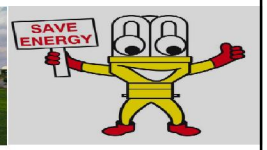
LOW CARBON SOLUTION IN VICEM HATIEN
BINH PHUOC CEMENT PLANT

THE BURNING OF CASHEW NUT SHELL REPLACING A PART OF ANTHRACITE COAL

SPEAKER: Mr. NGUYEN QUOC THANG – PLANT MANAGER





AFCM 2015 VIETNAM

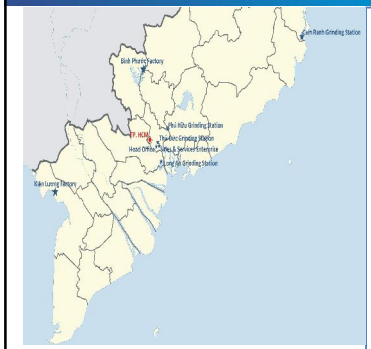
AGENDA

A • Vicem Hatien Profile.

B • Alternative fuel in Binh phuoc Cement Plant.

C • Conclusions & Comments.

VICEM HATIEN PROFILE



VICEM HATIEN has two main plants and 4 grinding stations to manufacture 4.1 Mio. T clinker and 6.8 Mio. T cement.

Cement & Clinker Manufacturing

Kien Luong Cement Plant
- Clinker Prod. Capacity : 2.3 Mio T.
- Cement Prod. Capacity: 1.5 Mio.T
- Fuel type : Coal, cashew oil.

Binh Phuoc Cement Plant
- Clinker Prod. Capacity : 1.8 Mio T.
- Cement Prod. Capacity: 1.0 Mio T.
- Fuel type : Coal, cashew.

Phu Huu Grinding Plant
- Cement Prod. Capacity: 2.0 Mio T.
- Fuel type : Rice husk.

Thu Duc Grinding Plant
- Cement Prod. Capacity: 1.3 Mio T.

Long An Grinding Plant
- Cement Prod. Capacity: 0.5 Mio T.

Cam Ranh Grinding Plant
- Cement Prod. Capacity: 0.5 Mio T.

VICEM HATIEN'S OBJECTIVES

CO2 EMISSION REDUCTION: this reduction will be achieved through improving some key following parameters:
- Clinker factor reduction (increasing puzzolana; limestone; fly ash; slag…)
- Thermal substitution rate (increasing Alternative Fuel and Raw Material)

Meet the fuel demand production needs & reduce production cost
- To compensate for the shortage of domestic coal.
- For cement industry worldwide: the using of alternative fuels for clinker production is becoming important and necessary


4

ALTERNATIVE FUEL IN BINH PHUOC CEMENT PLANT

OVERVIEW OF CASHEW IN VIETNAM

In the South-Eastern region of Vietnam, the cashew crop harvesting and processing is currently about 300,000 tons/year *(Source: VINACAS)*

Binh Phuoc province is about 70% of total yield, equivalent to 200,000 tons of cashew nut shell a year.

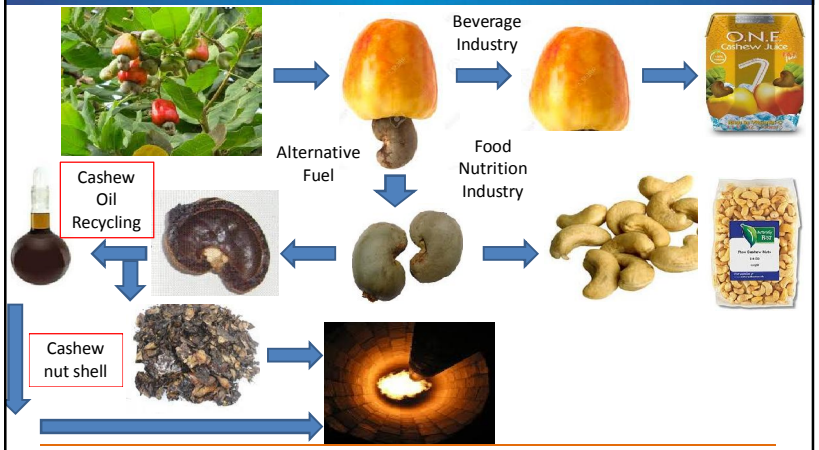
BENEFIT OF THE USING CASHEW NUT SHELL

The using this type of energy as an alternative fuel may brings both economical and environmental advantages for Binh Phuoc cement plant as well as the surrounding area.

Otherwise, burning cashew nut shell in cement kiln will significantly reduce the total CO2 emissions of the plant through replacement of fossil fuel by biomass.

5

CASHEW PROCESSING INDUSTRY



6

BINH PHUOC KILN PYRO - PROCESSING

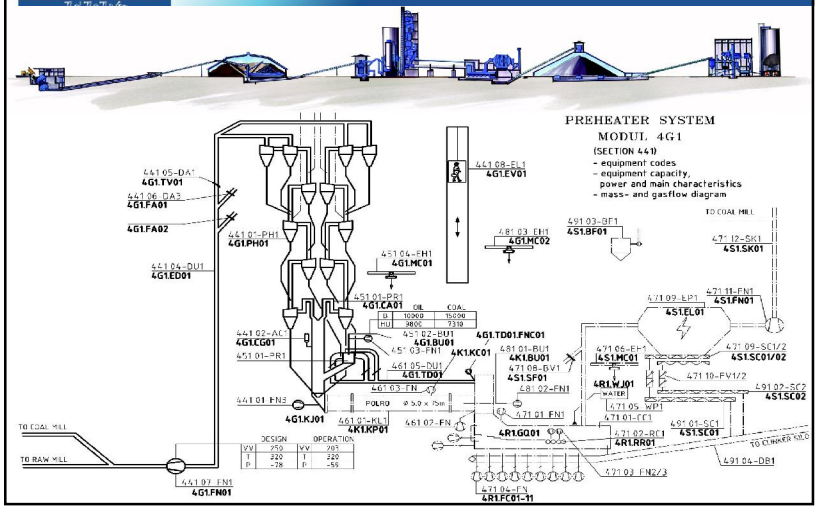
TECHNICAL DATA OF KILN PRODUCTION LINE & THEORETICAL COMBUSTION CALCULATION

The kiln line has capacity of 5,500 clinker tons per day equipped with 2 self-aligning piers, 5 stages/2 strings preheater tower and 1 DOPOL 90 AS-CC calciner. In normal condition, the fuel for clinker production is 100% of anthracite coal.

According to the calculation, the thermal substitution rate for this type of fuel can reach 25-35% of total heat consumption for kiln. Basing on the combustion test, this type of fuel can be burnt completely at the calciner combustion chamber with the maximum feed rate of 14 tons/hour.

7

BINH PHUOC KILN PYRO - PROCESSING



ALTERNATIVE FUEL IN BINH PHUOC CEMENT PLANT

Cashew nut shell contains a relatively higher volatile matter and less ash which is easier for combustion than anthracite coal in the burning system.

The comparison between fine anthracite coal and cashew nut shell is shown in Table 1.

No	Specification	Than antraxit	Vỏ hạt điều
1	Size	Residue on sieve 0,09mm ≤ 3%	≤ 25mm (piece form)
2	Density	0.8-0.85 Ton/m³	0.35 -0.4 Tấn/m³
3	Moisture	≤ 1%	≤ 10%
4	Calorific value	6800 Kcal/kg	4500Kcal/kg
5	Volatile mater	6.5%	80 - 82%
6	Sulphur	≤ 0.9%	0.1-0.2%
7	Ash	16-19%	1.5-2%

9

ALTERNATIVE FUEL IN BINH PHUOC CEMENT PLANT

PRELIMINARY THEORETICAL CALCULATION AND COMMENTS OF COMBUSTION TEST

The fire of cashew nut shell in kiln system needs higher hot gas volume than anthracite coal fire. This matter can be solved by some adjustment of the operational condition of kiln system.

The cashew nut shell can be easy to completely burnt at the calciner chamber because of high volatile content. Air for combustion is oxygen-rich which will improve the combustion efficiency.

With the maximum thermal substitution rate of 35%, some calculation results for the necessary cashew nut shell amount are as follows:

- Heat consumption of the kiln system: 780 kcal/kg of clinker
- Ratio cashew nut shell vs. coal at calciner: 35 / 65
- Kiln throughput: 5,500 tons/day clinker
- Combustion efficiency: 100% (assumed coal combustion efficiency is 100%)
- Necessary cashew nut shell amount: 282 tons/day

10

ALTERNATIVE FUEL COMBUSTION FLOWSHEET

PRICIPLE COMBUSTION SYSTEM

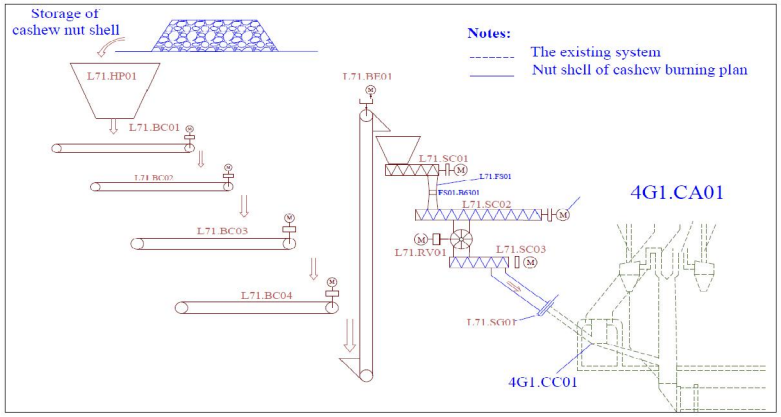
The cashew nut shell after extracting oil with size less than 25 mm is collected and stored in a separate storage equipped with fire prevention system. A wheel loader will load the cashew nut shell into a hopper (L71.HP01) and transported through the belt conveyor system (L71.BC01/04), a bucket elevator (L71.BE01) and continuously fed into the calciner by screw conveyor system (L71.SC01/03).

A flow meter (L71.FS01) measures the amount of alternative fuels is placed after bucket elevator. Cashew nut shell flow is kept stable automatically as set-point in CCR. Operation data can be monitored and controlled from CCR.

The principle of transporting and feeding system is shown in flowsheet below.

11

ALTERNATIVE FUEL COMBUSTION FLOWSHEET



12

ALTERNATIVE FUEL IN BINH PHUOC CEMENT PLANT

The extracted cashew nut shell as received at the cement plant storage

13

ALTERNATIVE FUEL COMBUSTION ARRANGEMENT

All the new transport equipment are arranged at free space which can help to easy maintenance and also ensure the safety.

The figure 1,2,3 f demonstrates the modification and arrangement of transporting system and the feeding point of alternative fuel.

Figure 1. Arrangement of belt conveyor from storage to kiln area

14

ALTERNATIVE FUEL COMBUSTION ARRANGEMENT

Figure 2.
Elevator – Screw conveyor system and Feeding point arrangement

15

ALTERNATIVE FUEL COMBUSTION ARRANGEMENT

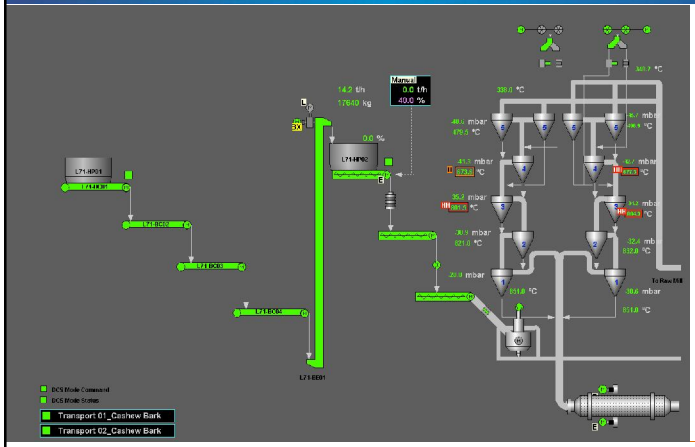


Figure 3. Cashew feeding display monitor

16

ALTERNATIVE FUEL COMBUSTION ARRANGEMENT

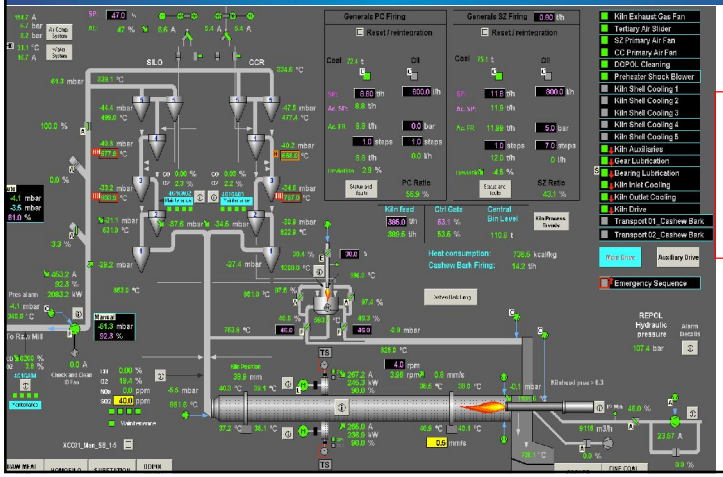


Figure 4. Kiln display monitor with cashew nut shell

ALTERNATIVE FUEL COMBUSTION ANALYSIS RESULTS

Currently, Binh Phuoc cement plant is gradually optimized the system from receiving, transporting and burning for better performance. The exhaust gas emission quality, was taken from the chimney when burning of cashew nut shell with thermal substitution rate of 35%, is shown in table 2.

Table 2. Emission monitoring results when burning cashew nut shell

No	Data	Unit	Test Method	Analysis result
1	Temp.	^{0}C		125,3
2	Volume	m^3/h	TCVN 6192 – 2010	670.000
3	SO_2	mg/Nm^3	TCVN 5975 – 1995	104
4	NO_x	mg/Nm^3	TCVN 5976 – 1995	644
5	CO	mg/Nm^3	TCVN 6501 – 1999	132
6	CO_2	%V		7,3
7	O_2	%V		11,2
8	Emission dust	mg/Nm^3	TCVN 5977 - 2009	44

18

ESTIMATE CO2 REDUCTION

Cashew nut shell replaces a part of anthracite coal (fossil fuel) for producing clinker. As an alternative fuel which collected from agriculture waste (biomass fuel), it can be considered as a zero emission fuel when fired in cement kiln. From this point of view, cement plant can cut down the total CO2 emission for clinker production.

The Table 3 calculates the amount of CO2 emissions in case of maximum usable amount of cashew nut shell replacing 35% of total heat consumption in clinker production.

19

ESTIMATE CO2 REDUCTION

Table 3. Estimation of energy saving and CO2 reduction

No	Data	Unit	Amount	Remarks
A	Maximum amount of cashew nut shell uses at calciner	kg/ton clinker	51.3	
B	**Reduction of direct CO2 emissions**	**Kg CO_2/ton clinker**	**96.78**	**B = B1*B2**
B1	Max amount of coal to be replaced	kg/ton clinker	34.2	B1 = A/1.5
B2	Emission factor CO2 of antharcite coal	kgCO_2/kg coal	2.83	
C	**Reduction of indirect CO2 emmission**	**kgCO_2/ton clinker**	**0.532**	**C = C1 * C2**
C1	Reduction power consumption at coal mill	kWh/ton clinker	0.95	
C2	Emissions factor CO2 of VN national grid	kgCO_2/kWh	0.5603	

20

CONCLUSIONS & COMMENTS

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Preliminary study shows that 1.5 tons of extracted cashew nut shell is equivalent to about 1 ton of anthracite coal. From this result, it can be seen that this type of alternative fuel is a very high value type when compare with the other source of common waste.

By using cashew nut shell as an alternative fuel, Binh Phuoc cement plant can save the energy cost and cut down the total CO2 emission for clinker production. Summary of preliminary results for economic and environmental advantages are described as following:

- Reduce cost of fuels: max. US$1.39/ton clinker
- Reduce electrical energy: max.US$ 13,695.40/month
- Reduce 174,200 tons CO2 per year.

Difficulties:

- The cashew harvest season which starts from April to September annually, so troubled about the cost of storing inventory too high and price increasing in the remaining months of the year.
- Market cannot meet demand in improper cashew season.

21

THANK YOU FOR YOUR PAY ATTENTION!