

## 5 MULTI CHAMBERS KILN

### INTRODUCTION AND HISTORY

This model was adapted to the local context with good results. The operational principle is very similar to the Hoffman kiln, the only difference is the fuel consumption that is slightly higher due to the large mass of the kiln<sup>1</sup>.

One of the advantages is the possibility to produce different products (in each chamber) with a superior and uniform quality since the product is not in direct contact with the flame. In Colombia the kiln usually is operated with coal.

Front view of the kiln



### GEOGRAPHICAL DISTRIBUTION:



#### TYPE OF KILN

kiln



Continuous

#### CHARACTERISTICS OF ENTERPRISES USING THIS TECHNOLOGY:

Nature of Organisation



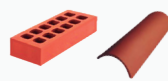
Industrial

Level of  
mechanisation



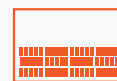
Semi-mechanised

Type of bricks/ tiles  
produced



Solid bricks  
Hollow/perforated  
bricks

Annual production capacity  
of the enterprise



> 1 & < 10 million bricks  
(medium scale)

Operational period



Round the year

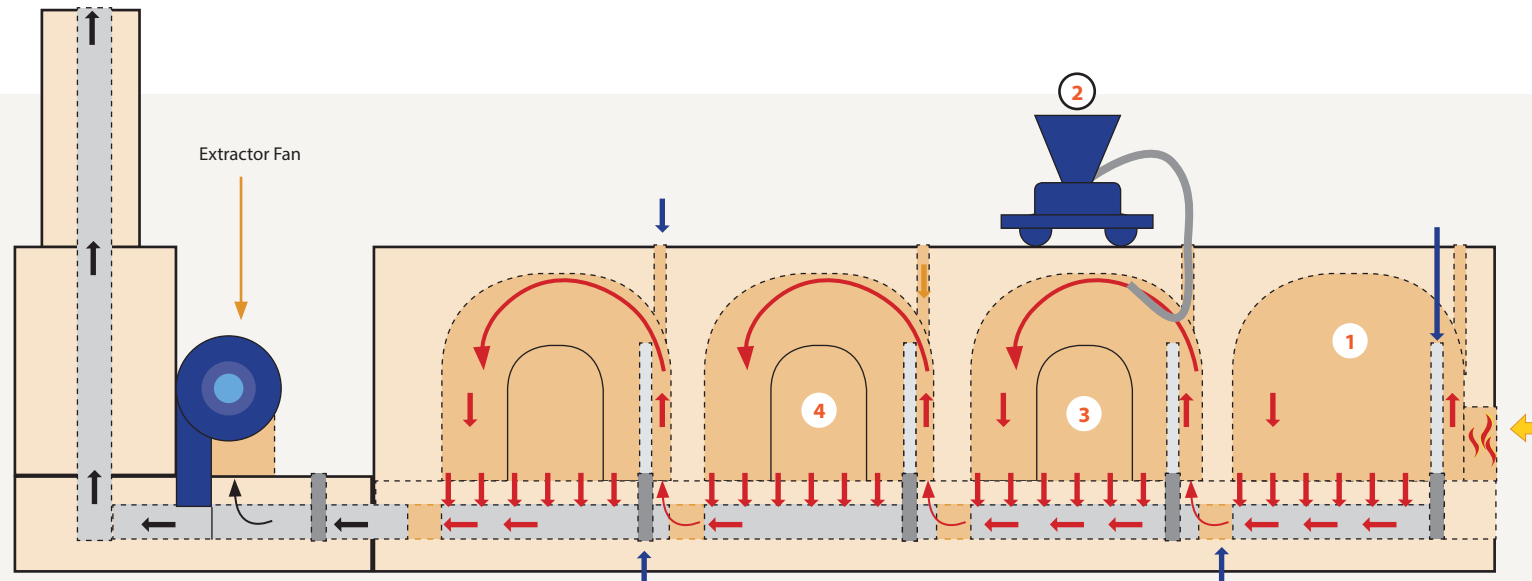
#### ESTIMATED N° OF OPERATIONAL ENTERPRISES AND TOTAL PRODUCTION (USING MULTICHAMBER KILN)

Country	N° of enterprises	Total Production (million bricks or tiles year)
Colombia	12	~ 26,07

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### DESCRIPTION & WORKING:

- Multi Chambers Kiln brings the possibility to use the heating energy in the interconnected chambers; this kiln also permits to recover the heat from the chamber to dry the green bricks, reducing the drying period. The recovery of the heat is made with a specially designed duct and a forced draught that drives the air through the chambers containing the bricks burned, the process takes place during the cooling stage.
- Cooling. This process can take between 6 to 12 hours per chamber supported with cooling fans until it reaches a temperature close to room temperature.
- The complete production cycle of the kiln is long and depends on the number of chambers, type of product, raw material and quality of fuel used.



**1**

Ignition and preheat. Begins at the first chamber, passing the residual heat of the combustion gases go to the adjacent chamber to preheat and complete the drying of the green bricks.

**2**

Fuel dosage. Each chamber has a sluice for the combustion, during this process the fuel supply is made on the top of the kiln using dosing equipment with supply hoses.

**3**

Firing of the bricks. When the first chamber reaches a temperature of 950 - 1050°C, the second chamber will be at 300 - 450°C, temperature to start the combustion on this chamber.

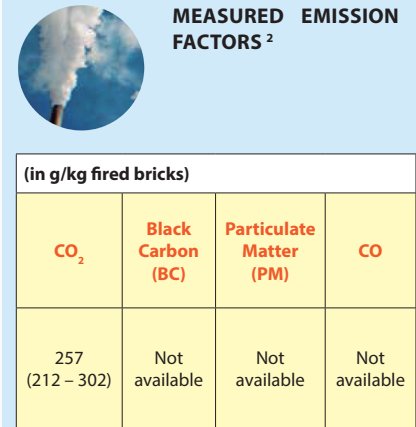
**4**

The third chamber will use the residual heat of the second chamber, and so on until complete the series of chambers.

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## MULTI CHAMBERS KILN

## AIR EMISSIONS AND IMPACTS:



**MEASURED PM EMISSION**

Average: 76,7 mg/Nm<sup>3</sup>

**EMISSION STANDARDS**

Emission standards are notified only for PM emissions

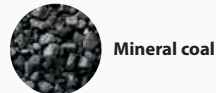
Country	PM (mg/Nm <sup>3</sup> )
Colombia	250 mg/Nm <sup>3</sup>

## COMMENTS ON EMISSIONS

Air infiltration on the lateral areas could increase of the percentage of oxygen; in this case the emissions will not meet the national standards. It is recommended to use refractory material on the domes of the chamber in order to improve the conditions of the heat flux into the combustion zone. This kiln produces low emissions of soot (particulate matter).

## FUEL AND ENERGY:

## COMMONLY USED FUELS

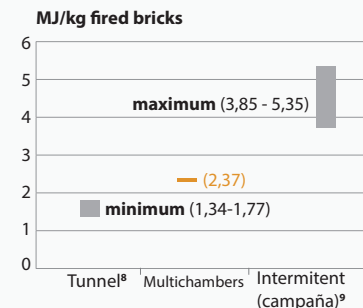
SPECIFIC ENERGY CONSUMPTION<sup>4</sup>  
(SEC)

(measured at firing temperature of 900-1100 °C)

Average: 2,37 MJ/kg fired bricks or tiles

## COMPARISON WITH OTHER KILN TECHNOLOGIES

Multi Chambers Kiln reports a usual SEC for intermittent kilns (SEC – 2 to 4 MJ/kg fired brick); these kilns operated semi continuously and more efficiently than the intermittent kilns.



## DESCRIPTION ON ENERGY CONSUMPTION AND MAIN CAUSES OF HEAT LOSS

Thermal losses could occur in the cracks on the doors and lateral walls of the kiln.

## FINANCIAL PERFORMANCE:

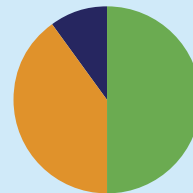
## Capital Cost of the kiln technology

(for annual production capacity of 1 - 3 million bricks)  
(excluding land and working capital cost)

100.000 - 170.000 USD

## Capital Cost Breakdown

Capital Cost Breakdown	
Material Cost	50%
Labour Cost	40%
Equipment Cost	10%
Total	100%

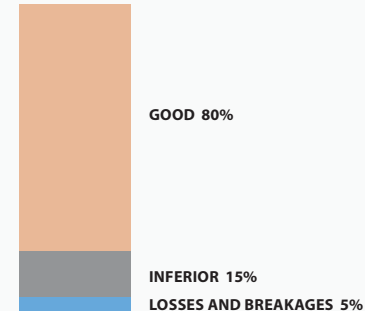


Production Capacity	120,000 bricks/tiles per month Main brick size: 300 x 200 x 100 mm	
No of Operators required	3-5	
Payback Period	Simple Payback	0.5 – 2.0 years
	Discounted Payback (@ 6.5%)	1 – 3 years

## PRODUCT QUALITY:

## Product quality:

(As per the local market perception)

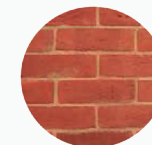


## Description on product quality

Non-uniform temperature across the vertical section of the kiln results in under-fired bricks/tiles at the bottom zone and hence differences in the quality of the products.

Types of product that can be fired in the kiln		
Solid bricks		✓
Hollow/ Perforated bricks		✓
Roof Tiles		
Others		

## GOOD BRICK

INFERIOR BRICK  
Under-fired and over-burnt

## OCCUPATIONAL HEALTH AND SAFETY (OHS):

Exposure to Respirable Suspended Particulate Matter<sup>7</sup>

Flue gases exhausted from the chimney or cracks on the walls unpaved surfaces around cause concentration of soot and dust in the surrounding environment and the workers are exposed to concentration of suspended particulate matter.

This can result in a few cases of respiratory diseases among workers.

Exposure to Thermal Stress<sup>6</sup>

Workers responsible of discharging products and fuel supply are exposed directly to heat and some radiation.

This can result in dehydration among workers.

## Risk of accidents

Danger of fall down during fuel supply on the top of the kiln.  
Electric shock by operating the equipment.

Risk of injuries.

Practices followed at Multichambers kiln enterprises do not comply with the International Labour Standards on occupational health and safety drawn up by ILO, majority of the workers are usually exposed to thermal stress and emissions from the chimney. Significant risk of accidents during fuel supply on the roof of the kiln. No migratory labour issues have been identified.

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## CONCLUSION &amp; REFERENCES:

Conclusion:			
Parameters		FCBTK	Comments
AIR EMISSION (G/KG FIRED BRICK)	CO2	257	The average value of PM emissions is within the notified limit (Colombian Norms)
	Black Carbon	NA	
	PM	NA	
	CO	NA	
FUEL & ENERGY	SEC (MJ/kg fired brick)	2,37	The value can be reduced when the kiln is operated continuously
FINANCIAL PERFORMANCE	Capital Cost (USD)	170.000	Is a model for producers with a capacity of 2 – 5 ton/hour, is an interesting alternative due to the short recovery period for the investment and the option to add more chambers. The production can be increased in 15-25%.
	Production Capacity	600 ton bricks/month	
	Simple Payback	0,5 – 2 years	
PRODUCT QUALITY	Types of product	Solids, hollow and perforate bricks and tiles.	The bricks produced meet the requirements established in the Colombian Technical Norm for construction products.
	Good Quality Product	80%	
OHS	Exposure to dust	yes	This model of kiln improves labor conditions compared with other intermittent technologies; the risk of accidents is reduced in 50% due to its ease of operation
	Exposure to Thermal stress	yes	
	Risk of accidents	yes	

## FOR MORE INFORMATION:

## REFERENCES:

References are provided as 'Endnotes'

- (1) CAEM 2011, Technical report of appropriate technologies for the reconversion of the artisan brick sector
- (2) Report on 'Brick Kiln Performance Assessment' available at [http://www.unep.org/ccac/Portals/24183/docs/Brick\\_Kilns\\_Performance\\_Assessment.pdf](http://www.unep.org/ccac/Portals/24183/docs/Brick_Kilns_Performance_Assessment.pdf)
- (3) CAEM 2014, Evaluation of the multi chamber kiln emissions in El Santuario Factory, Nemocón – Cundinamarca
- (4) *Ibid.*
- (5) Field observation.
- (6) *Ibid.*
- (7) By its initials in Spanish
- (8) Tunnel Kiln: EELA. Manual de hornos eficientes para la industria de cerámica roja. Feb, 2015. / Greentech, SDC. Factsheets about brick kilns in South and South-East Asia. Dec, 2013.
- (9) Intermitent (campaña): EELA. Diagnóstico inicial del sector ladrillero, Región del Seridó en el Nordeste de Brasil. Marzo, 2011

## ACKNOWLEDGEMENT:

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## Note:

In the initial stage of this initiative of developing factsheet on brick kiln technologies, factsheet are developed for South and South-East Asia and Latin America regions. Factsheet on brick kiln technologies of other regions will be developed over time.

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