Results of Energy Audit in Lao Vang Vieng Cement Co.

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The Energy Conservation Center, Japan
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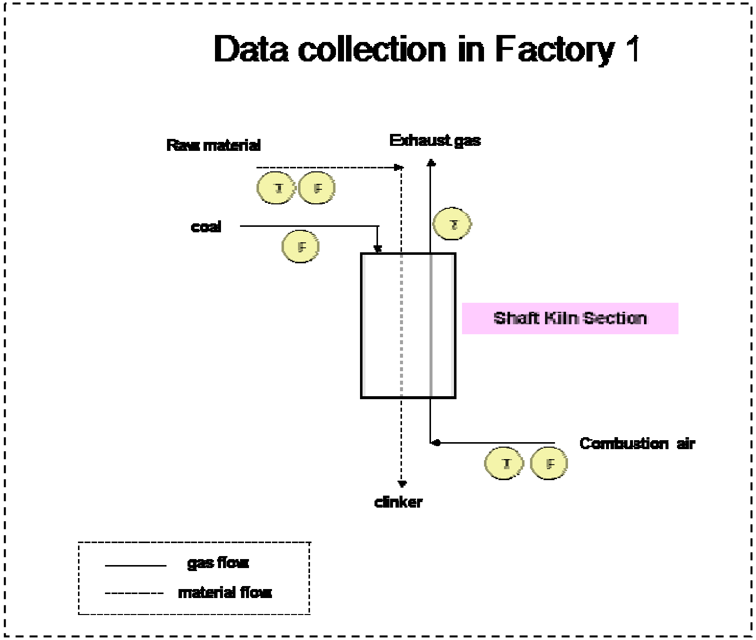
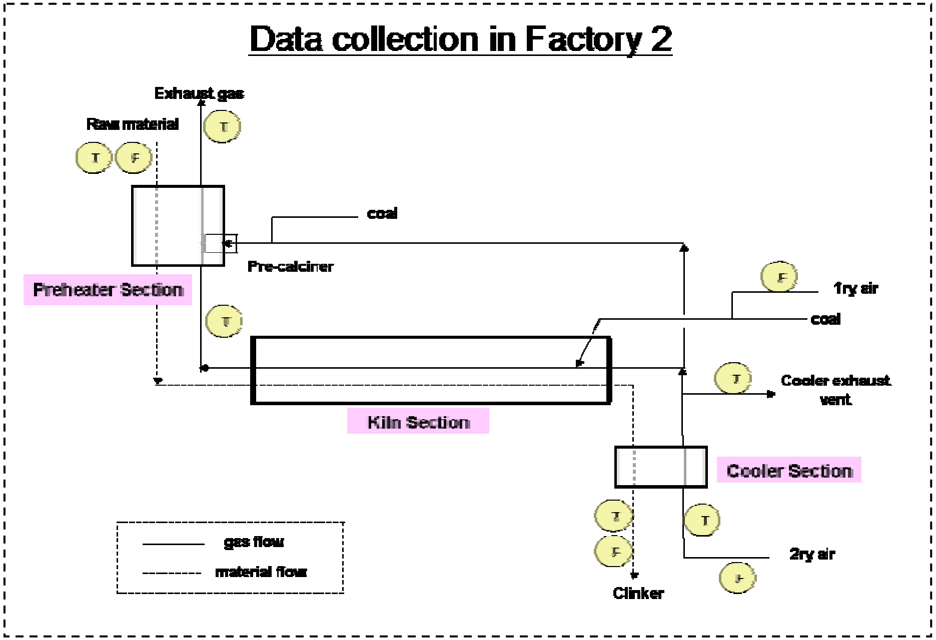
Data collection for Taking a Heat Balance of Cement Kilns





Major Data Collected

Item	unit	Factory 1	Factory 2
Kiln type		shaft	NSP
Dry raw material (dry RM)	t/d	370	1200
Water content in wet raw material	wt% on wet RM	14	0
Clinker	t/d	230	780
Coal rate	t/d	44	122
Low heat value of coal	kcal/kg	5600	5600
Exhaust gas temp at kiln or preheater exit	degC	200	320
Vent gas fraction in cooler	%	-	10
O_2 in exhaust gas	vol%	5	10

Heat Balance Table of Factory 1 (Shaft Kiln)

Heat Input		Heat Output	
Heat of combustion of fuel	1067.5	Heat for clinkering	470.0
Sensible heat of fuel	0	Sensible heat of clinker at cooler exit	16.3
Sensible heat of wet raw material	0	Sensible heat of cooler exhaust vent	0
Sensible heat of combustion air	0	Heat for evaporating water in raw material	141.5
		Sensible heat of kiln or preheater exhaust gas	107.1
		Radiation heat on kiln surface	7.8
		Radiation heat on preheater surface	0
		Radiation heat on cooler surface	0
		Unaccountable heat losses	324.8
Input total	1067.5	Output total	1067.5

Base of temperature : ambient air temperature

Base of heat amount : kcal per kg of clinker (kcal/kg-cl)

Clinker cooler : internal cooler

Heat Balance Table of Factory 2 (NSP Kiln)

Heat Input		Heat Output	
Heat of combustion of fuel	873.8	Heat for clinkering	470.0
Sensible heat of fuel	0	Sensible heat of clinker at cooler exit	19.2
Sensible heat of wet raw material	0	Sensible heat of cooler exhaust vent	0
Sensible heat of combustion air	0	Heat for evaporating water in raw material	0
		Sensible heat of kiln or preheater exhaust gas	179.0
		Sencible heat of cooler vent gas	5.0
		Radiation heat on kiln surface	30.4
		Radiation heat on preheater surface	8.0
		Radiation heat on cooler surface	4.0
		Unaccountable heat losses	158.2
Input total	873.8	Output total	873.8

Base of temperature : ambient air temperature

Base of heat amount : kcal per kg of clinker (kcal/kg-cl)

Clinker cooler : grate cooler

Estimation of Maximum Production Capacity

	Factory 1	Factory 2
Kiln type	Shaft	NSP
Gas rate in Lao ($m^3{}_N$/kg-cl)	1.86	1.74
Design capacity (t-cl/d)	200	700
Actual capacity (t-cl/d) @ 2006.10.3	230	780
Estmated max capacity (t-cl/d)	259	1005
Gas rate in Japan ($m^3{}_N$/kg-cl)	1.65	1.35

Note : This is a trial calculation where many data are assumed. The result should be a reference before a detail study.

Recommendations to Lao Vang Vieng Cement

Energy Management System

Aspect		Major Activity
Organization	Accountability	Employee education (awareness)
	Organization	EE&C promotion committee Appoint an energy manager
Monitoring	Monitoring	Data recording & sharing by all employees
	Targeting	Specific energy consumption (SEC) Key efficiency parameters (O_2%)
Technology		Technical review (energy audit)
Operation & maintenance (O&M)	House keeping	Product yield (avoid off-spec product) Preventive maintenance (avoid unscheduled shutdown)

Monitoring of SEC & Key Variables

Section	Monitored Item	Unit
Raw Mill	SEC = Electric Power / Raw Material Charge	(kWh/kg-raw mat'l)
Clinker Burning	SEC = Fuel / Clinker production O_2% of Kiln Exhaust Gas	(kcal/kg-cl) (%)
Cement Mill	SEC = Electric Power / Cement Production	(kWh/kg-cement)

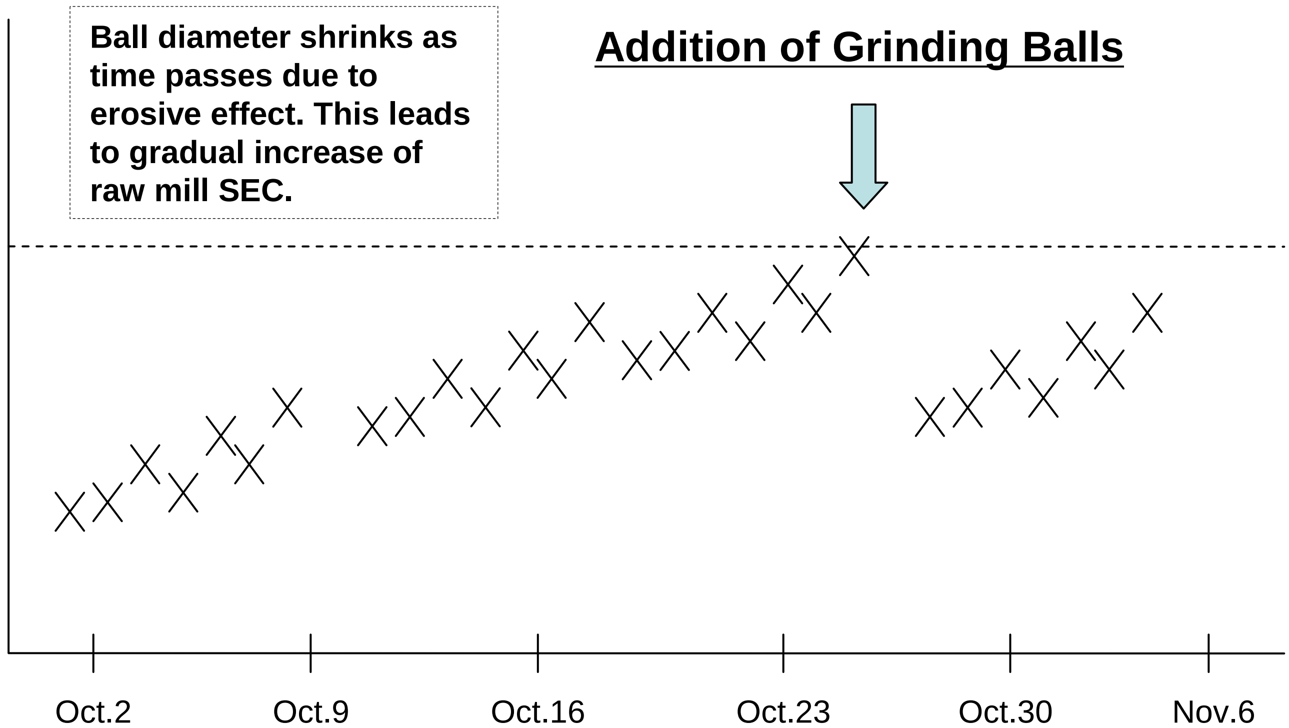
Recording of SEC on a Graph

Grinding Ball Management

SEC should be monitored daily, and when SEC arrives at certain level, grinding balls is compensated.

Raw mill SEC

(kWh/kg-mat'l)

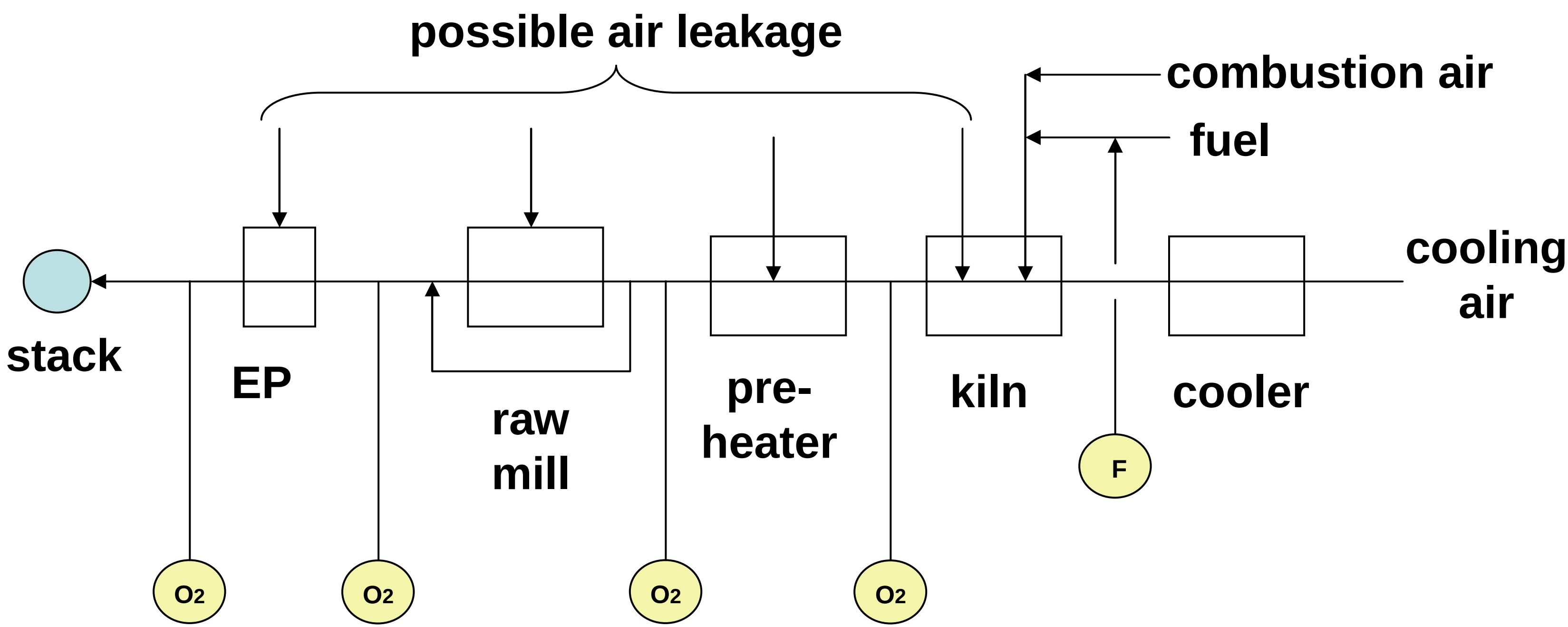


Filling level of grinding balls is also important in grinding efficiency. Optimum level of filling should be maintained.

Monitor raw mill SEC daily and add grinding balls in right timing

→ 10% energy saving expected

Air Leakage Measurement



Air leakage may bring about an increase of both fuel consumption and fan power consumption.

Air leakage occurred in kiln and pre-heater increases fuel consumption in order for heating leaked cold air up to process temperature.

However, air leakage in EP and raw mill does not normally increase fuel consumption, but it increases required power of fan motor.

Energy Saving Measures in Cement Factory

	Raw material section	Clinker burning section	Finishing section
First step	1)Selection of raw materials 2)Management of particle fineness 3)Management of grinding media	1)Prevention of unscheduled shutdown 2)Selection of fuel 3)Prevention of leakage	1) Management of particle fineness 2) Management of grinding media
Second step	1)Replacement of fan rotor 2)Improvement of temperature and pressure control system 3)Improvement of mixing & homogenization system 4)Installation of closed circuit mill (separator)	1)Use of industrial waste (waste tire, etc) 2)Heat recovery of pre-heater exhaust gas and cooler exhaust gas (drying of raw material and generation of electricity) 3)Replacement of cooler dust collection from multiclone to EP	1)Installation of closed circuit mill (separator) 2)Installation of feed control system
Third step	1)Conversion from wet process to dry process 2)Replacement of ball or tube mill by vertical roller mill 3)Pneumatic transfer of raw material to mechanical transfer	1)Conversion of fuel from petroleum to coal 2)Conversion of SP to NSP 3)Conversion of planetary cooler to grate cooler	1)Use of industrial waste (slag, pozzolan)