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2015
90 YEARS

1-day Technical Seminar

November 9th, 2015

Evaluating the TCO of 3 different grinding solutions

presented by Dipl. Ing. Tim Nowack

- TCO basics
- Evaluated grinding systems
  - Ball mill in closed circuit
  - Ball mill & rollerpress with DSS separator
  - Vertical roller mill
- Comparison
- Conclusion

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TCO Basis

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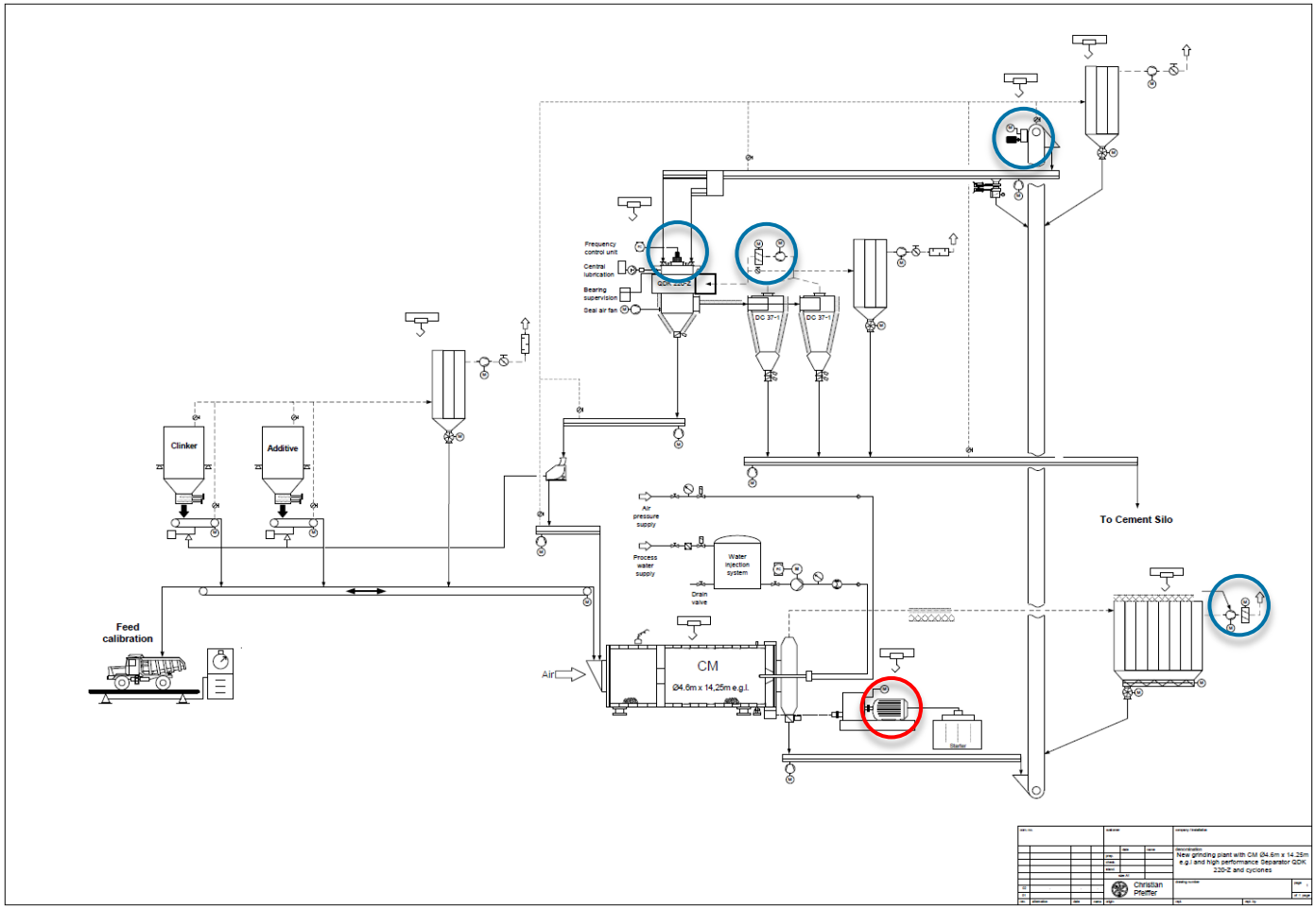

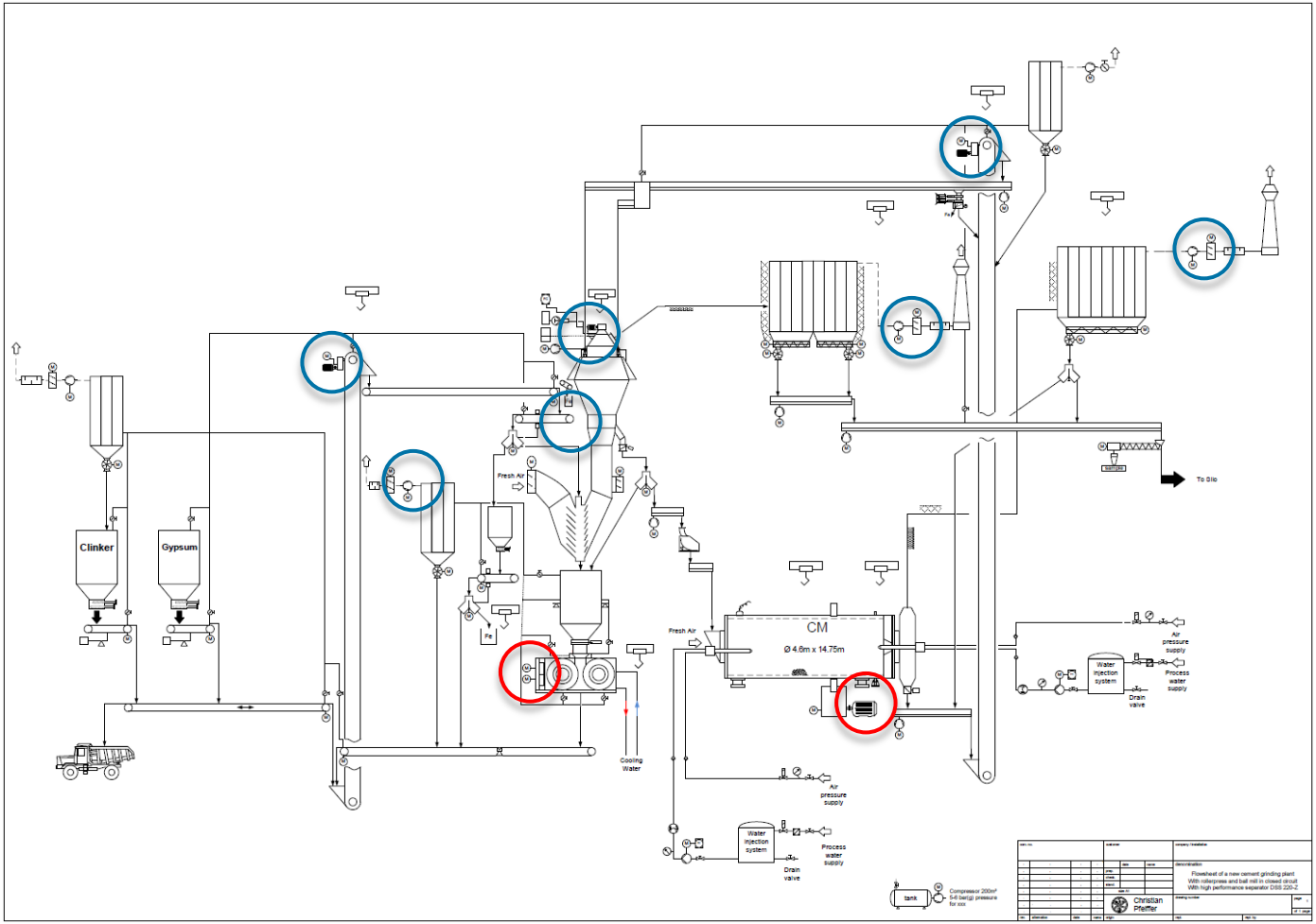

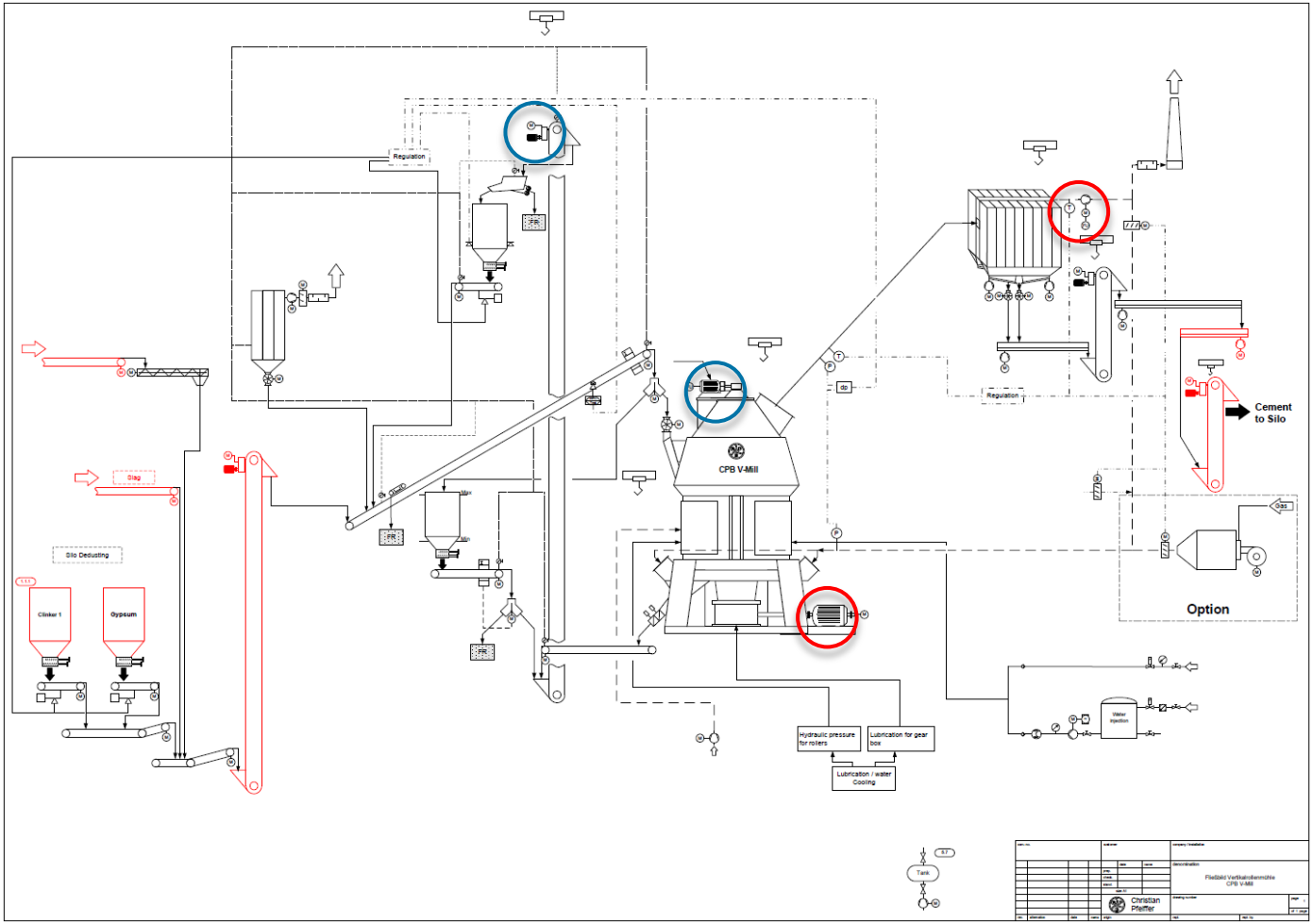

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System:	Ball Mill (closed circuit)				Rollerpress with Ball Mill				Vertical Mill	
Circuit description	2x Grinding unit consisting of ball mill Ø4.6m x 14.25m with QDK220-Z separator and cyclone discharge				1x Grinding unit consisting of rollerpress HPGRS 850/17-1500 in closed circuit with DSS 370-Z with filter discharge and ball mill Ø4.6m x 14.75m for finish grinding				1x Grinding unit consisting of a vertical mill V-MILL 63/4 with DSM 800-Z separator and filter discharge	
Project number	CASE A				CASE B				CASE C	
	Installed power		Absorbed power		Installed power		Absorbed power		Installed power	Absorbed power
	kW		kW		kW		kW		kW	kW
Aggregates:										
RP-Drive					2400	(2x1200)	2090	(2x1045)		
BM-Drive	10400	(2x5200)	9100	(2x4550)	5200		4840			
VRM-Drive									6600	5500
Mill-Fan	264	(2x132)	200	(2x100)	172	(132+45)	130	(100+30)	(sep. fan)	(sep. fan)
Separator	710	(2x355)	220	(2x110)	400		260		850	500
Separator-Fan	900	(2x450)	660	(2x330)	900		750		2800	2370
BM-Bucket elevator	180	(2x90)	120	(2x60)	132		90			
RP-Bucket elevator					372	(2x186)	250	(2x125)		
RP-Transport aux.					78,5	(30+30+18,5)	55			
VRM-Transport aux.									100	80
Total	**12454**		**10300**		**9654,5**		**8465**		**10250**	**8370**
			t/h				t/h			t/h
Production rate			**270**	**(2x135)**			**270**			**270**
Specific power consumption:			kWh/t				kWh/t			kWh/t
Milling only			**33,7**				**25,7**			**20,4**
All main consumers			**38,1**				**31,4**			**31,0**

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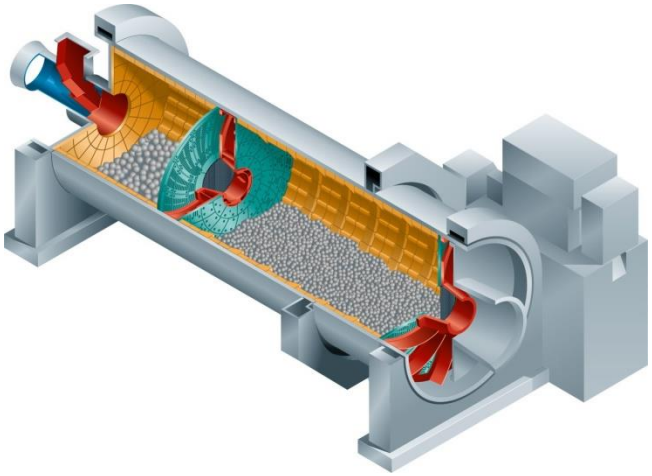
Project number	CASE A	CASE B	CASE C
Power cost:			
Production (6400h/a)	1728000	1728000	1728000
Cost per kWh	0,05 €	0,05 €	0,05 €
Power cost €/a	3.296.000 €	2.708.800 €	2.678.400 €
Power savings €/a	- €	- 587.200 €	- 617.600 €
Maintenance cost:			
Production (6400h/a)	1728000	1728000	1728000
Material specific value €/t	0,20 €	0,50 €	0,70 €
Personal specific value €/t	0,40 €	0,60 €	0,55 €
Maintenance cost €/a	1.036.800 €	1.900.800 €	2.160.000 €
Savings €/a	- 1.123.200 €	- 259.200 €	- €
Annual Operational cost	4.332.800 €	4.609.600 €	4.838.400 €
Savings €/a	- 505.600 €	- 228.800 €	- €
Total circuit investment (assumed)	14.000.000 €	16.000.000 €	18.000.000 €
Evaluation:			
Years required for starting of economical effect (considering electrical power cost of 5ct/kW)	From the 1st day	NEVER	NEVER
Required power cost for economical effect within 5 years	-	11 ct/kWh	16 ct/kWh
Plant availability based on long term experience	> 95%	85%	75%

Project	CASE A	
Project No.	xxx	
Ball mill name CM8	CM8	
Ball mill diameter	4,6	m
Length 1st comp.	4,75	m
Length 2nd comp.	9,50	m
Power absorbed	4550	kW/h
Operating hours per year	6400	h
Throughput per hour	135	t/h
Throughput per year	864000	t/a
Energy cost	5	ct/kWh
Energy cost per year	1456000	€/a
Scrap metal price	80	€/t

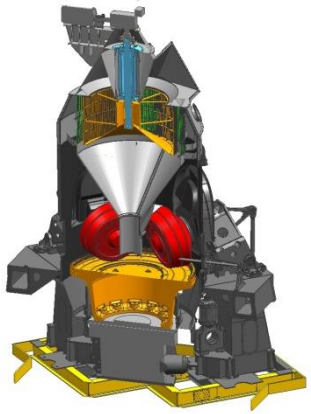


Total cost of mill internals and grinding media of a cement ball mill

Component	Weight	Utilisation	Operating lifetime	Specific wear rate	Specific wear gross	Specific Price	Wear cost	Specific wear cost	Scrap payback
	[kg]	[%]	[h]	[g/t]	[g/t]	[€/kg]	[€/a]	[ct/t]	[ct/t]
Blind liner - Mill head	5000	80	12000	2,47	3,09	2,8	7467	0,864	-0,005
Shell liner 1st comp.	46000	45	30000	5,11	11,36	2,8	27477	3,180	-0,050
ID Slotted plates	3000	80	18000	0,99	1,23	4,5	4800	0,556	-0,002
ID Backside plates	3500	80	18000	1,15	1,44	4,5	5600	0,648	-0,002
Shell liner 2nd comp.	65000	50	60000	4,01	8,02	2,5	17333	2,006	-0,032
DD Slotted plates	3500	80	24000	0,86	1,08	4,5	4200	0,486	-0,002
Grinding media 1st comp.	100000	100	24691	30	30,00	1,2	31104	3,600	0,000
Grinding media 2nd comp.	208000	97	102716	15	15,46	1,3	17369	2,010	-0,004
08/11/2013-Now							**115350**	**13,35**	**-0,097**

Specific wear cost mill internals **13,25** ct/t

Project	CASE C	
Project No.	xxx	
Mill name	CM1	
Mill table diameter	6,3	m
Roller diameter	2,50	m
Number of rollers	4,00	pc.
Power absorbed	5500	kW/h
Operating hours per year	6400	h
Throughput per hour	270	t/h
Throughput per year	1728000	t/a
Energy cost	5	ct/kWh
Energy cost per year	1760000	€/a
Scrap metal price	80	€/t



Total cost of mill internals of a vertical cement mill

Component	Weight	Price	Operating lifetime	Specific Price	Wear cost	Specific wear cost
	[kg]	[€]	[h]	[€/kg]	[€/a]	[ct/t]
Master roller	14000	350000	10370	25	216008	12,500
Support/Slave roller	9000	225000	11523	25	124967	7,232
Grinding table liner	42000	650000	16889	15	246314	14,254
Dam ring	10000	50000	11111	5	28800	1,667
Wall liner replacement		250000	60000		26667	1,543
Rocker arm / bearing seats		250000	75000		21333	1,235
Hydraulic cylinders		150000	75000		12800	0,741
Triple gate replacement		150000	50000		19200	1,111
Gear box replacement		500000	100000		32000	1,852
Mill feed chute		25000	50000		3200	0,185
08/11/2013-Now					**731290**	**42,32**
				Specific wear cost mill internals		**42,32**

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Conclusion

Ball Mill (closed circuit)	Rollerpress with Ball Mill	Vertical Mill
CASE A	CASE B	CASE C
-Lowest operational cost -Lowest investment cost -Highest availability -Higher flexibility by 2 grinding units -Easiest maintenance -Local spare part availability	-Better grinding efficiency results in a lower specific power consumption -Operational cost are higher at actual electrical cost ==> No economical profit!	-Better grinding efficiency results in a lower specific power consumption -Operational cost are higher at actual electrical costs ==> No economical profit!

- Operational cost is not only the electrical power demand!
- How flexible must be your system?
- Each plant has different circumstances – evaluating carefully!

A new ball mill circuit from CPB is not „old fashion“!
(Mostly, it is the best solution for the customer.)

Any questions?

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