

PART 1 FROM LIMESTONE

(Second Revision)

UDC 666·92·041·464

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

December 1990

Price Group 1

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards on 23 April 1990, after the draft finalized by the Building Lime and Lime Products Sectional Committee had been approved by the Civil Engineering Division Council.

Though lime is one of the most important materials available for building construction, the technique of manufacture of building lime is still not well established in the country. A satisfactory building lime should have certain essential characteristics in regard to slaking and its subsequent performance in mortars and concrete. These characteristics will be satisfactorily developed only if the limestone is calcined in the kiln at the right temperature and with the right type of fuel. The Committee has, therefore, felt the need for not only specifying the quality of building lime that is required but also to lay down a guide which will give necessary guidance to manufacturers to achieve its quality.
With the present experience in lime manufacture in the country, it is found that the most suitable type of kiln for burning lime is the mixed-feed vertical type, with regard to both performance and economy. Accordingly, this standard has been prepared to cover the manufacture of lime in vertical mixed-feed kilns.

The Committee responsible for the preparation of this standard has taken into consideration the views of producers, consumers and technologists and has related the standard to the manufacturing and trade practices followed in the country in this field.

This standard was first published in 1961 and subsequently revised in 1975. In the first revision, the standard was split into two parts, Part 1 covering manufacture of lime from limestone and Part 2 covering manufacture of lime from limeshell. Further, at the time of first revision in 1975 it was decided to cover Part 1 in two sections, Section 1 for manufacture of lime in small scale industries and Section 2 for manufacture of lime in higher capacity kilns using modern process and forced draft. Accordingly, IS 1861 (Part 1/Sec 1) : 1975 was published.

However, now it has been felt that since the same manufacturing technique could be used for manufacture of lime irrespective of the kiln capacity, there was no need to have two Sections for this standard. Therefore, this standard has now been revised as Part 1 only. In addition to modifying some requirements based on experience gained with the use of this standard, this revision covers recommendations for manufacture of lime in kilns up to a capacity of 10 tonnes per day working on natural or forced draft.

Indian Standard

MANUFACTURE OF LIME IN VERTICAL MIXED-FEED TYPE KILNS — GUIDE

PART 1 FROM LIMESTONE

(Second Revision)

1 SCOPE

1.1 This standard (Part 1) covers essentially the operations for the burning of limestone in vertical kilns of the mixed-feed type up to a capacity of 10 tonnes per day with natural or forced draft.

2 REFERENCES

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

IS No.	*Title*
6508 : 1988	Glossary of terms relating to building lime *(first revision)*
11255 (Part 1) : 1985	Methods for measurement of emission from stationary sources: Part 1 Particulate matter

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 6508 : 1988 shall apply.

4 NECESSARY INFORMATION

4.1 For the manufacture of quality lime, information with regard to the chemical composition of the limestone and proximate analysis of the fuel will be necessary.

5 MANUFACTURE

5.0 Principle

The charge of limestone and fuel is fed from top and the burnt product is drawn from bottom of shaft through openings. Initial firing is started by means of fire wood or oil, at the bottom and due to the natural draft the burning zone gradually travels upwards and burning is restricted to the central burning zone with scheduled withdrawals of burnt product. The natural draft that is available cools the down-coming product while getting itself heated up before entering the burning zone; hot air and combustion gases escaping from this zone preheat the charge above it, while losing their own heat. Therefore, during manufacture, three zones are formed which are cooling (lower), burning (middle) and preheating (upper) zones and these zones are instrumental in the successful operation.

5.1 Preparation of Limestone

The size of the limestone should generally be 40 to 100 mm depending upon the quality.

5.2 Preparation of Fuel

The size of coal or coke should be reduced and graded to the size required as in **5.2.1.** During hot weather, coal or coke may be moistened before charging.

5.2.1 The maximum and minimum size of coal or coke used for burning limestone may be half of the maximum and minimum size of limestone respectively.

5.3 Reserve Storage

Adequate quantities of properly sized limestone and fuel should be kept in reserve at the site.

5.4 Charging and Discharging

5.4.1 The proportions of the limestone and fuel in the mix for charging into the kiln should be calculated with regard to the heat requirements for calcination and the calorific value of the fuel. On an average 12 to 16 percent coal is used. The recommended proportions of common type of fuel are given in Table 1.

Table 1 Recommended Percentage of Fuel and Limestone for Various Types of Fuels

Sl No.	Type of Fuel	Percentage of Fuel by Mass of Limestone
(1)	(2)	(3)
i)	Steam coal	12-16
ii)	Soft coke	12
iii)	Fire wood (babul, tamarin, neem, mango, etc)	16-20

5.4.2 Kiln loading and drawing may be done manually or mechanically. It is impractical to weigh limestone and fuel each time; mass may be converted into volume and correct mass-volume factors (relationship) be arrived at.

5.4.2.1 When newly constructed kiln is ready for commissioning it should be well dried for a week and slowly fired before charging, so as to draw out the inside moisture of the shell to avoid

cracking of kiln wall. While commissioning a new kiln or restarting an old one, sufficient ignition material, such as wood, should be placed at the bottom and then alternate layers of fuel and stone charged in.

5.4.2.2 The drawing of lime should be done at regular intervals that have been fixed with due regard to retention time, which normally varies from 2 to 4 hours depending on the size and quality of limestone. The best practice will be to establish intermittent operations at as close an interval as possible, so as to approach a continuous cycle. The interval between two consecutive withdrawals of lime from the kiln may not be longer than eight hours.

5.4.3 Lime should be drawn equally from each of the discharge openings ensuring that the charge comes down evenly in the kiln.

5.5 Temperature Control

The temperature in the kiln will be regularly observed during operation of the kiln. Temperature observations shall be taken at not less than three points as stated below:

a) Temperature of the calcination zone,
b) Temperature of drawn lime, and
c) Temperature of exhaust gas.

5.5.1 *Temperature of Calcination*

In normal practice the temperature in the calcination zone should be maintained between 1 000 and 1 200°C for high-calcium limestone and below 1 000°C for magnesian and *kankar* limestone. Temperature should be measured through poke holes by means of thermocouple. This can also be assessed roughly by the colour of the flame as below:

Colour of Flame	*Temperature* °C
Just visible red	500
Dark red	700
Just cherry red	800
Bright red	1 000
Bright orange	1 200

5.5.2 *Temperature of Drawn Lime*

The temperature of drawn lime should be kept as low as possible, generally not higher than 100°C.

5.5.3 *Temperature of Exhaust Gas*

For obtaining the maximum thermal efficiency, the temperature of the exhaust gas will be as low as possible, preferably within 100°C. This will be achieved by maintaining the proper height of pre-heating zone. For controlling the operations in the kiln, it will be necessary to know the composition of the exhaust gas collected from a point near the topmost poke hole according to the procedure described in IS 11255 (Part 1) : 1985. Presence of carbon monoxide will indicate incomplete combustion within the kiln. To ensure complete combustion of the fuel, certain quantity of excess air, say about 10 percent, will be necessary; larger quantities of excess air, however, will reduce the efficiency of the kiln. For conditions of efficient operation, the carbon dioxide content in the exhaust gas will be as high as possible and may range from 25 to 40 percent depending upon the type of kiln and raw materials used; whereas the carbon monoxide content will not exceed 0·5 percent and that of oxygen not more than 3 percent.

5.6 Observation of Operation of Kiln

Kiln conditions can also be judged to some extent from visual observation of conditions at the top of the kiln and guidance may be obtained from the condition of the flame as given below:

a) Heavy black smoke, or black smoke from the top of the kiln indicates incomplete combustion.
b) Flame on the kiln top indicates very wasteful condition.
c) Light haze at the kiln top and appearance of smoke with slight reduction in air supply indicates satisfactory condition.
d) Clear at the top of the kiln indicates too much air.

5.7 Kiln Control

Exhaust gases should be analysed for carbon monoxide, carbon dioxide, oxygen and suspended particulate matter content. Depending upon the results obtained, suitable modifications in the supply of air, limestone-fuel ratio, and the quantity of the feed should be adjusted to rectify the imbalances.

5.8 Quality of Drawn Lime

5.8.1 The quality of lime drawn from the kiln should be regularly observed for presence of core or overburnt lime and discolouration.

5.8.2 Presence of core or overburnt lime may be minimized either by increasing or decreasing respectively the retention time in the calcination zone and also by adjusting the limestone-fuel ratio.

5.8.3 Discolouration in drawn lime may be due to the presence of coloured matter or other impurities either in the limestone or in the fuel fed to the kiln.

5.9 Sorting

The drawn lime will be spread over the floor for cooling and hand picked for wellburnt and overburnt and unburnt lime.

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