

# **Research on Energy Savings and Environmental Protection Measures in the Cement Industry in China**

**24<sup>th</sup>.OCT.2008**

**New Energy and Industrial Technology Development  
Organization (NEDO)**

**Contractor: Taiheiyo Engineering**

# Location of the Cement Plant Selected for Site Investigation



# Outline of the Research

## (1) Purpose

- Energy savings and environmental protection measures in the Chinese cement plant shall be studied and proposed.

## (2) Plant Investigated

- A cement plant in Heilongjiang and Shanxi Province

## (3) Survey method

- Preparation and transmittal of the questionnaire prior to the on-site survey and reviewing of pre-existing materials.
- On-site survey (Aug. 20 to 27, 2008) ... Field confirmation of the plant facility and operating conditions.
- Research in Japan ... Compilation and analysis of the survey results, identification of possible measures for energy savings and environmental protection, and estimation of improvement of such measures.

# *Yatai Haerbin Cement*



# Outline of the Surveyed Plant

[Yatai Haerbin Cement](#)

## (1) System of the plant

- No.1 line: NSP Kiln (1070 tons/day)
- No.2 line: NSP kiln (2500 tons/day)

## (2) Production volume (2007)

- Clinker production volume: 1.15 million tons/year
- Cement production volume: 2.2 million tons/year  
(Product types are P.O 42.5)

## (3) Energy consumption

- Heat consumption: 945 kcal/kg – cli (low calorific value basis)
- Electricity consumption : 92 kWh/t - cem

# Major equipment

[\*Yatai Haerbin Cement\*](#)

## Raw Material and Clinker Burning Process

ITEM		DETAILS	
No.1 Line	Raw Mill	Vertical Roller Mill	
	Kiln	NSP Kiln	5-Stage Pre-heater, Single String 3 Channel kiln burner Coventional cooler
	Coal Mill	Vertical Roller Mill	
No.2 Line	Raw Mill	Vertical Roller Mill	
	Kiln	NSP Kiln	5-Stage Pre-heater, Two String 4 Channel kiln burner Air beam cooler
	Coal Mill	Vertical Roller Mill	

## Finishing Process

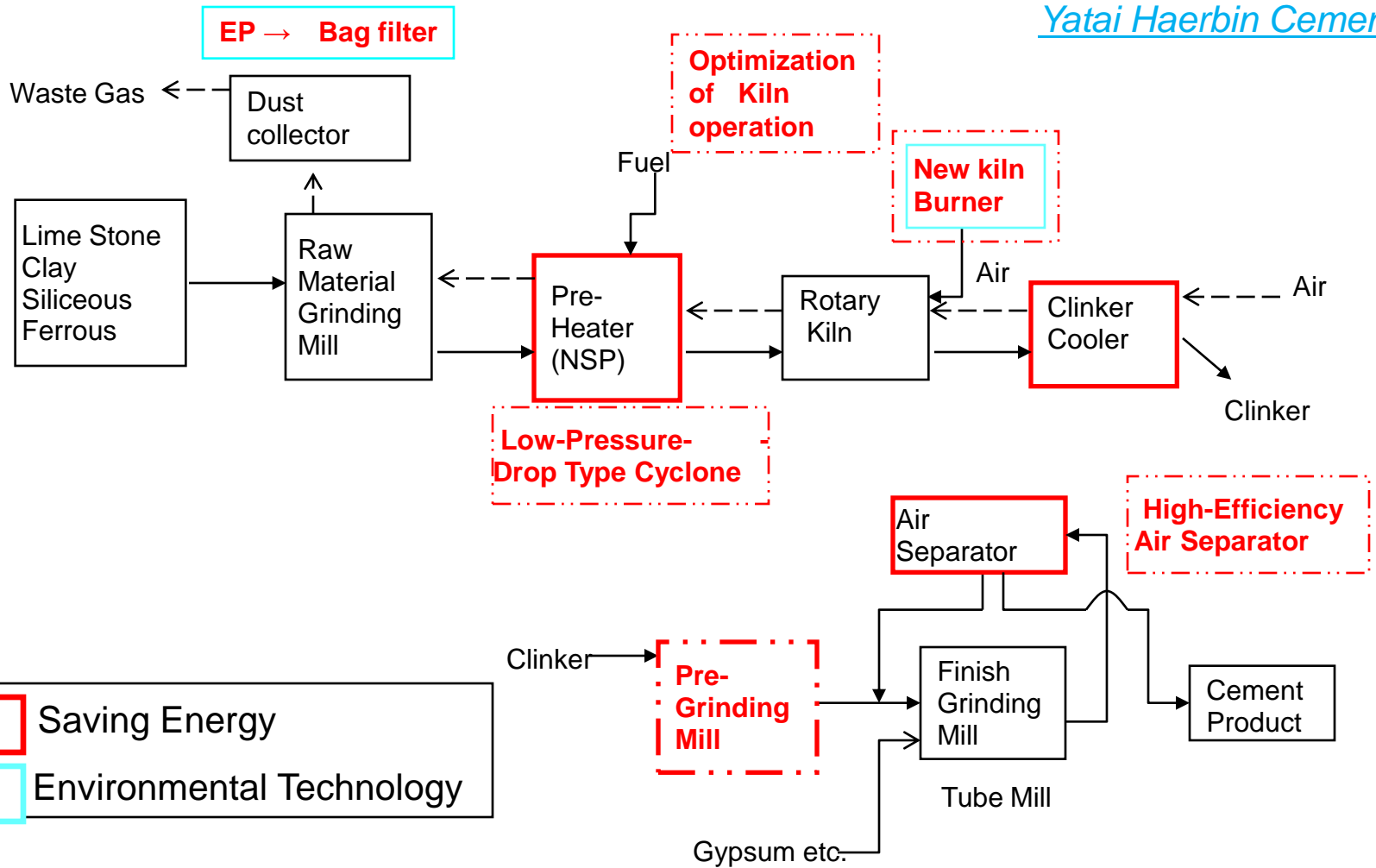
Yatai Haerbin Cement

Line Number	Mill Number	Size	Capacity	Pre-grinder	Separator
No.1 Line	No.3 Cement Mill	2.6m × 13mL 1,250kW	25.5t/h	—	FLS
	No.4 Cement Mill	2.6m × 13mL 1,250kW	25.5t/h	—	FLS
	No.5 Cement Mill	4.2m × 11mL 2,800kW	90t/h	—	O-SEPA
No.2 Line	No.6 Cement Mill	4.2m × 13m L 3,150kW	150t/h	Roller Press	V-SEPA DYNAMIC-SEPA

O-SEPA: made in China

# Areas for Saving Energy and Environmental Protection in a Cement Plant

*Yatai Haerbin Cement*





## Adoption and Effectiveness of Equipment for Saving Energy and Environmental Protection

[Yatai Haerbin Cement](#)

- B e c a u s e of introducing the most up-to-date equipments, the energy efficiency level is high.
- No.2 Line is clean and tidy. It seems to bring saving energy.
- However, further saving energy will be possible by introduction of facilities for higher energy efficiency etc.

# Adoption and Effectiveness of Equipment for Saving Energy and Environmental Protection

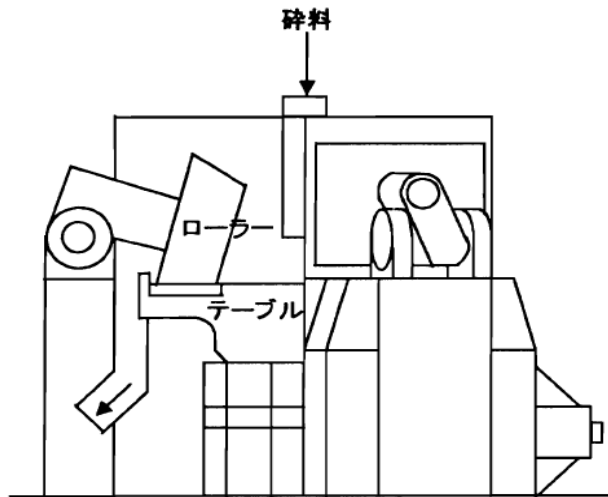
*Yatai Haerbin Cement*

## (1) Use of Pre-grinder and High-Efficiency Separator in Finishing Mill

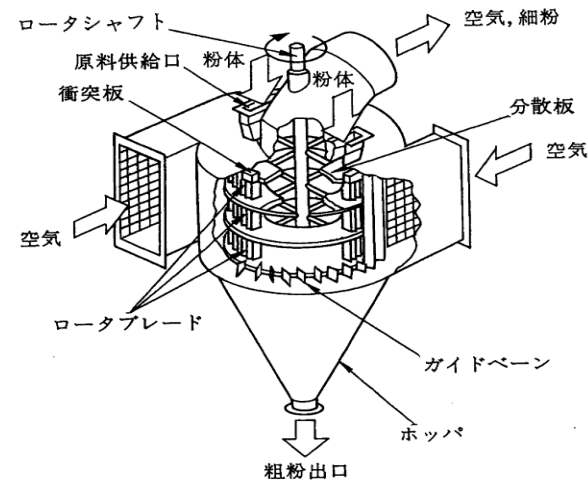
No. 5 mill: Closed-loop ball mill with separator

⇒ Installation of vertical roller mill as pre-grinder and O-SEPA H

**Expected saving energy 4.89 kWh/t-cement**



Schematic structure of  
CKP Vertical Roller Mill



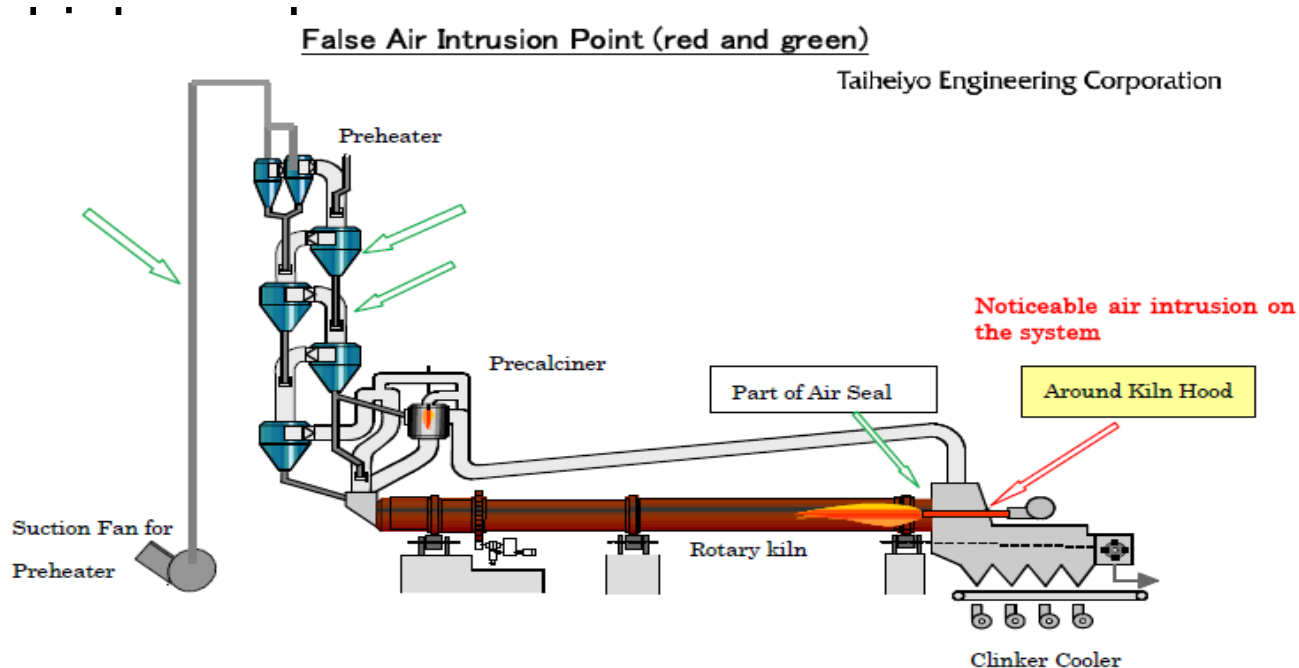
Schematic structure of O-SEPA H

## (2)Improvement of Combustion Operation in a Kiln

Yatai Haerbin Cement

- Although the measurement of temperature, pressure, density of O<sub>2</sub> and CO<sub>2</sub> in the kiln has been carried out, It is needed to do it for appropriate combustion operation more strictly.
- preventing fresh air intruding into the kiln and the pre-heater

through  
keeping  
saving



ity of

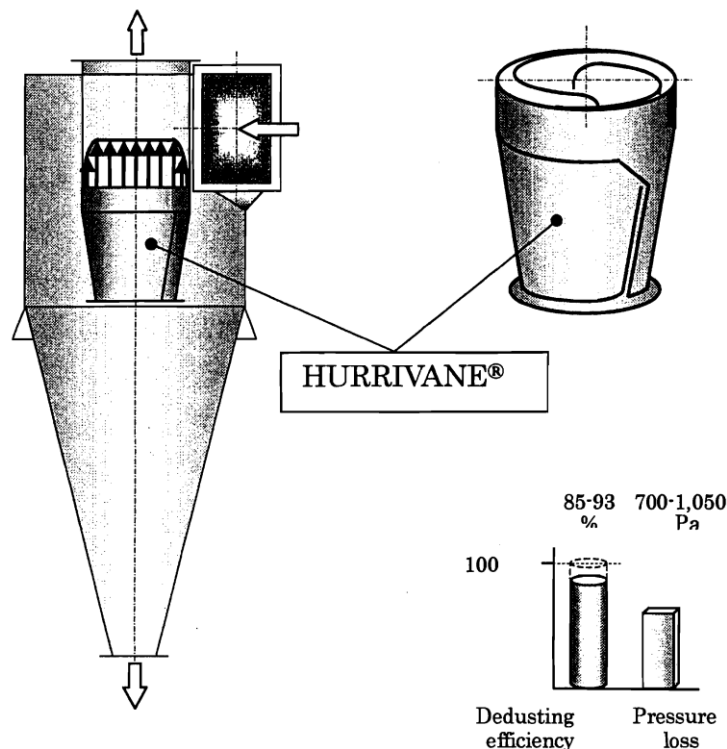
### (3) Use of Low-Pressure-Drop Type Cyclone in the Pre-heater Top Cyclone

*Yatai Haerbin Cement*

- Reduction of power loss by decreasing pressure loss of the pre-heater top cyclone.  
⇒ Installation of the Low-Pressure-Drop Type Cyclone (HURRIVANE®)

Pressure drop 30%

**Expected energy saving 0.47 kWh/t-cement**



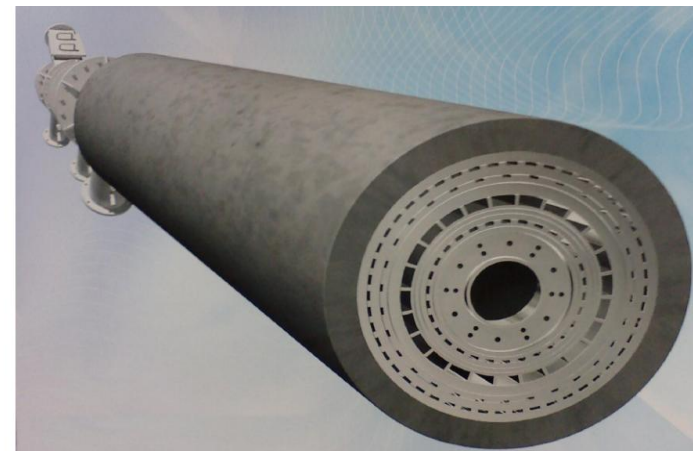
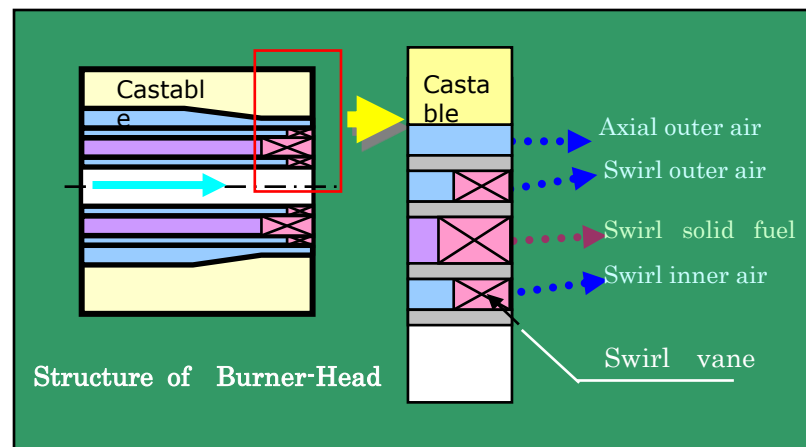
**Structure of Low-Pressure-Drop Type Cyclone (HURRIVANE®)<sup>12</sup>**

## (4)Introduction of New Kiln Burner

[\*Yatai Haerbin Cement\*](#)

3 channel kiln burner has been used in No.1 line. If 4 channel kiln burner with high functionality is introduced in this line, It will produce good result on saving energy, improvement of effect combustibility, reduction of NOx emission, and improvement of clinker's quality.

4 Channel kiln burner

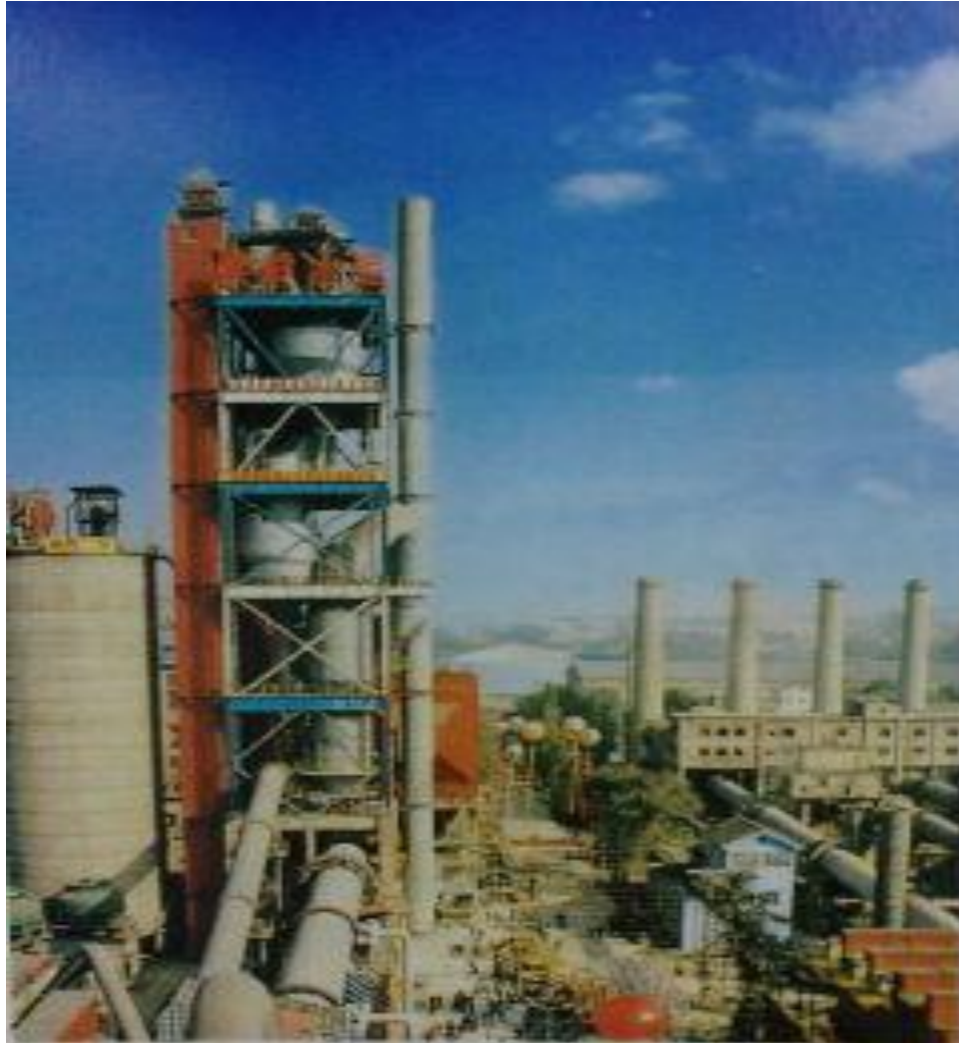


## (5) Summary of Improvement in Saving Energy and Reducing the Environmental Burden

*Yatai Haerbin Cement*

Equipment for Saving Energy and Environmental Protection	Effect on Saving Energy	Effect on Reduction of CO <sub>2</sub> Emissions	Effect on Reduction of Environmental Burden
(1) Use of Pre-grinder and High-Efficiency Separator to Finishing Mill (No.1Line)	4.89kWh/t-cem	4.5 kg-CO <sub>2</sub> /t-cem	—
	3,080 MWh/y	2,862 t-CO <sub>2</sub> /y	
(2)Improvement of Combustion Operation in a kiln (No.1Line and No.2 Line )	38 Kcal/kg-cli	16 kg-CO <sub>2</sub> /t-cli	—
	38,080 Gcal/y	18,409 t-CO <sub>2</sub> /y	
(3) Use of Low-Pressure-Drop Type Cyclone In the Pre-heater Top Cyclone (No.1Line)	0.47 kWh/t-cli	0.4 kg-CO <sub>2</sub> /t-cli	—
	164 MWh/y	153 t-CO <sub>2</sub> /y	
(4) Introduction of new Kiln Burner (No.1Line)	7 Kcal/kg-cli	2.9 kg-CO <sub>2</sub> /t-cem	200ppm NOx.
	2,450 Gcal/y	1,020 t-CO <sub>2</sub> /y	—
Total		<b>22,444 t-CO<sub>2</sub>/y</b>	— 14

# *Shanxi Qinling Cement*



# Outline of the Surveyed Plant

[\*Shanxi Qinling Cement\*](#)

## **(1) System of the plant**

- No.1-No.4 line: wet-process Kiln (700 tons/day X 4)  
\*these lines will be disposed.
- No.5 line: NSP kiln (2000 tons/day)
- No.6 line: NSP kiln (2200 tons/day)  
(No. 7 line: NSP kiln (5000 tons/day))  
\*No.7 line is in a trial run now.

## **(2) Production volume (2007)**

- All Cement production volume: 5 million tons/year  
{ Product types : P.O32.5, P.O42.5, P.C32.5, P.C42.5,  
P.F32.5, P.F42.5, P.F52.5, }

## **(3) Energy consumption**

- Heat consumption: 845 kcal/kg – cli (low calorific value basis)
- Electricity consumption : 127.2 kWh/t - cem



## Major equipment

[Shanxi Qinling Cement](#)

### Raw Material and Clinker Burning Process

ITEM		DETAILS	
<b>No.5 Line</b>	<b>Raw Mill</b>	<b>Double Rotator Mill</b>	
	<b>Kiln</b>	<b>NSP Kiln</b>	<b>5-Stage Pre-heater, Two String 3 Channel kiln burner Air beam cooler</b>
	<b>Coal Mill</b>	<b>Ball Mill</b>	
<b>No.6 Line</b>	<b>Raw Mill</b>	<b>Double Rotator Mill</b>	
	<b>Kiln</b>	<b>NSP Kiln</b>	<b>5-Stage Pre-heater, Single String 3 Channel kiln burner Air beam cooler</b>
	<b>Coal Mill</b>	<b>Ball Mill</b>	

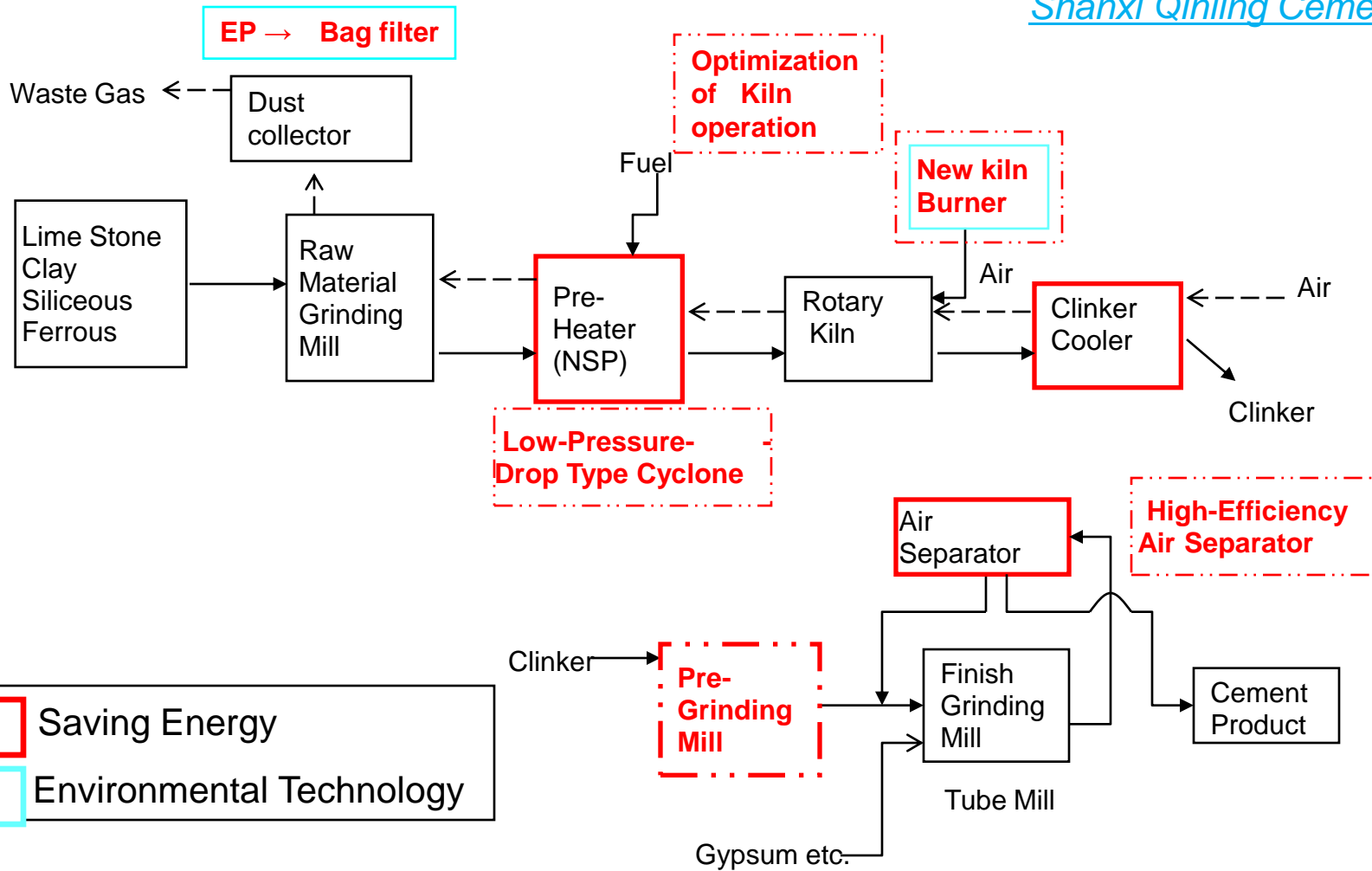
## Finishing Process

*Shanxi Qinling Cement*

Line Number	Mill Number	Size	Capacity	Pre-grinder	Separator
No.5 Line	No.6 Cement Mill	3.8m × 14mL 2,500kW	64t/h	—	O-SEPA
	No.7 Cement Mill	3.8m × 14mL 2,500kW	64t/h	—	O-SEPA
No.6 Line	No.8 Cement Mill	3.8m × 14mL 2,500kW	63t/h	—	O-SEPA
	No.9 Cement Mill	3.8m × 14mL 2,500kW	63t/h	—	O-SEPA
No.7 Line	No.10 Cement Mill	3.8m × 13mL 2,500kW	180t/h	Roller Press	O-SEPA V-SEPA
	No.11 Cement Mill	3.8m × 13mL 2,500kW	180t/h	Roller Press	O-SEPA V-SEPA

# Areas for Saving Energy and Environmental Protection in a Cement Plant

*Shanxi Qinling Cement*



## Adoption and Effectiveness of Equipment for Saving Energy and Environmental Protection

*Shanxi Qinling Cement*

- B e c a u s e of introducing the most up-to-date equipments, the energy efficiency level is high.
- It seems that the top management make an effort to improve employees' cost conscience.
- However, further saving energy will be possible by introduction of facilities for higher energy efficiency etc.

# Adoption and Effectiveness of Equipment for Saving Energy and Environmental Protection

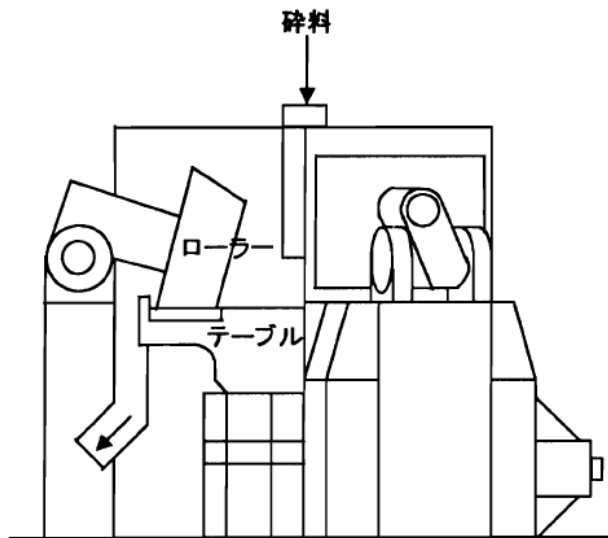
Shanxi Qinling Cement

## (1) Use of Pre-grinder and High-Efficiency Separator in Finishing Mill

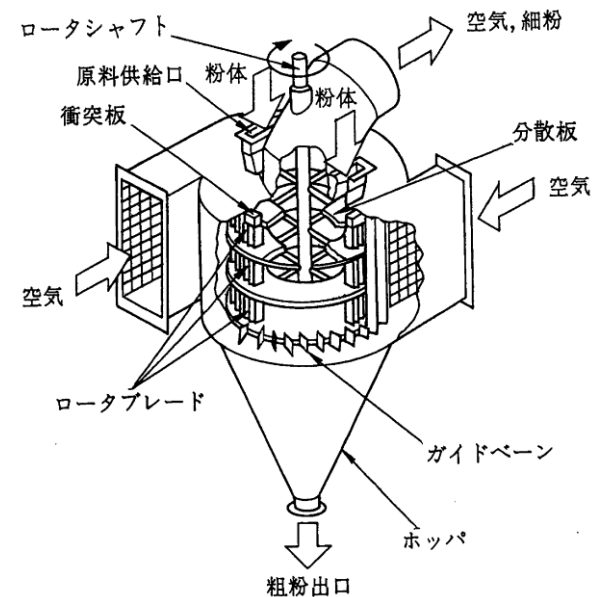
No. 6-9 mills: Closed-loop ball mill with separator

⇒ Installation of vertical roller mill as pre-grinder and O-SEPA H

**Expected saving energy 8.19 kWh/t-cement**



Schematic structure of  
CKP Vertical Roller Mill

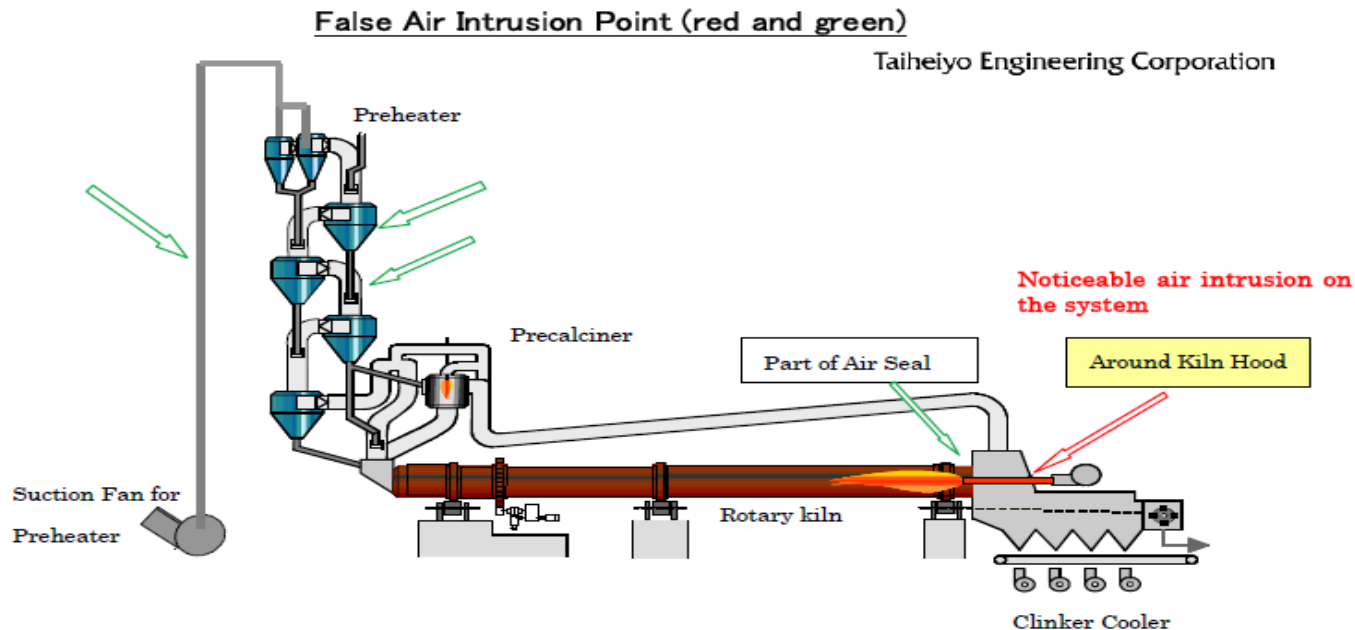


Schematic structure of O-SEPA H

## (2)Improvement of Combustion Operation in a Kiln

[Shanxi Qinling Cement](#)

- Although the measurement of temperature, pressure, density of O<sub>2</sub> and CO<sub>2</sub> in the kiln has been carried out, It is needed to do it for appropriate combustion operation more strictly.
- preventing fresh air intruding into the kiln and the pre-heater through chinks and keeping appropriate density of O<sub>2</sub> and CO<sub>2</sub> are necessity of saving energy and electricity.



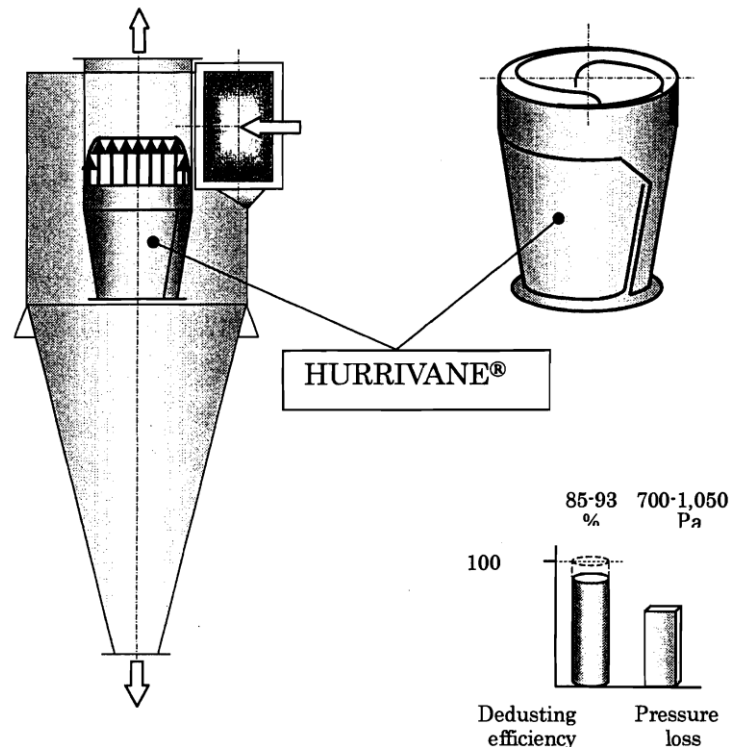
### (3) Use of Low-Pressure-Drop Type Cyclone in the Pre-heater Top Cyclone

Shanxi Qinling Cement

- Reduction of power loss by decreasing pressure loss of the pre-heater top cyclone.  
⇒ Installation of the Low-Pressure-Drop Type Cyclone (HURRIVANE®)

Pressure drop 30%

**Expected saving energy 0.3 kWh/t-cement**



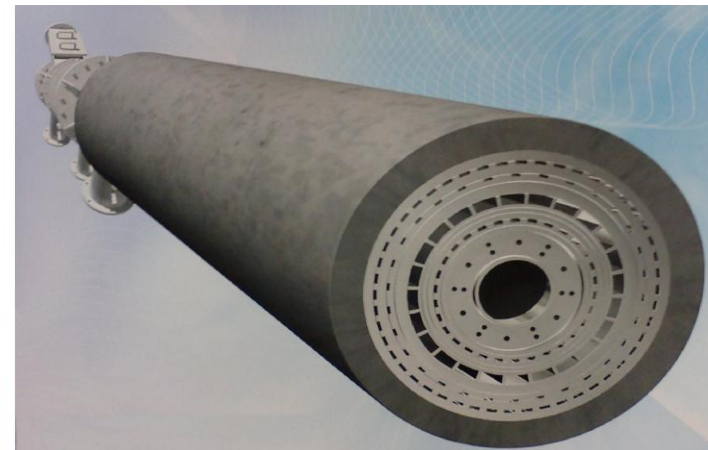
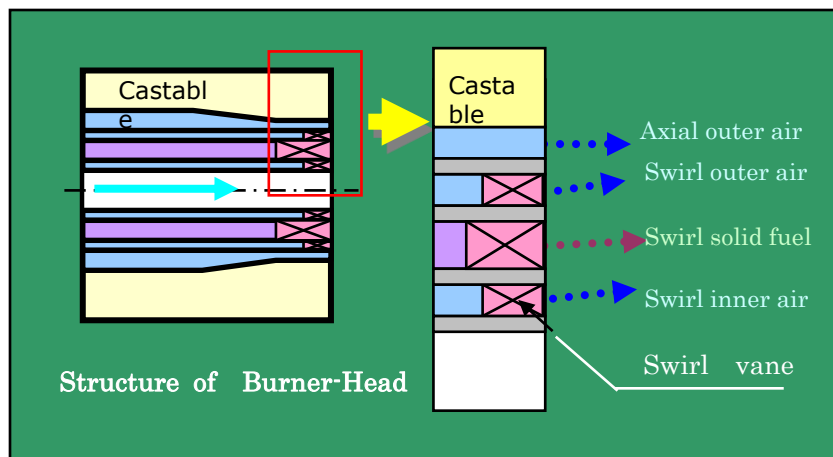
**Structure of Low-Pressure-Drop Type Cyclone (HURRIVANE®)<sup>23</sup>**

## (4) Introduction of New Kiln Burner

[Shanxi Qinling Cement](#)

3 channel kiln burner has been used in No.5 and No.6 line. If 4 channel kiln burner with high functionality is introduced in these lines, It will produce good result on saving energy, improvement of effect combustibility, reduction of NOx emission, and improvement of clinker's quality.

4 Channel kiln burner





# (5) Summary of Improvement in Saving Energy and Reducing the Environmental Burden

*Shanxi Qinling Cement*

Equipment for Saving Energy and Environmental Protection	Effect on Saving Energy	Effect on Reduction of CO <sub>2</sub> Emissions	Effect on Reduction of Environmental Burden
(1) Use of Pre-grinder and High-Efficiency Separator to Finishing Mill (No.5 Line and No.6 Line)	8.19 kWh/t-cem	7.6 kg-CO <sub>2</sub> /t-cem	—
	7,280 MWh/y	6,764 t-CO <sub>2</sub> /y	
(2) Improvement of Combustion Operation in a Kiln (No.5 Line and No.6 Line)	32 kcal/kg-Cli	13.3 kg-CO <sub>2</sub> /t-cli	—
	40,960 Gcal/y	17,060 t-CO <sub>2</sub> /y	
(3) Use of Low-Pressure-Drop Type Cyclone in the Pre-heater Top Cyclone (No.5 Line)	0.32 kWh/t-cli	0.3 kg-CO <sub>2</sub> /t-cli	—
	201MWh/y	187t-CO <sub>2</sub> /y	
(4) Introduction of new kiln Burner (No.5 Line and No.6 Line)	7.5 kcal/kg-Cli	3.1 kg-CO <sub>2</sub> /t-cli	200ppm NOx
	9,590 Gcal/y	3,994 t-CO <sub>2</sub> /y	—
Total		<b>28,005 t-CO<sub>2</sub>/y</b>	—