

4 PAULISTINHA KILN

INTRODUCCION AND HISTORY

This model basically consists of pairs of rectangular chambers with walls and dome roof constructed with conventional bricks. The door for loading and unloading material is located in the lateral wall. The internal floor of the chambers is constructed of bricks leaving openings between the pieces which are connected to the chimney through underground ducts.

Paulistinha Kiln has burners (four or six) at the lateral walls, generally constructed in pairs; moving the fire from the floor to the roof and then the heat moves down burning the bricks and the flue gases are conducted to the duct stacked at the floor of the rear wall of the kiln and then moved to the chimney. The fuels commonly used are logs, branches and pieces of wood.

This kiln presents a slight deficiency related to the heat distribution, that determines hot and cold spots in certain zones and, consequently, different quality products; however, it is a widely disseminated model in all Brazilian regions due to the low construction cost.



GEOGRAPHICAL DISTRIBUTION:



TYPE OF KILN

kiln



Intermittant

CHARACTERISTICS OF ENTERPRISES USING THIS TECHNOLOGY:

Nature of Organisation



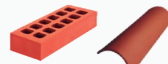
Industrial

Level of
mechanisation



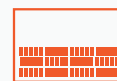
Semi-mechanised

Type of bricks/ tiles
produced



Hollow/perforated
bricks - Tiles

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 PAULISTINHA KILN)

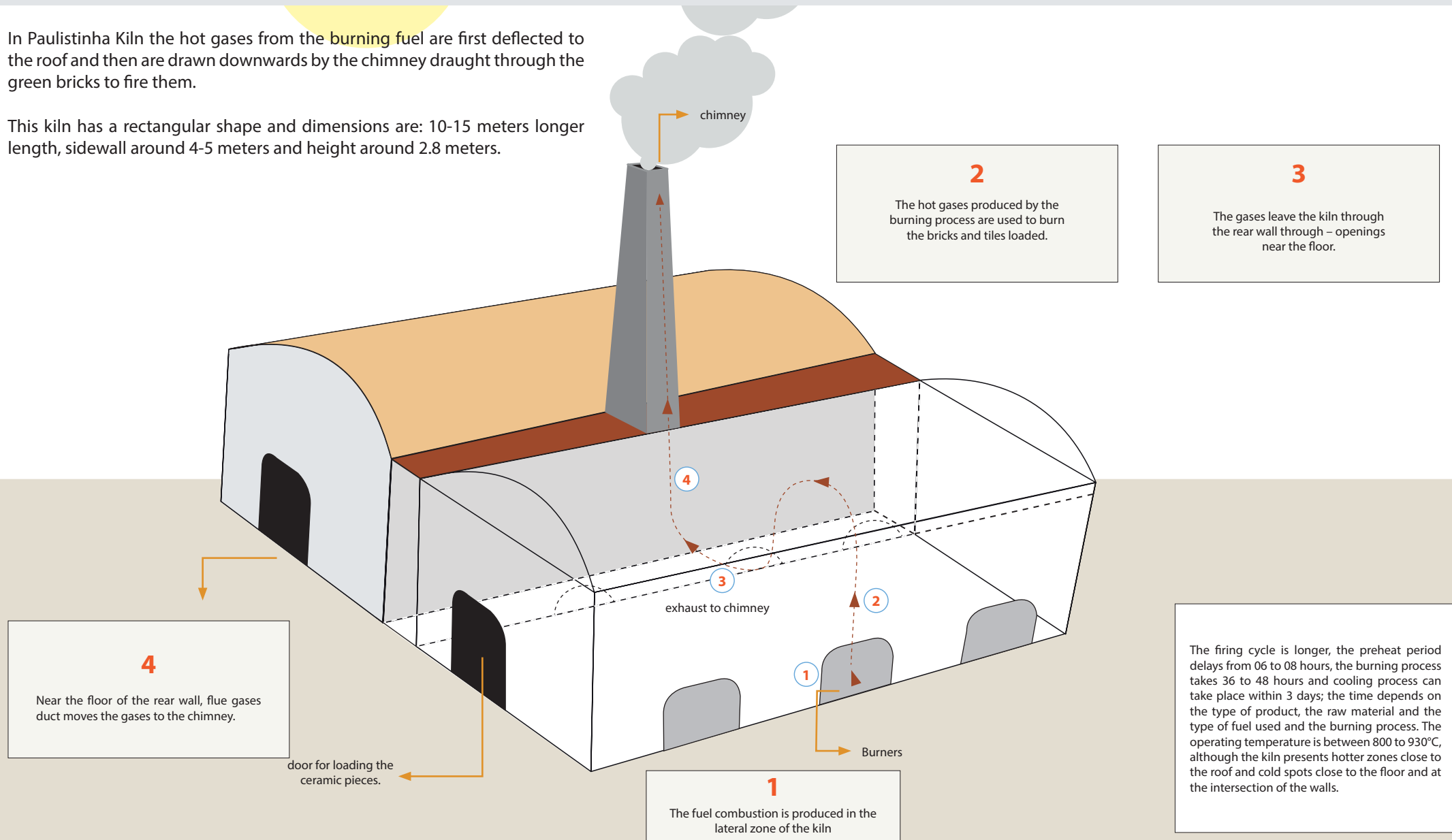
Country	N° of enterprises	Total Production (billion bricks/tiles/year)
Brazil	~ 1,100	~ 6,2

4 PAULISTINHA KILN

DESCRIPTION & WORKING:

In Paulistinha Kiln the hot gases from the burning fuel are first deflected to the roof and then are drawn downwards by the chimney draught through the green bricks to fire them.

This kiln has a rectangular shape and dimensions are: 10-15 meters longer length, sidewall around 4-5 meters and height around 2.8 meters.



The firing cycle is longer, the preheat period delays from 06 to 08 hours, the burning process takes 36 to 48 hours and cooling process can take place within 3 days; the time depends on the type of product, the raw material and the type of fuel used and the burning process. The operating temperature is between 800 to 930°C, although the kiln presents hotter zones close to the roof and cold spots close to the floor and at the intersection of the walls.

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PAULISTINHA KILN

AIR EMISSIONS AND IMPACTS:

MEASURED EMISSION
FACTORS¹

(in g/kg fired bricks)			
CO ₂	Black Carbon (BC)	Particulate Matter (PM)	CO
380 (360-400)	Not available	Not available	Not available

MEASURED PM EMISSION

Average: Not available

EMISSION STANDARDS

Emission standards are notified only for PM emission

Country	PM (mg/Nm ³)
Brazil	730 (< 10 MW) 520 (between 10 and 30 MW)

COMMENTS ON EMISSIONS

Its values of the emission standards of fixed sources depend on the thermal power rating (MW) of the sources (kilns).

This kiln usually produces soot (particulate matter) mainly during the intermittent firewood feeding process, when the kiln is fed with the wood occurs lack of the combustion air, which causes an increasing of the emissions soot. After 10 to 15 minutes the ratio of air/fuel stabilizes and emissions are reduced until the next feeding process.

FUEL AND ENERGY:

COMMONLY USED FUELS



Biomass
Biomass (eg. - firewood, biomass briquettes, sawdust).

SPECIFIC ENERGY CONSUMPTION²
(SEC)

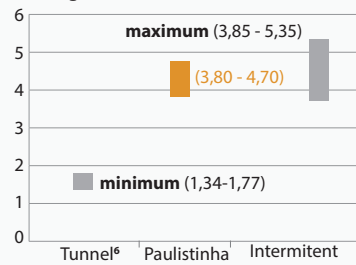
(measured at firing temperature of 900-1100 °C)

Average: 4,0 MJ/kg fired bricks/tiles
(Range: 3,8 – 4,7 MJ/kg fired/brick or tile)

COMPARISON WITH OTHER KILN
TECHNOLOGIES

Paulistinha Kiln presents a slightly higher SEC value compared with other intermittent kilns (SEC – 2 to 4 MJ/kg fired brick) due mainly to its structure.

MJ/kg fired bricks

DESCRIPTION ON ENERGY
CONSUMPTION AND MAIN CAUSES OF
HEAT LOSS

Incomplete combustion of wood, heat losses in the exhaust gases and intermittent cycle (batch cycle).

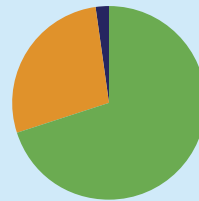
FINANCIAL PERFORMANCE:

Capital Cost of the kiln technology
(for annual production capacity of 3 – 5 million bricks)
(excluding land and working capital cost)

28.000 to 46.000 USD

Capital Cost Breakdown

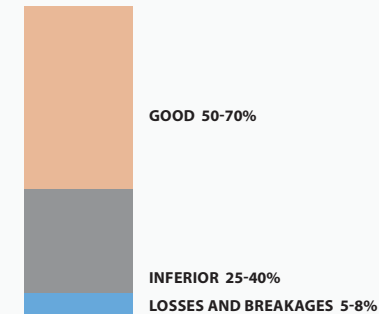
Capital Cost Break-up	
Material Cost	70%
Labour Cost	28%
Equipment Cost	2%
Total	100%



Production Capacity	50.000 to 75.000 bricks / tiles per week Main brick size: 180 x 180 x 85 mm Main tile size: 490 x 130 mm	
No of Operators required	8-10	
Payback Period	Simple Payback	0.7 – 2.1 years
	Discounted Payback (@ 6.5%)	0.9 – 3.0 years

PRODUCT QUALITY:

Product quality:
(As per the local market perception)

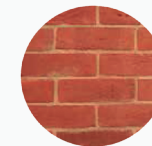


Description on product quality

Non-uniform temperature across the horizontal-section of the kiln results in under-fired bricks/tiles at the rear zone and hence differences in the product quality.

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 Matter³

Description about the exposure: Flue gases exhausted from the chimney cause a very high concentration of dust in the surrounding environment and the workers are exposed to high concentration of a suspended particulate matter.

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

Exposure to Thermal Stress⁴

Description about the exposure: The workers that are engaged in kiln activities (discharging products and fueling) are exposed directly to heat and some radiation.

Impacts: This can result in dehydration among workers.

Risk of accidents

Danger of burning during firing or discharging.

Impacts: Risk of injuries.

Practices followed at Paulistinha 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 emissions and thermal stress.

No migratory labour issues have been identified.

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CONCLUSION & REFERENCES:

Conclusion:			
Parameters		Paulistinha Kiln	Comments
AIR EMISSION (G/KG FIRED BRICK)	CO2	380	Incomplete combustion in kiln results in high value of emissions, mainly after wood feeding.
	Black Carbon	NA	
	PM	NA	
	CO	NA	
FUEL & ENERGY	SEC (MJ/kg fired brick)	4,0	Incomplete combustion and heat losses result in increase in the fuel consumption in Paulistinha Kiln.
FINANCIAL PERFORMANCE	Capital Cost (USD)	28.000-48.000	Low capital investment and high return is one of the main reasons for popularity of Paulistinha technology.
	Production Capacity	3-8 million bricks/year	
	Simple Payback	0,7 – 2,1 years	
PRODUCT QUALITY	Types of product	All types of product	Non-uniform temperature distribution across the kiln cross-section results in variation in product quality.
	Good Quality Product	60 %	
OHS	Exposure to dust	yes	Paulistinha Kiln complies partially OHS conditions.
	Exposure to Thermal stress	yes	
	Risk of accidents	yes	

FOR MORE INFORMATION:

REFERENCES:

References are provided as 'Endnotes'

(1) Report on 'Brick Kiln Performance Assessment' available at

http://www.unep.org/ccac/Portals/24183/docs/Brick_Kilns_Performance_Assessment.pdf

(2) *Ibid.*

(3) Field observation.

(4) *Ibid.*

(5) By its initials in Portuguese

(6) 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.

(7) Intermitent (campanha): EELA. Diagnóstico inicial del sector ladrillero, Región del Seridó en el Nordeste de Brasil. Marzo, 2011

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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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