COMPANY PROFILE

1 . Name ： **Hai Duong Porcelain Company**

2 . Address ： Pham Ngu Lao str Hai Duong City , Vietnam

3 . State ： State Owned Company

4 . Capital ： Government 10 billion vnd , Bank 3 million vnd

5 . Annual sales ： 3 million US $

6 . Product ： Porcelain

7 . Production ： 14 million pieces/year

8 . Employee ： 955

9 . Working hour ： 7.00 ～17.00

10 . Energy consumption

	CONSUMPTION		FACILITY
	2001	2002	
Diesel oil (kg)	25,229	25,473	Generator
L P G (ton)	251.8	799.1	Porcelain firing
Natural gas (m^3)	647,623	594,160	Insulator firing
Coal (ton)	4,407	4,736	Porcelain firing

1

PRODUCTION PROCESS

PROCESS	DETAIL	FACILITY
Raw material	Quartz , feldspar , kaolin , clay etc	
Crushing	Coarse , medium	Jaw crusher , roll mill
Blending	Fine crushing with water	Ball mill
Adjustment	Sieving , de-ironing , kneading ,	Filter press , de-airing machine
Forming	Jiggering , casting	Jiggering machine , plaster mould
Drying	Remove moisture	Dryer
Firing	Glossy , decoration	Tunnel , shuttle , roller hearth
Inspection	Warp , color , pinhole , crack etc	
Delivery	Packing	

2

MAIN FACILITY AND CAPACITY

FACILITY	ENERGY	CAPACITY
Power equipment	Electricity	90,755 kw
Boiler	Coal	3.2 ton/hr
Tunnel kiln	Coal	1 million pcs/mon
Decoration kiln	Electricity	496 pcs/hr
Decoration kiln (R H K)	L P G	1,230 pcs/hr
Shuttle kiln (10 m^3)	L P G	3,500 pcs/time
Shuttle kiln (4.7 m^3)	L P G	1,800 pcs/time

3

SPECIFICATION OF FIRING FACILITY

	TUNNEL KILN	ROLLER HEARTH KILN	SHUTTLE KILN	
			10m^3	4.7m^3
Length (m)	86.7	20	–	–
Inside width (mm)	1300	1150	2070	1550
Effective height (mm)	1250	260	1300	1100
Maximum temperature (℃)	1350	915	1350	1350
Firing atmosphere	Reduction	Oxidization	Reduction	Reduction
Number of burners (one side)	23	10	18	3
Pushing speed of kiln car	62 min/car	0.2 m/min	24 hr/time	19 hr/time
Fuel	Producer gas	L P G	L P G	L P G
Composition	CO 24 %	Butane60 % Propane40%	Butane60 % Propane40%	Butane60 % Propane40%
Calorific value (kcal /)	1,440 /m^3	11,000 /kg	11,000 /kg	11,000 /kg
Consumption	13,820,730m^3	38kg/hr	556kg/time	260kg/time
Kiln car				
Number of cars inside kiln	42	40slabs/row ×3rows	–	–
Length (mm)	2000	500/slab	–	–
Width (mm)	1300	380/slab	–	–
Effective height (mm)	1310	260	–	–

SURVEY AND ADVICE ITEM FOR ENERGY CONSERVATION

	EFFECT (ENERGY CONSERVATION)	INVESTMENT
Tunnel kiln		
Heat balance		Not necessary
Reduce radiation heat loss from kiln surface	Coal = 474 ton/year 21,400 us $/year	10,000 us$
Reduce heat loss of combustion exhaust gas	Coal = 237 ton/year 10,700 us $/year	Not necessary
Replace sand for sand seal and optimizing the volume	Temperature difference small	3,000 us$
Provide gap between sagger and car top	Decrease temperature difference between top and bottom	5,000 us$
Maintain sagger height for kiln car	Stabilize gas flow and temperature inside kiln , improve yield	Not necessary
Install kiln exit door	Stabilize atmosphere and temperature of maximum temperature zone , improve yield	1,000 us$
Extend pre-firing hour from entrance before reduction atmosphere zone	Decrease temperature difference between top and bottom , improve yield	Not necessary
Roller hearth kiln		
Increase kiln pressure to positive	LPG = 6.6 ton/year 2,500 us $/year	Not necessary
Introduce biscuit firing process	Improve quality of ware	Not necessary
Shuttle kiln		
Install high speed type burner or introduce high speed type kiln	Decrease temperature difference between top and bottom , improve yield	5,000 us$ 50,000 us$

HEAT BALANCE OF KILN

(Unit : kcal/t)

		TUNNEL KILN		ROLLER HEARTH KILN	
		Calorific value	%	Calorific value	%
Input heat	Fuel combustion heat	7387.2×10^3	99.8	836.0×10^3	99.6
	Heat carried by pre-fired goods and sagger	0	0	3.4	0.4
	Heat carried by pre-fired goods	0	0	2.1	0.2
	Heat carried by sagger	0	0	1.3	0.2
	Heat carried by kiln car	13.1	0.2	——	——
	Heat carried by the refractory	12.3	0.1	——	——
	Heat carried by iron part	0.8	0.1	——	——
	Total	7400.3×10^3	100	839.4×10^3	100
Output heat	Heat carried by pre-fired goods and sagger	8.0	0.2	23.8	2.8
	Heat carried by fired goods	3.1	0.1	6.2	1.9
	Heat carried by sagger	4.9	0.1	7.6	0.9
	Heat carried by kiln car	144.4	2.0	——	——
	Heat carried by the refractory	141.1	1.9	——	——
	Heat carried by iron part	3.3	0.1	——	——
	Heat carried by cooling air	1732.6	23.3	295.0	35.1
	Heat carried by combustion exhaust gas	1772.8	24.0	442.0	52.7
	Heat loss due to radiation and others	3742.5	50.5	78.6	9.4
	Total	7400.3×10^3	100	839.4×10^3	100
Effective heat	Effective heat per ton of fired goods	457.5×10^3		308.2×10^3	
	Heat required for firing the pre- fired goods	457.5		308.2	
	Effective heat per ton of fired goods including sagger	1188.5		395.9	
	Heat required for heating sagger	731.0		87.7	
Heat efficiency for fired goods only		**6.2 %**		**36.9 %**	
Heat efficiency for fired goods including sagger		16.1 %		47.4 %	

EFFECTIVE HEAT OF SHUTTLE KILN

		10m³ SHUTTLE KILN	4.7m³ SHUTTLE KILN
Effective heat	Effective heat per batch of fired goods	321.9× 10³ kcal/batch	165.6× 10³ kcal/batch
	Heat required for firing the pre-fired goods	321.9	165.6
	Effective heat per batch of fired goods including slabs	748.6	384.2
	Heat required for heating slabs	426.7	218.6
Heat efficiency for fired goods only		**5.3 %**	**5.8 %**
Heat efficiency for fired goods including heating slabs		12.2 %	13.4 %

7

ITEM OF ENERGY CONSERVATION

Response of HAPOCO: discussed by Management Board but not implemented yet

Ⅰ. Tunnel kiln

(1) Reduce radiation heat loss from kiln surface

Action : Cover (50 mm) kiln surface by ceramic fiber or board (only for firing zone)

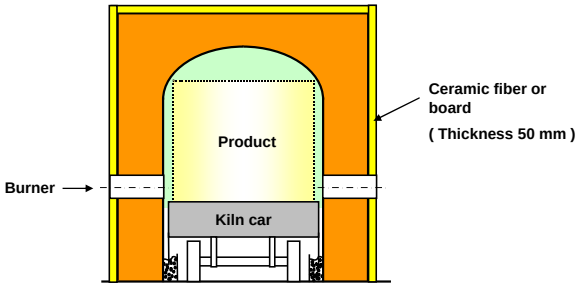
Effect : Energy conservation → 10 % (according to the actual results and experience)

Fuel (coal) consumption : 4,736 ton / 2001year

Unit price of coal : 700,000 vnd / ton

Energy consumption : 4,736 × 0.1 × 700,000 = 33,152 × 10^4 vnd / year

=21,400 us $ / year



8

Response of HAPOCO: implemented

(2) Reduce heat loss of combustion exhaust gas

Action : Maintenance of sand for sand seal and suitable kiln pressure

Effect : Energy conservation → 5 % (According to the actual results and experience)

Fuel (coal) consumption : 4,736 ton / 2001year

Unit price of coal : 700,000 vnd / ton

Energy consumption : $4{,}736 \times 0.05 \times 700{,}000 = 16{,}576 \times 10^4$ vnd / year

=10,700 us $ / year

Response of HAPOCO: implemented

(3) Replace sand for sand seal and optimizing the volume

Action : Replace sand for sand seal

Material : Shamott or sand

Grain size : 3 ～ 5 mmϕ

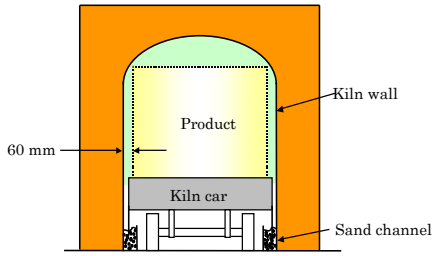
Charge : 80% of sand channel

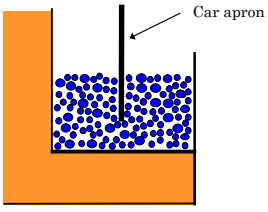
No, of charge : once a day from exit to entrance

Sieving : pass through small size

Effect : Cut off air from under car to inside of kiln , save fuel , temperature difference small

9





Sand channel

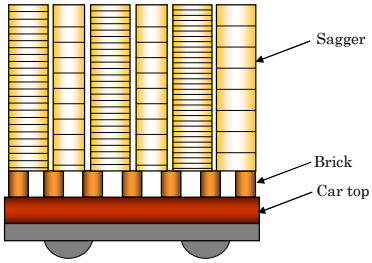
10

(4) Provide gap between sagger and car top

Action ： Laying bricks between sagger and car top

Effect ： Increase temperature of center and lower shelve ,
decrease temperature difference between top and bottom

Response of HAPOCO: implemented



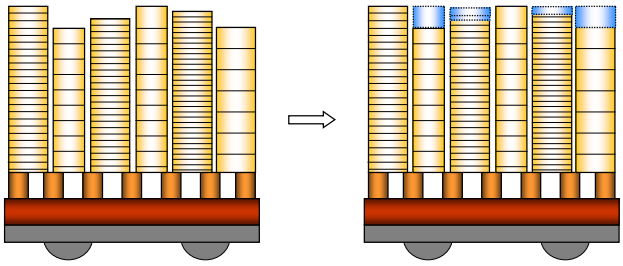
11

(5) Maintain sagger height for kiln car

Action ： Adjust height of same level

Effect ： Stabilize gas flow and temperature inside kiln , improve yield

Response of HAPOCO: Finished



12

(6) Install kiln exit door

Action ： Install door

Effect ： Prevent to intrude cold air into the kiln , stabilize atmosphere and temperature of maximum temperature zone , improve yield

Response of HAPOCO: sealed by high pressure air

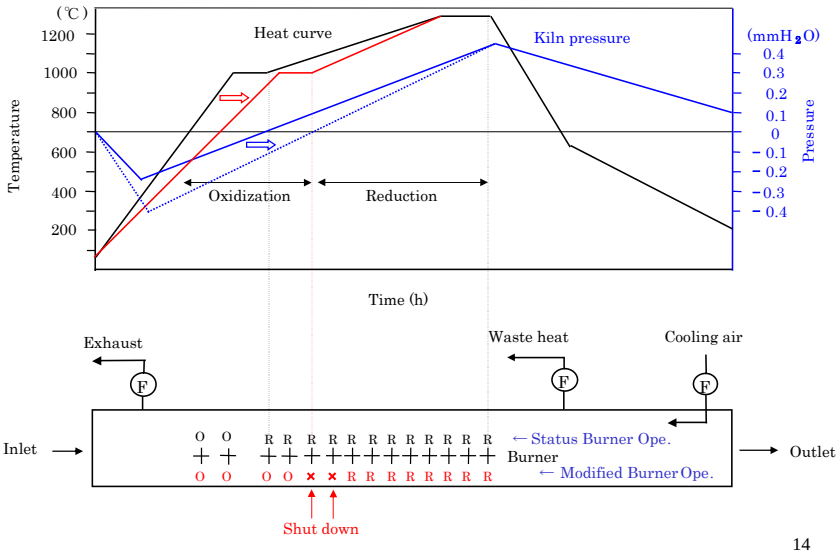
(7) Extend pre-firing hour from entrance before reduction atmosphere zone

Action ： Change 2 ～3 burners (each side) of reduction burner to oxidation burner

Effect ： Decrease temperature difference between top and bottom , improve yield

Response of HAPOCO: could not changed, to maintain temperature and products quality

13



14

Ⅱ. Roller hearth kiln

Response of HAPOCO: Finished

(1) Increase kiln pressure to positive

Action ： To be ±0 mmH_20 at 1st burner by closing exhaust damper

Effect ： Decrease to intrude cold air from outside into the kiln

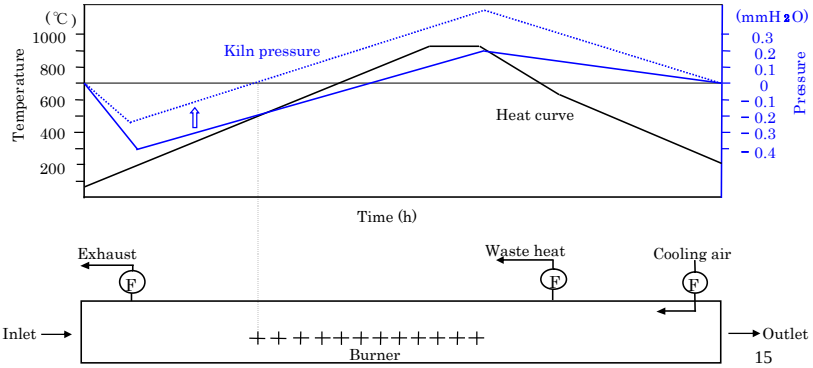
Energy conservation ⟶ 2 % (According to the actual results and experience)

Fuel (LPG) consumption： 328 ton / 2001year

Unit price of LPG： 6,000,000 vnd / ton

Energy consumption： 328 × 0.02 × 6,000,000 = 3,936 × 10^4 vnd / year

=2,500 us $ / year



15

Response of HAPOCO: implemented

(2) Introduce biscuit firing process

Action ： No need to change firing condition (heat curve, kiln pressure etc)
of decoration firing , but should be increase pushing speed

Effect ： Improve quality of ware (to be smooth glazed surface , whiteness and translucency)
but fuel (LPG) consumption increase much more than decoration firing

Response of HAPOCO: implemented

Ⅲ. Shuttle kiln

(1) Install high speed type burner or introduce high speed type kiln

Effect ： decrease temperature difference between top and bottom
shorten firing hour (firing cycle)

Energy conservation ⟶ 1 % (According to the actual results and experience)

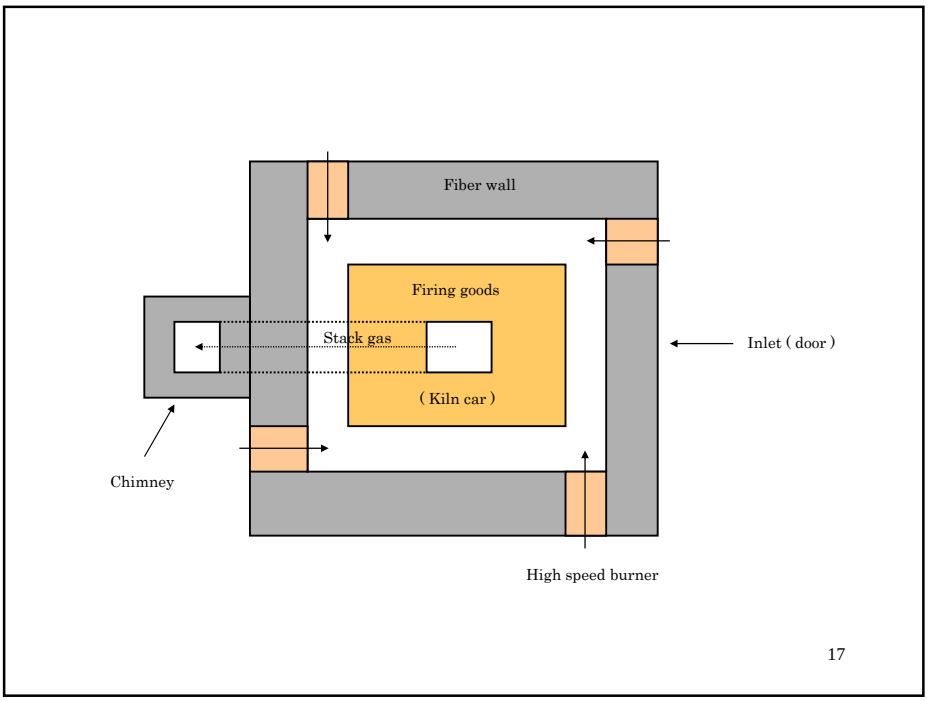
Fuel (LPG) consumption： 816 kg / batch for 2 kiln

Unit price of LPG： 6,000 vnd / kg

Energy consumption： 816 × 0.01 × 6,000 = 4.9 × 10^4 vnd / batch for 2 kiln

= 3 us $ / batch for 2 kiln

16


Fiber wall
Firing goods
Stack gas
(Kiln car)
Inlet (door)
Chimney
High speed burner
17