CLAY BRICKS MANUFACTURING

1. INTRODUCTION:

The fundamentals of brick manufacturing have not changed over time. However, technological advancements have made contemporary brick plants substantially more efficient and have improved the overall quality of the products. A more complete knowledge of raw materials and their properties, better control of firing, improved kiln designs and more advanced mechanization have all contributed to advancing the brick industry. Other Technical Notes in this series address the classification and selection of brick considering the use, exposure and required durability of the finished brickwork.

2. PRODUCT & ITS APPLICATION:

Brick is made of clay or shale formed, dried and fired into a durable ceramic product. There are three ways to form the shape and size of a brick: extruded (stiff mud), molded (soft mud) and dry-pressed. The majority of brick are made by the extrusion method. Brick achieves its color through the minerals in the fired clay or through coatings that are applied before or after the firing process. This provides a durable color that never fades or diminishes. Brick shrink during the manufacturing process as vitrification occurs. Brick will vary in size due to the manufacturing process. These variations are addressed by ASTM standards. The method used to form a brick has a major impact on its texture. Sand-finished surfaces are typical with molded brick. A variety of textures can be achieved with extruded brick. Brick manufacturers address sustainability by locating manufacturing facilities near clay sources to reduce transportation, by recycling of process waste, by reclaiming land where mining has occurred, and by taking measures to reduce plant emissions. Most brick are used within 500 miles of a brick manufacturing facility.

3. DESIRED QUALIFICATIONS FOR PROMOTER:

Graduate in any graduate.

4. INDUSTRY LOOK OUT AND TRENDS

The global concrete block and brick manufacturing market is gaining from the booming construction sector worldwide. Rapid urbanization leading to the demand for new housing units in developing countries is stoking demand for concrete blocks and bricks. For instance, Brazil is a key domestic market in Latin America in terms of manufacturing volume of concrete blocks and bricks. Concrete blocks are preferred in the construction of walls as they are less susceptible to damage and provide insulation as well.

Apart from this, foreign direct investments in manufacturing and construction sectors in several countries of Asia Pacific have led to significant expansion of the concrete block and brick manufacturing market in recent years.

The emergence of eco-friendly building materials has been significant factor acting in favour of this market predominantly in developed regions. Countries in North America and Europe are increasingly shifting towards sustainable construction with the introduction of green building materials. Eco-friendly building materials such as autoclaved aerated concrete (AAC) are obtained from non-toxic ingredients and industrial waste that do not leave fumes, unlike synthetic building materials.

5. MARKET POTENTIAL AND MARKETING ISSUES, IF ANY:

The construction sector is an important part of the Indian economy with the contribution of 10% in the GDP and is registering an annual growth of 9%. Clay fired bricks are the backbone of this sector. The Indian brick industry is the second largest producer of bricks in the world after China. India is estimated to produce more than 14000 crores of bricks annually, mainly by adopting age -old manual traditional processes. The brick sector consumes more than 24 million tons of coals annual along with huge quantity of biomass fuels. The per annum

O2 emissions from Indian brick industry are estimated to be 42 million tons. Due to large scale construction activities in major towns and cities, a number of brick plants have been set up on the outskirts of these cities. The Asia's overall production has increased from almost 77 percentages to 86.67 percentage of total production of world.

INDIAN SCENARIO

Indian Brick Kiln industry is the second largest producer in the world after china, as per the 2015, estimates production has been increasing annually from 5-10 percentages due to rapid expansion of the urbanization and real estate sector. India estimated to have more than 150000 registered and unregistered brick kilns; producing more than 250 billion bricks. The main cost components of these industries are labour, coal, land, mud, rent and electricity; since it is the largest consumer of coal after the power and thermal sector, it is consuming around 25 million tons every year. Indian brick kilns expanded their capacity of production from 150 billion in 2015 to 200 billion in 2020, almost 150 percentages in the total world production. It consumes 350 billion tons of clay; employing 10 million people, which is twice to the China's brick kiln but ten times lower than the China's employee production capacity.

6. RAW MATERIAL REQUIREMENTS:

Clay is one of the most abundant natural mineral materials on earth. For brick manufacturing, clay must possess some specific properties and characteristics. Such clays must have plasticity, which permits them to be shaped or molded when mixed with water; they must have sufficient wet and air-dried strength to maintain their shape after forming. Also, when subjected to appropriate temperatures, the clay particles must fuse together. Types of Clay Clays occur in three principal forms, all of which have similar chemical compositions but different physical characteristics. Surface Clays. Surface clays may be the up thrusts of older deposits or of more recent sedimentary formations. As the name implies, they are found near the surface of the earth. Shales Clay: shale's clay is

clays that have been subjected to high pressures until they have nearly hardened into slate. Fire Clays: Fire clays are usually mined at deeper levels than other clays and have refractory qualities. Surface and fire clays have a different physical structure from shale's but are similar in chemical composition. All three types of clay are composed of silica and alumina with varying amounts of metallic oxides. Metallic oxides act as fluxes promoting fusion of the particles at lower temperatures. Metallic oxides (particularly those of iron, magnesium and calcium) influence the color of the fired brick. The manufacturer minimizes variations in chemical composition and physical properties by mixing clays from different sources and different locations in the pit. Chemical composition varies within the pit, and the differences are compensated for by varying manufacturing processes. As a result, brick from the same manufacturer will have slightly different properties in subsequent production runs. Further, brick from different manufacturers that have the same appearance may differ in other properties.

7. MANUFACTURING PROCESS:

There are four different operations are involved in the process of manufacturing of bricks:

1. Preparation of clay
2. Molding
3. Drying
4. Burning

1. Preparation of clay for brick manufacturing:

Preparation of clay for bricks manufacturing is done in six steps: Unsoiling of clay we need pure clay for the preparation of bricks. The top layer of soil may contains impurities, so the clay in top layer of soil about 200mm depth is thrown away. This is called unsoiling. Digging After the removal of top layer, the clay is dug out from the ground and spread on the plain ground. Cleaning In this stage, the clay is cleaned of stones, vegetable matter etc. if large quantity of particulate matter is present, and then the clay is washed and screened. The lumps of clay are converted into powder with earth crushing rollers. Weathering the cleaned clay is

exposed to atmosphere for softening. The period of weathering may be 3 to 4 weeks or a full rainy season. Generally, the clay is dug out just before the rainy season for larger projects. Blending if we want to add any ingredient to the clay, it is to be added in this stage by making the clay loose and spread the ingredient over it. Then take small portion of clay into the hands and tuning it up and down in vertical direction. This process is called blending of clay. Tempering In this stage, water is added to clay and pressed or mixed. The pressing will be done by cattle or with feet of men for small scale projects, pug mill is used as grinder for large scale projects. So, the clay obtains the plastic nature and now it is suitable for molding**.**

2. Molding of clay for brick manufacturing

In the molding process, prepared clay is mold into brick shape (generally rectangular). This process can be done in two ways according to scale of project.

Hand molding (for small scale)

Machine molding (for large scale)

Hand molding of bricks

If manufacturing of bricks is on a small scale and manpower is also cheap then we can go for hand molding. The molds are in rectangular shape made of wood or steel which are opened at the top and bottom. The longer sides of molds are projected out of the box to serve it as handles. If we take durability in consideration steel molds are better than wooden molds. In hand molding again there are two types and they are Ground molded bricks, Table-molded bricks

Machine molding of bricks

The bricks required are in large quantity, and then machine molding is economical and also saves more time. Here also we are having two types of machines, Plastic clay machines, and Dry clay machines

Plastic clay machines: These machines contain an opening in rectangular shape and when we place the tempered clay in to this machine it will come out through this opening. Now, the rectangular strips coming out the opening are cut by wires

to get required thickness of brick. So, these are also called wire cut bricks. Now these raw bricks are ready for the drying process. Dry clay machines: Dry clay machines are more time saving machines. We can put the blended clay into these machines directly without tempering. Means tempering is also done in this machine by adding some water. When the required stiffness is obtained the clay is placed in mold and pressed hard and well-shaped bricks are delivered. These are called pressed bricks and these do not require drying they may directly sent to burning process.

3. Drying of raw bricks

After molding process the bricks contain some amount of moisture in it. So, drying is to be done otherwise they may cracked while burning. The drying of raw bricks is done by natural process. The bricks are laid in stacks. A stack consists 8 to 10 stairs. The bricks in these stacks should be arranged in such a way that circulation of air in between the bricks is free. The period of drying may be 3 to 10 days. It also depends upon the weather conditions. The drying yards are also prepared on higher level than the normal ground for the prevention of bricks from rain water. In Some situations artificial drying is adopted under special dryers or hot gases.

4. Burning of bricks

In the process of burning, the dried bricks are burned either in clamps (small scale) or kilns (large scale) up to certain degree temperature. In this stage, the bricks will gain hardness and strength so it is important stage in manufacturing of bricks. The temperature required for burning is about 1100oC. If they burnt beyond this limit they will be brittle and easy to break. If they burnt under this limit, they will not gain full strength and there is a chance to absorb moisture from the atmosphere. Hence burning should be done properly to meet the requirements of good brick.

8. MANPOWER REQUIREMENT:

The enterprise requires 13 employees as detailed below**:**

Sr. No.	Designation of Employees	Salary Per Person	Monthly Salary ₹	Number of employees required				
				Year-1	Year-2	Year-3	Year-4	Year-5
1	Machine Operators	12,000	24000.00	2	2	2	2	2
2	Helpers	8,000	48000.00	6	6	8	8	10
1	Production supervisor	15,000	15000.00	1	1	1	1	1
2	Accounts/Stores Asset	12,500	12500.00	1	1	1	1	1
3	Office Boy	9,000	9000.00	1	1	1	1	1
	Total		108500.00	11	11	13	13	15

9. IMPLEMENTATION SCHEDULE:

The project can be implemented in 3 months' time as detailed below:

Sr. No.	Activity	Time Required *(in months)*
1	Acquisition of premises	1.00
2	Construction (if applicable)	1.00
3	Procurement & installation of Plant & Machinery	1.00
4	Arrangement of Finance	2.00
5	Recruitment of required manpower	1.00
	Total time required *(some activities shall run concurrently)*	3.00

10. COST OF PROJECT:

The project shall cost ₹ 37.50 lacs as detailed below:

Sr. No.	Particulars	₹ in Lacs
1	Land	4.00
2	Building	11.00
3	Plant & Machinery	13.00
4	Furniture, Electrical Installations	1.00
5	Other Assets including Preliminary / Pre-operative expenses	1.30
6	Working Capital	7.20
	Total	**37.50**

11. MEANS OF FINANCE:

Bank term loans are assumed @ 75 % of fixed assets.

Sr. No.	Particulars	₹ in Lacs
1	Promoter's contribution	9.38
2	Bank Finance	28.13
	Total	**37.50**

12. WORKING CAPITAL CALCULATION:

The project requires working capital of ₹ 7.20 lacs as detailed below:

Sr. No.	Particulars	Gross Amt	Margin %	Margin Amt	Bank Finance
1	Inventories	3.60	0.25	0.90	2.70
2	Receivables	1.80	0.25	0.45	1.35
3	Overheads	1.80	100%	1.80	0.00
4	Creditors	-		0.00	0.00
	Total	7.20		3.15	4.05

13. LIST OF MACHINERY REQUIRED:

A detail of important machinery is given below: Power Requirement: 5 HP

Sr. No.	Particulars	UOM	Qtty	Rate (₹)	Value (₹ in Lacs)
	Plant & Machinery / equipments				
a)	***Main Machinery***				
i.	Chimney	NOS.	1	550000	5.50
ii.	Tables and moulds	Nos	1	300000	3.00

iii.	pump sets	Nos	2	100000	2.00
b)					
i.	Water tanks	Nos	1	60,000	0.60
ii.	Electrical and EB charges	NOS.	1	21000	1.90
	sub-total Plant & Machinery				**13.00**
Sr. No.	**Particulars**	**UOM**	**Qtty**	**Rate (₹)**	**Value**
	Furniture / Electrical installations				
a)	Office furniture	LS	1	10000	0.10
b)	Stores Almirah	LS	1	5,000	0.05
c)	Computer & Printer	L. S.	1	10000	0.85
	sub total				**1.00**
	Other Assets				
a)	preliminary and preoperative				1.30
	sub-total Other Assets				1.30
	Total				**15.30**

All the machines and equipment are available from local manufacturers. The entrepreneur needs to ensure proper selection of product mix and proper type of machines and tooling to have modern and flexible designs. It may be worthwhile to look at reconditioned imported machines, dies and tooling. Some of the machinery and dies and tooling suppliers are listed here below:

- Kamdhenu Agro Machinery
  Plot No. 6, Near Power House,
  Wathoda Road, Wathoda
  Nagpur - 440035
  Maharashtra, India

- Future Industries Private Limited
  Shed No. 15, Ambica Estate,
  Corporation Municipal Plot,
  Opposite Sadvichar Hospital,

Naroda, Ahmedabad - 382330,
Gujarat, India

- The Global Pharma Equipments
  Star Industrial Estate,
  D-32, Naik Pada,
  Near Hanuman Mandir,
  Opposite Dwarka Industrial Estate,
  Vasai East, Vasai - 401208,
  Maharashtra, India

14. PROFITABILITY CALCULATIONS:

Sr. No.	Particulars	UOM	Year-1	Year-2	Year-3	Year-4	Year-5
1	Capacity Utilization	%	60%	70%	80%	90%	100%
2	Sales	₹. In Lacs	21.60	25.20	28.80	32.40	36.00
3	Raw Materials & Other direct inputs	₹. In Lacs	14.18	16.55	18.91	21.28	23.64
4	Gross Margin	₹. In Lacs	7.42	8.65	9.89	11.12	12.36
5	Overheads except interest	₹. In Lacs	4.46	4.74	5.30	5.47	5.58
6	Interest	₹. In Lacs	2.81	2.81	1.88	1.41	1.13
7	Depreciation	₹. In Lacs	9.10	6.50	4.55	3.25	2.93
8	**Net Profit before tax**	₹. In Lacs	**-8.96**	**-5.40**	**-1.84**	**1.00**	**2.73**

The basis of profitability calculation:
The growth of selling capacity will be increased 10% per year. (This is assumed by various analysis and study; it can be increased according to the selling strategy.)

Energy Costs are considered at Rs 7 per Kwh and fuel cost is considered at Rs. 65 per litre. The depreciation of plant is taken at 10-12 % and Interest costs are taken at 14 -15 % depending on type of industry.

15. BREAKEVEN ANALYSIS:

The project shall reach cash break-even at 54.25 % of projected capacity as detailed below:

Sr. No.	Particulars	UOM	Value
1	Sales at full capacity	₹. In Lacs	36.00
2	Variable costs	₹. In Lacs	23.64
3	Fixed costs incl. interest	₹. In Lacs	6.71
4	BEP = FC/(SR-VC) x 100 =	% of capacity	54.25%

16. STATUTORY / GOVERNMENT APPROVALS

As per the allocation of business rules under the Constitution, labour is in the concurrent list of subjects. It is dealt with by the MOLE at the Central and Departments of Labour under State Governments in respective States / UTs. The MOLE has enacted workplace safety and health statutes concerning workers in the manufacturing sector, mines, ports and docks and in construction sectors.

Further, other Ministries of the Government of India have also enacted certain statutes relating to safety aspects of substances, equipment, operations etc. Some of the statutes applicable in the manufacturing sector are discussed below:

The Static and Mobile Pressure Vessels (Unfired) Rules, 1981

These (SMPV) Rules are notified under the Explosives Act, 1884. These rules regulate storage, handling and transport of compressed gases. These rules stipulate requirements regarding construction and fitments, periodic testing, location, fire protection, loading and unloading facilities, transfer operations etc.

in respect of pressure vessels whose water capacity exceeds one thousand litres. These rules are enforced by the Chief Controller of Explosives under the Ministry of Industry and Commerce, Govt. of India (PESO).

The Manufacture, Storage and Import of Hazardous Chemicals Rules (MSIHC), 1989

These MSIHC Rules are notified under the Environment (Protection) Act, 1986. These rules are aimed at regulating and handling of certain specified hazardous chemicals. The rules stipulate requirements regarding notification of site, identification of major hazards, taking necessary steps to control major accident, notification of major accident, preparation of safety report and on-site emergency plan; prevention and control of major accident, dissemination of information etc. These rules are notified by the Ministry of Environment and Forests (MOEF) but enforced by the Inspectorates of Factories of respective States / UTs in the manufacturing sector.

The Factories Act, 1948 and State Factories Rules

The Factories Act, 1948 is very comprehensive legislation dealing with the matters of safety, health and welfare of workers in factories. The Act places duties on the occupier to ensure safety, health and welfare of workers at work. Some of the salient provisions of the Act include:

- Guarding of machinery
- Hoists and Lifts; Lifting Machines and Appliances
- Revolving Machinery
- Pressure Plant
- Excessive Weight
- Protection of Eyes
- Precautions against dangerous fumes, gases etc.
- Explosive or inflammable dust, gas etc.

- Precautions in case of fire
- Safety of buildings and machinery
- Permissible limits of exposure of chemical and toxic substances
- Entrepreneur may contact State Pollution Control Board where ever it is applicable.

17. BACKWARD AND FORWARD INTEGRATIONS

Chemical companies often become integrated and undergo other activities outside the chemical industry. Increased competition prompts many companies to reduce supply chain costs by looking outside the chemical sector at suppliers and customers. While most companies within the chemicals sector primarily produce chemicals, some companies also conduct other manufacturing activities. The exact proportion of chemicals sector companies that are integrated with other sector activities is unknown, but many companies actively seek vertical integration. Many manufacturers pursue vertical integration to secure suppliers and customers for their products.

Mergers and acquisitions are a common way for companies to undertake new chemical ventures. By purchasing their chemical suppliers, some manufacturers secure future chemical feedstock for their products or other chemicals that they use in manufacturing. The company making the purchase obtains valuable expertise and equipment. Some mining and petrochemical production is more cost-effective when integrated within a chemical company.

Energy and feedstock costs are often a significant expense for chemical companies.

Integrating chemical production with activities that secure supplies of chemical feedstock and energy is relatively common as chemical companies grow. Chemical companies are located near mines, oil fields, ammonia factories and water supplies. This reduces transportation costs and increases the reliability of supplies by reducing the distance between feedstock and the factory.

Some companies, such as Sino-Coking Coal and Coke Chemical Industries Incorporated, own their mines. BHP Billiton operates a broad range of mines and is primarily a mining company. It does, however, also produce petrochemical feedstock for the chemical industry and therefore operates within the chemical industry as well. These companies technically operate within both the chemical and mining industries in their normal business operations.

Integrating a chemical company with other activities provides several direct benefits for the company and is becoming increasingly common. High energy costs necessitate greater control of energy resources and minimal reliance on expensive transportation. Chemical companies experience volatile profitability due to fluctuations in feedstock and energy expenses. Some companies control this volatility through careful supply chain management and by charging supply surcharges. Actively researching and developing alternative feedstock and energy supplies helps the company reduce costs.

Vertical integration supports these activities by eliminating redundant activities at multiple companies and increasing efficiency. By consolidating activity among multiple, similar operations, chemical companies achieve cost savings that contribute to higher profitability. End products are often very profitable, and some chemical companies purchase their former customers to take advantage of the

marked-up prices of products further along in the supply chain.

Integration may become more common for many chemical companies as competition strengthens and traditional feedstock becomes more expensive. Market demand for chemical feedstock increases as emerging market economies grow and result in increased consumer spending around the world.

18. TRAINING CENTERS AND COURSES

There is no such training required to start this business but, basic chemical bachelor's degree is plus point for enterpriser. Promoter may train their employees in such specialized institutions to grow up the business. There are few specialised Institutes provide degree certification in chemical Technology, few most famous and authenticate Institutions are as follows:

1. Department of chemical LD college of engineering
   No.120, Circular Road, University Area, Navrangpura,
   Opposite Gujarat University, Ahmedabad, Gujarat 380015

2. MIT College of chemical Engineering**, Pune**
   Gate.No.140, Raj Baugh Educational Complex, Pune Solapur Highway,
   Loni Kalbhor, Pune – 412201
   Maharashtra, India

Udyamimitra portal (link : www.udyamimitra.in) can also be accessed for handholding services viz. application filling / project report preparation, EDP, financial Training, Skill Development, mentoring etc.

Entrepreneurship program helps to run business successfully is also available from Institutes like Entrepreneurship Development Institute of India (EDII) and its affiliates.

Disclaimer:

Only few machine manufacturers are mentioned in the profile, although many machine manufacturers are available in the market. The addresses given for machinery manufacturers have been taken from reliable sources, to the best of knowledge and contacts. However, no responsibility is admitted, in case any inadvertent error or incorrectness is noticed therein. Further the same have been given by way of information only and do not carry any recommendation.

Source:- Udyami Mitra/Sidbi