

GUIDELINES FOR MANUFACTURING QUALITY FLY ASH BRICKS



**Prepared By
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State Pollution Control Board,
Odisha, Bhubaneswar**

1.0 INTRODUCTION

Fly Ash generated from combustion of Coal in Thermal Power Plants is a major environmental concern. As of now about 25 million tons of fly ash is generated from Thermal Power Plants in Odisha. Fly ash is classified into three types:

- Fly ash collected from ESP of Thermal Power Plants.
- Pond ash stored in ash pond/mounds.
- Bottom ash – collected at bottom ash hopper of the boiler, which has high concentration of carbon.

Fly ash is utilized in many sectors such as construction materials, road making, cement, asbestos, dykes etc. Therefore, it is considered as a resource.

At present around 1 million tons of fly ash is utilized in Brick making in Odisha, contributing to 4% use of total ash generated in the state. In order to promote and enhance ash utilization in brick manufacturing, this guideline has been prepared by Fly Ash Resource Centre (FARC), State Pollution Control Board, Odisha.

Fly Ash is a fine grey amorphous powder, rich in Silica and Alumina. The properties of Fly Ash may vary both physically and chemically depending on the nature of the coal and the combustion process.

Fly Ash generated due to combustion of pulverized coal has the main characteristics like –

- Fine particle size
- Spherical in shape
- Low carbon content
- Pozzolanic reaction
- Better finish
- Reduced shrinkage
- Increased long term strength
- Cost saving

Pulverized fuel ash-lime bricks are made from materials consisting of fly ash in major quantity, lime and an accelerator acting as a catalyst. Pulverized fuel ash-lime bricks are manufactured

by blending above raw materials and then moulded to form bricks. Crushed bottom fuel ash or sand is also used in the composition as a coarse material to control water absorption in the final product.

Advantages of Fly Ash Bricks

The advantages of fly ash brick are

- High compressive strength
- Lower water absorption
- Dimensional accuracy.
- High strength to weight ratio
- Consumption of less mortar in construction.
- Conservation of natural resources, like soil, sand etc.

Fly ash bricks are now widely used in construction of buildings, pavements, boundary wall etc.

Quality

For quality assurance and increase in market value, fly ash bricks need certification by **BIS. IS 12894:2002** for manufacture of pulverized fuel ash lime bricks specification stipulates the various requirements.

2.0 Notification of Ministry of Environment & Forest (MOEF), Govt. of India

The MOEF, Govt. of India notification S.O. 2804 (E) dt. 3rd November, 2009 stipulates that “Every Construction agency engaged in the construction of buildings within a radius of hundred kms from a coal or lignite based thermal power plants shall use only fly ash based products for construction, such as cement or concrete, fly ash bricks or blocks or tiles in every construction project.

Notification of Works Department, Govt. of Odisha

Govt. of Odisha in works department vide notification No. 6906 of 28.06.2013 have notified use of fly ash bricks conforming to relevant IS specification in construction of all govt. buildings within a radius of 100 km of fly ash generating plants w.e.f. 01.09.2013.

3. Characteristics of Fly Ash

The physical and chemical properties of Fly Ash are :

3.1.i Physical Properties

Specific Gravity	2.54 to 2.65 gm/cc
Bulk Density	1.12 gm/cc
Fineness	350 to 450 m ² /Kg

3.1.ii Chemical Properties

Silica	35-70%
Alumina	10-33%
Calcium Oxide	0.2-2.0%
Loss on ignition	0.1-2%
Sulphur	0.5-1.5%
Iron	2-7%

It may be seen that lignite fly ash is characterized primarily by the presence of silica, alumina, calcium etc.

Presence of silica in fine form makes it excellent pozzolanic material. Its abundant availability at practically nil cost gives a very good opportunity for the construction agencies.

3.2. Characteristics of Lignite and Coal Fly Ash :

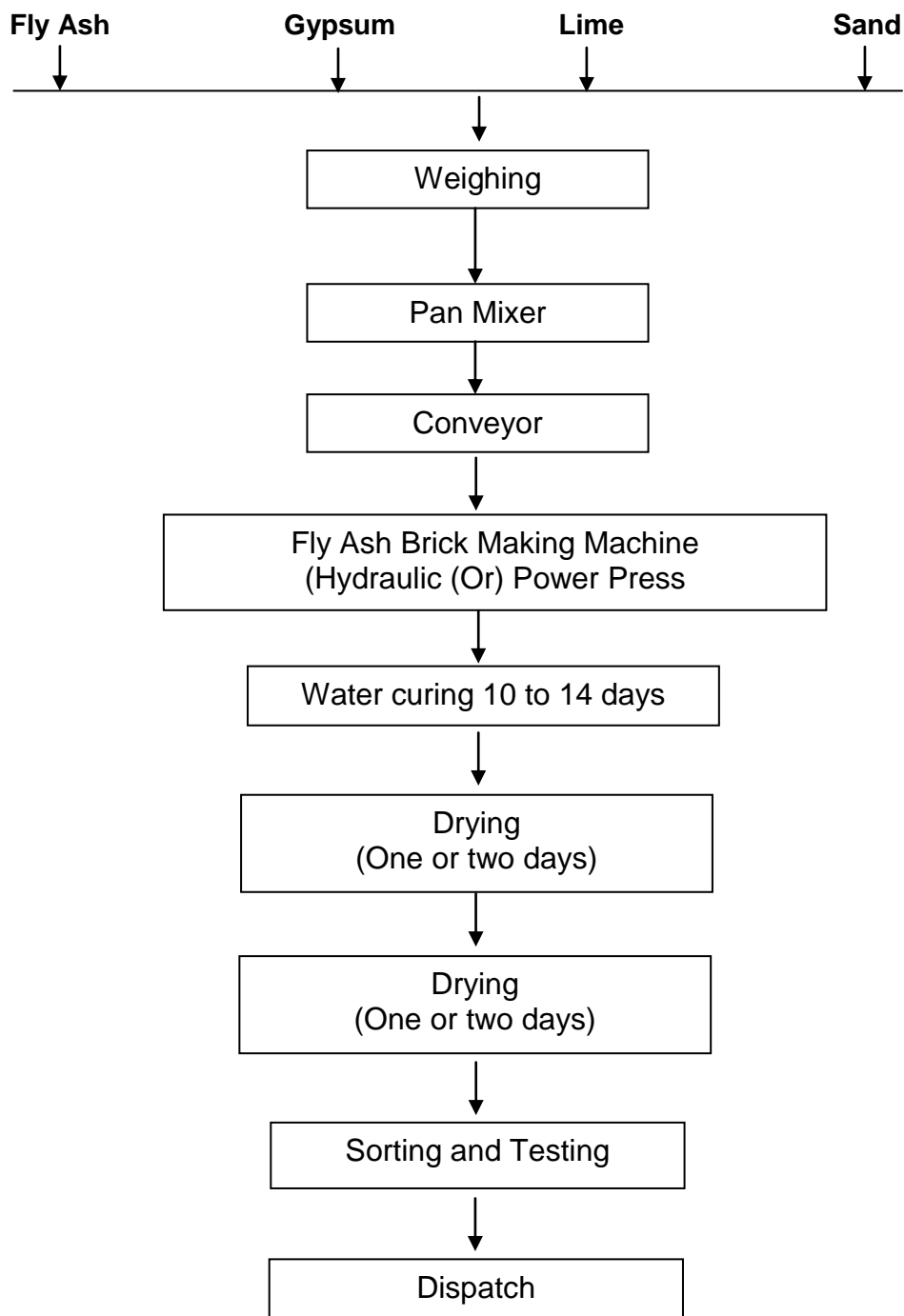
CONTENTS	LIGNITE FLY ASH (%)	COAL FLY ASH (%)
L.O.I.	1.0 to 2.0	3-15
SiO ₂	45.59	35-70
Al ₂ O ₃	23-33	10-33
Fe ₂ O ₃	06-4.0	2-7
CaO	5.0-16.0	0.2-2.0
MgO	1.5-5.0	0.1-4.0
SO ₃	0-5.0	0.1-1.7

About 50 to 80% fly ash may be used for the production of fly ash bricks.

4.0 Manufacturing Process

Fly Ash (70%) Lime (10%) Gypsum (5%) and sand (15%) are manually fed into a pan mixer where water is added to the required proportion for homogeneous mixing. The proportion of raw material may vary depending upon quality of raw materials. After mixing, the mixture are led through the belt conveyor to automatic brick making machine, where the bricks are pressed automatically and then the bricks are placed on wooden pallets and kept as it is for two days, thereafter transported to open area where it is water cured for 10-14 days. The bricks are sorted and tested before dispatch.

FLOW DIAGRAM

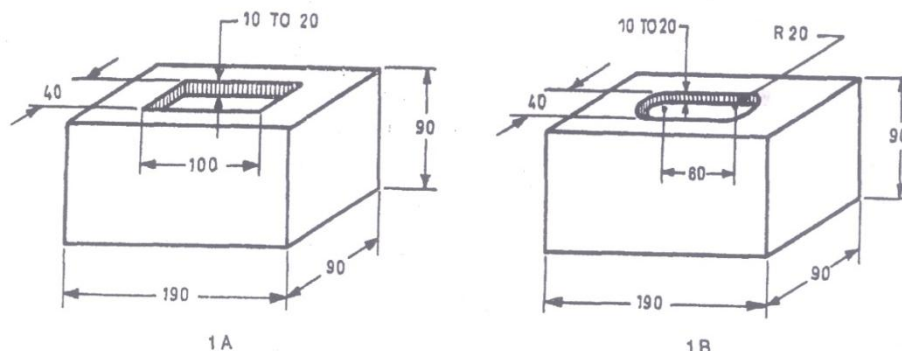


5. India Standard – IS12894 : 2002
(Pulverised Fuel Ash – Lime Bricks)

This standard lays down the requirements for classification, general quality, dimensions and physical requirements of pulverized fuel ash-lime bricks used in buildings. Pulverized fuel ash-lime bricks having wet compressive strength less than 30 N/mm² approximately 300 kgf/cm² are covered in this standard and for higher strength)

General Requirement

- 5.1 Visually the bricks shall be sound, compact and uniform in shape. The bricks shall be free from visible cracks, war page and organic matters.
- 5.2 The bricks shall be solid and with or without frog 10 to 20 mm deep on one of its flat side. The shape and size of the frog shall conform to either Fig. 1 A or Fig. 1B.
- 5.3 In case of non-modular size of bricks, frog dimensions shall be the same as for modular size bricks.
- 5.4 Hand-moulded bricks of 90 mm or 70mm height shall be moulded with a frog 10 to 20 mm deep on one of its flat sides; the shape and size of the frog shall conform to either Fig. 1A or Fig. 1B. Bricks of 40 or 30 mm height as well as those made by extrusion process may not be provided with frogs.
- 5.5 The bricks shall have smooth rectangular faces with sharp corners and shall be uniform in shape and colour.



All dimensions in millimetres.

FIG. 1 SHAPE AND SIZE OF FROGS IN BRICKS

6. Classification

- 6.1 Pulverized fuel ash-lime bricks shall be classified on the basis of average wet compressive strength as given in Table 1.

Table-1
Classes of Pulverized Fuel Ash-Lime Bricks

Class Designation	Average Wet Compressive Strength not Less Than	
	N/mm ²	Kgf/cm ² (Approx)
1	2	3
30	30.0	(300)
25	25.0	(250)
20	20.0	(200)
17.5	17.5	(175)
15	15.0	(150)
12.5	12.5	(125)
10	10.0	(100)
7.5	7.5	(75)
5	5.0	(50)
3.5	3.5	(35)

7. Dimensions and Tolerance

As per figure 1A or 1B

8. Tolerance

As mentioned in IS 12894:2002

9. Materials

Pulverised fuel ash i.e. Fly Ash, Bottom Ash, sand, lime, additives are used in manufacture of Fly ash bricks.

9(i) **Bottom Ash** used shall not have more than 12 percent loss on ignition when tested according IS specification.

9(ii) **Sand / Stone dust**

The materials in sand such as clay and silt shall preferably be less than 5 percent.

9(iii) **Lime**

It should conform to class-c hydrated lime. It should have minimum 40% CaO content.

9(iv) **Additives**

Any suitable additive considered not detrimental to the durability of the bricks such as gypsum, cement may be used. Hydrated Calcium Sulphate is called Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$). Gypsum should have at least 80% purity. However in variation of purity percentage of Gypsum in the mix should be adjusted to obtain quality of finished bricks. Cement also can be used as a binding material in place of lime & gypsum.

10. **Physical Characteristics**

10.1 **Compressive Strength**

The minimum average wet compressive strength of pulverized fuel ash-lime bricks shall not be less than the one specified for each class in 4.1 when tested as described in IS3495 (Part-I). The wet compressive strength of any individual brick shall not fall below the minimum average wet compressive strength specified for the corresponding class of bricks by more than 20 percent.

10.2 **Drying Shrinkage**

The average drying shrinkage of the bricks when tested by the method described in IS 4139, being the average of three units, shall not exceed 0.15 percent.

10.3 **Efflorescence Test**

The bricks when tested in accordance with the procedure laid down in IS 3495 (Part-3), shall have the rating of efflorescence not more than “moderate” up to class 12.5 and ‘slight’ for higher classes.

10.4 **Water Absorption**

The bricks, when tested in accordance with the procedure laid down in IS3495 (Part-2), after immersion in cold water for 24 hr shall have average water absorption not more than 20 percent by mass up to class 12.5 and 15 percent by mass for higher classes.

11. **Marking**

Each brick shall be marked in a suitable manner with the manufacturer’s identification mark of initials.

12. **BIS Certification Marking**

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 there under. The details of

conditions under which the license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

In order to apply BIS Certification the application form to be submitted and the check list is attached as Annexure-I

Applicable Codes

IS-12894-2002	:	Fly ash lime bricks specification
IS-1514-1990	:	Methods of sampling and test for quick lime and hydrated lime.
IS-3495 (Part-I)-1976	:	Methods of test determination of compressive strength
IS-4139-1989	:	Methods of test described for drying & shrinkage
IS-3495 (Part-II) 1976	:	Methods of test described for determination of water absorption
IS-3495 (Part-III) 1976	:	Methods of list for Efflorescence test

प्रपत्र 1 Form 1

(विनियम 3 देखें) [See Regulation 3]



भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS



उत्पाद प्रमाणन योजना

Product Certification Scheme

मानक मुहर के उपयोग के लिए लाइसेंस के लिए आवेदन

APPLICATION FOR LICENCE TO USE THE STANDARD MARK

व्यक्ति अथवा फर्म का पूरा नाम
Full name of individual or firm

कार्यालय Office	पता Address	<input type="text"/>	दूरभाष Tel	<input type="text"/>
			फैक्स Fax	<input type="text"/>
	शहर City जिला District राज्य State देश Country पिन Pin		ई-मेल E-mail	<input type="text"/>
	<input type="text"/>		<input type="text"/>	<input type="text"/>

फैक्टरी FACTORY	पता Address	<input type="text"/>	दूरभाष Tel	<input type="text"/>
			फैक्स Fax	<input type="text"/>
	शहर City जिला District राज्य State देश Country पिन Pin		ई-मेल E-mail	<input type="text"/>
	<input type="text"/>		<input type="text"/>	<input type="text"/>

शीर्ष प्रबंध Top Management		तकनीकी प्रबंध Technical Management	
नाम Name	पदनाम Designation	नाम Name	पदनाम Designation
प्रबंध Management	1. <input type="text"/>	1. <input type="text"/>	
	2. <input type="text"/>	2. <input type="text"/>	
	3. <input type="text"/>	3. <input type="text"/>	
	4. <input type="text"/>	4. <input type="text"/>	
संपर्क किये जाने वाले व्यक्ति व दूरभाष सं. CONTACT PERSON & Tel No.		<input type="text"/>	

पत्राचार का पता
CORRESPONDENCE
ADDRESS

कार्यालय Office	
फैक्टरी Factory	

स्तर
SCALE

बड़ा Large	
लघु Small	

क्षेत्र
SECTOR

सार्वजनिक Public	
निजी Private	

यह आवेदन-----पर भामाब्यूरो की मानक मुहर के उपयोग के लिए किया जा रहा है ।
This application is being made to use the BIS Standard Mark on -----

उत्पाद
PRODUCT

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भारतीय मानक
INDIAN STANDARD

भा मा IS:
भाग Part:
खंड Sec:

ग्रेड/टाइप/श्रेणी
GRADE/TYPER/CLASS

--

वर्तमान संस्थापित क्षमता
PRESENT INSTALLED
CAPACITY
(उत्पादन प्रतिवर्ष)
(Production per annum)

उत्पाद की इकाईयाँ
Units of Production

प्रमात्रा
Quantity

मूल्य (रु.)
Value (Rs.)

भामा ब्यूरो अधिनियम के अधीन पिछले निरस्तीकरण/
कन्विकशन, यदि कोई है, के विवरण
DETAILS OF PREVIOUS CANCELLATION/CONVICTION
IF ANY UNDER BIS ACT

--

फर्म की सील
SEAL OF FIRM

--

हस्ताक्षर _____

Signature

नाम

Name _____

पदनाम _____

Designation

आवेदन की तिथि _____

Date of applicaton

- महत्व - 1. आवेदन पर फर्म के सीईओ अथवा उनकी अनुपस्थिति में अधिकृत प्रतिनिधि के हस्ताक्षर हों ।
2. विदेशी निर्माताओं से आवेदन की स्थिति में उनके प्राधिकृत भारतीय प्रतिनिधि के भी प्रति हस्ताक्षर आवेदन पर हों ।
3. कृपया सूचित करें कि आपके पास अन्य किसी उत्पाद(दों) के लिए भामाब्यूरो लाइसेंस है ।

- Important: 1. Application should be signed by CEO of the firm, or in his absence by authorized representative.
2. Application from Foreign Manufacturers should be countersigned by authorized Indian representative.
3. Please inform whether you are holding BIS licence(s) for any product(s).