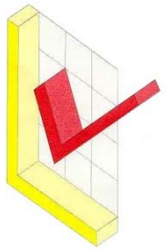
L. V. Technology Public Company Limited



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L. V. Technology Public Company Limited

Part of Your Success

Kiln system upgrades

Preheater *(pressure loss, efficiency)*

Calciner *(fuel burn out, retention time, mixing, NOx)*

Gas transport *(fans, cond. tower, filter)*

Kiln *(speed, volume)*

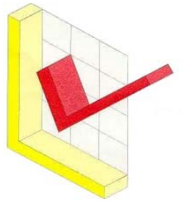
Cooler *(inlet, fan flows, grate plates)*

Fuel system *(capacity)*

LVT procedure for a kiln system upgrade project

- Data collection (exist. equipment), Layout (available space) and Measurements (exist. operation)
- Simulation of existing operation (project basis)
  - Pinpoint of interesting and beneficiary areas to “attack”
- Implementation of necessary modifications (theoretical)
  - Reaching upgrade target
- Tailor made solutions – project by project
  - Short stop time
  - Low investment
- Simulation of the upgraded kiln system (Design basis)

Kiln system upgrade – normal areas for LVT modifications



- New top stage L V Cyclones
  - Tailor made based on simulation result
  - Maintain or improve efficiency, reduced pressure drop
- Other cyclone stages
  - Reduction of pressure drop (increasing inlet areas)
  - Improve efficiency (dip tube, flow controlling cut)
  - Install LV cyclone (or partly)
- Calciner
  - Extension/enlargement (proper retention time)
  - Improve mixing of fuel and comb. Air and hereby the comb. conditions
- Cooler
  - Fixed inlet
  - Additional cooling air fan capacities
- Others
  - Kiln feed system, spreader boxes, DC water injection

Kiln system upgrade – simulation of operation - input

Kiln simulations for SP, ILC, ILC-E and SLC-S kilns.

Plant: Chinfon line 2, exist oper. Date: 09.03.09

Kiln type: ILC

Main input values:	By:	KEJ		Combustible kcal/kg cl.	Pressure mb
Hight above sea level	m	4			
Production	t/day	4300			
No. of cyclone stages	n	5	Cyclone no 1		-51
Ambient temperature	Deg. C	20	Cyclone no 2		-37
Bypass	%	0	Cyclone no 3		-30
Heat to kiln	kcal/kg	310	Cyclone no 4		-22
			Cyclone no 5		-12.5
Excess air in kiln inlet	%	17	Calciner outlet		
Excess air after calciner	%	14		Separation Efficiency	Temp.dif. Gas-Mat.
Primary air to kiln	%	14			
Primary air to calciner	%	4	Cyclone no 1	0.96	5
Temperature of raw feed	Deg. C	70	Cyclone no 2	0.84	5
False air with feed	kg/kg cl.	0.02	Cyclone no 3	0.83	5
Radiation loss from kiln	kcal/kg cl.	34	Cyclone no 4	0.81	5
VDZ-standard cooler loss	kcal/kg cl.	114	Cyclone no 5	0.76	10
Heat of reaction	kcal/kg cl.	415	Cyclone no 6		
Temp. in lower cyclone	Deg. C	851		False Air kg/kg cl.	Radiation kcal/kg cl.
Recarbonation heat	kcal/kg cl.	24			
Raw feed:			Cyclone no 1		6
Free water	%	0.2	Cyclone no 2	0.02	4.2
Combined water	%	0.7	Cyclone no 3	0.02	5.7
Loss on ignition	%	35.5	Cyclone no 4	0.02	5.7
Titration	%	78	Cyclone no 5	0.02	5.7
Varios input values:			Cyclone no 6		
Calcination material to kiln	%	90	In kiln inlet seal	0.03	
Ign. loss in material to kiln	%	5.2	In kiln outlet seal	0.03	
Dust kiln to preheater	%	15	Calcining system	0.01	14
Ign.loss,dust from kiln to preheat.	%	3	**Bypass data:**		
Dust from cooler to calciner	%	5	Dust from bypass	kg/kg cl.	0.003
Moisture in air	kg/kg air	0.0098	L.O.I. in dust	%	2
Water addition to kiln	kg/kg cl.	0	Temp. in riser at bypass	Deg.C	1000
			Heat of formation bp dust	kcal/kg	430

Type of Fuel:		Actual analysis		Standard Analysis		
		No.1	No. 2	Coal	Oil	Gas
Moisture	%	0.70	1.42	2.00		
Ash	%	3.80	12.78	15.00		
C	%	89.20	70.00	68.33	85.20	68.12
H	%	3.04	4.23	4.36	11.60	21.03
S	%	0.48	0.99	1.03	2.09	
N	%	1.05	0.76	1.50	0.88	5.86
O	%	1.73	9.82	7.78	0.23	4.99
Gross heat value	kcal/kg fuel	8176	6845	6663	10366	
Net heat value	kcal/kg fuel	8018	6664	6429	9778	10311
Type of fuel to kiln						
Type of fuel to calciner						
					Kiln	Calciner

Kiln system upgrade – simulation of operation – output A

Kiln simulations for SP, ILC, ILC-E and SLC-S kilns.

Plant: Chinfon line 2, exist oper. **Date:** 09.03.09
Kiln type: ILC **By:** KEJ

Heat balance: Ref. 0 Deg C.		kcal/kg cl.	Cyclone temperatures:	Gas	Material
Heat in exit gas		157.5	Feed		70
Evap. of free water in feed		1.6	Cyclone no. 1	310	305
Radiation from preheater		41.3	Cyclone no. 2	479	474
Radiation from kiln		34.0	Cyclone no. 3	627	622
Cooler loss		127.1	Cyclone no. 4	759	754
Heat loss with bypass		0.0	Cyclone no. 5	851	841
Heat of reaction		415.0	Cyclone no. 6		
Combustible in raw feed		0.0	Fuel type to kiln:	Standard Oil	
Free heat input		-29.4	Fuel type to calciner:	Standard Oil	
Heat consumption		747	Air cooler to kiln	0.424	kg/kg cl.
Heat to kiln		310	Air cooler to calciner	0.630	kg/kg cl
Heat to calciner		437	Total air from cooler	1.053	kg/kg cl.
Cooler data:			Remarks:		
Total cooler loss	kcal/kg cl.	130.8			
Standard cooler loss	kcal/kg cl.	114.0			
Combustion air from cooler	kg air/kg cl.	1.053			

	Preheater data (wet basis):				(Dry,vol basis)	
Gas:	Nm3/kg cl.	kg/kg cl.	m3/sec.	kg/m3	%CO2	%O2
Cyclone no. 1	1.372	1.948	153.5	0.632	32.03	3.25
Cyclone no. 2	1.342	1.914	191.1	0.498	32.28	3.03
Cyclone no. 3	1.317	1.883	222.9	0.420	32.54	2.81
Cyclone no. 4	1.301	1.863	250.5	0.370	32.96	2.57
Cyclone no. 5	1.298	1.868	269.5	0.345	34.10	2.31
Cyclone no. 6						
Kiln inlet	0.452	0.602	117.5	0.255	19.09	2.99
In calciner	1.270	1.823	261.7	0.347	33.84	2.08

Material:	kg/kg cl.	kg/kg cl.	LOI	
Rawmaterial/Clinker:	1.550	Dust	35.50	
Feed	1.630		35.48	
Cyclone no.1	1.916	0.080	35.18	
Cyclone no.2	1.949	0.371	34.79	
Cyclone no.3	2.000	0.410	33.84	
Cyclone no.4	1.962	0.460	29.81	
Cyclone no.5	1.261	0.398	5.20	
Cyclone no.6				

For flow calculation the temperature in the kiln inlet = 1150 oC.

Kiln system upgrade – simulation of operation – output B

ADDITIONAL GAS AND FAN DATA

Plant: Chinfon line 2, exist ope
Date: 09.03.09
By: KEJ

Gas Data (wet basis)

Gas:	H2O kg/kg cl	H2O wgt %	N2 kg/kg cl	N2 wgt %	CO2 kg/kg cl	CO2 wgt %	O2 kg/kg cl	O2 wgt %	kg/Nm3
Cyclone no. 1	0.104	5.33	1.005	51.59	0.781	40.11	0.058	2.96	1.420
Cyclone no. 2	0.095	4.97	0.990	51.71	0.776	40.54	0.053	2.77	1.428
Cyclone no. 3	0.090	4.76	0.974	51.75	0.771	40.92	0.048	2.57	1.430
Cyclone no. 4	0.089	4.80	0.959	51.49	0.771	41.37	0.044	2.35	1.431
Cyclone no. 5	0.089	4.78	0.944	50.54	0.795	42.59	0.039	2.09	1.438
Cyclone no. 6		–		–		–		–	--
Kiln inlet	0.037	8.15	0.395	85.83	0.152	25.29	0.017	2.89	1.332
In calciner	0.089	4.88	0.929	50.95	0.771	42.28	0.034	1.89	1.435
Ambient air	–	0.98	–	76.06	–	0	–	22.96	1.281
Inlet, ID-fan	0.104	5.29	1.000	51.83	0.781	39.72	0.062	3.16	1.422
Outlet ID-fan	0.104	5.14	1.065	52.54	0.781	38.58	0.076	3.74	1.418

	mbar	kg/m3	m3/s
Inlet, ID-fan	-55	0.635	154.19
Outlet ID-fan	-9.5	0.664	151.913

DOWNCOMER WATER SPRAY

Downcomer loss (mbar)	4		
ID-fan in/out temp(oC)	305	305	Water Amount
Water Temp. (oC)	22		0.00 m3/h
False air DC/CT (%)	1		
Temp. loss radiation (oC)	2		
False air, ID-fan (%)	3		

ID-fan operation

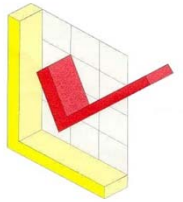
Efficiency	80	%
Dp, fan	4550	Pa
Est. power	913	kW(nt)
Temp incr.	0	oC
Dew Point	44.7	oC

ID-fan design

Flow safety	1	Flow	154.19	m3/s
Press. safety	1.00	Static Dp	4550	Pa
Motor safety	1.1	Motor	1004	kW
#VALUE!		Dust load	28	g/m3
		Norm. flow	68.86	Nm3/s

Notes: The "Outlet, ID fan" (yellow) can be be used in raw mill heat balance program. The motor size under "ID-fan design" is included dust and direct drive (no gear box) is considered.

Kiln system upgrade – selection of new LVT std. cyclones



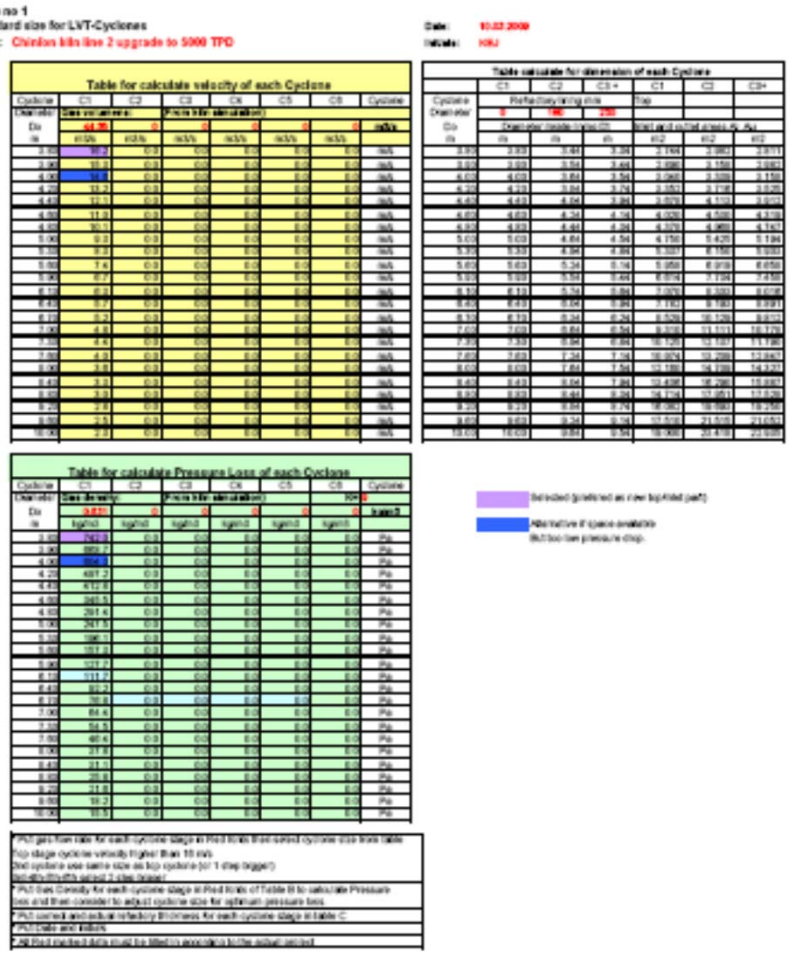


Table no 1
Standard size for LVT-Cyclones
Plant: Chinilon kiln line 2 upgrade to 5000 TPD

Table for calculate velocity of each Cyclone

Table for calculate Pressure Loss of each Cyclone

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L. V. Technology PCL, Order reference list – all jobs

REFERENCES OF L.V. TECHNOLOGY PUBLIC COMPANY LIMITED.

Sr. No.	Year Sales	Client	Country	Type of Mill	Original Classifier	Product
714	2009	Chinfon	Vietnam			Preheater
713	2009	Chinfon	Vietnam			Raw, Coal, Cement
712	2009	TPI Polene	Thailand			Coal
711	2009	ShanShui Yishui Cement	China	MLS4531A	Chinese	Raw
710	2009	ShanDong Anqiu ShanShui Cement	China	MLS4531A	Chinese	Raw
709	2009	ShanShui Liao Yang Qianshan (Xiao Tun)	China	MLS4531A	Chinese	Raw
708	2009	APODI	Brazil		New Plant	Cement
707	2008	Lafarge Cantagalo	Brazil	Kiln 1		Engineering
706	2008	Usiminas	Brazil	Coal Mill		Engineering
705	2008	Usiminas	Brazil	Cyclone		Engineering
704	2008	Shanxi Yaobai Cement	China			Engineering
703	2008	Pascamayo	Brazil	Raw Mill 2		Engineering
702	2008	Pacasmayo	Brazil	Kiln 3 Upgrade		Engineering
701	2008	Cimpor Formoso	Brazil	Kiln 2 Upgrade		Engineering
700	2008	Cimpor Formoso	Brazil	Atox Mill		Engineering
699	2008	Cimpor Formoso	Brazil	Kiln 1 Upgrade		Engineering
698	2008	Cimpor Candiota	Brazil	Kiln Upgrade		Engineering
697	2008	Cimpor Candiota	Brazil	Raw Mill		Engineering
696	2008	Liyang Tianshan Cement	China	Coal Mill		Engineering
695	2008	Yura Cement	Peru			Engineering
694	2008	Manigarh Cement	India			Conducting Efficiency Test
693	2008	SGMK Uchaleniky*	Russia	Atox 37.5	RAR-LVT	Raw
692	2008	Xi'an Chenghe Shifeng*	China	Atox 50	RAR-LVT	Raw
691	2008	Tianrui Cement, 9*	China	Atox 50	RAR-LVT	Raw
690	2008	Tianrui Cement, 8*	China	Atox 50	RAR-LVT	Raw
689	2008	Tianrui Cement, 7*	China	Atox 50	RAR-LVT	Raw
688	2008	Tianrui Cement, 6*	China	Atox 50	RAR-LVT	Raw
687	2008	Tianrui Cement, 5*	China	Atox 50	RAR-LVT	Raw
686	2008	Red Lion Cement*	China	Atox 50	RAR-LVT	Raw
685	2008	Red Lion Cement*	China	Atox 50	RAR-LVT	Raw

L. V. Technology PCL, Order reference list – PYRO jobs

REFERENCES OF L.V. TECHNOLOGY PUBLIC COMPANY LIMITED

For Kiln Upgrade Projects

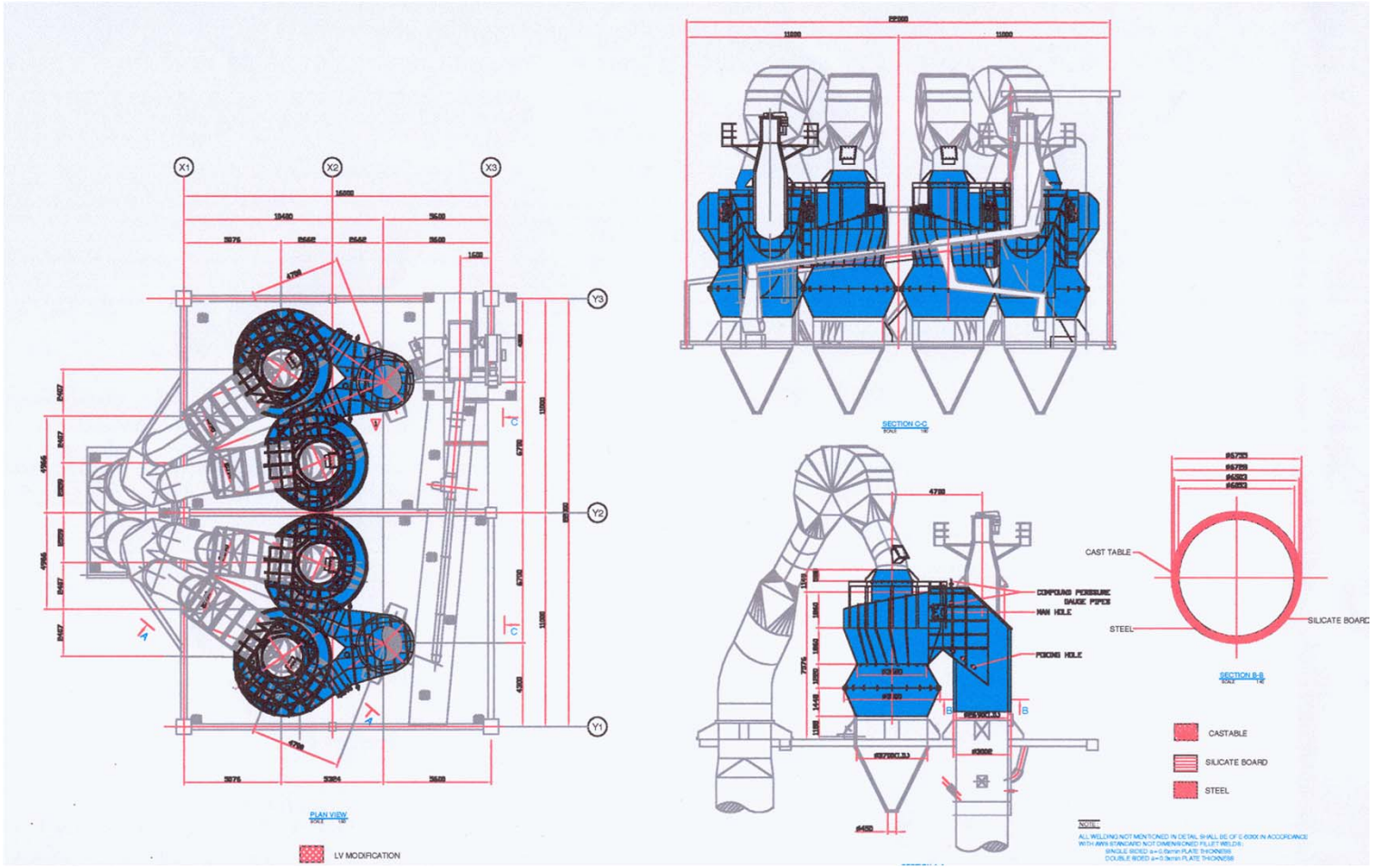
Sr. No.	Year Sales	Client	Country	Number of LVT Top Stage Cyclones	From (TPD)	To (TPD)
678	2008	Hanil Cement Kiln #5	Koren	4	4400	4800
677	2008	NSCI - Perlis	Malaysia	2	2125	2750
656	2008	Bodoquena	Brazil	5	1620	1900
626	2008	APIAI	Brazil	2	2200	3000
578	2007	Khamseh Cement	Iran	New Line (1)	0	3500
577	2007	Mondedashti Cement	Iran	New Line (1)	0	3500
574	2007	Yura Cement Phase II	Peru	New SCL String	1400	3300
549	2007	Bojnourd Cement	Iran	2	2150	2850
523	2007	Yura Cement Phase I	Peru	2	1150	1400
516	2007	Negeri Sembulan	Malaysia	4	3600	4000
427	2005	Hoang Mai Cement	Vietnam	4	4150	4500
399	2005	Cosmos Niebla	Spain		950	1010
391	2005	Fecto Cement	Pakistan	4	2000	2600
390	2005	Al Abbas Kiln #1	Pakistan	2	500	1300
		Al Abbas Kiln #2	Pakistan	2	1000	1950
372	2005	Hanil Cement Kiln #6	Koren	4	4400	4800(5000)
367	2004	Khash Cement	Iran	2	2000	2800
332	2004	Thatta Cement	Pakistan	2	1000	1550
329	2004	Bestway Cement	Pakistan	2	3800	4200
319	2004	Kordestan Cement	Iran	2	2300	3200
331	2004	Chinfon Haiphong	Vietnam	4	4500	4800
271	2003					
302	2004	Cemex Saraburi Kiln #1	Thailand	2	900	1200
210	2003	Qayen Cement	Iran	0	2350	2650
208	2003	Shahroud Cement	Iran	0	2350	2800
118	2002	Chinfon Haiphong	Vietnam	4	4200	4500

Via LNV India

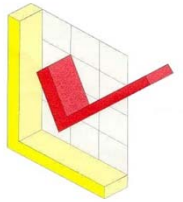
396	2005	Manikgarh Cement	India			Upgrade
395	2005	Century Cement	India			Upgrade
394	2005	Century Cement	India			Upgrade
393	2005	Malhar Cement	India		1100	1250
351	2004	Holcim Lanka	Sri Lanka	Chloride bypass	1000	1000
341	2004	Holcim Lanka	Sri Lanka	2	880	1000
308	2004	Laksmhi Cement	India		1600	1800
307	2004	Malhar Cement	India		1100	1250
		NCL	India		1500	New Kiln line
		NCL	India		3000	New Kiln line
		Shree Jayajhoddi	India		5000	New Kiln line

Updated : 12 May 2009

Change of Top Cyclones At Chinfon Cement - line 1



Result from Kiln Upgrade, Chinfon Cement – line 1

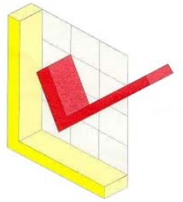


THE MODIFICATIONS:

- Additional EP filter fan (in parallel to existing) + PIACS in ESP
- Fixed cooler inlet
- *New classifier for Raw mill (production up 17 %)*
- *New classifier for Coal mill (production + reduced fineness)*
- 4 new LVT top stage cyclones - decrease top stage pressure loss from 19.5 mbar to 8 mbar

	Before	After (today)
Production (tpd)	4300	4800 (4900)
Heat cons. (kcal/kg)	815	800 (~780)
Pres. Preheater out (mbar)	68	59 (~59)

Kiln Upgrade, Chinfon Cement – line 2

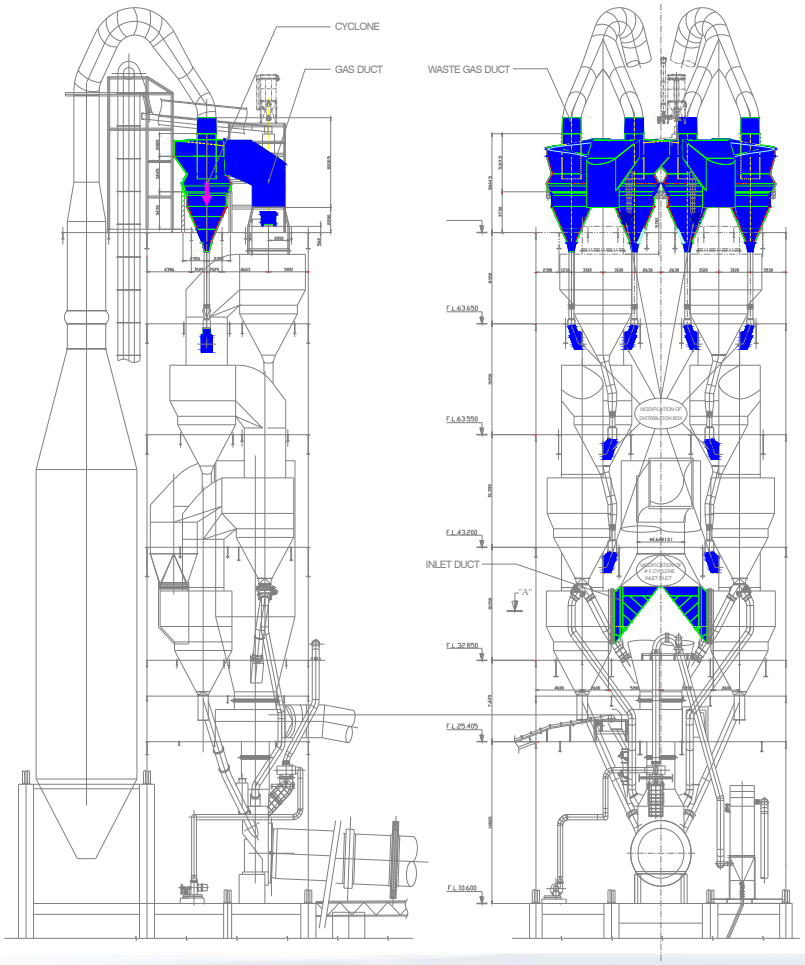


THE MODIFICATIONS:

- Additional EP filter fan (in parallel to existing)
- Speed up most of the cooler fans
- Upgrade (speed up) Kiln feed system and clinker transport
- New main burner
- 4 new LVT top stage cyclones - decrease top stage pressure loss from 13 mbar (today at 4300 TPD) to 9 mbar (at 5000 TPD) for cyclone alone

	Before	After (expect)
Production (tpd)	4300/4376	5000 (5200)
Heat cons. (kcal/kg)	~ 750	A bit less
Pres. Preheater out (mbar)	51/53	61 (65)

Preheater Modifications at Hanil Cement – kiln 6



Result from Kiln Upgrade, Hanil – kiln 6

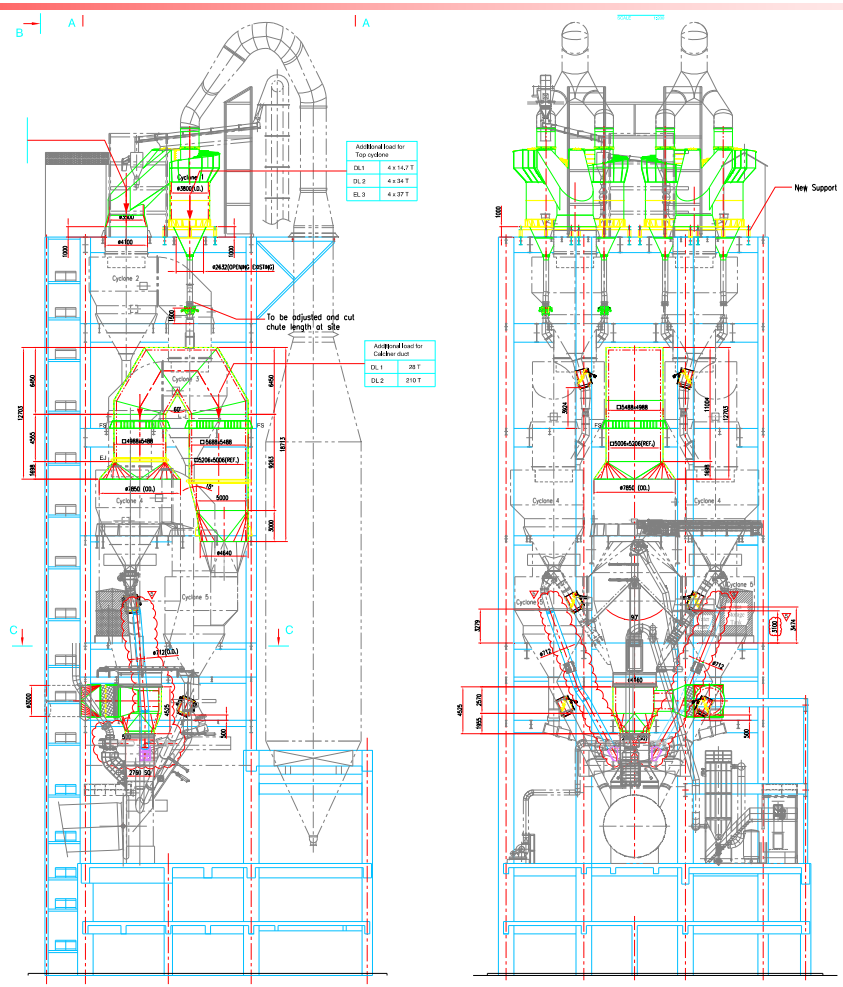
THE MODIFICATIONS:

- 4 new LVT top stage cyclones
- Modification to bottom stage cyclone inlets
- New LVT spreader boxes throughout the preheater

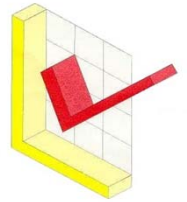
	Before	After
Production (tpd)	4425	5000
Heat cons. (kcal/kg) (*)	697	647
Pres. Preheater out (mbar)	50	55
ID fan power cons. (kWh/t)	5.9	6.6

(*) not including the (not constant) amount of combustibles added to the raw meal

Preheater Modifications at Hanil Cement – kiln 5



Result from Kiln Upgrade, Hanil – kiln 5



THE MODIFICATIONS:

- 4 new LVT top stage cyclones
- Large calciner extension
- Modification of TAD inlet to calciner and installation of LVT mixing chamber
- Lovering of the coal firing in the calciner

	Before	After
Production (tpd)	4461	4800
Heat cons. (kcal/kg) (*)	657	A bit less
% firing of waste (of total)	20	20
Pres. Preheater out (mbar)	51	54
ID fan power cons. (kWh/t)	NA	NA

(*) not including the (not constant) amount of combustibles added to the raw meal

L. V. Technology Product Summary

- **Modification of Vertical Roller mills**
  - LV Classifier
- **Modification of Ball Mills**
  - LV Classifier + Fluidized Bed
- **Modification of cyclones**
  - LV Cyclone
  - Increase of inlet area
- **Total kiln line upgrades**
  - Calciner modifications
  - Cooler improvements
  - By pass installations
  - NOx reduction technology
- **Vertical Mill Installations**
  - Mitsubishi VRM with LV Classifier
- **Plant evaluations and consultancy**

- Thinking of untraditional solutions?
- Thinking of saving equipment cost, operation cost and/or installation time ?

- Think: L. V. Technology PCL.
  – we find a solution to your new project.

- Thank you for listening.