



Case Studies on Cleaner Brick Production

Case Study No.2

Production of Bricks through Natural Draft Zigzag Kiln

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1 Introduction

1.1 Background

In several of the developing countries, fired-clay bricks are the prevalent building materials and are still produced through traditional technologies and practices. Some of these practices have adverse impacts on the environment. Various studies have established that improvements in technology and practices can reduce fuel consumption and pollutants emissions (including black carbon) significantly. Climate and Clean Air Coalition (CCAC) is a collective effort of governments of some of the countries along with United Nations Environment Programme (UNEP) towards mitigation of the impacts of short-lived climate pollutants and address the climate change. The CCAC Brick Production Initiative is aimed at substantial mitigation of emissions of black carbon and other pollutants from brick kilns through employing a range of technology and policy approaches. International Centre for Integrated Mountain Development (ICIMOD), is coordinating CCAC-BPI activities in South Asia.

The reduction in emissions can be achieved through shifting to efficient brick kiln technologies as well as through production of resource efficient products such as perforated/hollow bricks or flyash-clay bricks (utilizing flyash, an industrial waste, in brick making). The objective of these case studies is to showcase the examples of brick manufacturing enterprises who have adopted these measures to improve efficiency and reduce emissions. In this endeavour, case studies on four brick manufacturing enterprises operating in South Asia region have been developed. These case studies are focused on:

1. Production of perforated bricks;
2. Production of bricks through Natural Draft Zigzag Kiln;
3. Production of bricks through Hybrid Hoffman Kiln (HHK);
4. Utilisation of flyash in brick making.

This case study is focused on an enterprise producing bricks through Natural Draft Zigzag Kiln.

1.2 Introduction to Natural Draft Zigzag Kiln

Natural Draught Zigzag firing kiln is a moving fire kiln in which the fire moves in a closed rectangular circuit through the bricks stacked in the annular space between the outer and the inner wall of the kiln. It has many similarities with FCBTK technology; the main difference being the zigzag air flow path. The bricks are stacked in such a manner to guide the air flow in a zigzag path. Zigzag flow increases the air flow path length and turbulence in the air, thereby

resulting in improved combustion & heat transfer rate and uniform temperature across the kiln cross section. Also the long firing zone and fuel feeding practice improves the combustion efficiency of the kiln. The main innovation in natural draught zigzag kiln is that while traditionally zigzag firing was done with the assistance of fan draught, in this kiln the zigzag operation is achieved through the chimney draught. The main advantages of natural draft zigzag kilns are reduced energy consumption, reduced pollutant emissions and improved product quality.



Figure 1: A view of the Natural Draft Zigzag Kiln

1.3 Brief description of the enterprise

Name of the company/enterprise	Pawan Bricks
Name of the owner	Mr Shyam Sharma
Location	Barh, Patna, Bihar, India
Operating since	2013
Installed production capacity	40,000-45,000 bricks per day
Estimated annual production capacity	6-7 million bricks

Operational season	5-6 months
Type of products	Solid bricks
Type of fuel	Coal and sawdust

2 Production process

The schematic of the brick manufacturing process practiced in the natural draft zigzag is shown in the picture below:



Figure 2: Schematic of brick production process at the Natural Draft Zigzag Kiln

The steps involved in the brick manufacturing process in the Natural Draft Zigzag Kiln plant along with the photographs is described below:

<p>Clay preparation and moulding is done manually and the green bricks are dried in open Sun.</p>	
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<p>The dried bricks are stacked in the kiln in chamber setting so as to guide the air to flow in zigzag path. The brick setting in this plant is such that it creates 3 parallel zigzag paths of air flow.</p>	
<p>Fuel is fed in the kiln through feed holes provided at the top of the kiln. Fuel is fed into 6 chambers (36 feet firing zone) simultaneously by a single firemen. In the front chamber only sawdust is fed, while in the later chambers, coal powder is fed.</p>	
<p>Fired bricks after getting cooled are unloaded from the kiln manually.</p>	

3 Main Features and Benefits of Natural Draft Zigzag Kiln

Main Features:	
Production capacity	40,000-45,000 bricks per day
Estimated annual production	6-7 million bricks
Foot-print area of the kiln	~ 2500 square meters
Capital cost of setting up of the kiln	INR 4 – 4.5 million ¹

¹ The major cost is the cost of 0.7 million bricks used in the construction. The cost data is for the year 2013.

(excluding cost of land and buildings)			
Weight of dried green bricks	3.35 kg		
Weight of fired bricks	3.0 kg/brick		
Firing temperature	950-1050 °C		
Advantages: (Performance of the Natural Draft Zigzag Kiln as compared to a FCBTK, the prevalent kiln technology in the region ²)			
Parameter	Natural Draft Zigzag Kiln	FCBTK	Remarks
Specific Energy Consumption (MJ/kg fired bricks)	1.05	1.3	21% reduction compared to FCBTK
CO ₂ emission (g/kg fired brick)	100.2	131.2	24% reduction compared to FCBTK
SPM emission (g/kg fired brick)	0.11	1.18	91% reduction compared to FCBTK
% of Class-I bricks	90%	60%	50% more class I bricks compared to FCBTK

4 Conclusions

- Because of zigzag flow and better operating practices and kiln design, Natural Draft Zigzag Kilns are more energy efficient and less polluting.
- Natural Draft Zigzag Kilns increase the profitability of the enterprise because of reduced fuel cost and increased revenue due to better product quality.

² The performance numbers are based on monitoring conducted jointly by the University of Illinois, Clean Air Task Force, Enzen Global and Greentech Knowledge Solutions.