Pyrolyse de résidus agricoles dans un procédé Brésilien

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BIOENERGY FOR LOCAL PRODUCTION

CONFÉRENCE INTERNATIONALE

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Montpellier (France)

www.Bio4Africa.eu

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Brazilian kilns : set up at a glance

UASZ (Sénégal)

INP-HB (Côte d'Ivoire)

SAVANET (Ghana)

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Why the Brazilian kilns selected in B4A?

Kiln-furnace system LAPEM/UFV

LAPEM develops research, and extension activities in the areas of Bioenergy

Engineering Services

The Sustainable Steel Industry Project was created to:

- *encourage the reduction of greenhouse gas emissions in the Brazilian steel industry.*
- *developp cleaner and more efficient production technologies*
- *offer a technology to small and medium-sized rural producers*

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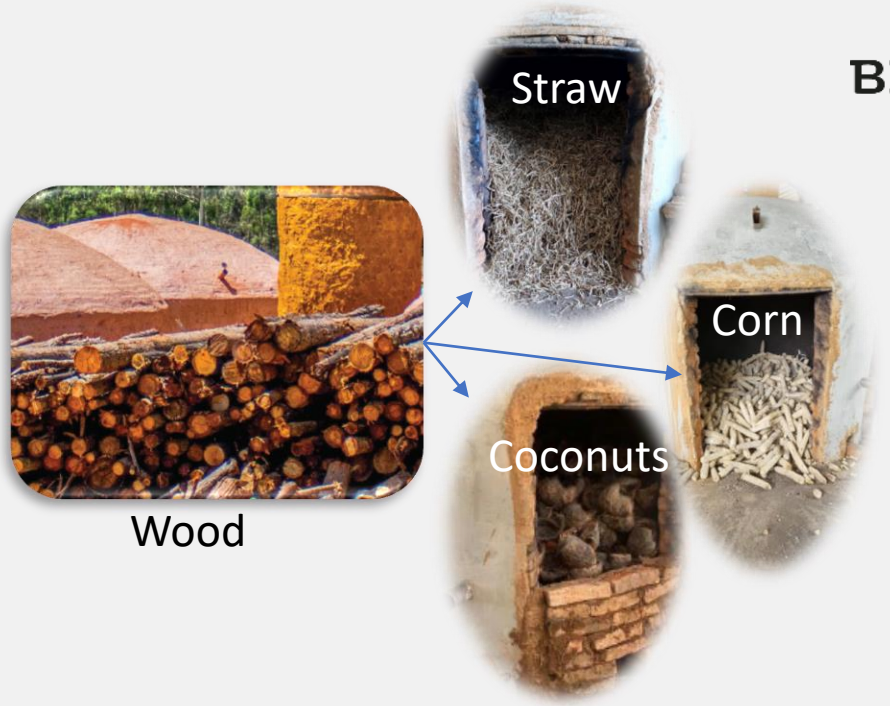
Brazilian kilns: Challenges for B4A

1. Replace wood with agricultural residues that have very different physicochemical properties.
2. Transfer the technology with the support of Brazilian universities.
3. To size the furnaces according to local contexts.
4. Find the necessary materials for furnace construction in each concerned country.
5. Create infrastructure
6. Train operators.
7. Ensure remote maintenance.
8. Duplicate and disseminate the technology at low cost.



- Peanuts
- Rice husks
- Ground nut husk
- Cashew nuts
- …

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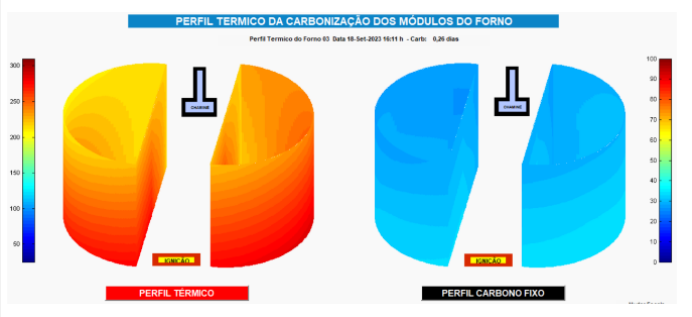
Brazilian kilns : Transfer method adopted in B4A

1. Contact with Labem and explanation of the B4A project.
2. Sharing data on the biomass selected in B4A.
3. Carbonization test at Labem using similar biomasses.
4. Definition and optimization of pyrolysis operating conditions (biomass size, temperature, duration, etc.)
5. Characterization of the produced biochars (proximate analysis).
6. Calculation of mass yields.
7. Transfer of data to partners.
8. Acceptance by African partners.
9. Preparation for technology transfer.

Pyrometry

CARBORAAD



Brazilian kilns: Exemple of trial done at UFV by Nascente

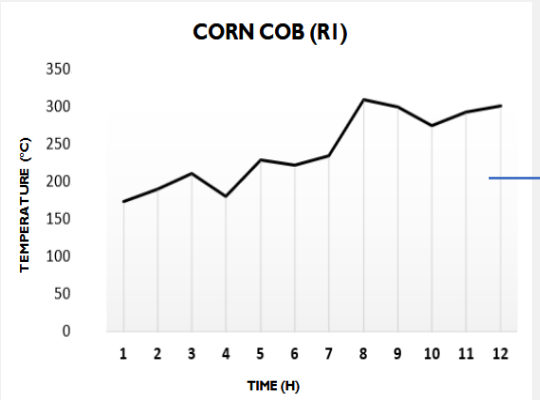
Raw corn cob

Corn cob bulk density

Filling the kilns with corn cobs

Raw biomass characterization

Holocellulose content (%)	76.32
Extractives content (%)	5.67
Lignin content (%)	18.01
Dry basis moisture content (%)	24.42
Bulk density (kg/m³)	125.00
Fixed carbon content (%)	14.16
Volatile matter content (%)	83.26
Ash content (%)	2.58



	Repetition 1	Repetition 2
Carbonization time (h)	12	12
Mass of biomass (kg)	144.00	151.15
Dry basis moisture content (%)	24.42	24.42
Dry mass of biomass (kg)	108.84	114.24
Mass of charcoal (kg)	32.00	32.00
Gravimetric yield of charcoal (%)	29.40	28.01

Carbonization

	Repetition 1	Repetition 2
Bulk density (kg/m³)	98.89	90.28
Fixed carbon content (%)	75.81	76.73
Volatile matter content (%)	17.99	16.88
Ash content (%)	6.20	6.39

Biochar characterization

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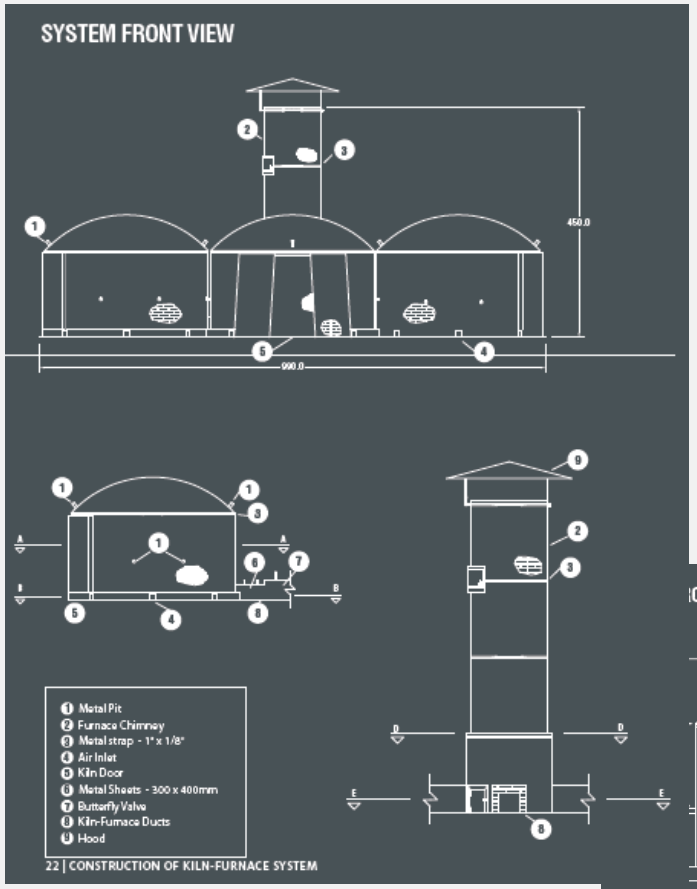
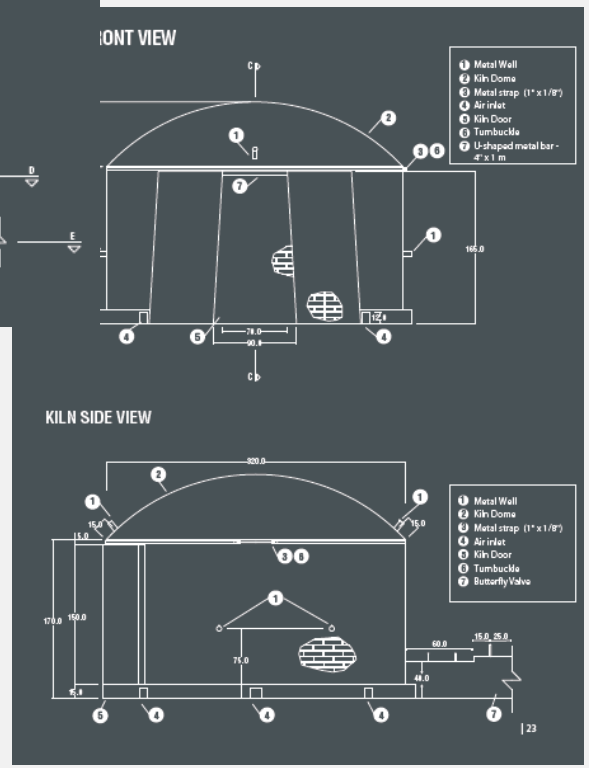
Brazilian kilns: the construction in each study case (1)

TYPE AND QUANTITY	SPECIFICATIONS	PURPOSE OR USE	FIGURE
1860 burnt clay solid bricks	■ Bricks measuring 5 x 10 x 20 cm, used as follows: ■ 1700 for the construction of 4 kilns and 4 ducts; ■ 160 for closing the kiln doors (40 per kiln).	Construction of kilns and ducts. Closing of doors.	
1 trammel with an iron rod and a wooden rod. ITEM PRODUCED THROUGH METALWORKING	Trammel with two rods: ■ 1 3/8' iron rod measuring 1.2 m in length ■ 1 wooden rod measuring 0.7 m in length, made from wood with width and thickness of 5x2cm.	Demarcation of the kiln bases. Guide the construction of the kiln walls.	
3 m³ of clayey soil and add water.	Mortar made from earth available on the property mixed with water. Clay soil to be sieved in a 2mm sieve.	Laying the bricks. Coating the kilns.	
1 template, made with wooden boards of different sizes.	4 boards 20 cm wide and 2 cm thick: ■ 2 boards 50cm long ■ 2 boards 86cm long	Marking the entrance doors each kiln.	
1 template, made with a wooden lath.	Wooden lath 1.2 m long, 5 cm wide and 2 cm thick.	Construction of domes.	
4 metal belts in carbon steel, 1 per kiln. ITEM PRODUCED THROUGH METALWORKING	Made in 1" wide, 3 mm thick and 4.1 m long sheets. At the ends of the strap, an angle must be welded, one on each side, in the dimensions of 1" in length and width and 3 mm in thickness. These angles will serve to place the threaded bar.	Prevention of the expansion of the kiln walls.	
4 threaded steel bars 3/8'' in diameter, 1 per kiln; 16 metal nuts; 8 washers. ITEM PRODUCED THROUGH METALWORKING	■ threaded bars, 25 cm long; ■ 16 nuts, 4 for each strap; ■ 8 washers, 2 for each strap.	Locking of the kiln belts (Tensioner).	
4 "U" profile bars in 1040 carbon steel, for kiln entrance doors, 1 for each kiln. ITEM PRODUCED THROUGH METALWORKING	Each bar measuring 0.7 m long, 12.7 cm wide and 30 mm high.	Installation over the opening of the entrance doors of each kiln, aiming at greater support of the kiln domes.	
4 metal sheets, 1 for each kiln. ITEM PRODUCED THROUGH METALWORKING	Sheets 30 cm long, 10 cm wide and 3 mm thick.	Support for the kiln wall over the gas outlet opening to the duct.	
4 metal sheets, 1 for each kiln. ITEM PRODUCED THROUGH METALWORKING	Sheets 15 cm wide, 25 cm long and 3 mm thick, with handle.	Closing of the kiln and obstruction of the side of the furnace, during the cooling of the kilns.	
4 metallic tubes, 1 for each duct. ITEM PRODUCED THROUGH METALWORKING	Tubes 2 or 3 mm thick, 10 cm long and 1.2 cm in internal diameter.	Support for butterfly valve.	

Collaboration between Nascente/UFV and the partners to prepare the materials.





Plans sent to the partners

Brazilian kilns: the construction in each study case (2)


COTE D'IVOIRE

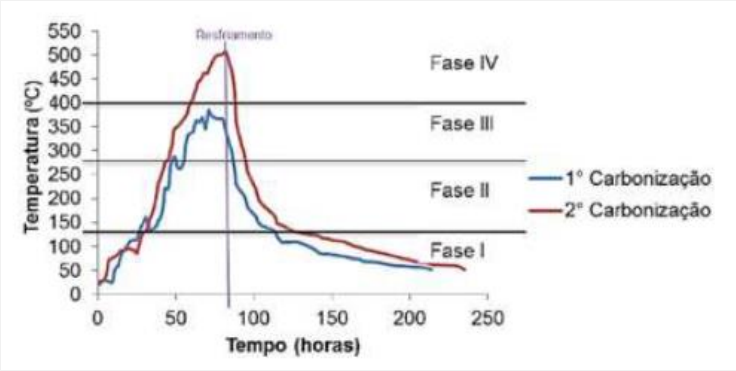

GHANA


SENEGAL

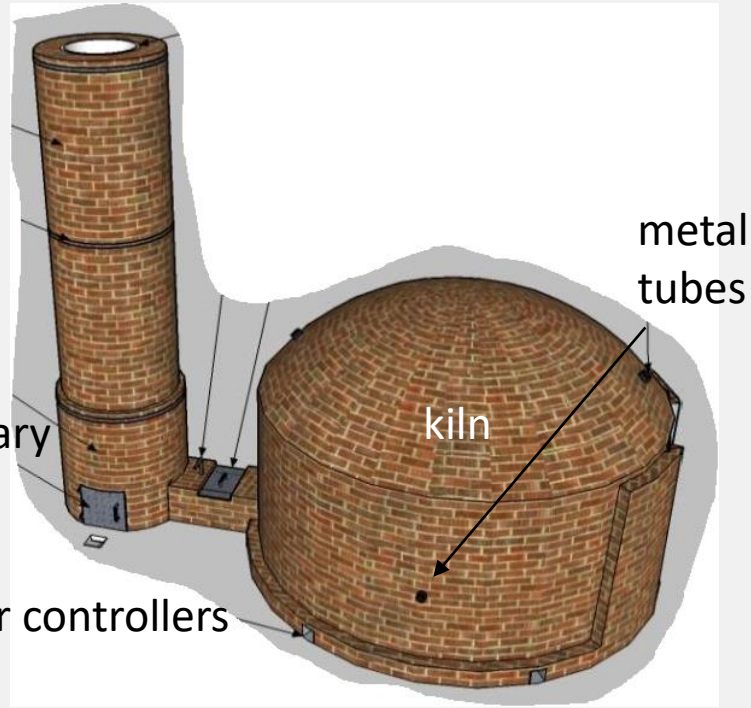
Brazilian kilns: Operation

The furnace-kiln system is composed:

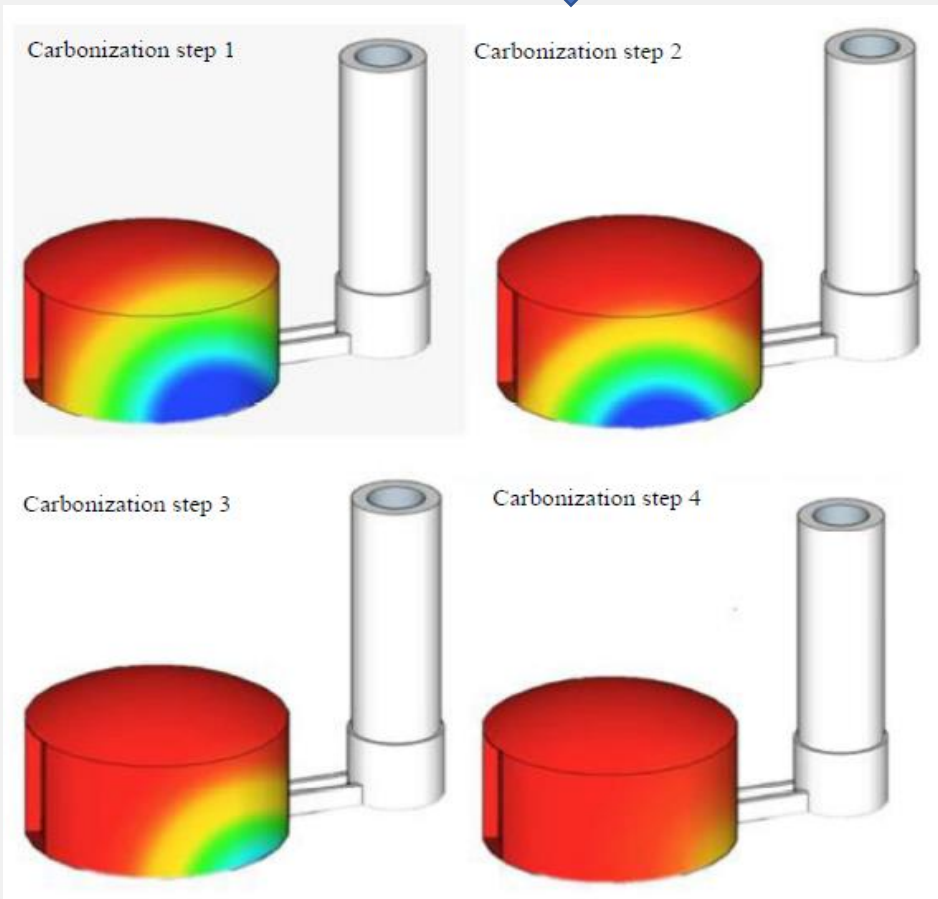
- 4 circular surface kilns (1m3)
- 1 combustion chamber
- Temperature control : air controllers (6 per kiln) / 8 metal tubes (pyrometer)



Furnace/cheminey



metal tubes



Brazilian kilns: Operation

Corn cob

Coconuts

Straw

Ground nut husk

Raw materials drying

Kiln loading

Temperature measurement

Biochar

Kiln unloading

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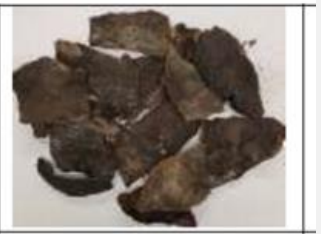
Brazilian kilns : 1st Results at INP-HB (Cote d 'Ivoire)

Biochars produced with the Brazilian kilns (INP-HB, Yamoussoukro, Côte D' Ivoire)

BIOMASS		BIOCHAR	YIELD	CYCLE	PRODUCTIVITY
Kind	kg db	kg db	%	h	kg/h
Cashew Nut Shell	80	20	25%	20	1,00
Coconut shell wet	87	13	15%	20	0,65
Mango seed shell	72	19	27%	12	1,59

Biochar production yield

Raw biomass proximate analysis	
	Cocoa pods
Moisture content (%)	13,98
Volatile matter(% wt)	57,4
Ash content (% wt)	7,9
Fixed carbon (% wt)	20,7
C (%)	41,8
H (%)	5,22
N (%)	0,89
HHV (kj/g)	16,06

Specific Surface Area (m^2/g)	Total Pore Volume (cm^3/g)	Average Pore Diameter (nm)
341.11	0.80	144

Brazilian kilns : 1st Results at SAVANET (Ghana)

Corn cob

Biomass (kg)		Biochar (kg)	Yield (%)	Cycle	Productivity (kg/h)
Corn Cob	89	26	29%	12	2,13

Biochar production parameters

Parameter	Results
pH	279.18
Bulk Density (g/L)	6.51
Electrical Conductivity (µS)	818.75
Moisture Content (%)	1.776
Volatile Matter (%)	41.222
Ash Content (%)	15.29
Fixed Carbon (%)	41.712

Biochar proximate analysis with Brazilian kilns pyrolysis technology

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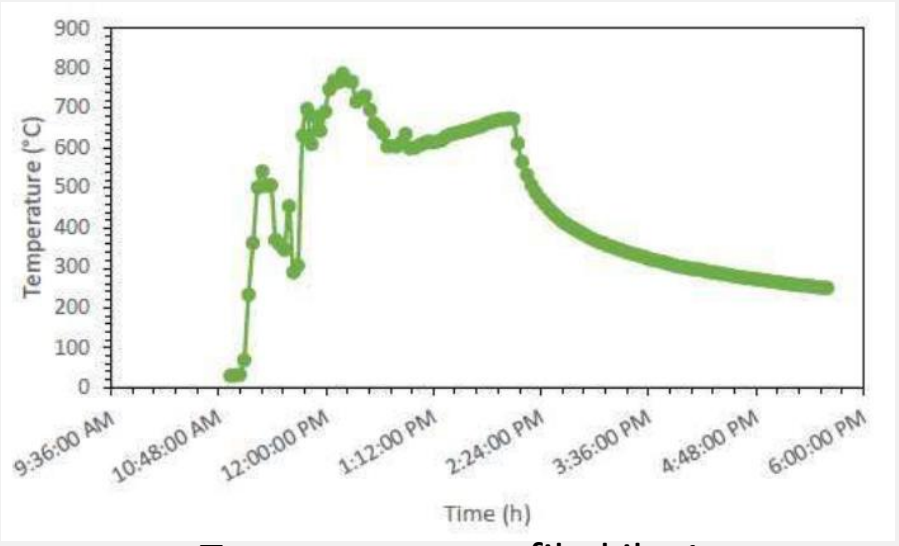
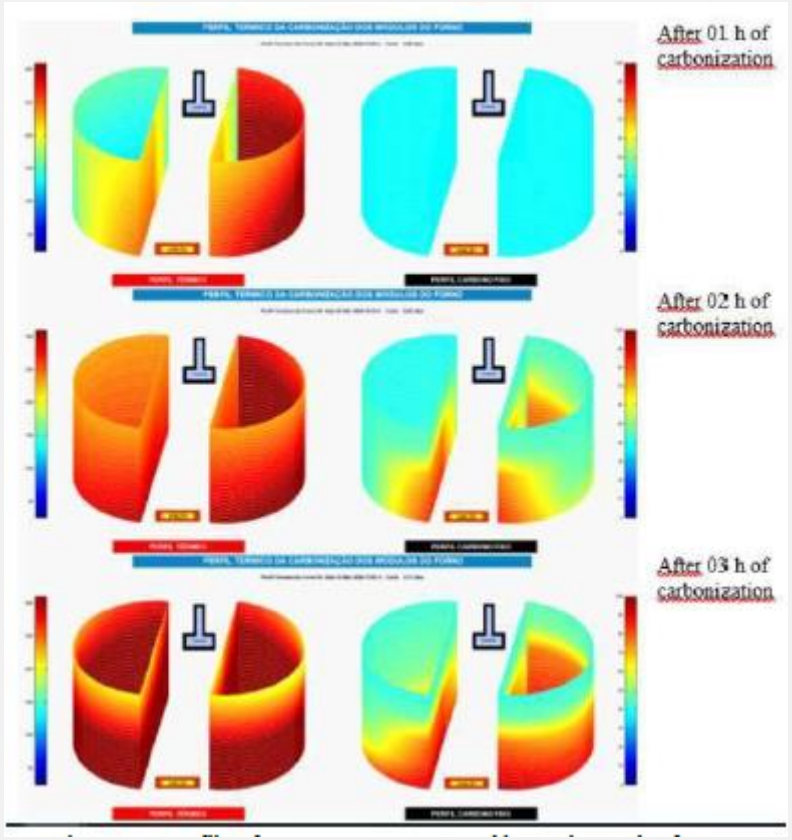
Brazilian kilns : 1st Results at UASZ (Senegal)

Corn cobs

Carbonization of corn cobs						
	Input (kg)	output (kg)	Yield (%)	Carbo time (h)	Cooling time (h)	Kiln State
Kiln 01	100.566	21.787	21.66	3	20	Operating
Kiln 02	108.66	33.275	30.62	3	19	Operating
kiln03	103.556	25.621	24.74	3	20	Operating
kiln04	109.104	35.090	32.16	3	19	Operating



Temperature profile kiln 1



Profile of temperature powered by Carboraad software

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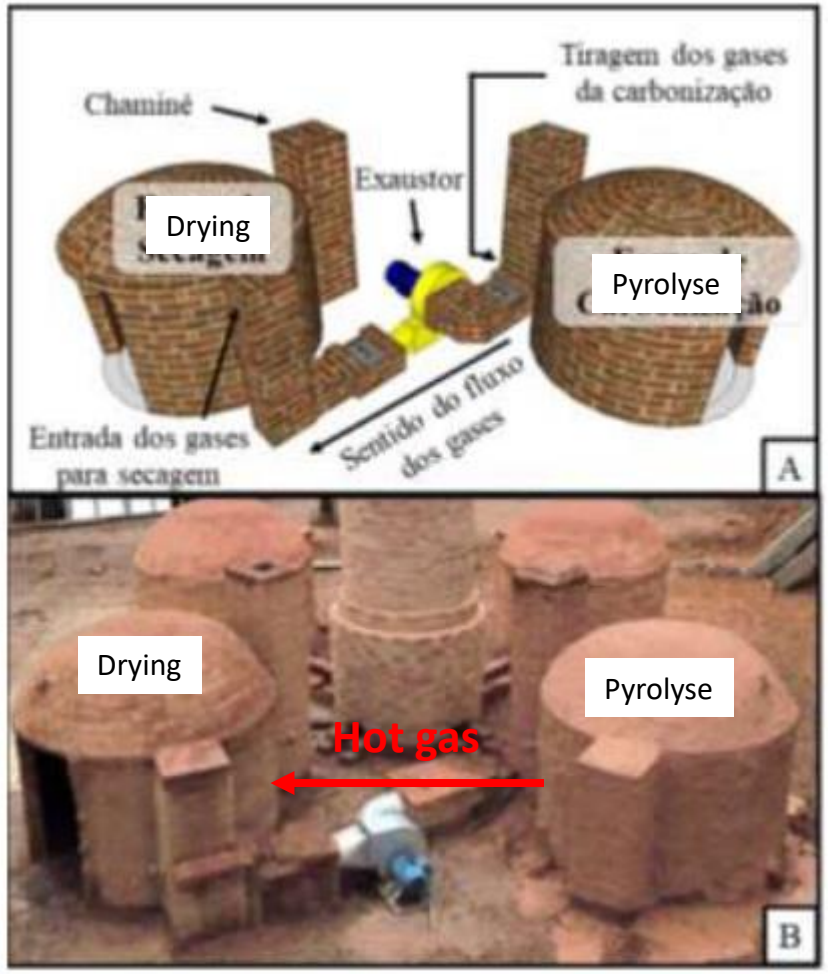
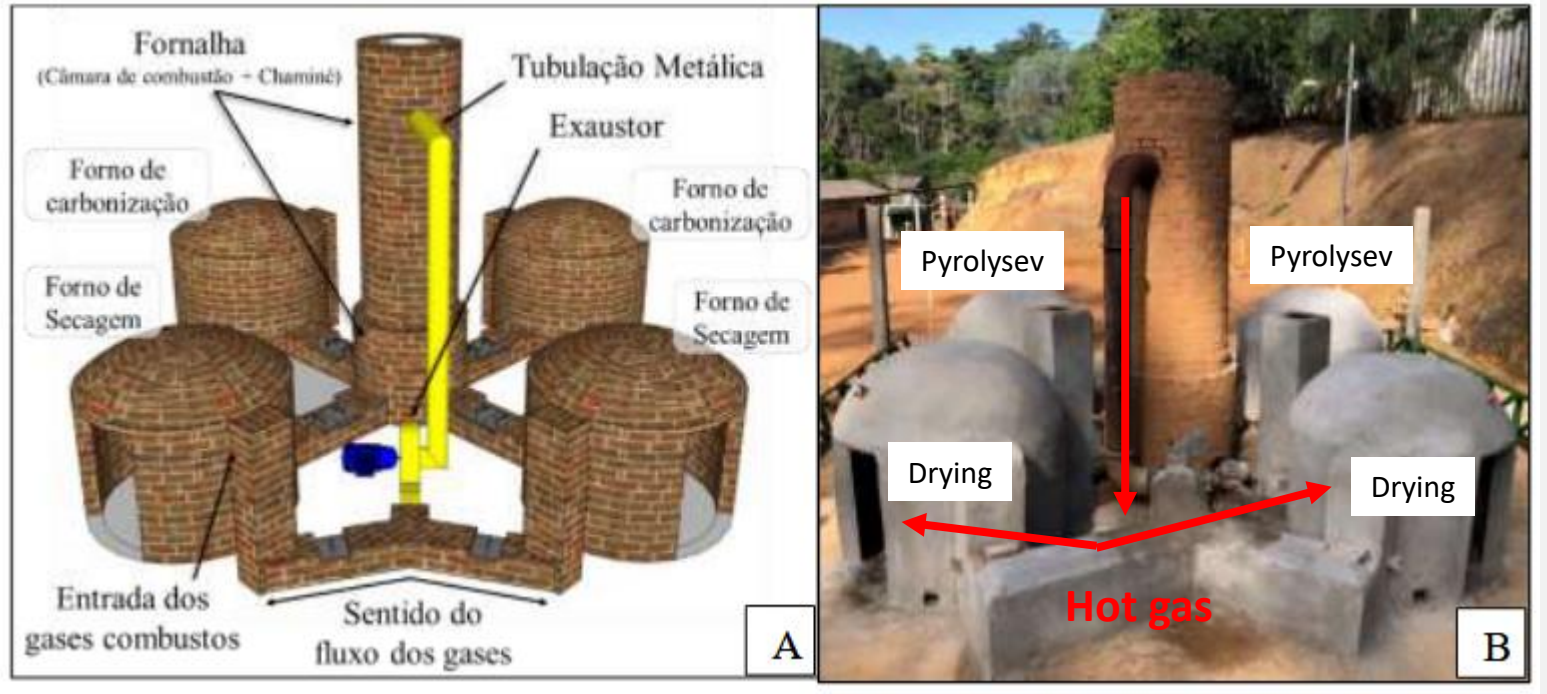
Brazilian kilns : Next step/Drying





HUMBERTO SIQUEIRA, UFV 2021

The hot gases come either from the furnaces or from the chimney.

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