FIELD VISIT REPORT

ON

BHARAT BRICK FACTORY, CHANDIGARH, PUNJAB, INDIA

Submitted by: Group 3 & 4

2016 ProSPER.Net Young Researchers' School

'Sustainable Energy for Transforming Lives: Availability, Accessibility, Affordability'

1. BACKGROUND

Considering the increasing population and urbanization in India, architecture will play a very important role in the evolution of society. More and more infrastructure, homes, and commercial buildings will be built, as well as a great promotion on building material manufacturing industries. Challenges exist in current building material industries, such as huge energy consumption, environment pollution, lack of technical innovation and skilled employees. It will be a great opportunity to take the interventions from the beginning phase before it gets too late to take action. There is significant potential to reduce energy use, curtail emissions, improve sustainable building material production, and promote innovation on product design and organizational reformation, etc. What happens at the BHARAT BRICKS Co. may provide one example of working with an Institute (TERI) to reduce energy consumption by creating appropriate infrastructure for sustained adoption of new and improved technologies for production and use of resource efficient bricks in India.

2. INTRODUCTION

Brick is a building material and no construction is possible without brick. Generally two types of bricks are manufactured by using machines that are concrete and clay brick. The raw materials used by the machines for making interlocking bricks are fly ash, sand lime, iron oxide, lime sludge, quarry wastes etc. Bharat Brick Factory, Chandigarh, manufactures up to 14,000 bricks per day. Production relies on clay, which is the most abundant natural resource to make bricks and tiles. Different types of bricks are manufactured there; primarily hollow bricks and tiles. They also manufacture color bricks by adding fly ash or other material but presence of fly ash gives it an undesired color which makes it very less popular in the market even after being economically cheaper.

3. METHODOLOGY

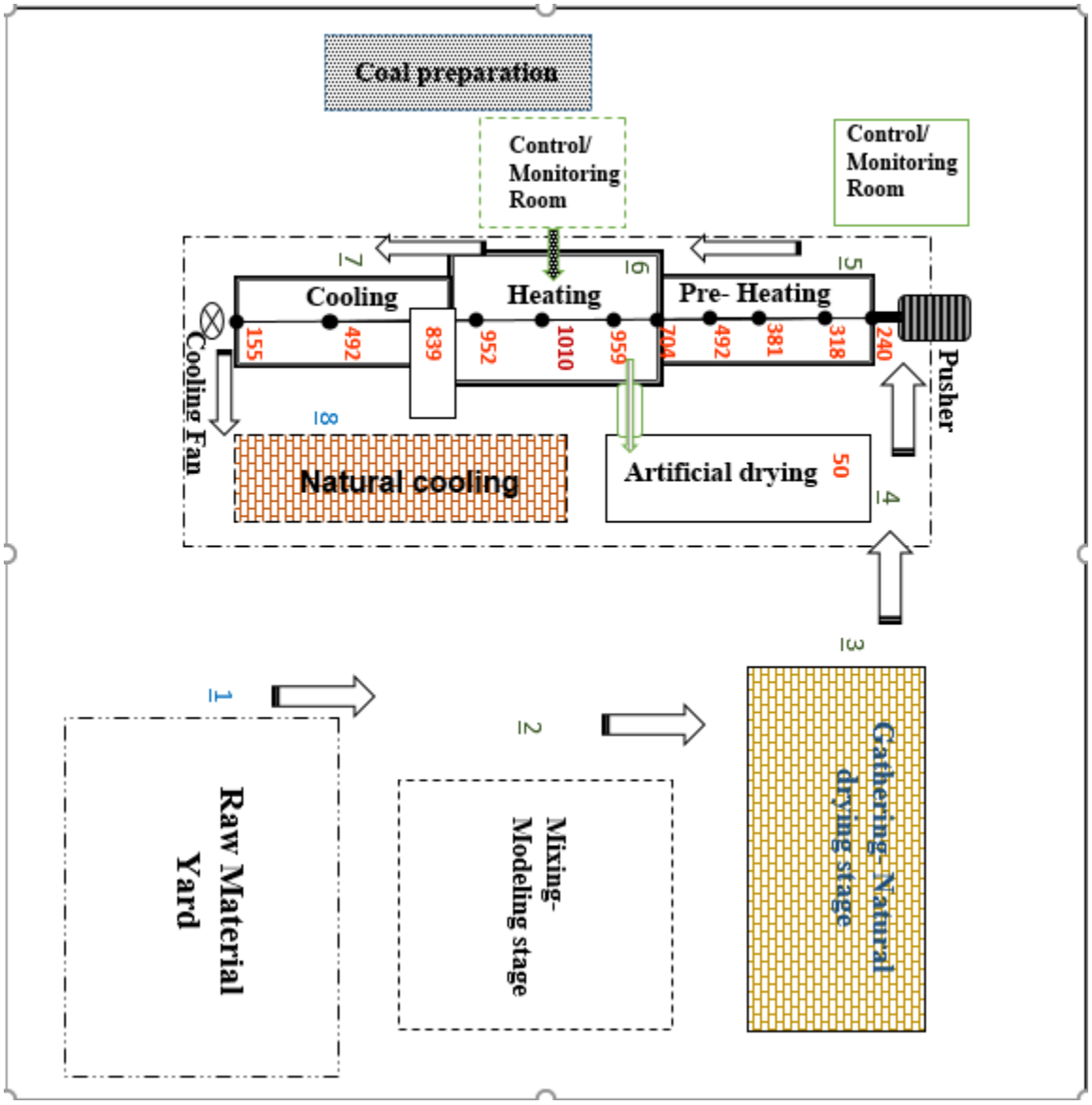

Figure: Overall Broad Framework of Brick Formation

3.1 Raw Material Collection

The process of the brick formation starts with the collection of raw material i.e. clay. 50% of high plasticity clay and 50% of low plasticity clay is mixed so as to get a mixture of desired composition. The mixture is then put into an excavator for further mixing and loose dough is prepared out of it which is kept for a day. With the help of labor, dough is put into moulds. As

per the statistics, a husband and a wife can prepare 1800 bricks per day & is paid Rs 600/- for 1000 bricks.

3.2 Drying

For the production of strong and durable bricks, it is being fired in three stages: pre-heating, firing, and cooling. After moulding, bricks are sent for drying to evaporate off the moisture out of them. Drying is a physical phase and is done by two ways: natural drying, i.e. stacking the bricks under the shade and artificial one which utilizes waste heat. Artificial drying takes place at around 50°C and one brick trolley requires 1 hour 45 minutes for drying. Color of the bricks indicates if they are dried. For artificial drying, tunnel kiln is attached with a dryer. Exhaust gases from the tunnel and the hot air extracted from the cooling zone of the tunnel are used for drying the bricks. Depending upon the season, it takes 4-15 days for the bricks to get dried.

3.3 Firing

Afterwards, they are sent to the firing tunnel. Firing is the last stage in the production process of bricks and needs to be managed appropriately as the problems of how to reduce the number of bricks breakage, how to make the system energy efficient and achieve good results needs to be addressed at this stage. There are many brick firing technologies e.g. Bull's Trench Kiln (BTK), Zig-zag, Tunnel Kiln etc, having different processes and their respective advantages.

Tunnel Kiln firing technology involves stationary firing zone near the centre of the tunnel while bricks are carried on trolleys. It includes extruder moulding, shade-drying, & tunnel-drying. Cold air, going through the fired bricks, is taken out from the exit end of the kiln whereas the combustion gases travel towards the kiln entrance, transferring part of their heat to the incoming bricks. Air extraction and supply can be done at several points along the kiln. Firing of the product changes the mineral association of the clay through chemical and physical reactions. Tunnel kilns are the preferred technology for firing bricks in developed countries. As bricks get broken in the firing process, to economize the coal consumption, brick firing is started when 5-7 lakhs of bricks are there in the kiln. Firing takes almost 25 days.

3.4 Cooling

Afterwards bricks need to be cooled down which usually takes approximately 5 days. As there has been a slow and continuous rise in temperature in the brick firing, a continuous fall of the temperature in the kiln needs to be maintained; and this temperature must be controlled so as to make sure that clay products contract at a steady rate as too rapid cooling may crack the bricks. Composition and characteristics of clay is an important factor to decide upon the cooling speed. When bricks reach the outside ambient air temperature, they are taken out from the kiln.

4. ENERGY EFFICIENCY MEASURES

Brickmaking is an energy-intensive process. However, Bharat Bricks Company has taken some steps towards improving energy efficiency to reduce energy consumption.

4.1 Efficient kiln design:

Kiln firing is one of the most energy intensive stages in brick manufacture, so any strategies that can improve the efficiency of the firing process can save significant amounts of energy. The kiln at Bharat Bricks Co. is a double-wall construction, which creates an air barrier between the internal wall of the firing tunnel and the outside wall exposed to the ambient air. This air gap reduces heat loss from the firing zone by reducing convective heat transfer.Another important energy efficiency measure is the addition of insulation to reduce heat loss in the firing zone. Mineral wool insulation has been added to the walls and top of the firing kiln, creating an insulating barrier between the ambient air and the firing zone. Mineral wools have good insulating properties that reduce thermal conduction. Finally, two strategies have been implemented at either end of the firing tunnel to reduce heat losses. A barrier has been added at the pusher-end of the firing tunnel and an air curtain has been added to the cooling end of the tunnel.

4.2 Energy efficient kiln operation:

Bharat Bricks Co. uses a tunnel kiln in the brick manufacturing process. In this type of kiln, bricks can be continually transported through the kiln. Once 5-7 lakh bricks (500,000-700,000

bricks) are ready for processing, the kiln is fired up and trolleys of bricks are transported through the kiln in a continuous process. This avoids the need to heat the kiln structure for each batch.

4.3 Automated kiln temperature control

Automated temperature controls help to maintain the pre-heating, firing, and cooling zones of the kiln at optimum temperatures. A series of thermostats along the length of the kiln relay information to a central control station that regulates the temperature in each zone to ensure they remain within predetermined limits. Data is logged by hand at regular intervals to help manage the system.

4.4. Efficient drying: Natural drying and waste heat re-use

Prior to firing, excess moisture must be removed from the bricks in a drying stage. Green bricks are dried first in an open shed using ambient air and low-energy ceiling fans to aid air-flow. This reduces the need for large amounts of energy to remove moisture. Following the air drying, a waste heat reuse process has also been implemented at Bharat Bricks Co. This drying stage requires temperatures of around 50°C to remove this excess moisture. Waste heat from the cooling zone is captured and diverted for use in the drying zone. The waste heat is drawn from the cooling zone instead of the firing zone in order to maintain the efficiency of the firing process. By utilising waste heat for the drying process, energy consumption is reduced.

5. LIMITATIONS & SUGGESTIONS

After visiting the site and studying its scenario, the following suggestions were made:

- As coal is used as the primary fuel source in brick manufacture and its combustion leads to significant GHG emissions, efforts could be made to switch to a cleaner fuel.
- Roof tops at the site would be useful to install solar photovoltaic panels to produce energy. There are numerous suitable applications for this energy, such as fans, motors, and lights.
- Additional energy efficiency measures could be investigated, such as improved controls to more accurately manage air flow through the kiln.