# "TECHNO ECONOMIC FEASIBILITY REPORT ON FLYASH BRICKS"

**Building Materials & Technology Promotion Council**
**Ministry of Housing & Urban Poverty Alleviation**
**Government of India**
**New Delhi**

## TO THE USERS

This Techno-Economic Feasibility Report has been prepared on the basis of information available. The intention here is to provide preliminary information to the prospective entrepreneur. Prior to making a firm decision for investment in the project the entrepreneur must verify the various feasibility aspects together along with the addresses for the procurement of plant and machinery and raw materials independently. The information supplied in this report is obtained from the reliable sources.

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## 1. INTRODUCTION

Fly ash is a fine, glass-like powder recovered from gases created by coal-fired electric power generation. Flyash material is solidified while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Since the particles solidify while suspended in the exhaust gases, flyash particles are generally spherical in shape and range in size from 0.5 µm to 100 µm. They consist mostly of silicon dioxide (SiO2), aluminum oxide (Al2O3) and iron oxide (Fe2O3).

### What is Pozzolan?

Fly ash closely resembles with volcanic ashes used in production of the earliest known hydraulic cements about 2,300 years ago. Those cements were made near the small Italian town of Pozzuoli - which later gave its name to the term "pozzolan.". A pozzolan is a siliceous or siliceous / aluminous material that, when mixed with lime and water, forms a cementitious compound. Fly ash is the best known, and one of the most commonly used, pozzolan in the world. Fly ash is an inexpensive replacement for Portland cement used in concrete, while it actually improves strength, segregation, and ease of pumping of the concrete. Fly ash is also used as an ingredient in brick, block, paving, and structural fills.

### History of fly ash utilization

Fly ash concrete was first used in the U.S. in 1929 for the Hoover Dam, where engineers found that it allowed for less total cement. It is now used across the world.

**Why use fly ash in concrete?**

How much fly ash in concrete?

Typically, concrete designers use fly ash a partial replacement for Portland cement at values up to 30 percent of the total cementitious composition.

The use of high percentages (high volumes) of fly ash has been studied extensively over the last 15 years, and the benefits of this type of concrete have been well documented. When properly designed and constructed, the increased benefits of concrete made with 40, 50, and 60 percent fly ash replacement include dramatically reduced concrete permeability, and excellent resistance to all forms of premature deterioration.

**Cost of fly ash**

Fly ash typically costs approximately 1/2 to 1/3 that of Portland cement as delivered, assuming a suitable means of batching is already in place.

**Other Names of Fly Ash**

Coal Ash

Pulverized Flue Ash.

**Application**

- Classified and quality ensured Fly ash is used as
- Performance improver in manufacturing of OPC (Ordinary Portland Cement).
- Pozzolan material in manufacture of PPC (Portland Pozzolana Cement).

- Cementitious material used as partial replacement of cement in concrete and mortar applications.
- Raw material for manufacturing of building material like clay ash bricks /cement lime ash bricks, blocks and Tiles.
- Material for road embankment and construction of base course of road.
- Material for back filling of open cast mines & stowing of underground mines. Light weight aggregates.
- Source of plant nutrients and soil amendment in Agriculture.
- Filler replacement material of paints.
- Raw material for roofing sheets manufacturing.
- Industrial flooring.

**Properties**

**General Properties**

Fly Ash is

- Fine powder in grey color
- Having no virtual odour
- Non – Toxic
- Non – Flammable
- Non - Explosive

Fly ash does not have any adverse health effects, however when the exposure to fly ash is more than the recommended limits, the necessary protective equipment for respiratory / eye / hand / skin protection to be used.

**Key Properties**

Fly ash addition in concrete mixture generates more cementitious paste.

**Portland cement + H2O = CSH + Ca (OH) 2**{free lime liberated}

**Fly ash + Ca (OH) 2 = CSH** {additional cementitious paste}

**CSH** - Calcium Silicate Hydrate

The cement in concrete mix liberates free lime when it starts to hydrate with water. Fly ash in concrete mix produces cementitious paste by reacting with this free lime only. Fly ash in concrete mix can be active only after the availability of sufficient free lime, hence fly ash component of concrete starts reacting after a little while only.

- This phenomenon reduced the strength growth of concrete in early hours and allowing more time for working / compacting and to place more concrete without a cold joint
- Due to the partial material (cement) reacts immediately with addition of water, heat generated by reaction during hydration (Hydration heat) is reduced. Low hydration heat reduces the risk of surface cracks on concrete due to thermal stress
- Low hydration heat also yields uniform concrete surface and excellent finish
- Fly ash shape is spherical in nature. This feature enables fly ash to flow and blend easily with the angular shaped cement particles in concrete mix.

This phenomenon

- Increases the workability of concrete (workability - ease of handling / placing / finishing of fresh concrete)
- Fills the gaps in cement matrix and significantly reduces the voids in concrete. Hence the impermeability of concrete is improved and it offers great resistance to water penetration / salt attack and makes it suitable for marine environment
- Increased impermeability of concrete also protects the reinforcement material
- Fly ash cement mixed concrete requires less water than the normal cement concrete. This phenomenon improves the water to cement ratio. Improved water to cement ratio yields
- Less cementitious compound requirement to achieve the design / required strength
- Reduces the risk / possibility of segregation

**Advantages**

**Key advantages of using fly ash**

- Improved workability
- Reduced permeability
- Reduced heat of hydration
- High sulphate resistance
- Increased long term strength
- High chloride corrosion resistance
- Grater resistance to alkali reactivity

- Better concrete finish
- Reduced shrinkage
- Improved workability

**Environmental effects**

Utilization of fly ash is environment friendly with improved cementitious binder economics.

- Fly ash utilization reduces the requirement of clay, sand, lime stone in cement manufacturing and hence conserves natural resources.
- Fly ash utilization reduces the cement requirement and hence carbon-di-oxide liberation during cement manufacturing is reduced.
- Fly ash utilization reduces the top soil requirement for land filling / brick manufacturing and saves agricultural land.
- Fly ash utilization achieves increased strength of the finished concrete product without increasing the cement content

**HITEPOZZO** is a quality classified fly ash - One of the finest cement extenders in the world.

**HITEPOZZO** is the value added Quality Classified Fly Ash product from Hi-Tech Fly Ash (India) Pvt. Ltd. - a 100% Export Oriented Unit, exported to various satisfied customers in Middle East Asian Countries, South East & Far East Asian countries, etc.

**HITEPOZZO** processing plant located at Tuticorin is the first fly ash processing plant in South India, using modern processing equipment, has been certified to ISO 9001: 2000 by BVQI with accreditation to UKAS, UK.

**Limitation of Unprocessed Fly Ash**

Quality of the Unprocessed Fly Ash (directly fly ash from the thermal power station ESP hoppers) fluctuates with changes in coal mill and boiler condition and will be having inconsistency in the key parameters like Particle size, unburnt carbon content, Moisture content, etc.

Particle size of unprocessed fly ash is not guaranteed and will affect the end applications severely. Presence of unburnt carbon will lead to negative undesired impact on the concrete, creating severe problem on workability, strength and durability and also increases the water demand.

Bricks may be made from a no. of different kinds of material, but they must usually possess (can be capable of developing) a certain amount of plasticity. Fly ash is one of them. Fly ash is an industrial waste of thermal power stations using pulverised coal. it is finely divided residue, resulting from the combustion of pulverised coal in the boiler, which is transported by the flue gases and subsequently collected by means of electrical or mechanical precipitators.

There are about 40 major thermal power plants in India which produces about 15 million tones of fly ash every year. Such enormous quantities need huge dumping grounds, and create pollution problems.

Fly ash being a puzzolanic material forms cementations products in conjunction with time and thus find use in civil Engineering Works. In advanced countries fly ash has been used in variety of product during the last 2-3 decades. Whereas

in this country a very limited use of fly ash has been made in hydraulic structures. However, very little has been done on the diversified use of lips fly ash viz. in road construction, soil slabbing, precast block etc.

Even though research and development and suprimental construction has shown that fly ash can be used with considerable advantages in building construction, the construction industry has still not taken to the use of fly ash to any large extent.

The reasons assigned for this may be.

1. Unawareness of the usefulness of fly ash in conjunction with lime, cement or bricks in the various civil engineering works.
2. Unavailability of ready mix lime fly ash mixture of standard quality.

There is considerable lack of awareness and appreciation about the possibility of use of fly ash in partial replacement of cement to the extent of 15 to 20% without affecting in any way the strength of the structure adversely or producing any other detrimental affect. This report is intended to give the essential technical information and data regarding the use of in building construction and the process and feasibility of making lime fly ash mix which can be used in variety of works.

Fly ash lime bricks are chemically bonded bricks manufactured by utilizing 80-82% of fly ash, which is a major waste bye-product of pulverised coal fired in Thermal Power Stations, 9-10% of lime, 9-10% of sand and 0.2% of Chemical

accelerator (Covered by Central Fuel Research Institute, Dhanbad's patent). The process know-how has been developed by Central Fuel Research Institute, Dhanbad and marketed through National Research Development Corporation, 20-22, Zamroodpur Community Centre, Kailash Colony Extension, New Delhi - 110 048.

For manufacturing fly ash lime bricks no firing is needed. Curing in steam for predetermined period is employed to enable the bricks to gain desired strength. Thus, fly ash lime bricks satisfy the basic parameters of building units, moreover the bricks are also suitable for the construction of building in coastal areas where normal red clay burnt bricks are found to be affected.

Various special features of fly ash lime bricks are as follows:

a) Being machine finished these are uniform in size and shape.
b) Consumes 20-25 percent less cement mortar.
c) Stronger than Class-I, burnt clay building bricks.
d) Outside wall plastering is not essential as these bricks have cement gray colour, smooth surface and low water absorption capacity.
e) Resistance to salinity.
f) Being lighter in weight in comparison to the conventional red bricks, the dead building load and the transportation cost will be less.
g) Adoption of this process helps to conserve invaluable top soil of agricultural land.
h) By consuming 80-82% fly ash, the cause of environmental pollution and hazards due to disposal is minimized.

i) As firing of the bricks is not needed thus pollution due to firing is eliminated.

## 2. FLYASH LIME BRICKS SPECIFICATION

Fly ash is a useful by-product from thermal power stations using pulverized coal as a fuel and has considerable pozzolanic activity. This national resource can be gainfully utilized for manufacture of fly ash-lime bricks as a supplement to common burnt clay building bricks leading to conservation of natural resources and improvement in environmental quality. Fly ash-lime bricks are obtained from materials consisting of fly ash in major quantity, lime and an accelerator acting as a catalyst.

Fly ash-lime bricks are generally manufactured by inter-grinding or blending various raw materials which are then moulded into bricks and subjected to curing cycles at different temperatures and pressures. On occasions, as and when required, crushed bottom ash or sand is also used in the composition of the raw material. Crushed bottom ash or sand is used in the composition as a coarser material to control water absorption in the final product. Fly ash reacts with lime in presence of moisture to form a calcium silicate hydrate which is the binder material. Thus fly ash-lime brick is a chemically bonded brick.

These bricks are suitable for use in masonry construction just like common burnt clay bricks. Production of fly ash-lime building bricks has already started in the country and it is expected that this standard would encourage its production and use on mass scale. This standard lays down the essential requirements of fly ash-lime bricks so as to achieve uniformity in the manufacture of such bricks.

## 3. USES AND APPLICATIONS

Fly ash bricks are used in building industry.

Fly ash Sand-Lime bricks:

Building industry:

Fly ash sand-lime bricks can be used as an alternative material for burnt clay bricks which is one of the important building materials used for construction of housing and buildings. The fly ash building bricks are unable in all types of brick masonry works and can substitute the conventional burnt clay bricks in nearly all applications.

Advantages of Fly ash sand-Lime bricks:

1. Uniform size, require less quantity cement mortar.
2. Can be used as facing bricks without any external plastering.
3. Lower bulk density.
4. More resistant to salinity and water seepage.
5. Utilization of waste and conservation of soils.
6. Saving in fuel.

**Uses & Applications of Burnt Clay Fly ash Bricks:**

Building Industry.

## 4. PROPERTIES & CHARACTERISTICS

Fly ash-Sand Lime bricks :

(As per Central Fuel Research Institute, Dhanbad)

Properties :

1. Size : 9" x 4.5" x 3" (230 x 110 x 70 mm)
2. Colour : Cement Gray
3. Bulk Density : 1550 Kg/m3
4. Unit Weight : 3.0 - 3.2 Kg.
5. Water Absortion : 15 - 20%
6. Crushing Strength : 100 - 120 Kg/m2
7. Free lime content : Less Than 0.2%

Properties of Fly ash-Sand Lime bricks :

**(Source CBRI Roorkee)**

1. Brick Weight : 2.5 - 3 Kg.
2. Brick Size : Machine Made Modular size 20 cm x 10 cm x 10 cm

Characteristics of Fly ash-Sand-Lime bricks:

1. Bricks are of uniform size and shape.
2. They have high wet compressive strength
3. They have low drying shrinkage
4. They are free from efflorescence
5. The quality of fly ash sand lime brick is found to be superior to conventional burnt clay bricks in some respects such as water absorption, crushing strength, etc.
6. The bricks are also lighter as compared to burnt clay bricks.

**Advantages of Fly ash-Sand Lime Bricks over Clay-Bricks:**

1. Lower requirement of water in construction
2. Elimination of plastering from outside wall
3. More resistance to salinity and water

**Properties of Burnt Clay Flash Bricks :**

(Source BMT/PT)

| | | |
|---|---|---|
| 1. | Size | : 9" x 4.5" x 3" |
| 2. | Colour | : Red |
| 3. | Bulk Density | : 1700 - 1900 Kg/m3 |
| 4. | Water absorption | : 12% to 18% |
| 5. | Unit Weight | : 2.5 to 3 Kg. |
| 6. | Crushing Strength | : 75 - 100 Kg/cm2 |

**Clay-Fly ash Burnt Bricks:**

Fly ash generally contains 5 to 6% of unburnt carbon, incorporation of fly ash, therefore, results into a better burnt product together with an economy in fuel consumption. It has been experimentally verified that saving of about five tons of coal per Lac bricks could be achieved by mixing 40% flash ash by volume with the clay for making bricks.

**Advantages of Clay Fly Ash Bricks :**

Reduction in drying shrinkage and about 15 to 25% of the weight of the bricks with better thermal insulation. The properties of bricks are not affected by mixing fly ash with the clay.

## 5. B.I.S. SPECIFICATIONS

The following B.I.S. Specifications are available for Fly Ash bricks :

IS : 12894 = 1990 : Fly Ash Lime bricks.

IS :13757 = 1993 : Burnt Clay Fly Ash Building Bricks.

B.I.S. has also formulated the following Indian Standards relating to the raw materials and methods of test which can be referred to while manufacturing fly ash lime bricks. IS : 3812 = 1981: Fly ash for use as pozzolana & admixture (first revision) Reaffirmed 1992.

IS: 6491 = 1972: Method of sampling of fly ash.

IS: 10153 = 1982: Guidelines for utilization and disposal of fly ash Reaffirmed 1993.

## 6. RAW MATERIAL

1. Fly Ash

Fly ash forms the major component of the raw min for Fly ash bricks. Therefore it controls to a large extent the properties of the finished product. As the ash is non-plastic, a binder must be added either plastic clay or Portland cement. Fly ash content ranges from 60 to 80%.

2. Lime

It is generally desirable to use a high calcium lime of reasonable purity as it is the most important constituent which reacts with silica and alumina etc. present in the fly ash to form the binder under hydrothermal conditions other burnt lime is not desirable as it does stake readily. The particles of lime should be fine

enough to be thoroughly distributed and coat the grains of the mix. It should also satisfy IS: 712-1973. Lime content range from 20 to 30%.

3. Water

Generally potable water from a well or a river is required.

Series of Fly ashes from various Thermal Power Station

**Physical Properties**

| SL.No. | Name of Thermal Power Station | Finener S.S.m. by Blaine method. | Lime reactive Kg/cm2 |
|---|---|---|---|
| 1. | Bandal | 6247 | 57.0 |
| 2. | Basin Bridge | 4080 | 56.8 |
| 3. | Bokaro | 6140 | -- |
| 4. | Chandarpura | 4700 | 50.0 |
| 5. | Delhi | 3595 | 63.8 |
| 6. | Durgapur | 4480 | -- |
| 7. | Ennore | 5283 | 51.6 |
| 8. | Hardwagani | 3780 | 52.7 |
| 9. | Kanpur(Panki) | 6091 | 54.0 |
| 10. | Neyveli | 3509 | 62.43 |
| 11. | Palondh (A.P.) | 3800 | 58.00 |
| 12. | Badarpur | 3300 | 54.00 |
| 13. | Faridabad | 3900 | 52.00 |

Suitable for making fly ash bricks. Sea-water should be avoided as far as possible. Soluble salts or organic matter in water should not exceed 0.25%. Water is an essential but temporary constituent of fly ash bricks. If is needed to form them but is subsequently eliminated during drying.

**Stain Chemicals**

Stains, chemicals added to control the presence of soluble salts, and other minor additions to the clay are sometimes made to improve the quality of brick.

## 7. PROPERTIES & CHARACTERISTICS OF RAW MATERIALS

**Properties of Fly Ash:**

Fly ash is a fine residue obtained from thermal power stations using ground or powered coal as boiler fuel. It can be utilized in various forms as building material. The thermal power stations in the country throw large quantities of fly ash which goes as waste but which could be effectively used as partial replacement of cement.

The chemical and physical properties of fly ash from various power in India which produce fly ash as a by-product are given in the table a 1, 2, and 3. It will be seen that the physical and chemical properties of fly ash obtained from different thermal power stations vary widely. There will be considerable difference in these properties of fly ash even if they fly ash is obtained from the same power station depending upon the coal used by the power stations.

However, the range of variation permissible as regards the chemical property is concerned is so wide that most of the fly ash obtained from the power stations are suitable for use as puzzolanic material. IS: 3812 (Part II) gives the permissible range of chemicals the concentration. Table 3 shows the comparison between the composition of the fly ash normally obtained from the power station generally confirm to the prescribed Indian Standards.

As regards the physical properties BIS prescribes a fineness corresponding to specific area of 3200 sq-cm/gm but as the fly ash normally obtains is found to have a specific area of 2500 to 6000 sq-cm./gm. The ISI prescribes a minimum puzzolanic activity of 50 kg per sq-cm. and the fly ash normally obtained fully satisfies this stipulation.

**Chemical Properties of Fly Ash from different Thermal Power Stations in India**

| Sl. NO. | THARMAL POWER STATION NAME | SIO2 % | AL2O3 % | AL203+Fe2O3 % | Fe2O3 % | TiO2 % | CaO % | MgO % | ALKALI % | SO2 % | P2O3 % | Loss of Ignition% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Badarpur | 55.00 to 68.30 | - | 19.50 to 29.80 | 3.50 to 18.30 | 1.00 to 2.00 | 1.00 to 2.00 | 0.26 to 1.20 | 0.16 to 3.04 | 0.4 to 1.88 | 0.13 to 0.28 | |
| 2. | Bandel | 45.40 to 53.70 | - | 18.70 | 15.40 | - | 2.00 | 1.40 | - | 1.6 | - | 6.50 to 7.30 |
| 3. | Basin Bridge | 82.92 | 5.87 | | - | - | 1.19 | - | - | 0.53 | - | 2.64 |
| 4. | Bhusaval | 56.80 | - | 24.20 | 13.30 | 1.00 | 1.70 | 1.10 | 0.60 | 1.20 | 0.30 | - |
| 5. | Bokaro | 55.00 to 57.00 | | 24.00 to 25.00 | | | 0.33 to 1.40 | 0.08 to 0.84 | | 0.04 to 0.7 | - | - |
| 6. | Chandrapura | 60.90 | - | 27.98 | 6.00 | - | 2.52 | 0.63 | | 0.34 10.95 | - 1.90 | - 6.00 |
| 7. | Delhi | 54.25 | - | 31.10 | 5.00 | 2.42 | 2.31 | 0.68 | 2.2 | 0.2 | 1.0 | - |
| 8. | Durgapur | 50.00 to 60.00 | - | 25.00 to 28.00 | 5.00 to 10.00 | 0.5 to 1.0 | 2.00 to 3.00 | 0.10 to 0.50 | 1.00 to 2.00 | 0.4 - | 2.0 0.86 | 4.9 |
| 9. | Faridabad | 62.26 | - | 14.74 | 15.11 | 0.60 | 1.60 | 0.40 | 0.07 | 1.33 | - | 1.34 |
| 10. | Nellore | 60.64 | | 23.16 | 10.96 | - | 2.09 | - | - | 1.66 | - | 0.95 |
| 11. | Neyvelli | 53.72 | 29.48 | - | - | - 10.15 | 3.47 | 0.07 | | | | |

**Comparison Properties With BIS :**

| Sl.No. | % Composition | Indian Fly ashes | Prescribed by BIS |
|---|---|---|---|
| 1. | Loss on Ignition | 1 to 6.00 | 12% (Maximum) |
| 2. | Silicon as SiO2 | 45 to 65.25 | 6% (Max) for R.C.C |
| 3. | Iron Oxide as Fe2O3 | 13 to 15.00 | 70 (minimum) |
| 4. | Alumina as Al2O3 | 14 to 31.10 | - |
| 5. | Titanium as TiO2 | 0.5 to 2.42 | - |
| 6. | Phosphates as P2O5 | 0.1 to 1.90 | - |
| 7. | Calcium Oxide as CaO | 0.1 to 2.31 | - |
| 8. | Magnesium Oxide as MgO | 0.2 to 2.3 | 5 (max) |
| 9. | Sulphur as So 3 | 0.4 to 1.8 | 3 (Max) |
| 10. | Available alkalies as Na2O | 0.1 to 3.4 | 1.5 (Max) |

Specification for Fly Ash for use as Pazzolana and Admixture: (As per IS: 3812 - 1981).

The fly ash should confirm to the following chemical and physical requirements (IS: 3813-Part II-1966)

**Chemical Requirements**

| CHEMICAL REQUIREMENTS | % BY WEIGHT |
|---|---|
| a) Silicon dioxide ($SiO_2$) plus Aluminum oxide ($Al_2O_3$)+ Iron oxide ($Fe_2O_3$)+ % by weight (Minimum) | 70.00 |
| b) Magnesium oxide (Mgo) % by weight (Maximum) | 5.00 |
| c) Total sulphur as sulphur trioxide ($SO_3$) % by weight (Maximum) | 3.00 |
| d) Available alkalies as Sodium oxide ($Na_2O$) % by weight (Maximum) | 1.5 |
| e) Loss on ignition % (Maximum) | 12.00 |

**PHYSICAL REQUIREMENTS**

| PHYSICAL REQUIREMENTS | % BY WEIGHT |
|---|---|
| a) Fineness-specific surface in cm2/gm by blaines air permeability method (Minimum) | 2800 |
| b) Lime Reactivity-Average Compressive strength in kg/cm2 obtained by testing at least 3 mortar cubes at the age of 7 days (Minimum) | 50 |
| c) Drying shrinkage at 28 days Maximum | 0.1 |
| d) Soundness by autoclave test | 0.8 |

**B.I.S. Specification for Lime :**

IS: 712 - 1973 has been prepared by the Indian Standard Institution for the building grade lime. According to this standard, building lime can be classified according to :-

CLASS A:-

Eminently hydraulic lime used for structural purpose.

CLASS B:-

Semi-hydraulic lime used for masonry mortars.

CLASS C:-

Fat lime used for finishing coat in plastering white and with addition of pozzolanic materials for masonry mortars.

CLASS D:-

Magnesium lime used for finishing coat in plastering and white washing etc.

CLASS E:-

Kankar lime used for masonry mortars.

CHEMICAL REQUIREMENT:

| Sl. | Type of Test | Class`B' | | Class `C' | |
|---|---|---|---|---|---|
| | | Quick | Hydrated | Quick | Hydrated |
| 1. | Calcium and Magnesium oxide % Min. | 70 | 70 | 85 | 85 |
| 2. | Magnesium oxide % Max | 5 | 5 | 5 | 5 |
| | Min | - | - | - | - |
| 3. | Silica,Alimina,and ferric oxide % Min | 15 | 15 | - | - |
| 4. | Unhydrated oxide % Max | - | - | - | - |
| 5. | Insoluble residue in hydrochloric acid less the silica % Max | 3 | 2 | - | - |
| 6. | Insoluble Matter in sodium carbonate solution ,% Max | 5 | 5 | 5 | 5 |
| 7. | Loss of Ignition, % Max | 5 for large lumps, 7 for lime other than | | 5 for large lumps,7 for olime other | |
| 8. | Carbon dioxide,% Max | 5 | 5 | 5 | 5 |
| 9. | Cementation value | | | | |
| | Min | 0.3 | 0.3 | - | - |
| | Max | 0.6 | 0.6 | - | - |

Fly Ash Lime Bricks - Specifications :
(As per IS : 12894 : 1990)

General Requirements :

Visually the bricks shall be sound, compact and uniform in shape. The bricks shall be free from visible cracks, warpage and organic matter.

The bricks shall be solid and with or without frog 10 to 20 mm deep on one of its

Dimensions and Tolerances :

The size of the fly ash-lime bricks shall be 190 mm x 90 mm x 90 mm. The tolerance on length shall be +3 mm and that on breadth and height shall be +2 mm.

**Note:** By agreement between the purchaser and the manufacturer, fly ash-lime bricks may be manufactured in other sizes also. The tolerance requirements on length, breadth and height shall remain the same as given above.

Materials :

Fly Ash :

Fly ash shall conform to Grade 1 or Grade 2 of IS 3812 : 1981.

Bottom Ash :

Bottom ash used as replacement of sand shall not have more than 12 percent loss on ignition when tested according to IS 1727 : 1967.

Sand :

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

Lime:

Lime shall conform to Class C hydrated lime of IS 712 : 1984.

Additives :

Any suitable additive considered not detrimental to the durability of the bricks may be used.

Classification :

The fly ash-lime bricks shall be of the following four classes depending upon their average compressive strength :

| Class | Average Compressive Strength N/mm2 | |
|---|---|---|
| | Not less than | Less Than |
| 7.5 | 7.5 | 10.0 |
| 10 | 10.5 | 15.0 |
| 15 | 15.0 | 20.0 |
| 20 | 20.0 | - |

**Physical Characteristics:**

Compressive Strength:

The minimum average compressive strength of fly ash-lime bricks shall not be less than the one specified for each class in 6.1 when tested as described in IS 3495 (Part-I):1976. The compressive strength of any individual brick shall not

fall below the minimum average compressive strength specified for the corresponding class of bricks by more than 20 percent.

Drying Shrinkage:

The average drying shrinkage of the bricks when tested by the method described in IS-4139:1989, being the average of three units, shall not exceed 0.15 percent.

Efflorescence Test:

The bricks when tested in accordance with the procedure laid down in IS-3495 (Part-3):1976, shall have the rating of efflorescence not more than 'moderate' up to class 10 and 'slight' for higher classes.

Water Absorption:

The bricks, when tested in accordance with the procedure laid down in IS-3495 (Part-2):1976, after immersion in cold water for 24 hours, shall have average water absorption not more than 20 percent by mass up to class 10 and 15 percent by mass for higher classes.

Sampling and Criteria for Conformity:

Sampling and criteria for conformity of the bricks shall be as given in IS-5454:1976.

**Burnt Clay Fly Ash Building Bricks - Specification:**

Classification :

Burnt clay fly ash bricks shall be classified on the basis of average compressive strength as given in Table below.

Classes of Burnt Clay-Fly Ash Bricks

| Class Designation | Average Compressive Strength Not Less than | |
|---|---|---|
| | N/mm2 | kgf/cm2 (Approx) |
| 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) |

General Quality

Clay fly ash bricks shall be hand or machine moulded and shall be made from the admixture of suitable soils and fly ash in optimum soils and fly ash in optimum proportions, see IS 2117:1991. The fly ash used for manufacture of

bricks shall conform to grade 1 or grade 2 as per IS 3812:1981. The bricks shall be uniformly burnt, free from cracks and flaws as black coring, nodules of stone and/or free lime and organic matter. In case of non-modular size of bricks, frog dimensions shall be the same as for modular size bricks.

Hand-moulded bricks of 90 mm or 70 mm 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 (Refer 6.1.1 for L, W and H). Bricks of 40 or 30 mm height as well as those made by extrusion process may not be provided with frogs.

The bricks shall have smooth rectangular faces with sharp corners and shall be uniform in shape and color.

**Dimensions and Tolerances**

Dimensions :

The standard modular sizes of clay building fly ash bricks shall be as follows

| Length (L) mm | Width (W) mm | Height (H) mm |
|---|---|---|
| 190 | 90 | 90 |
| 190 | 90 | 40 |

The following non-modular sizes of the bricks may also be used

230 110 70

230 110 30

For obtaining proper bond arrangement and modular dimensions for the brick work, with the non-modular sizes, the following sizes of the bricks may also be used :

70 110 70 1/3 length brick

230 50 70 1/2 width brick

Tolerances:

The dimensions of bricks when tested in accordance with 6.2.1. shall be within the following limits per 20 bricks:

a) For modular size

Length 3720 to 3880 mm (3800 + 80 mm)

Width 1760 to 1840 mm (1800 + 40 mm)

Height 1760 to 1840 mm (1800 + 40 mm)

(For 90 mm High Bricks)

760 to 840 mm ( 800 + 40 mm)

(for 40 mm high bricks)

b) For non modular size

Length 4520 to 4680 mm (4600 + 80 mm)

Width 2240 to 2160 mm (2200 + 40 mm)

Height 1440 to 1360 mm (1400 + 40 mm)

(For 70 mm High Bricks)

640 to 560 mm ( 600 + 40 mm)

(for 30 mm high bricks)

Twenty (or more according to the size of stack) whole bricks shall be selected at random from the sample selected under 8. All blisters, loose particles of clay and small projections shall be removed. They shall then be arranged upon a level surface successively in contact with each other and in a straight line. The overall length of the assembled bricks shall be measured with a steel tape or other suitable inextensible measure sufficiently long to measure the whole row at one stretch. Measurement by repeated application of short rule or measure shall not be permitted. If, for any reason it is found impracticable to measure bricks in one row, the sample may be divided into rows of 10 bricks each which shall be measured separately to the nearest millimeter. All these dimensions shall be added together.

**Physical Requirements :**

Compressive Strength :

The bricks, when tested in accordance with the procedure laid down in IS 3495 (Part 1) : 1992 shall have a minimum average compressive strength for various classes as given above.

The compressive strength of any individual brick tested shall not fall below the minimum compressive strength specified for the corresponding class of brick. The lot shall be then checked for next lower class of brick.

Water Absorption :

The bricks, when tested in accordance with the procedure laid down in IS 3495 (Part 2) : 1992 after immersion in cold water for 24 hours, water absorption shall not be more than 20 percent by weight up to class 12.5 and 15 percent by weight of higher classes.

Efflorescence :

The bricks when tested in accordance with the procedure laid down in IS 3495 (Part 3) : 1992 the rating of efflorescence shall not be more than 'moderate' up to class 12.5 and 'slight' for higher classes.

## 8. MARKET SURVEY

Construction work is basis to out development efforts - for agriculture and industry for the development of water, power transportation and communication

system and certainly for housing the people so that their living standard can be upgraded to promote their welfare and happiness.

Construction accounts for about 50% of the total development all our lays; but the scale of Housing shortage along should be sufficient to dispel any illusions as to be adequacy of our present efforts. It is imperatives therefore, that no lower the construction cost substitute; materials of improve performance can be developed and made available for mass scale use in developed and made available for mass scale use in urban as well as rural areas. Lime an excellent cementing material in terms of its workability imperviousness, inherent strength etc. is ideal for this purpose. Lime along in conjunction with puzzolenic material like fly ash can prove a good substitute for cement. In India is the estimate production capacity of all the brick industries is about 900 million which is far below the market demand and the shortfall is likely to increase manifold in future years during which a large increase in the building activity is anticipated. It is well recognized that traditional method of hand moulding cannot cope with the heavy demand.

In the state of Orissa there is not a single unit engaged in the manufacture of fly ash lime bricks. However, at present 3 SSI units are engaged in the manufacture of Fal-G (Fly ash-lime-gypsum) bricks with low investment.

National Aluminum Company Ltd. (NALCO) in Orissa is encouraging prospective entrepreneurs to go for the manufacture of fly ash-lime bricks by

utilising the ash generated in captive power plant at Angul under their ancillary and downstream development programme.

As regards the manufacture of fly ash-lime bricks inside our country, the first commercial plant of capacity 20000 bricks/day is in operation since 1986 at Barrackpore (West Bengal) and the product is being marketed to various users both in private and public sectors including the organisations like West Bengal Housing Board, Miligary Engineering Services, PWD (Roads) Kolkata Electric Supply Corporation etc. The second commercial plant of capacity 30000 bricks/day has been set up in private sector at Raichur (Karnataka), while the third one of 90,000 bricks/day capacity is being set up at Bondal (West Bengal) by M/s. Pulver-Ash, a subsidiary of West Bengal Small Industries Corporation. The fourth one having a capacity of 30000 bricks/day has been set up at Amarpur in West Bengal. In addition to the above one unit in Vijayawada (A.P) and NTPC, New Delhi have also taken up manufacture of the said bricks with the production capacity of 30000 bricks/day.

With the rise in population and increase in the constructional activities considering the improvement in the standard of living, the demand for building bricks is increasing day by day. Fly ash lime building bricks are not only the substitute for clay burnt building bricks but also are considered superior in comparision to clay burnt bricks. In Orissa at present people are switching over to cement concrete hollow and dense bricks and blocks and fly ash-lime-gypsum bricks manufactured inside the state. Most of the people are also not aware of the advantages of using the fly ash lime bricks. In future days

the manufacturers of fly ash based bricks will dominate over the manufacturers of clay burnt bricks in the market.

The Government of Orissa has also included the manufacture of fly ash bricks in the top priority industries group.

It is estimated that the present production of building bricks is around 230 billion numbers annually, in India and the requirement is expected to be around 285 billion numbers, as per the estimates available. To fill this large gap in availability of bricks, it is proposed to utilise the vast quantities of fly ash, which is at present available in quantities ranging around 40 million tonnes per annum - which would possible increase to 90 million tonnes by 2000 AD, as per the estimates available. The utilisation of fly ash will not only solve the environmental problem, but also save vast tracts of valuable agricultural & urban land.

Brick production for use in the construction industry can therefore be stepped up to fill the demand - supply gap. To bring about this change, more units are required to be set up in different zones of the country.

Various Fly ash Brick Compositions:

Fly ash Sand-Lime Bricks: (As per CBRI)

| | |
|---|---|
| Fly Ash | 40 - 50% |
| Sand | 50 - 40% |

Lime 10%

Burnt Clay-Fly Ash Bricks : (As per CBRI)

Fly Ash 30%

Clay 70%

Fly Ash Sand-Lime Bricks : (As per Central Fuel Research Institute, Dhanbad)

Patent %

Fly Ash* 80 - 82%

Sand 9 - 10%

Lime 9 - 10%

Chemical Accelerator 0.2%

Fly Ash : Major waste product of pulverized coal fired in Thermal Power Stations.

Chemical Accelerator/Binder used for Fly Ash Bricks :

As fly ash is non-plastic, a binder must be added either plastic clay or Portland cement.

Fly Ash Brick Composition : (As per Iswar B. Visakhapatnam)

Fly Ash 65 - 70%

Sand (Coarse) or

Crushed Stone 15 - 20%

Lime 5 - 10%

Gypsum 3.5-6.5%

Another Fly Ash Lime Bricks Composition:

(As per Iswar B. Visakhapatnam A.P)

Fly Ash 50%

Lime 20%

Sand 20%

Gypsum 8-10%

Other Fly Ash Sand Lime Brick Composition :

Fly Ash 70%

Sand 20%

Lime 10%

Sand-Lime Bricks Composition : (As per CBRI)

Sand 90%

Hydrated Lime 10%

=======

Total 100%

=======

## 9. PROCESS OF MANUFACTURE

Fly Ash-Sand-Lime Brick : (As per CBRI)]

Brick Composition:

Fly Ash 40 - 50%

Sand 50 - 40%

Lime 10%

Lime is finely ground in a ball mill/pulverizer. Fly ash, finely ground quick line and sand in requisite proportions are fed in double roll paddle mixer or U-shaft mixer (Double shaft mixer) by means of a feeder.

Then 4% water is added and intimate mixing is done. The mixing proportion (as per Brick composition given above) is generally 40-50% Fly Ash, 50-40% Sand 10% lime and 4% water.

Fly ash reacts with lime in the presence of moisture to form calcium silicate hydrate which is the binder material.

After this the mixture is discharged and sent to manual presses for moulding; which is a moulding machine developed by C.B.R.I.

C-Brick Machine has 4=Brick Block at a time with capacity 2500 Bricks/day (Cost of m/c = Rs. 40,000).

The raw mix is moulded in the moulding press/machine, pressed under a pressure into bricks. The bricks are then with drawn from the moulding machine and they are air dried under the sun and kept for 1 day.

The bricks are conveyed either by placing on platform trolleys or by conveyors to curing chamber/autoclave in which curing is done by steam at normal pressure and cured for 6 - 8 hours (Steam Curing).

Trolleys with ready bricks to the storage yard, where they are unloaded by overhead traveling crane and a grip tongue.

24 hours after curing, the bricks are ready for use. The final products are sorted out and inspected for quality and stacked in the go-down or yard or loaded on trucks for marketing for use in construction. The whole processes can be divided into following unit operations.

**1. Grinding & Mixing :**

Methods of grinding and mixing depend upon the composition of the fly ash and the layout of the plant. To get a high strength calcium silicate materials, it is advantageous to mix and grind lime and sand for a greater period and then mix the remaining quantity of fly ash and mix for a further short period so that only a portion of the ingredients receive such grinding. Mixing and proportioning may be done either by batch or continuous process. Generally batch methods are preferred for the primary stage to achieve a good control on the operation.

Raw materials, water stains and other chemicals are properly mixed in a double - shaft or U-shaped mixer or counter-current mixer (costlier) till the semi-dry mix is uniform and ready for pressing.

Trolleys: Each trolley carries about 750 to 1500 bricks and an autoclave may hold upto 20 such trolleys or more depending upon its length.

**2. Pressing :**

In general, after the mixing and grinding, the material is placed in an instant stripping mould with a high powered external vibrator of 180 112 frequency. During compaction the top surface is pressed at a 300 kg/cm2 on each brick. A wooden plate is then set on the top surface and the mould is turned upside down. Finally the mould is stripped by lifting it up. It is necessary to use high pressure moulding because the mixers are non-plastic in nature. The press required for this purpose has to be sufficiently robust to withstand the high chemical strains and wear and tear to which it is to be subjected.

**3. Removal & Stacking for Curing/Autoclaving :**

The pressed bricks are removed from the press either manually or by an automatic press off loading and brick stacking machine, designed to work in conjunction with the brick making press, and amonged on trolleys. Each trolley carries about 750 to 1500 bricks and an autoclave may hold upto 20 such trolleys or more depending upon its length .

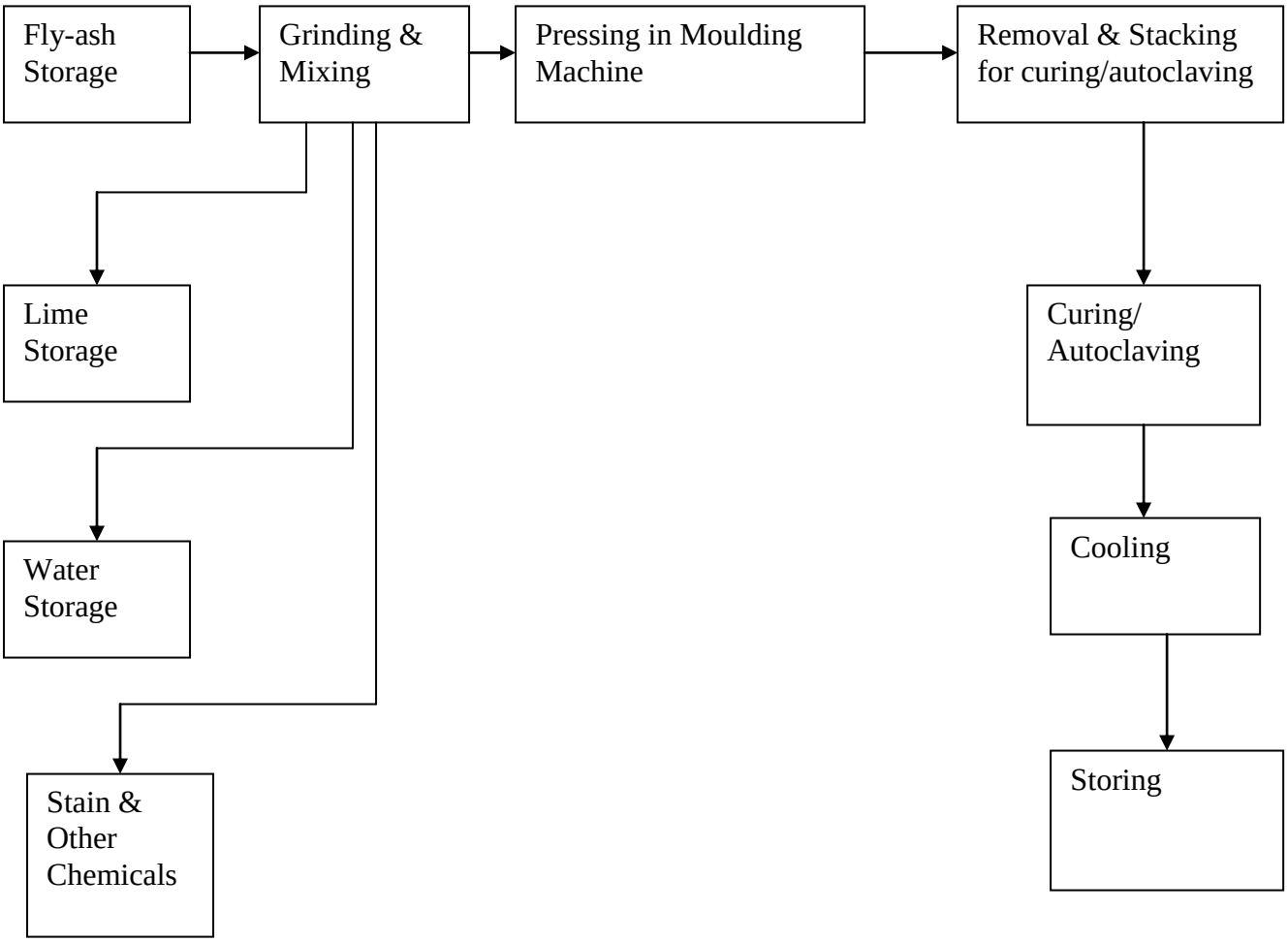
Autoclaving :

Autoclave, a long horizontal cylinder, with one of the end usually closed and the other door is removable to allow the trolleys to more in and out on rails. After that trolleys have been placed in the autoclaves, the doors are tightly closed and steam at normal pressure is fed inside and curing is done for 6-8 hours. The steam in autoclave is allowed to blow off slowly through a release valve and the contents are allowed to cool. The chamber is then

opened and the trolleys are drawn out and the cooled bricks are stored in the yard. Thus autoclave is available immediately for recharging.

## 10. PROCESS FLOW DIAGRAM FOR THE MANUFACTURE OF FLYASH SAND-LIME BRICK

**Fly ash-Sand-Lime Brick Source CBRI)**




**The Manufacture of Flyash-Sand-Lime Brick**

## 11. FEATURES

Fly Ash-Sand-Lime-Bricks

Technology Package and Machinery :

Process Know-How, Quality Assurance methods, Process Demonstration.

Major Plant Equipment and Machinery :

Screw feeders, Bucket Elevator, Double Shaft Mixers, Hydraulic Press, Autoclave, Boiler, Pulverizer.

Process of Manufacture of Burnt Clay Fly Ash Bricks : (As per CBRI)

Brick Composition :

| | | |
|---|---|---|
| Fly Ash | 30% | (10-40%) |
| Clay | 70% | |

10 to 40% or average = 30% of fly ash on the dry weight or 20 to 60% by volume of the soil depending upon the physico-chemical and ceramic characteristics of the soil is added to clay (70%) and mixed thoroughly in a double shaft mixer or blender or semi-mechanised Brick making machine (Mixer + Extruder costing Rs. 60,000). Water (4-10%) is added in the mixer.

After water addition, the stuff is passed through extruder. In the extruder the material is pressed and comes out in the form of a beam. The beam is cut into bricks manually by means of cutter. The bricks are dried in air in the open under the sun.

After drying the firing of the green bricks is carried out in a horizontal High Draught Kiln (archless top-fed coal fired kiln (30 meters in length provided with induced draught fan and chimney. Coal is burnt in the kiln. Kiln firing is done at intervals in different zones of the kiln.

The firing of green bricks (as per BMT/TP) may be carried out in a continuous type Bull's trench kiln at temperature of 950oC to 1050oC. The high draught kiln can be used for higher efficiency. However, Coal consumption (as per C.B.R.I. High Draught Kiln) is reduced by over 25% as compared to Bull trench kiln).

Technical Aspects of High Draught Kiln Used for Burnt Clay Fly Ash Bricks : (As per C.B.R.I.)

An archless top-fed, coal fired kiln with draught provided by an induced draught from power required for running the fan.

5 = 6 units/1000 Bricks

Coal consumption reduced by over 25% as compared to Bull's trench kiln. More uniform burning resulting in 75-80% class brick can be worked round the year.

Salient Technical Features of Semi-Mechanised Fly Ash Brick Making Machine :

The machine produces uniform size and superior strength building bricks. Adoptable for other day products. Easy operation and maintenance. The capacity of the machine is upto 2500 bricks per hour (Cost Rs. 60,000).

Major Components :

Double-deck extruder with hand-operated cutting table; belt conveyor, motors, and helical gear box.

Brick Making Machine : (As per C.B.R.I)

| | | |
|---|---|---|
| Production Rate | : | 2500 Bricks/hr. |
| Power Required | : | 45 KW |
| Machine | : | Double deck with cutting tool wearing parts tipped with Hard Alloy. |

Certain Features of Burnt Clay-Fly Bricks : (As per CBRI) ailment Technical Features :

Energy/Coal saving in firing upto 30% as compared to traditional clay bricks. Waste utilisation.

Environmental Aspects :

Help in disposal of waste (fly ash) which poses a serious threat to environment and ecology.

Major Plant Equipment & Machinery :

As per traditional brick production -

Double Shaft Mixer or blender/Semi-mechanised Brick-making machine (Mixer + Extruder). Archless top-fed coal fired kiln with draught provided by induced draught fan/Bull's Trench kiln.

Technology Package :

Process know-how, raw materials, specifications, process demonstration, training at site and laboratory.

Certain Features of Burnt Plant & Equipment : (As per MBT/TP)

1. Moulds
2. Double Shaft Mixer/Blender for mechanical process
3. Extrusion Machine
4. Bull's Trench kiln/High Draught Kiln
5. Jukb Equipment
6. Tube Well
7. Electrical Equipments/Fittings
8. Water Pipes and Fittings.

Certain Features of Burnt-Clay-Fly Ash Bricks : (As per BMT/TP)

Additional Information :

1. Incentives : Free Supply of Fly Ash
2. Source of Technology : CBRI Roorkee,, CPRI Bangalore
3. Information : BMTPC, NRDC, CBRI, CPRI, HUDCO HB, IDBI, ICICI, IFCI, SICOM.

4. Plant & Machinery : Indigenous

## 12. BRICKS FROM INFERIOR SOILS

CBRI (Central Building Research Institute)]

Red Soils :-

Admixture :-

3-5 % cinder of 20-25 % fly ash or 10-15 % rice husk ash or 5-10 % ground rice husk reduces drying losses 50-60 % improved strength, 25-35 % saving in fuel consumption.

Bricks of strength 60-100 Kg/sq-cm. water absorption 12-60 %.

Marine Soils :-

Admixture 25-30 % grog firing under controlled firing rate not exceeding $25^0$ C per hour checks drying losses.

Reduces bursting and cracking during firing, high compressive strength 300-350 Kg/sq-cm, low water absorption.

## 13. MANUFACTURE OF PROCESS OF FLY ASH BRICK

As per (Andhra Pradesh) IS WARBL Visakhapatnam

| | Brick composition |
|---|---|
| Fly ash | 65-70 % |
| Sand (coarse) or crushed stone | 15-20 % |
| Lime | 5-10 % |
| Gypsum | 3.5-6.5 % |

1. Dry mix all materials as per above formulation in a U-Shaft mixer/counter current (costlier).

2. Add 8-10 % water into the above dry mix and mix well

3. Transfer this mix to presses friction screw press 80-120 tons capacity or hydraulic/mechanical press. (Hydraulic press of 200-300 Tons capacity.

4. After presses, bricks are allowed to dry in open air for 24-36 hours depending upon the climate.

5. Curing :-

Curing is done by spray water on the dried bricks. Bricks are then covered, bricks develop themselves.

## 14. PROCESS OF MANUFACTURE OF SAND-LIME BRICKS

As per CBRI

Sand lime Brick Composition

| | |
|---|---|
| Sand | 90 % |
| Hydrated lime | 10 % |
| Total | 100 % |

1. Dry mix the ingredients
2. Pressed bricks are put into autoclave for steam curing.

Bricks are of uniform size and shape, have high net compressive strength, low drying shrinkage and are free from efflorescence.

Major Plant Equipment and Machinery

Box feeder, bucket elevator, double shaft mixers, hydraulic press, autoclave, boiler, pulverizer

## 15. SUPPLIERS OF PLANT & MACHINES

M/s. AMIC Industries Pvt. Ltd.

10, B.T. Road

Kolkata-700056.

M/s. Engineers Enterprises

SF No. 315, Muthuswamy Nagar

Ganapathy

Coimbatore-641006.

M/s. Keshab Machinery (P) Ltd.

Bose Park, Sukehar

24-Parganas.

M/s. S'Cube Engineers

B-5, Surat Singh Estate

Behind Agarwal Estate

Off. S.V. Road

Jogeshwari (West)

Mumbai-400102.

M/s. Neervan Engineering Co.

42/8, Kashinath Dutta Road

Kolkata-700036.

M/s. Mech-Tech. Engineer

113, SIDCO Indl. Estate

Ambattur

M/s. Conmach Manufacturers Eastern Pvt. Ltd.

86, D' Dr. Suresh Sarkar Road

Kolkata-700014.

M/s. Channa Engineering

12th Mile Stone

Mathura Road

Faridabad,  Haryana.

M/s. Cheema Engineering Services Pvt. Ltd.

Sugar Factory Road

Bazpur-262401

Nainital (U.P.).

M/s. Indcon Projects & Equipments Ltd.

D-170, Okhla Industrial Area

Phase-1

New Delhi-110020.

## 16 EQUIPMENT SUPPLIERS FOR FLY ASH BRICKS

### FLY ASH BRICK MAKING PLANT

Engineers Enterprises

189, Bharathiyar Road,

Ganapathy-Maniyakaranpalayam Road,

Near IEC Bus Stop, Ganapathy,

Coimbatore - 641 006

Ph: 0422-2530639

Fax: 0422-2532260

E-mail: engineer@md3.vsnl.net.in

Web: www.eng_ent.com

Hydro Force Industries

8/78, Gali No. 8

Anand Parbat Indl. Area

New Delhi, NCT of Delhi-110005

India

TEL : +91 (0) 11 5745783

Shree Ram Engg. & Manufacturing Industries

Opp. Narsinh Est., Pratapnagar

Vadodara, Gujarat-390004

India

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FAX : +91 (0) 265 581616

E-mail: shreeram@aahura.com

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Housing Board Cly.

Sect. 29, Faridabad, Haryana-121008

TEL : +91 (0) 129  5277212

FAX : +91 (0) 129  5276239

E-mail: naldehra@satyam.net.in

Deepa Machinery Manufacturers Pvt. Ltd.

28 SIDCO Indl. Est.

Coimbatore, Tamil Nadu-641001

India

TEL : +91 (0) 422  872721

Jayem Manufacturing Co. Construction Equipments Divn.

C-99, Sect. 4 Noida, Uttar Pradesh-201301

India

TEL : +91 (0) 120  4520242

FAX : +91 (0) 120  4538136

E-mail: jayem@vsnl.net

Gee Cee Chemicorp

11-175/19H, 1st Flr.

Valmiki Ngr., Fathenagar

Hyderabad, Andhra Pradesh-500018

India

TEL : +91 (0) 40  6504515

FAX : +91 (0) 40  3771353

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M/s. Cosywo Engineering Company

Laxmi Co-op. Industrial Estate

Near Nagarvel Hanuman Mandir

Amraiwadi Road

Ahmedabad-380026

Ph:848168, 848001

Resi:418857

M/s. Kilburn Engineering Ltd.

2, Fairlie Place

Kolkata-700001

Ph:204301

Telex:021-7365, 2504

Gram: TASCONIUM.

M/s. D. Parikh Engineering Works

115, Marol Co-op. Industrial Estate

M.V. Road, Near Sakinaka

Mumbai-400059

Ph:8344787-88

Fax:8379979

M/s. Singhasini Chemical Process

Plant & Equipment

3/26, Vishnupuri

P.O. Box No. 24

Kanpur-208002

Ph: 244128, 217348

Gram: SINGHASINI.

**AUTOCLAVES :-**

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Chaphekarwadi, Borivli (E)

Mumbai-400066

Ph:8057401, 8057622

Fax: 8058235

Gram: ADEPTENGG.

M/s. B.M.T. Industries

15, Neelkanth Shopping Arcade

Ist Floor, Near Vijaya Bank

R.C. Marg, Chembur

Mumbai-400071

Ph:5515131, 5518035, 5512544, 5519770.

M/s. Godrej & Boyce Manufacturing Co. Pvt. Ltd.

Pirojshahnagar, Vikhroli

Mumbai-400079

Ph:5171166-77

Telex: 011-71926 GFAB

Fax: 022-5170900, 5171969

Telex: 011-71502, 71913 GOVK IN

Gram:GODREJVIKH/GODREJMARK.

**BELT CONVEYOR :-**

M/s. Indiana Engg. Works (Bombay) Pvt. Ltd.

Indiana House, Post Box No. 7409

Makwana Road, Marol Naka

Andheri (E)

Mumbai-400059

Ph: 8349857, 8344743, 8340402

Telex: 011-75208 IEW IN,  011-76301 NTEK

Fax: 022-8367154.

M/s. Maharshi Udyog

4, Ruchi, 36, Swastik Society

Navarangpura

Ahmedabad-380009

Ph:409183

Telex: 0121-6369 GOPI IN

Fax:425456

Gram:GOPIEQUIP.

M/s. Recherche Hitek Engrs Pvt. Ltd.

Sai Shrushty, River Valley Road

Madona Colony Extn.

Borivli-400103

Ph:8932473, 8955994

Fax: 8932473, 8959629.

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M/s. Indiana Engg. Works (Bombay) Pvt. Ltd.

Indiana House, Post Box No. 7409

Makwana Road, Marol Naka

Andheri (E)

Mumbai-400059

Ph: 8349857, 8344743, 8340402

Telex: 011-75208 IEW IN,  011-76301 NTEK

Fax: 022-8367154.

M/s. Kitti Steels Limited

Kitti House

Sardar Patel Road

Secunderabad-500003

Ph: 040-813779, 849778, 840269, 815071

Fax: 040-814764.

M/s. R.H. Engineers

Nirmal Rubber & Boards Compound

I.B. Patel Road

Goregaon (E)

Mumbai-400063

Ph: 8735765.

**BRICK PRESS FOR FLY ASH SAND-LIME BRICKS :-**

M/s. Amic Industries

B.T. Road, 24, Paraganas

West Bengal.

M/s. Indian Sugar & General Eng.

Corporation (ISGEC)

Yamunagar

Haryana.

M/s. P.D. Sharma & Co.

Naraina

New Delhi.

M/s. Hindustan Machine Tools Limited

Hyderabad.

M/s. Electrol Neumatic Hydraulics

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M/s. Bemco Hydraulics

Belgaon

Karnataka.

M/s. Cheema Engg. Works

Bajpur

Dist. Nainital

U.P.

M/s. Cemtec Engineering Consultants Pvt. Ltd.

House-2, 1-8-304 to 308

Patigadda Road

Secunderabad-500003.

M/s. Engineers Enterprises

SF. No. 315, Muthusamy Nagar

Mamarathottam Road

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M/s. Projects & Engineering Services

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Ph:. 0129-5263017, 5291556

E-Mail : aqc1@rediffmail.com

M/s. Ambika Vijay Works

1H, Laxmi East Link Road

West, Mumbai - 53

Ph:. 6366894

M/s. Babbar Engineering

688/335, Munshi Ram Bagh

Near Ranjit Nagar

New Delhi - 110 008

Ph:. 5705367, 5705363

Also at: 8007/11,  Multani Dhanda

Paharganj, New Delhi - 110 055

Ph:.3522232, 3677804, Fax: 3512178

M/s. Chandra Orgo-chem Combines

306, Belscot Tower, Link Road

Lokhand Wala Complex

Andheri, Mumbai - 53

Ph:. 3430789

M/s. Dhiman Udyog

6026, Kapurthala Road

Nakodar - 144040

(Dist. Jalandhar)

Punjab

Ph:. 01821-20891, 22891, 22991

Fax: 0091-1821-20891

Website:www.dhimanudyog.com

M/s. Dolphin Engineering Works

6, Baburam Ghosh Lane

P.O. Hatkhola

Kolkatta - 5

Ph:. 2399378

M/s. D.P. Pulveriser Works

76, Nagindas Master Road

Fort, Mumbai - 23

Ph:. 2675724, 2670976

Fax: 022-2676435

M/s. Flour Tech Engineers (P) Ltd.

16/5, Mathura Road

Faridabad - 121002 (Hariyana)

Ph:.0129-5291556, 5263017

E-Mail : flourtech@rediffmail.com

M/s. Frigmaires Engineers

Post Box:16353

Janta Industrial Estate No.8L

Parel, Mumbai - 13

Ph:. 4941694

M/s. Hind Pulverizer Works

B-3/2, Ambica East

Near Sukhram Nagar

Ahemdabad - 23

Ph:. 2747451, 2744018

Fax : 079-2747451

M/s. JDP Enterprises

13, Kharwa Lane, Samad Building

Mumbai - 400004

Ph:. 3810054

M/s. Jikosha Engineering Corp.

2, Ratna Jyoti Industrial Estate,

Vile Parle - West, Mumbai - 56

Ph:. 6711312

M/s. K.B. Engineering

B-58, Kiran Industrial Estate

M.G Road, Goregaon (West)

Mumbai - 62

Ph:. 8720616

M/s. Kaps Engineers

831, GIDC, Makarpura

Baroda - 10 (Gujarat)

Ph:. 5781933, 011-5756760

Website : www.vmkaps.com

E-Mail : kapsvm@ad1.vsnl.net.in

M/s. Kabir Engineers Works

Niramay, B/H Suvidha Centre

Paldi, Ahemdabad - 7

Ph:. 6620270

Fax: 6576497

M/s. Kaps Engineers

Samrat Silk Mills  Compound

L.B.S. Marg, Vikhroli (West),

Mumbai - 400079 (M.S)

Ph:. 91-22-5781933

Fax:  5785741

E-Mail : vmsrehls@bom4.vsnl.net.in

M/s. Litho Tech Engineers

Sector-10/B25/Sh-13

Shanti Nagar, Mira Road - East,

Mumbai - 7

Ph:. 8110182

M/s. Micro Pulverizer Manufacturing Work

Universal Compound,

Old Nagar Das Road,

Andheri (East),

Mumbai - 69

Ph:. 8209725

M/s. Modern Fabricators

25/4, Industrial Area

Anand Parbat,

New Delhi - 110005

Ph:. 5722888

M/s. Precious Fab-Cast Pvt. Ltd.

4809, Ph-4, GIDC, Vatva,

Ahmedabad - 445 (Gujarat)

Ph:. 5832237

Fax : 5830026

M/s. Premier Engineering Works

7/23, Gali No. 7, Anand Parbat

Industrial Area

New Delhi - 110005

Ph:.5730730

M/s. Ruby Engineering Work

Memnee Building

1750, lmtimkar Road,

Nagpada, Mumbai - 8

Ph:. 3088552

M/s. Sreema Engineering Works Pvt. Ltd.

148/1A, Ultadanga

Main Road

Kolkatta - 67

Ph:. 3561639

M/s. S.S. Industries

Netaji Palkar Road

Asalpe Ghatkopar

West, Mumbai - 84

Ph:.5110336

M/s. Saxena Indusrtries

W-300, TTC, MIDC Rabale

New Bombay - 400701

Ph:.7692445

M/s. Techmac Engineering Works

310, Usha Kiran Building,

Commercial Complex

Azadpur, Delhi - 33

Ph:. 7137027

**BALL MILL :-**

M/s. Billy Engineering Enterprises

761, Thiruvottiyur High Road

Chennai-600081

Ph: 5954619, 5955359.

M/s. Harshadray Pvt. Ltd.

Jiji House, Damodardas

Sukhadwala Marg (Reveline Street)

Mumbai-400001

Ph: 2046281

Gram: FACTORIND

Telex: 011-82512 HPLB

Fax: 2040078.

**BOILER :-**

M/s. Accutech Engineering Co.

34, P.D. Estate

Near Revabhai Estate

C.T.M. Amraiwadi

Ahmedabad-380026

Ph: 871553, 479802 (Resi).

M/s. Bharat Heavy Plate & Vessels Ltd.

B.H.P.V. Post

Visakhapatnam-530012

Ph: 57381, 57621

Telex: 04595-213, 294, 313

Fax: + 91 (0891) 57626

Grams: HEAVYSELS.

M/s. Fluidtech Boilers

Plot No. 2609, G.I.D.C.

Phase IV, Vatva

Ahmedabad-382445

Ph:830105, 830106, 830041

Resi: 831660.

**FABRICATORS :-**

M/s. Larsen & Toubro

L & T House

Ballard Estate

Mumbai.

M/s. Cosmic Engineers & Fabricators

F-215 A, Laxmi Nagar

Delhi-92.

M/s. Alfa Laval (India) Ltd.

Mustafa Building

7 A, Sir Phirozeshah Mehta Road

Mumbai-400001.

M/s. Indcone Projects & Equipments

D-170, Okhla Indl. Area

Phase-I

New Delhi-110026.

**WEIGHING BRIDGE :-**

M/s. Ei-Digi Systems P. Ltd.

54, Suyog Industrial Estate

L.B.S. Marg

Vikhroli (W)

Mumbai-400083

Ph:5783733, 5782616

Telex: 11-75195 BTVA IN

Fax: 022-5793951.

M/s. Jay Computers Pvt. Ltd.

E-16, Everest Tardeo

Mumbai-400034

Ph:4937291-2-4, 4937314-6

Telex: 011-75379, 73004 JAYS IN

Fax: 91-22-4950489, 4950518.

M/s. Omega Electronic Scale Co. Ltd.

27, Tamarind Lane, Fort

Mumbai-400001

Ph:2656205, 2654581, 8748128

Fax: (022) 6247829, 8732209.

**WEIGHING SCALE :-**

M/s. Ei-Digi Systems P. Ltd.

54, Suyog Industrial Estate

L.B.S. Marg

Vikhroli (W)

Mumbai-400083

Ph:5783733, 5782616

Telex: 11-75195 BTVA IN

Fax: 022-5793951.

M/s. Nulab Equipment Co. Pvt. Ltd.

Lab House, Plot No.F-13

Opp. SEEPZ, M.I.D.C.

Andheri (E)

Mumbai-400093

Ph:8321420, 8325833, 8376701

Telex: 011-79306 NULAB IN

Fax: 91-22-8368275.

**TUNNEL DRIER :-**

M/s. Kilburn Engineering Ltd.

2, Fairlie Place

Calcuta-700001

Ph: 204301

Telex: 021-7365, 2504

Gram: TASCONIUM.

M/s. Heat Flow Engineers

Plot No. 305, Nehru Nagar

Perungudi

Chennai-600096

Ph: 4925176.

M/s. Gujarat Machinery Manufacturers Ltd.

Post Box No. 1

Karamsad-388326

Gujarat

Ph:(02692) 30416, 30516, 30467, 30367

Telex:0172-204.

**POLLUTION CONTROL EQUIPMENTS**

1. M/s. Acme Manufacturing Co. Ltd.

   The, Antop Hill,

   Wadala

   Mumbai - 400 037

   Tele-cum-Fax : 4128424 Telex: 011-71092

2. M/s. Batliboi & Company Ltd.

   Air Pollution Control Division

   Apeejay House

   Dr. V.B. Gandhi Marg

   Fort,

   Mumbai - 400 001

   Phone : 243823, 2851124, Telex: 011-82284, 84852

   Fax : (091-022) 2871558

3. M/s. Larsen & Toubro Ltd.

   L & T House

   Ballard Estate

   Mumbai - 400 038

   Phone : 2618188 Telex: 80020

**SAND FLY ASH BRICKS MAKING/PLANT/EXTRUDER :**

1. M/s. Rassi Refractories Ltd.

   Minerva House

   5th Floor

   94, S.D. Road

Secunderabad - 500 003

2. M/s. S.V. Refractories & Ceramics

   104, Area Indl. Estate

   Vishakhapatnam - 530 007

**BRICK MAKING PLANT :**

1. M/s. Dayal Machine Manufacturing Co.

   Swami Narayan Godown

   Near Dariapur Gate

   Ahmedabad - 380 023

**17 SUPPLIERS OF RAW MATERIALS**

**FLY ASH :**

Fly ash is procured from Thermal Power Plant.

**LIME :**

1. M/s. Mysore Acetate & Chemicals Company Ltd.

   P.B. No. 6772

   Mysugar Building

   Sri J.C.W. Road,

   Bangalore - 560 002

   Phone : 211999, 211360, 221462

   Telex: 0845-2236

2. M/s. National Chemical Industries

602, Monalisa, 6th Floor

Hari Niwas Circle

Thane (W) - 400 602

Maharashtra

Phone : 5334898, 5336767

3. M/s. Ramnarain Harcharanlal

Lohai Road

Farrukhabad - 209 625 (U.P)

Phone : (05692) 22199 Fax : 05692-22030

**GYPSUM :**

1. M/s. Atul Products Ltd.

Ashoka Chambers

Rasala Marg

Mithakhali Cross Road

Ellis Bridge

Ahmedabad - 380 006

Phone : 0272-40411, 448124

Telex: 423706, Fax: 079-404111

2. M/s. Bordia Chemicals Pvt. Ltd.

31, Bajaj Khana

Ratlam - 457 001

Phones : 20934, 20325 (R) 31122

Telex: (07301) - 204 BCPL IN Fax: (07412) 31745

3. M/s. Famous Minerals & Chemicals Co.

3/58, Sharda Building

Topiwala Lane

Lamington Road

Mumbai - 400 007.

Phones : 3871829, 3886089, 8952665

**SUPPLIERS OF RAW MATERIALS :**

1. M/s. Shri Modi Levigated Kaolin Pvt. Ltd.

   Neem-Ka-Thana-332 713

   Distt. Sikar

   Rajasthan.

2. M/s. Garodia Chemicals

   Rajagangpur

   Sundargarh - 17

   Orissa.

3. M/s. Talcher Thermal Power Station

   Talcher

   Angul Distt.

   Orissa.

4. M/s. Rourkela Steel Plant

   Rourkela (Orissa)

5. M/s. National Aluminium Company

   Damanjodi

6. M/s. Rourkela Limes

Power House Road

Rourkela

Sundargarh Distt.

Orissa

7. M/s. Ganesh Lime Products (P) Ltd.

Gochhapada Road

Phulbani

## 18 ADDITIONAL INFORMATION

1. The detailed process know-how is available from :

M/s. National Research Development Corporation

20-22, Zamroodpur Community Centre

Kailash Colony Extension

New Delhi - 110 048

2. The Director

Central Building Research Institute (CBRI)

Roorkee - 247 667

Phone : + 91 1331 72243

Telex: 0597 203 CBRI IN

Fax: +91 132 72272 & 72543

E-mail: Cbrie sirnetd ernet in

**CBRI:**

M/s. India Habitat Centre

Lodhi Road

New Delhi - 110 003

Phone : 4641182

However, Central Fuel Research Institute,

P.O. FRI - 828 108

Dhanbad

Bihar

can render services on payment basis from analysis of raw materials to assess the suitability of the same for brick making including project consultancy during erection & commissioning of the plants.

## 19. TECHNO-ECONOMICS OF FLY ASH-SAND-LIME BRICKS

(As per CBRI, Roorkee)

Investment for a plant for producing 40,000 bricks per day in 3 shifts is approximately Rs. 270 Lacs. The production cost of 1000 bricks comes to Rs. 1100/- approx.

Profile for Technology Developed by Central Fuel Research Institute, Dhanbad for making Fly ash-Sand-Lime-Bricks

1. End Product : Fly ash-Sand-Lime Bricks
2. Process : Semi Mechanised (CFRI Process)
3. End Use : Construction of load bearing/ non-load bearing walls/partition
4. Installed Capacity : 30 million Solid Bricks per

annum - 6250 bricks/hr.

5. No. of Shift per day : 2 (300 working days)

6. Capacity utilisation : 80% - 5000 bricks/hr. (Expected)

7. Saleable products : 24 million solid bricks/annum

8. Land Area : Total = 15000 m2

Covered = 2500 m2

9. Fixed Capital : i) Land & Buildings

Rs. 32.40 Lacs.

ii) Infrastructure -

Rs. 9.07 Lacs.

iii) Plant & Equipment -

Rs. 232.20 Lacs.

10. Working Capital Rs. 34.50 Lacs.

11. Preliminary & Pre-

operative expenses : Rs. 8.77 Lacs.

Total Investment : Rs. 316.64 Lacs.

12. Manpower

Managerial : 16

Technical : 12

Others : 30

13. Inputs (Per 1000 Nos. of Bricks)

a. Raw materials

Fly ash : 2880 Kg.

Lime : 288 Kg.

Sand : 432 Kg.

b. Chemical Accelerator : 26 Kg.

c. Process Water : 300 Lts.

d. Fuel-Coal : 66 Kg.

e. Electrical Energy : 50 Kwh

14. Equipment/Machinery

a. Hydraulic Press

b. Boilers

c. Auto-clave curing chambers

d. Pulverizer

e. Mixers

f. Electrical Hoists with monorail

g. Automatic tipping type buckets

h. Portable belt conveyors

i. Winch based scrapping hauler mechanism

j. Handling items like wheel barrows, curing trolleys, transfer cars, cycle carts etc.

15. Process Outline :

The fly ash, sand and lime with a small quantity of a chemical accelerator in a derived proportion is mixed dry in a mixer. In the second stage about 8-10% water, 0.2% chemical accelerator is added and is mixed thoroughly. The mix is then subjected to a pressure of 250 kg/cm2 in suitable hydraulic press. The green bricks are then exposed to natural drying for about 48 hrs. followed by curing in autoclave or in the open by sprinkling water or by steam curing.

16. Profitability

a. Estimated cost of production : Rs. 1200/1000

b. Estimated sale price : Rs. 1500/2000

c. Total sale proceeds/annum : Rs. 36 million

d. Break even point : 51%

e. Gross annual profit : Rs. 7.2 million

f. Percentage return on capital : 22.74%

17. Market

Within 70 Km radius from location of the plant.

18. Source of Technology

a. Indigenous : CFRI, NRDC, CBRI, NTPC, NLC, NCB, BMTPC

b. Foreign : United Kingdom, West Germany, Sweden, Denmark, Poland, Netherlands, China, France, Czechoslovakia.

19. Consultant : BMTPC, NRDC, CFRI, CBRI, NLC, NCB, INSWARED

20. Information and Guidance : BMTPC

21. Finance : HUDCO, NHB, IDBI, ICICI, IFCI, SICOM, State Financial

Corporations.

22. Infrastructure Facilities : NTPC, Department of Power, Ministry of Urban Affairs & Employment, State Electricity Board, CEA.

23. Fiscal Incentives : a. 100% exemption of import duty on critical machinery & equipment for finished goods containing minimum 25% of fly ash.

b. Availability of Fly ash free of cost.

## 20. TECHNO-ECONOMICS OF BURNT-CLAY FLY ASH BRICKS

TECHNO-ECONOMICS OF

(As per CBRI)

Plant Capacity : 2500 Bricks/Day

1 Shift : 8 Hours

Production Shed : 600 sq-m.

Approx. Project Cost : Rs. 15 Lacs.

Machinery Required :

1. Mixer

| | | |
|---|---|---|
| U Shaped Mixer | 1 No. | Rs. 50,000.00 |

| | | | |
|---|---|---|---|
| 2. | Moulding Machine | 1 No. | Rs. 50,000.00 |
| 3. | Curing Chamber | 1 No. | Rs. 80,000.00 |
| 4. | Steam Boiler Cap: 250 Kg/hr. | 1 No. | Rs. 2,00,000.00 |
| 5. | Belt Conveyor & Bucket Elevator | 1 No. | Rs. 1,00,000.00 |
| 6. | Lab. Equipments | | Rs. 40,000.00 |
| 7. | Instrument & Process Contra | | Rs. 50,000.00 |
| 8. | Miscellaneous | | Rs. 40,000.00 |
| | | | ========== |
| | Total | | Rs. 6,10,000.00 |
| | | | ========== |

(AS PER C.B.R.I. ROORKEE)

Estimated investment for a plant of 30,000 bricks per day capacity :

Manual Process : Rs. 15 Lacs

Semi-Mechanised Process : Rs. 75 Lacs.

## 21. PROFILE : BURNT CLAY FLY ASH BRICKS

### (AS PER B.M.T./T.P)

Project Cost/Manual Method :

1. Installed Capacity : 7.2 million bricks/annum
   (300 working days)
2. Saleable Product : 6.12 million
3. a. Fixed Capital : Rs. 8.45 Lacs

[For manual operation]

b. Working Capital : Rs. 9.63 Lacs.

4. Employment Potential : 146

5. Raw Material & Inputs

(Per 1 Lac Bricks)

a. Clay : 280 M.T.

b. Fly Ash : 50 M.T.

c. Sand : 200 M.T.

d. Fuel-Coal : 12 to 14 M.T.

e. Process Water : 1000 Lits.

f. Electricity : 50 kwh.

6. Annual cost of production: Rs. 69.39 Lacs

7. Gross annual Income

(Sale) : Rs. 80.49 Lacs.

8. Return on investment : 61.39%

9. Break Even Point : 52%

**TECHNO ECONOMIC OF SAND LIME BRICKS**

(AS PER C.B.R.I.)

Investment for a plant for producing 40,000 Bricks per day in 3 shifts is approx. Rs. 280 Lacs. The production cost of 1000 bricks comes to Rs. 1150/- approx.

Basis and Presumptions of the Project :

1. The unit will work 300 working days in a year on two shift basis and will be able to utilize its full capacity utilization after 2 to 3 months regular production. However, the efficiency of capacity utilisation be around 80%.

2. Labour wages will be as per the prescribed minimum wages.

3. Interest rate for fixed and working capital has been considered as 16.5%.

4. Margin money of around 25 to 35% of the project cost has to be arranged by the entrepreneur.

5. Operative period of the project has been considered as 10 years considering technology obsolescence rate and period of repayment of loan.

6. The cost of land, construction cost, cost of machinery and equipment etc. has been considered as per the prevailing market rate at the time of preparation of the project profile and are also subjected to change from time to time basing on local conditions at the time of implementation.

7. As the lime fly ash bricks are resource based products, the unit has to be situated in closed proximity to the deposit/availability of fly ash and lime, i.e. preferably nearby Thermal Power Station.

## 22 IMPLEMENTATION SCHEDULE

1. Survey for collection of data in respect 0 to 2nd month of demand, availability of raw material, power and skilled workmen, etc.

2. Preparation of project report and 2nd to 3rd month registration, arrangement for margin money and obtaining NCC from Pollution Control Board.

3. Arrangement for financial assistance. 4th to 6th month

4. Make-shift office 7th month

5. Obtaining clearance for pollution. 3rd to 6th month
6. Electricity, fuel and water tie-up for 4th to 6th month availability.
7. Construction of building & shed 6th to 9th month
8. Selection and procurement of machinery, 7th to 10th month erection and installation.
9. Arrangement for raw materials 8th to 10th month
10. Recruitment of Personnel 9th to 11th month
11. Trial Production. 11th month

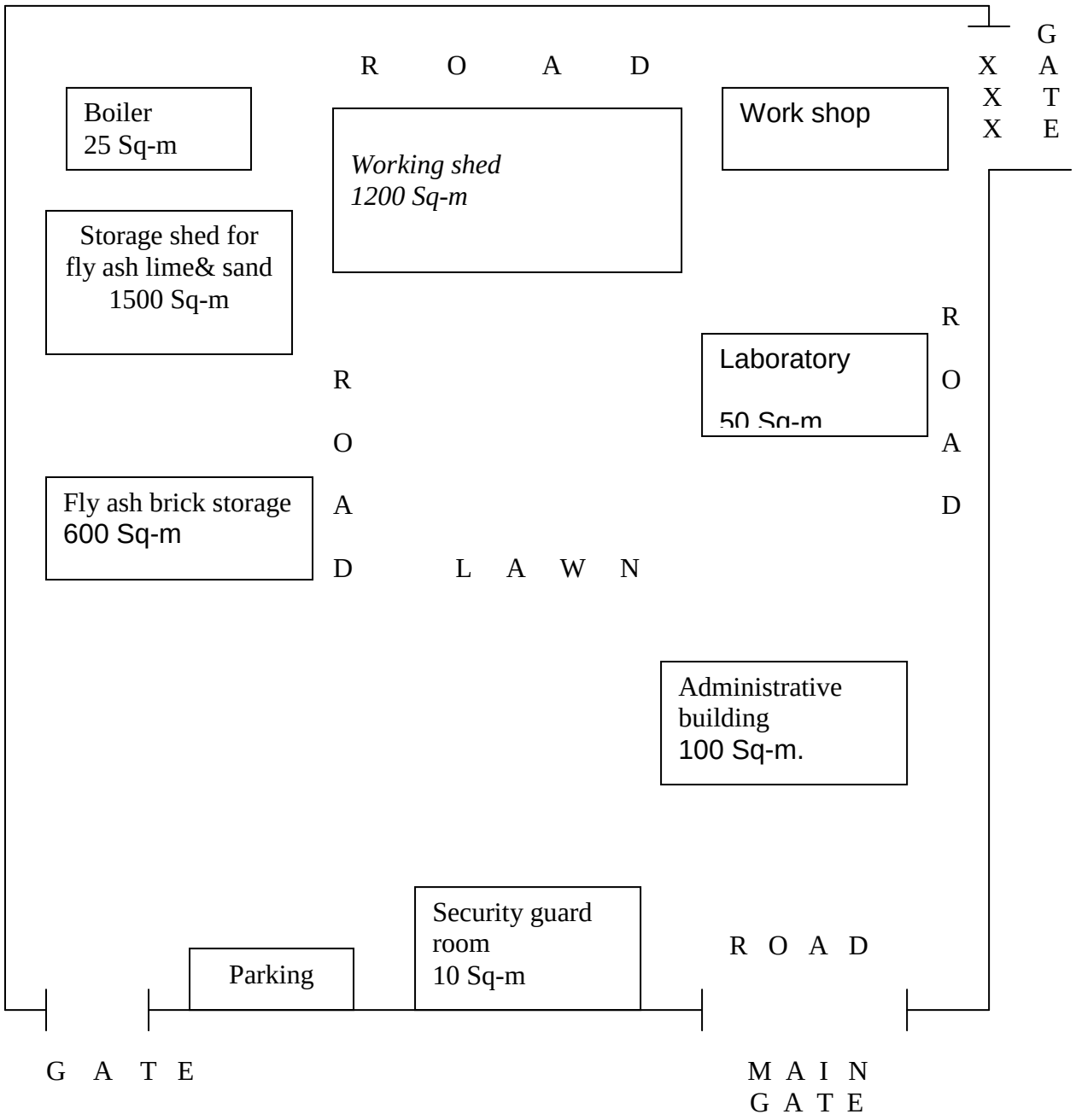
Pollution Control Needs :

Fly ash in the form of finer dust cause air pollution during its use. Workmen working with fly ash are to be provided with respiratory masks and other protective equipments like gum boots and hand gloves etc.

Energy Conservation Needs :

The management has to be vigilant to ensuring higher productivity by the best utilisation of employed man and machine hours. Periodic checks over working stages, functioning of machineries and their preventive maintenance and timely repair etc. will help in energy conservation.

## 23. PLANT LAYOUT OF FLY ASH BRICKS PLANT




**Plant Layout of Fly Ash Bricks Plant**

**Total Land Area = 3 Acres ( 12140 Sq-m.)**

## 24 RAW MATERIALS CALCULATIONS

Basis: 1 Month

Fly ash Sand Lime Bricks

Brick Composition

(as per CBRI)

| | |
|---|---|
| Fly ash | 50 % |
| Sand | 40 % |
| Lime | 10 % |
| Total | 100 % |

Prod. Capacity = 30,000 Bricks/Day

= 30,000 X 25 Bricks/Month

= 7,50,000 Bricks/Month

Wt. of 1 Brick = 2.5 Kg

Wt. of 7,50,000 Bricks = 7,50,000 X 2.5 Kg.

= 18,75,000 Kg

= 1875 MT

1. Fly ash required/month = 1875 X 0.5 = 937.5 MT

= 937.5 X 1.05 (Considering 5 % as process loss)

= 984.4 MT

2. Sand Required/month = 1875 X 0.4 = 750 MT

= 750 X 1.05 (Considering 5 % as process loss)

= 787.50 MT

3. Lime Required/month = 1875 X 0.1

= 187.5 MT

= 187.50 X 1.05 (Considering 5 % as process loss)

= 196.9 MT

## 25. FLYASH BRICK MANUFACTURING PLANT BY BRICK MAN

**Technology/Process Description:**

The Fly ash brick making plant has been designed to manufacture fly ash with FAL-G Technology. The heart of the plant “BRICK MAN” is an indigenously designed, a relatively low cost and high productivity machine. The plant consists of the following equipment:

BRICK MAN

1. It is a hydraulically operated, automatic and controlled by electronic circuits. The electronic circuit is self diagnosing. It has an optional alpha-numeric display, computer connection and modem that can be connected to the computer through telephone lines to detect local faults in advance.
2 Brick making machine develops 30 T of compressive force over the bricks uniformly to hold pressure for the required time allowing the material to flow and form

3. The compressive force can be varied by turn of a knob
4. The machine structure is designed to take up heavy cyclic loads
5. The compressive ratio (1:1.6- brick height: filling height) can be varied infinitely within the limits of the moulds
6. Different size of moulds can be fitted with maximum size of 230x 200x 100mm
7. Monogram on the brick can be embossed
8. Efficient water cooling system to ensure the continuous running of the machine

**Pan Mixer**

1. A sturdily constructed machine with heavy rollers to grind and mix material thoroughly
2. Drive through quality worm reducing gear box

3 Changeable bottom gear plates with scrappers fitted with TC tips

4. Easy bottom loading mechanism with rap pinion door arrangement

**Conveyor**

1. Frames and intermittent bins are fabricated sturdily
2. The fly ash mix can be regulated according to the speed of the brick making machine
3. Nylon with rubber top conveyor belts
4. Friction-less idlers

**Pallet Trucks**

Novel and ergometric design to handle the bricks with pallets for effortless and easy transportation of fly ash bricks.

**Fal-G Mix: Fly ash Lime And Gypsum Mix**

The FAL-G mix is a slow setting pozzolana cement mix. Clay and limestone are burnt with coal, gypsum is mixed and ground to make cement. Fly ash with burnt clay particles (Oxidizes of Clay) obtained from burning of coal are mixed

**Technology/Product Specifications:**

The company manufactures and designs cost effective high-tech construction equipment in India. It has supplied fly ash brick making plants with the state of the art which is an affordable high-tech process and equipment to manufacture high quality bricks with fly ash and other industrial waste.

**“HIGH DENSITY” CONCRETE BLOCK MANUFACTURING FACILITY**

**Technology/Process Description:**

In High Density Concrete Block Making Machine, wooden or steel pallets are fed and located by the chain conveyor, on high frequency vibrating table. Mould is filled manually which is over the pallet. The mix is pressed and vibrated on both sides simultaneously, resulting in voids free, high density blocks with excellent texture and finish.

The blocks thus formed are voids free, 30% more denser which makes the block less water absorption and manifold increase in strength which is not at all achievable in egg laying and hand operated machines.

Formed blocks are dragged away from the machine by the chain conveyor and handled manually.

**Technology/Product Specifications**:

The company manufactures and designs cost effective high-tech construction equipment in India. It has developed a range of concrete block making machines which are well accepted in the market and exported to other countries.

**Technical Specifications**

1. Production Capacity (50 - 60 Strokes/hour): This is indicative only. Actual production rate depends upon the operator efficiency, mix feeding and mix design. Weigh batching, pallet & block handling, steam curing systems can be supplied to the required level of automation of the customers.

**No. of blocks per stroke**

| | |
|---|---|
| 200 x 200 x 400 mm | 2/3 Nos. |
| 150 x 200 x 400 mm | 3/4 Nos. |
| 100 x 200 x 400 | 4/6 Nos. |
| 230 x 110 x 75 | 10 Nos. |
| Pavement Blocks | 2 sq-ft |
| Total power required | 27 H.P |

2. Hydrulic Pump Motor: 5 HP 1440 RPM

3. Mould Table Vibrator 5 HPx2: 10 HP 6000 RPM

4. Ram Vibrator 5HP x2: 10 HP 6000 RPM

5. Conveyor Chain Drive: 2 Hp 1440 RPM

6. Mould table Size: 600x800 mm

7. Hydraulic Load Developed & Applied on concrete blocks by Ram: 4000 Kg

8. Mix Feeding: Manual from two sides

9. Steel Pallet Feeding & Removal with Blocks: Manual / Mechanical

**Company Profile**

| | |
|---|---|
| Company Name | Engineers Enterprises |
| Address | 189, Bharathiyar Road (Ganapathy-Maniyakanpalayam Road, Ganapathy, Coimbatore- 641006, Tamil Nadu |
| Contact person | Mr. M, Gunasekar, Managing Partner |
| Phone | +91-0422-2530639 , 2530788 |
| Fax | +91- 0422 2532260, 2531693 |
| E-mail | engineer@md3.vsnl.net.in |
| Web Site | http://www.eng-ent.com/ |
| Year of Establishment | 1988 |
| Product(s) Manufactured | Fly Ash Brick Making Plant, Concrete Block Machines, Soil Block Plant, Rotatory Waste Press, Cement Tiles Moulds, Pavement Block Cutting Machine |

| | |
|---|---|
| | etc. |
| Installed Capacity per annum | Fly Ash Brick Making Plant – 120 Units<br><br>Concrete Block Machines – 300 Units |
| Sales Turnover | FY 05: USD 0.77 Million<br><br>FY 04: USD 0.54 Million<br><br>FY 03: USD 0.37 Million |
| Conformity to Standards | Indian Standards |
| Foreign Collaboration | NIL |
| Manpower Total (Nos.) | 50 |
| Effluent Generated | NIL |

**Broad Profile of Project Offer**

| Project Features | Project 1 A (Setting up Facility for Fabricating Plants for Making Fly Ash Bricks) | Project 1B (Setting up Facility for Fabricating Plants for Making Fly Ash Bricks) | Project 2 (Setting up Facility for Manufacturing HDM 1000 DLX High Density Stationary Type Concrete Block-Hollow Cavity, Solid & Inter-locking pavement block making machine) |
|---|---|---|---|
| Capacity | 2000 Bricks/ Hour of size 230x 110x 75mm | 4000 Bricks/ Hour of size 230x 110x 75mm | 1000 blocks/8 hr shift |
| Land | 70'x 70' | 100'x100' | 10,000 sq-ft of land with bore well or open well |
| Power | 80 HP | 106 HP | 27 HP |
| Plant & Machinery and Test Equipment | -BRICK MAN machine with 60T Press and 4 bricks per stroke with 30 HP Motor<br>Auto Mix Feeder with 2 HP Motor<br>-Pan Mixer with | BRICK MAN machine with 160T Press and 8 bricks per stroke with 30 HP Motor<br>- Auto Mix Feeder with 2 | Hydraulic Pump Motor<br>Chain Conveyor Motor<br>- Mould Table Vibrator<br>Ram Vibrator<br>Steel Pallets |

| | | | |
|---|---|---|---|
| | 750 Kg capacity with 30 HP Motor<br>- Belt Conveyor with 3 HP Motor<br>- Pallet Trucks<br>Optional Facilities<br>Raw Material Batch weigh bin<br>off- Bearer to remove bricks manually<br>- Silo for Fly ash of capacity 40T<br>- Front end loader of capacity 750 Kg<br>- Wooden Pallets | HP Motor<br>- Pan Mixer with 1000 Kg capacity with 40 HP Motor<br>- Belt Conveyor with 3 HP Motor<br>Pallet Trucks<br>Optional Facilities<br>-Raw Material Batch weigh bin<br>Off- Bearer to remove bricks manually<br>-Silo for Fly ash of capacity 40T<br>-Front end loader of capacity 750 Kg<br>Wooden Pallets | Main Mixer<br>- Face Mixer<br>Pallet Trucks<br>- Skip Loader<br>- Electronic Weighing Scale<br>Ram & Mould (Cavity Blocks)<br>-Solid Blocks and Pavement Blocks) |
| Implementation Period | 3-4 Weeks | 4-5 Months | 2-3 Weeks |
| Manpower Required | 12 people/shift | 14 people/shift | 13 people/shift |
| Raw Materials | Fly ash, Lime, Gypsum, Sand | Fly ash, Lime, Gypsum, Sand | Cement, Sand and down metal |
| Total Project Cost | USD 50000 (excluding land & building) | USD 0.1 million (excluding land & building) | USD 50000 (excluding land & building and taxes and duties) |
| Profitability | 20% | 20% | 20-25% |

Similar Facility profiles available for the following capacity of production:

- 375-500 Bricks/ Hour

- 1000- 1200 Bricks/ Hour

- 1500-1600 Bricks/ Hour

- 3000 Bricks/Hour

## 26. LIVE EXAMPLE OF FLY ASH FOR BRICK MAKING PLANT

IFFCO, Phulpur Unit utilises approx. 1200 MTPD of coal for its 12.5 MW thermal power plant and produces, in turn, approximately 400 - 450 MT per day which was disposed off as water - ash slurry in ash ponds acquired by IFFCO.However, after twenty years of continuous running, the ponds are now saturated and new ash pond is being utilised for ash disposal.

In order to solve the above problems and to utilise this huge quantity of fly ash, a project for fly ash brick making was taken up at the behest of IFFCO Phulpur Research and Development laboratory and was successfully completed. Finally, a pilot plant of capacity 3000 bricks per day was installed and was inaugurated on 2nd October 1993.

The raw materials for production of fly ash bricks are Fly ash, Lime and Sand. The important constituent of fly ash is silica which reacts with lime in the presence of saturated steam at elevated temperature and pressure to form Calcium Silicate Hydrate. Aluminum Oxide of fly ash reacts with lime to form Calcium Alumino Hydrate and hydrogarnates with some bonding properties.

$SiO_2 + Ca(OH)_2 + (n-1)\ H_2O \rightarrow CaO.SiO_2.\ n\ H_2O$

Silica Lime Steam Calcium Silicate Hydrate

The process involves four main operations.

i. Preparation of raw materials.

ii. Mixing

iii. Shaping or pressing.

iv. Curing.

One part by weight each of Hydrated Lime and Sand are added to 8 parts by weight of fly ash. The material is then fed to a Counter Current Mixer. Water is added in the CCM and the material is made homogeneous. The mixture is allowed to stand overnight. The material is then directly fed to the hydraulic press through a hopper where it is pressed at 180 - 200 Kg/cm2 to get moulded green bricks. These green bricks are air dried for 24 hours. The green bricks are then stacked on a trolley to be cured in a curing chamber called Autoclave and subjected to steam curing at 10 - 12 Kg/cm2 for 6 hours.

**Fly Ash Mixed Clay Bricks:**

Government of India has made the use of fly ash mandatory in the clay brick manufacture in brick kilns situated in a radius of 50 km of the Thermal Power plants. In spite of the order, the brick manufacturers are not keen in the use of fly ash. In order to motivate the local brick manufacturers in the use of fly ash in clay brick manufacture and maximize the utilization of fly ash in brick making, a study was undertaken.

Fly ash was made available at the doorstep of the kilns of a few local manufactures. Fly ash was mixed in different proportions with clay under the supervision of IFFCO and bricks were made. Bricks without fly ash addition were also made simultaneously for comparison. These bricks were tested for weight, compressive strength and water absorption. The results show that fly ash addition to the extent of 40 % are comparable to normal clay bricks.

**Ancillary Unit**

New-Tech Industries – an entity of Thiraviam Group of Companies, engaged in manufacturing high quality fly ash bricks and blocks. Being an ancillary unit of Hi-Tech Fly ash (India) Pvt. Ltd., New-Tech Industry is having rich experience on fly ash properties and behavior.

Infrastructure

- Production capacity - 20000 Bricks / Day.
- Facility for 21 days curing.
- Space for storing more than 4,00,000 Bricks.
- In-house strength testing facility.

Vision

- Additional 20000 Bricks / Day capacity by end of 2006.
- Additional 20000 Bricks / Day capacity in Middle of 2007.
- BIS certification for product

27. **THE GAZETTE OF INDIA (EXTRAORDINARY)**

PART II -- Section 3 -- Sub-section (ii)

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 14th September, 1999

8.0.763(E).- Whereas a draft notification containing certain directions was published, as required by subrule (3) of rule 5 of the Environment (Protection) Rules, 1986 under the notification of the Government of India in the Ministry of Environment and Forests number S.O. 453(E) dated 22nd May, 1998

inviting objections and suggestions from all persons likely to be affected thereby, before the expiry of the period of sixty days from the date on which the copies of the Gazette of India containing the said notification are made available to the public; And, whereas, copies of the said Gazette were made available to the public on the same date; And, whereas, the objections and suggestions received from the public in respect of the said draft notification have been duly considered by the Central Government;

Where as it is necessary to protect the environment, conserve top soil and prevent the dumping and disposal of fly ash discharged from coal or lignite based thermal power plants on land;

And, whereas, there is a need for restricting the excavation of top soil for manufacture of bricks and promoting the utilization of fly ash in the manufacture of building materials and in construction activity within a specified radius of fifty kilometers from coal or lignite based thermal power plants;

And, Whereas, the Hon'ble High Court of Judicature, Delhi vide its order dated 25th August, 1999 in CWP No. 2145/99 Centre for Public Interest Litigation, Delhi v/s Union of India directed that the Central Government to publish the final notification in respect of fly ash on or before 26th October, 1999;

Now, therefore, in exercise of the powers conferred by sub-section (1), read with clause (v) of sub-section (2) of section 3 and section 5 of the Environment (Protection) Act, 1986 (29 of 1986); and in pursuance of the orders of the

Hon'ble High Court, Delhi stated above, the Central Government hereby issues the following directions which shall come into force on the date of the publication of this notification, namely:-

1. Use of fly ash, bottom ash or pond ash in the manufacture of bricks and other construction activities.-

(1) No person shall within a radius of fifty kilometers from coal or lignite based thermal power plants, manufacture clay bricks or tiles or blocks for use in construction activities without mixing at least 25 per cent of ash (fly ash, bottom ash or pond ash) with soil on weight to weight basis. '

(2) The authority for ensuring the use of specified quantity of ash as per para (1) above shall be the concerned Regional Officer of the State Pollution Control Board or the Pollution Control Committee as the case may be. In case of non-compliance, the said authority, in addition to cancellation of consent order issued to establish the brick kiln, shall move the district administration for cancellation of mining lease. The cancellation of mining lease shall be decided after due hearing. To enable the said authority to verify the actual use of ash, the thermal power plant shall maintain month-wise records of ash made available to each brick kiln.

(3) In case of non-availability of ash from thermal power plant in sufficient quantities as certified by the said power plant, the stipulation under para (1) shall be suitably modified (waived/ relaxed) by the concerned State/Union Territory Government.

(4) Each coal or lignite based thermal power plant shall constitute a dispute settlement committee which shall include the General Manager of the thermal

power plant and a representative of All India Brick and Tile Manufacture's Federation (AIBTMF). Such a committee shall ensure unhindered loading and transport of ash without any undue loss of time. Any unresolved dispute shall be dealt with by a State/Union Territory level committee to be set up by State/Union Territory Government comprising Member Secretary of the State Pollution Control Board/Pollution Control Committee, representatives of Ministry of Power in the State/Union Territory Government and a representative of AIBTMF.

2. Utilisation of ash by Thermal Power Plants.

All coal or lignite based thermal power plants shall utilise the ash generated in the power plants as follows: -

(1) Every coal or lignite based thermal power plant shall make available ash, for at least ten years from the date of publication of this notification, without any payment or any other consideration, for the purpose of manufacturing ash-based products such as cement, concrete blocks, bricks, panels or any other material or for construction of roads, embankments, dams, dykes or for any other construction activity.

(2) Every coal or lignite based thermal power plant commissioned subject to environmental clearance conditions stipulating the submission of an action plan for full utilisation of fly ash shall, within a period of nine years from the publication of this notification, phase out the dumping and disposal of fly ash on land in accordance with the plan. Such an action plan shall provide for thirty per cent of the fly ash utilisation, within three years from the publication of this notification with further increase in utilisation by atleast ten per cent points

every year progressively for the next six years to enable utilisation of the entire fly ash generated in the power plant atleast by the end of ninth year. Progress in this regard shall be reviewed after five years.

(3) Every coal or lignite based thermal power plant not covered by para (2) above shall, within a period of fifteen years from the date of publication of this notification, phase out the utilisation of fly ash in accordance with an action plan to be drawn up by the power plants. Such action plan shall provide for twenty per cent of fly ash utilisation within three years from the date of publication of this notification, with further increase in utilisation every year progressively for the next twelve years to enable utilisation of the entire fly ash generated in the power plant.

(4) All action plans prepared by coal or lignite based thermal power plants in accordance with sub-para (2) and (3) of para 2 of this notification, shall be submitted to the Central Pollution Control Board/Committee and concerned, State Pollution Control Board/Committee and concerned regional office of the Ministry of Environment and Forests within a period of six months from the date of publication of this notification.

(5) The Central and State Government Agencies, the State Electricity Boards, the National Thermal Power Corporation and the management of the thermal power plants shall facilitate in making available land, electricity and water for manufacturing activities and provide access to the ash lifting area for promoting and setting up of ash-based production units in the proximity of the area where ash is generated by the power plant.

(6) Annual implementation report providing information about the compliance of provisions in this notification shall be submitted by the 30th day of April every

year to the Central Pollution Control Board, concerned State Pollution Control Board/Committee and the concerned Regional Office of the Ministry of Environment and Forests by the coal or lignite based thermal power plants.

3. Specifications for use of ash-based products.-

(1) Manufacture of ash-based products such as cement, concrete blocks, bricks, panels or any other material or the use of ash in construction activity such as in road laying, embankments or use as landfill to reclaim low lying areas including back filling in abandoned mines or pitheads or for any other use shall be carried out in accordance with specifications and guidelines laid down by the Bureau of Indian Standards, Indian Bureau of Mines, Indian Road Congress, Central Building Research institute, Roorkee, Central Road Research Institute, New Delhi, Building Materials and Technology Promotion Council, New Delhi, Central Public Works Department, State Public Works Departments and other Central and State Government agencies.

(2) The Central Public Works Department, Public Works Departments in e State/Union Territory Governments, Development Authorities, Housing Boards, National Highway Authority of India and other construction agencies including those in the private sector shall also prescribe the use of ash and ash-based products in their respective schedules of specifications and construction applications, including appropriate standards and codes of practice, within a period of four months from the publication of this notification.

(3) All local authorities shall specify in their respective building bye-laws and regulations the use of ash and ash-based products and construction techniques in building materials, roads, embankments or for any other use

within a period of four months from the date of publication of this notification. [F. No. 16-2/95-HSMD]

V RAJAGOPALAN, Jt.. Secy.

## 28 CARBON CREDIT?

In step with the dramatic rise in C02 emissions and other pollutants in recent years, a variety of new financial markets have emerged, offering businesses key incentives — aside from taxes and other punitive measures — to slow down overall emissions growth and, ideally, global warming itself.

A key feature of these markets is emissions trading, or cap-and-trade schemes, which allow companies to buy or sell “credits” that collectively bind all participating companies to an overall emissions limit. While markets operate for specific pollutants such as greenhouse gases and acid rain, by far the biggest emissions market is for carbon. In 2007, the trade market for C02 credits hit $60 billion worldwide — almost double the amount from 2006.

### Key Stats

• Size of global carbon credit market: Approximately $60 billion

• Amount of C02 the United States traded in 2007: Nearly 23 million metric tons

• Amount of C02 the EU traded in 2007: More than 1.6 billion metric tons

### How It Works

Emissions limits and trading rules vary country by country, so each emissions-trading market operates differently. For nations that have signed the Kyoto

Protocol, which holds each country to its own C02 limit, greenhouse gas-emissions trading is mandatory. In the United States, which did not sign the environmental agreement, corporate participation is voluntary for emissions schemes such as the Chicago Climate Exchange. Yet a few general principles apply to each type of market.

Under a basic cap-and-trade scheme, if a company's carbon emissions fall below a set allowance, that company can sell the difference — in the form of credits — to other companies that exceed their limits. Another fast-growing voluntary model is carbon offsets. In this global market, a set of middlemen companies, called offset firms, estimate a company's emissions and then act as brokers by offering opportunities to invest in carbon-reducing projects around the world. Unlike carbon trading, offsetting isn't yet government regulated in most countries; it's up to buyers to verify a project's environmental worth. In theory, for every ton of C02 emitted, a company can buy certificates attesting that the same amount of greenhouse gas was removed from the atmosphere through renewable energy projects such as tree planting.

**Why It Matters Now**

Industry watchers say carbon markets will continue to grow at a fast clip — especially in the United States, where Fortune 500 powerhouses such as DuPont, Ford, and IBM are voluntarily capping and trading their emissions. Even though a national cap on carbon emissions doesn't yet exist in the United States, most consider it inevitable, and legislators are already pushing the issue in Congress.

It’s not just governments who are demanding emissions compliance — consumers want it, too. The commitment a company makes to curb its pollutant output is an increasingly public aspect of strategy. More and more employees are taking these factors into account when deciding where to work. A recent study from MonsterTRAK found that 80 percent of young professionals want their work to impact the environment in a positive way, and 92 percent prefer to work for an environmentally friendly company.

**Why It Matters to You**

Let’s say a company can’t afford to modify its operations to reduce C02. Purchasing carbon credits or offsets buys it time to figure out how to operate within C02 limits. For others, it can be a cost-effective tool to help lower emissions while earning public praise for the effort. Each credit a company buys on the Chicago Climate Exchange — usually for about $2 — means another company will remove the equivalent of one metric ton of carbon.

**The Advantages**

Companies in different industries face dramatically different costs to lower their emissions. A market-based approach allows companies to take carbon-reducing measures that everyone can afford. “The private sector is better at developing diversified approaches to manage the costs and risks [of reducing emissions],” says Jesse Fahnestock, spokesman at Swedish power company Vattenfall, which is a member of a global Combat Climate Change coalition.

Reducing emissions and lowering energy consumption is usually good for the core business. For example, in 1997 British energy company BP committed to bring its emissions down to 10 percent below 1990 levels. After taking simple steps like tightening valves, changing light bulbs, and improving operations efficiency, BP implemented an internal cap-and-trade scheme and met its emissions goal by the end of 2001 — nine years ahead of schedule. Using the combined C02 reduction strategy, BP reported saving about $650 million. Then there's the long-term investment angle: Buying into the carbon market boom now suggests significant dividends later on. Carbon credits are relatively cheap now, but their value will likely rise, giving companies another reason to participate.

**The Disadvantages**

As with any financial market, emissions traders are vulnerable to significant risk and volatility. The EU's trading scheme (EU-ETS), for instance, issued so many permits between 2005 and 2007 that it flooded the market. Supply soared and carbon prices bottomed out, removing incentives for companies to trade. Enforcement of trading rules can be just as unpredictable, though Fahnestock says the EU is working to correct the problems. Carbon offsets have their own drawbacks, which reflect a fast-growing and unregulated market. Some offset firms in the United States and abroad have been caught selling offsets for normal operations that do not actually take any additional C02 out of the atmosphere, such as pumping C02 into oil wells to force out the remaining crude. In 2008 the Climate Group, the International Emissions Trading Association, and the World Economic Forum will work to develop a Voluntary Carbon Standard to verify that

offsetting projects are beyond business-as-usual and have lasting environmental value.

The lack of offset regulations has also made marketing problematic. Recently, companies have taken to declaring themselves “carbon neutral.” But until the Federal Trade Commission determines the guidelines for such terms, it’s unclear which companies actually merit the distinction. Already Vail Resorts, the organizers of the Academy Awards, and other organizations have taken heat for touting their investments in carbon offset projects that were not entirely environmentally sound.

**Key Players**

Bank of America is a leader in carbon-reduction strategies. The bank recently launched a $20 billion, 10-year initiative to finance emission-reduction projects, invest in green technology, and facilitate carbon-credit trading. BP is among the most well-known companies to implement an internal cap-and-trade system. The company assigned its 150 units an emissions quota and allowed them to buy and sell carbon credits among themselves.

The European Union Emission Trading Scheme (EU ETS) is the mandatory cap-and-trade program for the EU.

The Chicago Climate Exchange (CCX) is a U.S. carbon-trading scheme in which companies make a voluntary but legally binding commitment to meet emissions targets.

**How to Talk About It**

Cap-and-trade scheme: A market approach to reducing greenhouse gases that works by setting emissions targets. Governments or businesses that reduce their carbon outputs in excess of the target can sell the difference to those who produce more than the limit. This is the favored solution of many business groups. -3

MACs: Marginal abatement costs refer to the cost of cutting C02 emission, which varies from country to country and industry to industry.

Free-market environmentalism: This theory holds that the free market, which offers economic incentives, is the best tool to address global warming. This view goes against the traditional approach to environmentalism, which looks to government regulation to prevent environmental destruction.

Further Reading

“The Combat Climate Change Roadmap,” the 3C Initiative’s recommendations to political leaders

“Getting Ahead of the Curve: Corporate Strategies That Address Climate Change,” a report of the Pew Center on Global Climate Change

“Industry Caught in Carbon ‘Smokescreen,’” Financial Times, April 25, 2007, on the problems with carbon offsetting

“A Green Employment Tax Swap: Using a Carbon Tax to Finance Payroll Tax Relief,” by Gilbert Metcalf, discusses the advantages of a revenue-neutral carbon tax

“Another Inconvenient Truth,” BusinessWeek, March 26, 2007, on carbon-offset deals that don’t deliver what they promise.

## 29 FLY ASH FOR CLEAN DEVELOPMENT MECHANISM

### Kyoto Protocol – The outlines

The need and greed of human race have punctured the protection mechanism of ‘Mother Earth’, bringing a negative effect on the climate. It has been globally realized that rampant emission of greenhouse gases such as carbon dioxide, sulphur dioxide, methane and chloro-fluoro carbons increases the temperature on the earth, leading to droughts and floods through the phenomena of EI Nino and La Nino. The cautions of scientists since 80s went unheeded aggravating the dimensions and, at last, the world acknowledged the gravity in 1992 at the Earth Summit in Rio de Janeiro, when the United Nations Framework Convention on climate Change (UNFCCC) was opened for signature. Here, the international community agreed to prevent the harmful effects of climate change, such as those resulting in shifts of agricultural zones, melting of polar ice caps and rising sea levels.

There were further follow up meetings out of which the summit hosted by Kyoto, Japan, in 1997 was of high profile, attended by about 10,000 delegates, scientists, observers, journalists world over. At this summit, the Governments of various countries committed to promote actions to prevent climate change and agreed on the Kyoto Protocol that establishes targets for reduction of greenhouse gases emitted by the industrialized countries under which the latter would reduce their combined greenhouse gas emissions by at least 5% compared to 1990

levels, by the period 2008-12. The Convention and its Protocol, no doubt, gave the world hope and direction, but it took a long time to decide how to implement the goals agreed by the parties.

It was ultimately decided that at the COP-6 (the Sixth Conference of Parties) held at The Hague in November 2000, the issues would be thrashed out; the Protocol would be given a final shape and put to implementation. He conference was charged with strong determination, carrying themes such as, 'work it out' and 'Make it or break it'. The authors have sent a report to UNFCC and Government of India, in their capacity as the observer organization to the COP [72] highlighting the reasons for the stalemate of COP-6 and dealing with the issues of 'equity' enshrined in the protocol.

But ultimately, after burning oil for over fifteen days, the nations at The Hague could not work out the climate Change Convention to ratify the Kyoto Protocol. The reasons were many among which the politicization laden with selfishness and irrationality was the predominant reason. It was difference of opinion among three main groups:

1. USA, Canada, Japan and Australia as one block;
2. European Union as another block;
3. G77 and China as the third block;

Notwithstanding the above groupisms, it was a tussle between haves (developed countries identified as Annex I countries) and have-nots (non-annex I countries) The former is assigned with emission caps to comply which a lot of money has to

be spent whereas the latter is relieved from such caps. To achieve these caps through emission reductions three mechanisms are designed.

The first mechanism, international '**emission trading'** regime allows industrialized countries to buy and sell emission credits amongst themselves. The second one, **Joint Implementation (JI)** is meant to promote projects towards reduction of emissions within the developed countries. The third one, the **Clean Development Mechanism (CDM**) is designed in the Protocol that will enable industrialized countries to finance emission-reduction projects in developing countries and to receive the emission credits. This is the symbiosis for both blocks; the developing countries can rise to meet the objectives of clean environment and sustainable development at somebody's investment and the developed countries can get the credits accrued at somebody's efforts.

The stand of developing countries is understandable to some extent where, developed countries like USA, Canada and Australia have tend to lower their liabilities and the former have opted to bring due pressure. But the adamancy with which the equitable rights have been claimed by G77 and China appeared to be illogical and impractical. The meaning of 'equity' in the Convention or protocol means, while drafting the clauses, the yardsticks and parameters should be common to all wherever applicable. It doesn't mean that the developing countries have the right to increase the emission levels to those of developed nations, vetoing the very purpose of the protocol.

Each country is destined with geo-ecological conditions by which its mineral potential, crop patterns and overall wealth are decided. For that matter, even the Sun and his temperature are not common to all countries. Such temperature variance, in turn, reflects in variable concentration of background radiation of radio-activity from country to country, giving relief to the poor in tropical countries. The rapidity with which the photosynthesis takes place in tropical countries, resulting in the absorption of $CO_2$ in commensurate volumes, can not be envied by cold countries. All these factors are the law of nature.

The equitable right is meant to prevent exploitation in the society but can never be practiced in reality. The equality of law and justice, though enshrined in the constitution as fundamental right to all citizens in every country, can not be afforded by poor in any country due to socio-economic implications.

The countries, proponing equality to the Protocol, can not ensure equal municipal amenities to the village dwellers at par to the city dwellers. The infrastructure facilities such as roads, sewerage, electricity, protected water, parks and socializing locations are not within the reach of villages and mostly concentrated to cities as if the latter are only destined for such privileges. With unchecked population growth in many countries of G77, the argument of equitable per capita emission is not to the convincement of developed countries. However, the latter are not inclined to make an issue on this helpless factor of the third world countries. But, at the same time, the developed countries can never concede to the argument of equity which defeats the very purpose of emission reduction targets of the convention.

Developed countries have reached to the present level of emissions by extensive industrialization and automation, over the last one century, which reflects on the consumption of fossil fuels one way or the other. Till a decade back there was no realization at the administrative level of various countries on the issues of climate change despite extensive warnings from the research scientists. By the time the realization has come, it was too late and the per capita emission levels have risen to alarming dimensions in developed countries. But the developing countries, who are relatively at low ebb of industrialization but on the verge of progress, have access to the wisdom and wealth of the former to resort to right strategies of technologies and investment, as facilitated by the Protocol.

Then one may question the scope and compliance of equitable distribution! The developed nations have the wealth amassed through industrialization over decades, but at the cost of global climate. The developing nations have the opportunity to develop carbon credits by virtue of their being modest to tap the fossil fuels on account of various logistics. Hence the carbon credits should flow from developing nations to developed ones and the wealth should flow vice versa. This is the simple and practical principle based on which the visionaries have articulated the CDM that, in turn, facilitates the distribution of carbon credits and wealth hopefully to the equity of all nations.

Ulritch Batsch and Benito Muller, have made some interesting studies on economic impacts to various countries with reference to emission mitigation costs (-) and benefits (+) as measured by the so called Paasche Index [73]. Though it is a wide guesstimate under ‘global compromise scenario’ with a lot of bearing on

various variable yardsticks those have yet to be established, the pattern can be accepted as an indicator. This study says that, when the Protocol is put to implementation, while USA loses about US$ 15 and 35 billions respectively. This is nothing but a penalty to USA for its luxurious emission levels and an incentive to china and India for their frugal control on emissions.

Regardless of rationalities, no country accepts the liability to such an extent that effects its GDP to drastic levels, that too when the issues are not localized but that of global ramifications. The Convention and the Kyoto Protocol have made a great success by enforcing the developed countries to submit to the basic framework of mechanisms. This has enormous impact on the internal and overall costs of various factors in the developed countries to slow down their GDP growth rate and, in turn, accelerating that of developing nations. Missing this vital spectrum of fiscal analysis and aiming to strike a deal within their frame, the G77 and China have gone at a tangent with the focus on equity. When this type of deals fail, the giver is enriched by the amount which he is supposed to part with but saved, and the receiver becomes poorer in equal terms, by not receiving the fund. Over and above, the climate change makes the latter further poorer through natural calamities because the burden of droughts and floods are beyond the affordability of developing nations rather than industrialized countries.

It appears that, despite being a member to the Convention, India has faulted in throwing its weight with G77 and China in opposing various issues of the Kyoto Protocol, beyond thwarting the Annex I countries from escaping the liability. This observation is made based on the following analysis :

- G77 block is constituted of OPEC countries that are very unhappy for the cap on use of fossil fuels that would affect their national income. This loss is conceived as US$ 63 billion per annum and hence the successful implementation of Kyoto Protocol is not to their choice.
- The well-to-do economies of OPEC countries such as Bahrain, Iran, Kuwait, Qatar, Saudi Arabia and United Arab Emirates, are altogether different to that of India. While the fiscal opportunities those can generate out of Kyoto Protocol work favourable for the economic health of India the same act on negative side for OPEC countries.
- India is on the threshold of racing with China on economic reforms. To gain en edge over its competitor, India is summoned to fare better through innovative techniques because china has netted over US$ 150 billions of foreign exchange reserves as against over US$ 55 billion in Indian coffers. The revenue out of CDM would be an opportunity to improve foreign exchange reserves which is missed by India by delaying to sign the Kyoto Protocol.
- On economic revolution point of view, India's logistics cannot wait for other fellow countries of G77 such as, Angola, Botswana, Ethiopia, Honduras, Lebanon, Mali, Peru, Somalia, Tonga and Vietnam.

For a moment, let us assume that the Protocol is suspended for signing for a few years. Who are going to have the brunt of the climate change? It is always the non-developing nations who are on the receiving end of climate wrath. The tangible impact of climate change that reflects as EL Nino and La Nino directly

gets manifested as drought or cyclones, exposing the village and sum dwellers of many G77 countries to the ensuing tragedies. Hence, it is in the interest of these countries to vindicate their stand diplomatically rather than going on egos and emotions.

**Developments at COP-7**

After two weeks of difficult and highly technical negotiations, a package of decisions was adopted at COP-7 in Marrakech that saliently includes :

- A strong compliance system has been established that will be put in place after entry into force of the Kyoto Protocol.
- Rules and modalities on the Kyoto Mechanisms were decided that will allow the immediate start of the clean Development Mechanisms and from 2008 on the start of Joint Implementation projects.
- International emission trading can start as of 2008.
- Monitoring and reporting procedures were established providing transparency and certainty for the operation Kyoto mechanisms.

The decisions taken in Marrakech establish an international regulatory framework making the Kyoto mechanisms operational. It provides certainty for the Parties and the private sector to engage in international emissions trading. Joint Implementation and the CDM. All these three will ensure that Kyoto emission reduction targets can be achieved in a flexible and cost-effective manner. Thus COP-7 was wrapped up with the adoption of a rule book for the 1997 Kyoto

Protocol to curb global warming, paving the way for the pact to enter into force this year (2002) even without the United States, the world's largest $CO_2$ emitter.

During the proposed Johannesburg Summit in September this year, leaders are to adopt concrete steps and identify quantifiable targets to better implement Agenda 21, a global action plan for sustainable development adopted at the 1992 Earth Summit. This would be followed by the next summit, COP8 at New Delhi, India in October, 2002.

**Clean Development Mechanism :**

CDM is defined under the Kyoto Protocol to the UN Framework Convention on climate Change (UNFCCC) as flexibility mechanism which allows an investor or a donor country to fund projects that reduce green house gas (GHG) emissions in a host country. In return, the donor country receives credits, which contribute to their GHG emission targets. In the CDM the donor country will be an industrialized country with emission targets, whilst the host country will be a developing country (DC) free from targets. The credits that will be transferred are called Certified Emission Reductions (CERs).

Article 12 of Kyoto Protocol has enshrined CDM as :

*'to assist parties not included in Annex I, in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3.*'

The CDM creates a commodity (GHG/carbon equivalent units) and aims to provide mutually shared benefits for investors and hosts. As mechanism intended to channel private sector investment towards climate-friendly projects, the CDM aims to support the development of an internationally novel set of arrangements for public/private partnership. This aspect inevitably will have implications for the design and operation of CDM's procedures and institutions, including its Executive Board and operational entities, and the scope for participation by non-party entities in decision making and dispute resolution.

As of now, the CDM Executive Board has been elected. The mandate for the Board has been established giving it sufficient power to facilitate the implementation of CDM. This includes the accreditation of operational entities that will independently verify the emission reductions.

Rules and modalities of CDM have been clarified giving potential investors sufficient certainty to start the CDM projects. The rules provide for transparency through public participation during the project appraisal phase. Projects that were already started can generate certified emission reductions (CERs) retroactively as from 1.1.2000. Those projects will have to be registered with the CDM executive Board before 31.12.2005.

CDM gives an incentive for 'climate friendly' investments in developing countries. It will, therefore, promote the transfer of environmentally sound technologies to developing countries. Emission reductions achieved through the CDM can be

credited and banked during 200-2008, and credits can subsequently be used by the Annex I investor country to meet a part of its emission limitation obligations during the first budget period of 2008-2012. This could provide a competitive advantage to the CDM over other forms of emission trading units.

**Fly Ash for CDM :**

India falls under non-Annex I countries and qualifies as the host for CDM projects by virtue of its commitment to sustainable development. With its vast marketing needs, receptivity for eco-friendly technologies and absolute entrepreneurism, India may prove as a potential host to promote more and more CDM-friendly projects to the advantage of Annex I countries.

Brick and cement are one of the profuse pollutant industries on the earth with massive $CO_2$ emissions. It is estimated that each million clay bricks cause to generate 300 tons of CO2 and each million tons of OPC cause to generate equal quantity of $CO_2$.

In India, brick industry is liable to generate million tons $CO_2$ out of 300 billion bricks production and the cement industry generates 100 million tons of $CO_2$ out of same quantity of production.

Kyoto Protocol offers an opportunity to non-annex I countries such as India, to participate in the carbon abatement program through CDM. Under this program, for carbon abating industries funds are available from the developed countries. These funds are repayable against CERs (Certified Emission Reductions)

accrued annually for participating carbon abatement process. Each type of production activity has its own base line for $CO_2$ emission, to be defined based on the erstwhile production practices for the same type of product manufacturing. The reduction in the $CO_2$ emission below the base line definition, through the shift in the process, is quantified as CER through environment audit and rewarded from carbon fund.

**Baseline :**

A number of proponents argue that baseline standardization is necessary to ensure that emissions reductions under the CDM are not exaggerated. Standardization limits the space for gaming and assigns the baseline according to the project type, size, sector and country. If there is a large uncertainty in baseline the same percolates equally well for emission reduction too. Further such uncertainty is not likely to be reduced despite detailed work due to the counterfactual nature of the baseline. Thereby, it is argued that standardization of baseline definition across projects of the same type would not be prudent in the background of such high uncertainty.

The baseline standardization for CDM projects can be calculated from the assessment of a number of parameters of operative commercial projects with particular reference to shift in nature of raw materials, t $CO_2$/unit production.

Fly Ash Brick and Blocks as CDM Project

**Baseline Indicator :**

| | | |
|---|---|---|
| Basis | : | Per Million bricks |
| Coal Consumption | : | 200 tons |
| Fixed Carbon 40% | : | 80 tons Gross |
| | | 73.6 tons Net (after leaving 8% in cinder) |
| Effective $CO_2$ abatement | : | 270 tons/million bricks |

**Contribution to Ecology**

| | | |
|---|---|---|
| Conservation of top soil | … | 3,500 tons per million |
| Conservation coal | … | 200 tons per million |
| Abatement of $CO_2$ | | |
| (vide baseline) | … | 270 tons per million |

Potential

40 billion bricks to the extent of 40 million tons of fly ash utilization which means :

| | | |
|---|---|---|
| Conservation of top soil | … | 140 million tons |
| Conservation of Coal | … | 8 million tons |
| Abatement of $CO_2$ | … | 10.8 million tons. |

Fly ash based cement and ready-mixed Concrete for CDN :

**Baseline Indicator**

Basis : One tone of clinker production

| | | |
|---|---|---|
| Limestone consumed | … | 1.5 tons |
| Purity of limestone | … | 80 % |
| Effective calcium carbonate content | … | 1.2 tons |
| $CO_2$ in the above (I) | … | 0.528 tons |

| | | |
|---|---|---|
| Coal utilized per ton | … | 0.25 tons |
| Fixed carbon in the above | … | 0.45 % |
| | i.e. | 0.1125 tons |
| $CO_2$ emitted out of the above (II) | … | 0.412 tons |

Total $CO_2$ per each ton of clinker (I+II)

(The baseline for clinker) … 0.940 tons.

The present production of cement is in the order of 100 million tons., With the production of blended cements and also blended cement-concretes, there is every chance to put 40 million tons fly ash in the years to come. Taking this potential into consideration:

Contribution to Ecology :

| | | |
|---|---|---|
| Conservation of cement | … | 40 million tons |
| Resulting in : | | |
| Mineral conservation | … | 60 million t |
| Coal conservation | | |
| (for thermal energy) | … | 10 million t |
| Abatement of $CO_2$ | | |
| (vide baseline workings) | … | 37.6 million t |

**Rice Husk Ash Utilisation for CDM**

A controlled combustion of rice-husk in threshold temperature zone gives raise to ash with amorphous silica which, in association with cement, acts as super-

pozzolan because of its high reactivity. This phenomenon helps to develop concretes with high performance and high durability.

RHA is the formidable product to share the market with silica fume for the parallel performance of improving the durability of concrete. The date in Table 4 on 28-day concrete prove the technical parameters of positioning RHA as another super-pozzolan. Thus, every ton of RHA that supplements cement as mineral admixture can abate 0.94 tons of $CO_2$ as given in the baseline indicator for clinker. With 18 million tons of rice husk in India, the potential is for 3.6 million tons.

**Mechanism of Implementation :**

A document on preliminary examination of technical, financial and institutional issues on the clean development mechanism [74] was prepared for UNCTAD) that discussed the mechanism in detail.

**Sponsors / Investors**

Public and private entities of Annex I countries including institutions vested with the responsibility of CDM funding. The bonafide brokers of emission trading could also be involved as catalysts to facilitate the link between private entities and hosts.

**Hosts**

1. Rice-husk based power plants integrated with utilization of RHA.

2. FaL-G (fly ash) brick plants in organized sector such as corporate or cooperative entities.
3. Corporate houses engaged in the production of blended cements and blended cement concretes.

**Sharing the benefits between sponsor and host**

Wherever the sponsor proves to be an institution or private broker, the host can bank the CERs with the sponsor for trading in secondary market, which can be encashed at opportunistic time through auctions, sale or lease. The benefits could be shared between the sponsor and host on mutually agreeable terms.

Once certain projects become functional to establish the operational methodologies for CDM, with omissions and commissions wherever warranted, the marketing and fiscal forces become alive to tap the potential further.

CDM is a complex mechanism with various undefined issues. This is natural with any such programme at the natal stage. However, they can be tied up as the implementation progresses, as and when the issues and impediments crop up. Hence, it may be prudent to put CDM into action with such technological adoptions which would ensure emission reductions in tangible terms beyond technical controversies. Identification of countries with such success-sure projects paves the way for promotion of CDM. Utilisation of fly ash is certainly a sure scorer for emission accruals.

**APPENDX A**

**PLANT ECONOMICS**

**RATED PLANT CAPACITY = 30000.00 NOS/DAY**

**= 9000000.00 NOS/ANNUM**

**BRICKS FROM FLY ASH**

Basis

No. of working days = 25 days/month

= 300 days/annum

No. of shifts = 2 per day

One shift = 8 hours

**LAND & BUILDING**

1. Land required, 3 acres
   (12,140 sq-m)
   @ Rs. 2.5 lacs per acre Rs. 7,50,000.00
2. Working shed, 1200 sq-m
   @ Rs. 2000/- sq-m Rs. 24,00,000.00
3. Storage shed for fly ash, lime &
   sand, etc., 1500 sq-m
   @ Rs. 1000/-sq-m Rs. 15,00,000.00
4. Fly ash bricks storage, 600 sq-m
   @ Rs. 1000/- sq-m Rs. 6,00,000.00

| | | |
|---|---|---|
| 5. Lab, 50 sq-m | | |
| @ Rs. 2500/-sq-m | Rs. | 1,25,000.00 |
| 6. Adm. bldg., 100 sq-m | | |
| @ Rs. 2500/- sq-m | Rs. | 2,50,000.00 |
| 7. Workshop, 100 sq-m | | |
| @ Rs. 2000/- sq-m | Rs. | 2,00,000.00 |
| 8. Boiler shed, 25 sq-m | | |
| @ Rs. 2000/-sq-m | Rs. | 50,000.00 |
| 9. Security guard room, 10 sq-m | | |
| @ Rs. 2000/- sq-m | Rs. | 20,000.00 |
| 10. Boundary wall, gate etc. | Rs. | 2,00,000.00 |
| | | --- |
| TOTAL | Rs. | 60,95,000.00 |
| | | --- |

**PLANT & MACHINERY**

| | | |
|---|---|---|
| 1. Skip hoist of 750 Kg cap. with in- | | |
| digenous 10 HP motor & complete | | |
| with other accessories | | |
| including feed hopper, etc. (1 Set) | Rs. | 4,00,000.00 |
| 2. U-Shaped mixer/double-shaft mixer/ | | |
| counter-current mixer, 750 liters | | |
| capacity with 2 sets (cont...) | | |
| 15 HP Motors and one set of 20 HP | | |
| motor and other accessories (1 set) | Rs. | 12,00,000.00 |

| | | | |
|---|---|---|---|
| 3. Belt conveyor of 14 m length with 5 HP motor and complete with all accessories (1 set) | | Rs. | 3,00,000.00 |
| 4. Press feed hopper with vibrator (1 set) | | Rs. | 50,000.00 |
| 5. Rotary table press of 200 MT capacity table size 1400 mm dia with 3 HP motor for table rotation and 40 HP motor for hydraulic power jack & production capacity 1000 bricks per hour | 2 No. | Rs. | 20,00,000.00 |
| 6. Transfer cars | 2 No. | Rs. | 50,000.00 |
| 7. Curing cars | 8 No. | Rs. | 2,00,000.00 |
| 8. Curing chamber/autoclave of size 1900 mm dia X 4800 mm length with working pressure 35 to 40 lbs/Sq-inch with other accessories | | Rs. | 4,00,000.00 |
| 9. Boiler, capacity 500 Kg/hr | 1 No. | Rs. | 4,00,000.00 |
| 10. Pollution control equipments | | Rs. | 15,00,000.00 |
| 11. Weighing balance testing equipments & other miscellaneous tools & equipments | | Rs. | 1,00,000.00 |
| | TOTAL | Rs. | 66,00,000.04 |

**OTHER FIXED ASSETS**

| | | |
|---|---|---|
| 1. Office equipment, furniture plus other equipment & accessories | Rs. | 50,000.00 |
| 2. Installation costs for water, electricity, fuel etc. | Rs. | 6,50,000.00 |
| 3. Pre-operative & preliminary expenses | Rs. | 1,00,000.00 |
| 4. Technical know-how & consultancy | Rs. | 50,000.00 |
| 5. Trucks (2 Nos) | Rs. | 20,00,000.00 |
| 6. Factory vehicles (2 Nos) | Rs. | 6,00,000.00 |
| 7. Miscellaneous | Rs. | 50,000.00 |
| | | --- |
| TOTAL | Rs. | 35,00,000.00 |
| | | --- |

**FIXED CAPITAL**

| | | |
|---|---|---|
| 1. LAND & BUILDING | Rs. | 60,95,000.00 |
| 2. PLANT & MACHINERY | Rs. | 66,00,000.04 |
| 3. OTHER FIXED ASSETS | Rs. | 35,00,000.00 |
| | | --- |
| TOTAL | Rs. | 1,61,95,000.04 |
| | | --- |

**WORKING CAPITAL REQUIREMENT/MONTH**

**RAW MATERIALS**

1. Fly ash, 984.4 MT

   @ Rs. 25/-MT Rs. 24,610.00

2. Coarse sand, 787.5 MT

   @ Rs. 100/-MT Rs. 78,750.00

3. Lime, 196.9 MT

   @ Rs. 1000/-MT Rs. 1,96,900.00

4. Chemical accelerator (plastic clay/

   Portland cement), 4.5 MT

   @ Rs. 2000/-MT (approx) Rs. 9,000.00

---

TOTAL Rs. 3,09,260.00

\- ---

**SALARY & WAGES / MONTH**

| | | | | |
|---|---|---|---|---|
| 1. | Manager | 1 No. | Rs. | 15,000.00 |
| 2. | Assistant Manager production | 1 No. | Rs. | 9,000.00 |
| 3. | Shift supervisor | 2 No. | Rs. | 8,000.00 |
| 4. | Skilled Workers | 16 No. | Rs. | 48,000.00 |
| 5. | Unskilled Workers | 24 No. | Rs. | 52,800.00 |
| 6. | Marketing Personnel | 2 No. | Rs. | 8,000.00 |
| 7. | Accountant | 1 No. | Rs. | 3,500.00 |
| 8. | Clerk/Typist | 1 No. | Rs. | 3,000.00 |
| 9. | Electrician-cum-mechanic | 2 No. | Rs. | 6,000.00 |

| | | | | |
|---|---|---|---|---|
| 10. Machine operators | 6 No. | Rs. | 21,000.00 | |
| 11. Peon/Chowkidar | 4 No. | Rs. | 8,000.00 | |
| | | | --- | |
| | TOTAL | Rs. | 1,82,300.00 | |
| | | | --- | |
| Plus perks @ 25% p.a. | | | | |
| | | Rs. | 45,575.00 | |
| | | | --- | |
| | TOTAL | Rs. | 2,27,875.00 | |
| | | | --- | |

**UTILITIES AND OVERHEADS**

| | | | |
|---|---|---|---|
| 1. Power Consumption of 15000 | | | |
| Kwatt hrs @ Rs. 4.50 per Kwatt hr. | | Rs. | 67,500.00 |
| 2. Water Consumption of 1000 | | | |
| K*ls* @ Rs. 3.00 per KL | | Rs. | 3,000.00 |
| 3. Stationery, Postage, Telephone etc. | | Rs. | 6,000.00 |
| 4. Conveyance & Transportation etc. | | Rs. | 10,000.00 |
| 5. Publicity & Sales Promotion | | Rs. | 10,000.00 |
| 6. Repairs & maintenance | | Rs. | 10,000.00 |
| 7. Miscellaneous | | Rs. | 4,000.00 |
| 8. Fuel oil, lubricants, etc. | | Rs. | 15,000.00 |
| | | | --- |
| | TOTAL | Rs. | 1,25,500.00 |
| | | | --- |

**TOTAL LOAD IS 41 KWATTS**

**TOTAL WORKING CAPITAL/MONTH**

| | | |
|---|---|---|
| 1. RAW MATERIAL | Rs. | 3,09,260.00 |
| 2. SALARY & WAGES | Rs. | 2,27,875.00 |
| 3. UTILITIES & OVERHEADS | Rs. | 1,25,500.00 |
| TOTAL | Rs. | 6,62,635.00 |

| | | |
|---|---|---|
| **1. WORKING CAPITAL FOR 3 MONTHS** | **Rs.** | **19,87,905.00** |
| 2. MARGIN MONEY FOR W/C LOAN | Rs. | 4,96,976.25 |

**COST OF PROJECT**

| | | |
|---|---|---|
| TOTAL FIXED CAPITAL | Rs. | 1,61,95,000.04 |
| MARGIN MONEY | Rs. | 4,96,976.25 |
| TOTAL | Rs. | 1,66,91,976.29 |

**TOTAL CAPITAL INVESTMENT**

| | |
|---|---|
| TOTAL FIXED CAPITAL | Rs. 1,61,95,000.04 |
| TOTAL WORKING CAPITAL FOR 3 MONTHS | Rs. 19,87,905.00 |
| TOTAL | Rs. 1,81,82,905.04 |

**Cost of Production/Annum**

| | |
|---|---|
| 1. Working Capital for 1 year | Rs. 79,51,620.00 |
| 2. Interest @ 12.00% on T.C.I | Rs. 21,81,948.60 |
| 3. Depreciation @ 10.00% on buildings | Rs. 5,34,500.00 |
| 4. Depreciation @ 10.00% on Plant and Machinery | Rs. 6,60,000.00 |
| 5. Depreciation @ 20.00% on office equipment & furniture | Rs. 10,000.00 |
| TOTAL | Rs. 1,13,38,068.61 |

**TURN OVER/ANNUM**

1. By sale of 90,00,000 fly ash-sand

   lime bricks

   @ Rs. 1600/per 1000 Nos of bricks  Rs. 1,44,00,000.00

---

TOTAL  Rs. 1,44,00,000.00

---

PROFIT = RECEIPTS - COST OF PRODUCTION

= 1,44,00,000.00 - 1,13,38,068.61

= 30,61,931.39

PROFIT SALES RATIO = Profit / Sales x 100

$$= \frac{30,61,931.39}{1,44,00,000.00} \times 100$$

**= 21.26 %**

RATE OF RETURN = Operating profit / T.C.I x 100

$$= \frac{30,61,931.39}{1,81,82,905.04} \times 100$$

**= 16.84 %**

**BREAK EVEN POINT (B.E.P)**

Fixed Costs of the plant are as under -

| | | |
|---|---|---|
| 1. Interests | Rs. | 21,81,948.60 |
| 2. Depreciation | Rs. | 12,04,500.00 |
| 3. 40.00% of salaries | Rs. | 10,93,800.00 |
| 4. 40.00% of overheads | Rs. | 6,02,400.00 |
| TOTAL | Rs. | 50,82,648.61 |

$$B.E.P. = \frac{\text{FIXED COSTS}}{\text{FIXED COSTS + PROFIT}} \times 100$$

$$= \frac{50,82,648.61}{50,82,648.61 + 30,61,931.39} \times 100$$

**= 62.41 %**

LAND MAN RATIO = Total land / Manpower

**3 : 60 :: 0 : 1**

**RESOURCES FOR FINANCE**

1. Term loans from Financial institutions

   ( 65.00 % of fixed capital )

   at @12.00% p.a rate of interest Rs. 1,05,26,750.03

2. Bank loans for 3 months

   ( 65.00 % of working capital )

   at @ 12.00% p.a rate of interest Rs. 12,92,138.25

3. Self raised capital from even

   funds & loans from close ones to

   meet the margin money needs at a

   @ 12.00% p.a rate of interest Rs. 63,64,016.76

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**TOTAL Rs. 1,81,82,905.04**

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**Institutions Providing Term Loans**

Institutions that provide term loans in India may be divided into three broad categories as follows:

All India Financial institutions These include IFCIP ICICI, and IDBI, the three oldest general term-lending institutions (ICICI and IDBI have been transformed into banks in recent years)1 specialised institutions like Exim Bank, IL&FS, Power Finance Corporation, IDFC, and SIDBI, and insurance companies (tIC and GIC) with marginal exposure to term-lending.

State Level Financial Institutions Most of the states have a State Industrial Development Corporation(SIDC) and a State Financial Corporation (SFC) which are refinanced by IDBI.

Commercial Banks Historically1 commercial banks were marginal players in the term- lending arena, as their main thrust was on providing working capital finance. In recent years, commercial banks have stepped up their term-lending activities.

**INSTALMENT PAYABLE IN 5 YEARS**

| Year | To Financial institutions (Rs. 10526750) | To Commercial banks (Rs. 1292138) | To others (Rs. 6364017) | Total |
|---|---|---|---|---|
| 1 | 21,05,350.01 | 2,58,427.65 | 12,72,803.35 | 36,36,581.01 |
| 2 | 21,05,350.01 | 2,58,427.65 | 12,72,803.35 | 36,36,581.01 |
| 3 | 21,05,350.01 | 2,58,427.65 | 12,72,803.35 | 36,36,581.01 |
| 4 | 21,05,350.01 | 2,58,427.65 | 12,72,803.35 | 36,36,581.01 |
| 5 | 21,05,350.01 | 2,58,427.65 | 12,72,803.35 | 36,36,581.01 |

**INTEREST PAYABLE IN 5 YEARS**

| Year | On term loans (Rs. 10526750) @ 12.00 % P.A. | On bank loans (Rs. 1292138) @ 12.00 % P.A. | On self loans (Rs. 6364017) @ 12.00 % P.A. | Total |
|---|---|---|---|---|
| 1 | 12,63,210.00 | 1,55,056.59 | 7,63,682.01 | 21,81,948.60 |
| 2 | 10,10,568.00 | 1,24,045.27 | 6,10,945.61 | 17,45,558.88 |
| 3 | 7,57,926.00 | 93,033.95 | 4,58,209.21 | 13,09,169.16 |
| 4 | 5,05,284.00 | 62,022.64 | 3,05,472.80 | 8,72,779.44 |
| 5 | 2,52,642.00 | 31,011.32 | 1,52,736.40 | 4,36,389.72 |

**TOTAL REPAYMENT SCHEDULE FOR 5 YEARS**

| Year | Interest | Installments | Total |
|---|---|---|---|
| 1 | 21,81,948.60 | 36,36,581.01 | 58,18,529.61 |
| 2 | 17,45,558.88 | 36,36,581.01 | 53,82,139.89 |
| 3 | 13,09,169.16 | 36,36,581.01 | 49,45,750.17 |
| 4 | 8,72,779.44 | 36,36,581.01 | 45,09,360.45 |
| 5 | 4,36,389.72 | 36,36,581.01 | 40,72,970.73 |

**DEPRECIATION CHART FOR 5 YEARS**

| Year | Building costs ( Rs. 5345000.00 ) @ 10.00 % P.A. | Plant & Machinery ( Rs. 6600000.04 ) @ 10.00 % P.A. | fur. & office equip. ( Rs. 50000.00 ) @ 20.00 % P.A. | Total |
|---|---|---|---|---|
| 1 | 5,34,500.00 | 6,60,000.00 | 10,000.00 | 12,04,500.00 |
| 2 | 4,81,050.00 | 5,94,000.00 | 8,000.00 | 10,83,050.00 |
| 3 | 4,32,945.00 | 5,34,600.00 | 6,400.00 | 9,73,945.00 |
| 4 | 3,89,650.50 | 4,81,140.00 | 5,120.00 | 8,75,910.50 |
| 5 | 3,50,685.45 | 4,33,026.00 | 4,096.00 | 7,87,807.45 |

**PROFIT ANALYSIS FOR 5 YEARS**

| YR | CAP. UTIL | Sales | Mfg. Expenses | Gross Profit | Depre-ciation | Interest | Net profit before tax | Net profit after tax @ 35.00% |
|---|---|---|---|---|---|---|---|---|
| **1** | **70%** | **10080000** | **5566134** | **4513866** | **1204500** | **2181949** | **1127417** | **732821** |
| **2** | **80%** | **11520000** | **6361296** | **5158704** | **1083050** | **1745559** | **2330095** | **1514562** |
| **3** | **80%** | **11520000** | **6361296** | **5158704** | **973945** | **1309169** | **2875590** | **1869133** |
| **4** | **90%** | **12960000** | **7156458** | **5803542** | **875911** | **872779** | **4054852** | **2635654** |
| **5** | **100%** | **14400000** | **7951620** | **6448380** | **787807** | **436390** | **5224183** | **3395719** |

**CASH FLOW STATEMENT FOR 5 YEARS**

| YR | CAP. UTIL | Net profit (after tax) | Depre-ciation | Cash in hand | Repayment of Instalment | Net surplus |
|---|---|---|---|---|---|---|
| **1** | **70%** | **732821** | **1204500** | **1937321** | **2363778** | **-426456** |
| **2** | **80%** | **1514562** | **1083050** | **2597612** | **2363778** | **233834** |
| **3** | **80%** | **1869133** | **973945** | **2843078** | **2363778** | **479301** |
| **4** | **90%** | **2635654** | **875911** | **3511564** | **2363778** | **1147787** |
| **5** | **100%** | **3395719** | **787807** | **4183526** | **2363778** | **1819749** |

**PROJECTED BALANCE SHEET FOR 5 YEARS**

| Construction Period | 1 Yr. 70 % Cap. Util. | 2 Yr. 80 % Cap. Util. | 3 Yr. 80 % Cap. Util. | 4 Yr. 90 % Cap. Util. | 5 Yr. 100 % Cap. Util. |
|---|---|---|---|---|---|

**LIABILITIES**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. Promoters capital | 63,64,016 | 63,64,016 | 59,37,561 | 61,71,396 | 66,50,698 | 77,98,486 |
| 2. Net Surplus | 0 | -4,26,455 | 2,33,835 | 4,79,302 | 11,47,788 | 18,19,752 |
| 3. Term loans | 1,05,26,750 | 84,21,400 | 63,16,050 | 42,10,700 | 21,05,350 | 0 |
| 4. W/C loans | 12,92,138 | 10,33,711 | 7,75,284 | 5,16,857 | 2,58,430 | 0 |
| TOTALS | 1,81,82,904 | 1,53,92,672 | 1,32,62,730 | 1,13,78,255 | 1,01,62,266 | 96,18,238 |

**ASSETS**

| | | | | | | |
|---|---|---|---|---|---|---|
| **1. W.D.V. of Fixed Asset** | **1,19,95,000** | **1,07,90,500** | **97,07,450** | **87,33,505** | **78,57,595** | **70,69,788** |
| **2. Working Capital in stock** | **0** | **13,91,533** | **15,90,324** | **15,90,324** | **17,89,114** | **19,87,905** |
| **3. Surplus funds** | **61,87,904** | **32,10,639** | **19,64,956** | **10,54,426** | **5,15,557** | **5,60,545** |
| **TOTALS** | **1,81,82,904** | **1,53,92,672** | **1,32,62,730** | **1,13,78,255** | **1,01,62,266** | **96,18,238** |