

CEMEX Emissions

Kiln-Flash Calciner

year	Actual Raw Material Usage [tons]	Actual Clinker Production [tons]	Operating Hours	Annual Coal Use [tons]	Annual Coal Heat Input [MMBtu]	Annual % Firing Coal	Natural Gas Use [mscf]	NG Heat Input [MMBtu]	SO2 [tpy]	SO2 [lbs/ton of Clinker]	Average SO2 (lbs/hr)	NOx [tpy]	NOx [lbs/ton of Clinker]	Average NOx (lbs/hr)	% Raw Material Loss
2000	846,000	539,992	8020					-	14.4	0.053	3.6	1,729.6	6.41	431.3	-36.17%
2001	759,699	508,733	7893	111,677	2,702,583	96.08%	102,156	110,328	18.7	0.074	4.7	1,858.9	7.31	471.0	-33.03%
2002	738,067	472,945	7526	92,418	2,236,516	91.38%	195,375	211,005	95.0	0.402	25.3	1,747.1	7.39	464.3	-35.92%
2003	830,428	516,251	7871	99,919	2,418,040	96.14%	89,802	96,986	48.0	0.186	12.2	1,835.0	7.11	466.3	-37.83%
2004	791,866	472,053	7927	96,796	2,342,463	91.92%	190,587	205,834	26.3	0.111	6.6	1,708.9	7.24	431.2	-40.39%
2005	739,260	440,384	7641	86,730	2,098,866	93.13%	143,343	154,810	27.2	0.123	7.1	1,591.3	7.23	416.5	-40.43%
2006	734,456	466,173	7921	97,667	2,363,541	96.58%	77,411	83,604	44.7	0.192	11.3	2,011.7	8.63	508.0	-36.53%
2007	788,780	479,225	7941	89,683	2,170,329	95.81%	87,890	94,921	65.0	0.271	16.4	1,689.0	7.05	425.4	-39.24%
2008	749,325	478,520	7534	88,264	2,135,989	96.97%	62,002	66,838	55.8	0.233	14.8	1,295.5	5.41	343.9	-36.14%
2009	312,845	185,076	2990	34,914	844,919	96.36%	29,624	31,935	15.5	0.167	10.4	495.5	5.35	331.4	-0.4084
Average:	455,935	455,935		88,674	2,145,916		108,688	117,362	41	0.181	11.2	1,596.25	6.91	428.92	-37.82%
(excluding 2009) Average:	486,031	486,031		95,394											

6,160.50 6,120.47

Title V Permit Limits

Kiln Raw Material Usage (max feed): 967,680 (tons/year) dry basis
 Kiln-Calciner: 8064 (hours/year)-condition # 10.2
 Clinker Processing: 8064 (hours/year)-condition # 11.2

error reported by CEMEX, numbers are now correct

SO2 Emissions Control Analysis for the Kiln

Control Technology	Resultant SO2 Emissions [tons/yr]	Resultant SO2 Emissions [lbs/hr]	Resultant SO2 Emissions [lbs/ton of clinker]	Estimated Control Efficiency [%]	SO2 Emission Reduction [tons/yr]	Annualized Cost [\$ /yr]	Cost Effectiveness [\$ /ton]	Incremental Cost Effectiveness [\$ /ton]
Baseline SO2 Emissions	95.0	25.3	0.40		-			
Lime Addition to Kiln Feed	71.3	19.0	0.30	25	23.8	\$3,640,178	\$153,271	
Fuel Substitution (coal supplemented with TDF)	57.0	15.2	0.24	40	38.0	\$172,179	\$4,531	(\$243,368)
Dry Sorbent Injection	47.5	12.7	0.20	50	47.5	Not provided	-	-
Wet Lime Scrubbing (Tailpipe scrubber)	9.5	2.5	0.04	90	85.5	\$2,529,018	\$29,579	\$49,618

NOx Emissions Control Analysis for the Kiln

Control Technology	Resultant SO2 Emissions [tons/yr]	Resultant NOx Emissions [lbs/hr]	Resultant NOx Emissions [lbs/ton of clinker]	Estimated Control Efficiency [%]	NOx Emission Reduction [tons/yr]	Annualized Cost [\$ /yr]	Cost Effectiveness [\$ /ton]	Incremental Cost Effectiveness [\$ /ton]
Baseline NOx Emissions	1,747.1	464.3	7.39		-			
Water Injection	1,624.8	431.8	6.87	7	122.297	43,598,231	\$356	
Firing TDF	1,572.4	417.9	6.65	10	174.710	172,178,777	\$986	\$2,453.22
Indirect Firing with LNB	1,397.7	371.4	5.91	20	349.4	\$710,750	\$2,034	\$3,083
SNCR (45% control)	960.9	255.4	4.06	45	786.2	\$1,636,636	\$2,082	\$2,120
SNCR (48.43% control)	901.0	239.4	3.81	48.43	846.1	\$1,636,636	\$1,934	\$1,864
SNCR w/LNB	786.2	208.9	3.33	55	960.9	\$1,686,395	\$1,755	\$434

128,580.55
52.41 2453.219

Visibility improvement for SO₂ Controls – Kiln Only

Control Method	98th Percentile Impact (Δ dv)	98th Percentile Improvement (from 24-hr Max) (Δ dv)	Cost Effectiveness (\$/ Δ dv)
24-hr Maximum (\approx 104 lbs/hr)	0.760	-	
Baseline (\approx 25.3 lbs/hr)*	0.730	0.030	
Lime Addition to Kiln (\approx 19.0 lbs/hr)*	0.727	0.033	\$110,308,420
Fuel Substitution (\approx 15.2 lbs/hr)*	0.726	0.034	\$5,064,082
Dry Sorbent Injection (\approx 12.7 lbs/hr)*	0.724	0.036	
Wet Lime Scrubbing (\approx 2.5 lbs/hr)	0.720	0.040	\$63,225,462

Visibility improvement for NO_x Controls – Kiln Only

Control Method	98th Percentile Impact (Δ dv)	98th Percentile Improvement (from 24-hr Max) (Δ dv)	Cost Effectiveness (\$/ Δ dv)
Maximum (24-hr max)	0.760		
Revised Baseline* (\approx 464.3 lb/hr)	0.572	0.188	
Original Baseline* (\approx 446.8 lb/hr)	0.555	0.205	
Water Injection (\approx 431.8 lb/hr)	0.540	0.220	\$198,174
Firing TDF (\approx 417.9 lbs/hr)	0.526	0.234	\$735,807
Indirect Firing with LNB (\approx 371.4 lb/hr)	0.481	0.279	\$2,547,493
Original Proposed BART Limit – SNCR (\approx 268.0 lb/hr)	0.380	0.380	
Proposed BART Limit – SNCR (30-day limit)** (\approx 255.3 lb/hr)	0.368	0.392	\$4,175,091
Proposed BART Limit – SNCR (annual limit)** (\approx 239.0 lb/hr)	0.352	0.408	\$4,011,362
SNCR w/LNB** (\approx 208.9 lb/hr)	0.322	0.438	\$3,850,217

Cemex BART Determination

Control Type	Estimated Reduction	SO2 [lb/hr]	SO2 [lb/ton of clinker]	SO2 [tpy]	Reduction
Present SO2 BART	%	48	0.80	97	
Baseline	-	25.3	0.40	95.0	
Lime Addition	25%	18.94	0.30	71.3	(23.8)
Fuel Substitution	40%	15.15	0.24	57.0	(38.0)
DSI	50%	12.63	0.20	47.5	(47.5)
WLS	90%	2.53	0.04	9.5	(85.5)

 Proposed BART limits

Control Type	Estimated Reduction	NOx [lb/hr]	NOx [lb/ton of clinker]	NOx [tpy]	Reduction
Present NOx BART	40%	268	4.45	901	
Baseline	-	464.3	7.39	1,747.1	
Water Injection	7%	431.8	6.87	1,624.8	(122.3)
Firing TDF	10%	417.8	6.65	1,572.3	(174.7)
LNB w/IDF	20%	371.4	5.91	1,397.6	(349.4)
SNCR	40%	278.6	4.43	1,048.2	(698.8)
SNCR (30-day roll)	45.00%	255.35	4.06	960.9	(786.2)
SNCR (annual)	48.43%	239.4	3.81	901.0	(846.1)

 Proposed BART limits

CEMEX Emissions

Pollutant	Source	Maximum 24-hr Avg Emission Rate [lb/hr]	Allowable [tpy]*	2008 Actual [tpy]**	2008 Actual [lbs/ton of Clinker]	% Reduction (actual - allowable)/allowable
SO2	Raw Materials Dryer	19.4	36.7	0.89	0.004	-97.6%
NOx	Raw Materials Dryer		13.9	10.41	0.04	-25.1%
PM10	Raw Materials Dryer		22.8	5.12	0.02	-77.5%
CO	Raw Materials Dryer		57.3	2.98	0.01	-94.8%
SO2	Kiln and Flash Calciner	104	1,340.0	55.8	0.23	-95.8%
NOx	Kiln and Flash Calciner		2,649.0	1295.5	5.41	-51.1%
PM10	Kiln and Flash Calciner		133.0	42.04	0.18	-68.4%
CO	Kiln and Flash Calciner		396.0	345.1	1.44	-12.9%

2008 Clinker Production (from Kiln APEN) [tpy]
478,520
478,520
478,520
478,520
478,520
478,520
478,520
478,520

Notes: VOC Emissions not included in the BART analysis because VOC is not a significant contributor to the formation of secondary organic carbon particulates

* Allowable emissions from CEMEX Title V Operating Permit 95OPBO082 issued on 01 FEB 2000 and renewed on 01 MAR 2008

** Actual emissions from APENs (submitted in 2009, based on 2008 production)

CEMEX Tire Derived Fuel (TDF) Performance Test Results

Performance test date: November 13 - 22, 2002

Performance test report date: 3/21/2003

Pollutant	Fossil Fuel [ppm]	TDF [ppm]	% Change (TDF-FF)/FF
PM (M29 train)	8.8	9.7	10.2%
PM (M26A train)	9.5	9.1	-4.2%
NOx	517.7	391.2	-24.4%
SOx	26.2	15.7	-40.1%
THC	0.5	1.8	260.0%
CO	50.3	120.2	139.0%

Cemex Lime Addition to Kiln Feed - SO2 Cost Analysis

Capital Costs

Direct Equipment Cost (silo & feed system) \$ 2,000,000

Direct Installation Cost

Indirect Costs

Total Capital Costs \$ 2,000,000

Capital Recovery Costs \$ 188,786 7%, 20 years

O&M Costs

Operating Labor

Materials (CaO-lime) \$ 4,612,608 (amended by Cemex 29 JUL 2010)

Utilities

Total Annual O&M Costs \$ 4,612,608

Value of extra Clinker (@\$40/ton) \$ 1,161,216

Total Annualized Costs: \$ 3,640,178

Baseline SO2 Emissions: 95.0 [tpy]

SO2 Reduction from Lime Add: 25% (amended by Cemex 29 JUL 2010)

SO2 Reduction from Lime Add: 23.8 [tpy]

Lime Add Controlled SO2 Emissions: 71.3 [tpy]

Lime Add Control Cost: \$ 153,271 [\$ /ton]

Cemex Firing w/TDF - Cost Analysis

Capital Costs

Direct Equipment Cost \$ 3,000,000

Direct Installation Cost

Indirect Costs

Total Capital Costs \$ 3,000,000

Capital Recovery Costs \$ 283,179 7%, 20 years

O&M Costs

Fuel savings (300,000)

annual \$ 189,000

Total O&M Costs \$ (111,000)

Total Annualized Costs: \$ 172,179

Baseline SO2 Emissions:	95.0 [tpy]
SO2 Reduction from Firing TDF:	40%
SO2 Reduction from Firing TDF:	38.0 [tpy]
Firing TDF Controlled SO2 Emissions:	57.0 [tpy]

Firing TDF Control Cost: \$ 4,531 [\$ /ton]

Source: Jan. 15, 2007 Letter to J Geier from Amarjit Gill

Cemex Wet Lime Scrubbing - Cost Analysis

Capital Costs

Direct Equipment Cost	\$	8,482,500
Direct Installation Cost	\$	7,210,125
Indirect Costs	\$	2,968,875
Total Capital Costs	\$	18,661,500

Capital Recovery Costs \$ **1,761,514** 7%, 20 years

O&M Costs

Operating Labor	\$	10,074
Maintenance Labor and Materials	\$	17,520
Utilities-Electricity	\$	571,180
Utilities-Limestone Slurry	\$	5,235
Utilities-Water	\$	103,202
Utilities-Sludge Disposal	\$	60,293
Total O&M Costs	\$	767,505

corrected by Divisor

Total Annualized Costs: \$ 2,529,018

Baseline SO2 Emissions:	95.0 [tpy]
SO2 Reduction from WLS:	90%
SO2 Reduction from WLS:	85.5 [tpy]
WLS Controlled SO2 Emissions:	9.5 [tpy]

WLS Control Cost: \$ 29,579 [\$ /ton]

Original Cemex O&M Costs	\$	767,505	
Original Cemex Capital Recovery Costs	\$	4,714,000	7%, 8 years
Original Cemex Annualized Costs	\$	5,481,505	

Original Baseline SO2 Emissions:	97.0 [tpy]
Original SO2 Reduction from WLS:	90%
Original SO2 Reduction from WLS:	87.3 [tpy]
Original WLS Controlled SO2 Emissions:	9.7 [tpy]

Original WLS Control Cost: \$ 62,789

Cemex Water Injection - Cost Analysis

Capital Costs

Direct Equipment Cost	\$	250,000
Direct Installation Cost		
Indirect Costs		
Total Capital Costs	\$	250,000

Capital Recovery Costs \$ **23,598** 7%, 20 years

O&M Costs

annual	\$	20,000
Total O&M Costs	\$	20,000

Total Annualized Costs: \$ **43,598**

Baseline NOx Emissions:	1,747.1	[tpy]
NOx Reduction from Water Injection:	7%	
NOx Reduction from Water Injection:	122.3	[tpy]
Water Injection Controlled NOx Emissions:	1,624.8	[tpy]

Water Injection Control Cost: \$ **356** [\$/ton]

Source: Jan. 15, 2007 Letter to J Geier from Amarjit Gill

Cemex Firing w/TDF - Cost Analysis

Capital Costs

Direct Equipment Cost \$ 3,000,000

Direct Installation Cost

Indirect Costs

Total Capital Costs \$ 3,000,000

Capital Recovery Costs \$ 283,179 7%, 20 years

O&M Costs

Fuel savings (300,000)

annual \$ 189,000

Total O&M Costs \$ (111,000)

Total Annualized Costs: \$ 172,179

Baseline NOx Emissions: 1,747.1 [tpy]

NOx Reduction from Firing TDF: 10%

NOx Reduction from Firing TDF: 174.7 [tpy]

Firing TDF Controlled NOx Emissions: 1,572.4 [tpy]

Firing TDF Control Cost: \$ 986 [\$ /ton]

Source: Jan. 15, 2007 Letter to J Geier from Amarjit Gill

Cemex Indirect Firing with LNB - Cost Analysis

Capital Costs

Direct Equipment Cost \$ 7,000,000

Direct Installation Cost

Indirect Costs

Total Capital Costs \$ 7,000,000

Capital Recovery Costs \$ 660,750 7%, 20 years

O&M Costs

annual \$ 50,000

Total O&M Costs \$ 50,000

Total Annualized Costs: \$ 710,750

Baseline NOx Emissions: 1,747.1 [tpy]
NOx Reduction from IF w/LNB: 20%
NOx Reduction from IF w/LNB: 349.4 [tpy]
IF w/LNB Controlled NOx Emissions: 1,397.7 [tpy]

IF w/LNB Control Cost: \$ 2,034 [\$ /ton]

Source: Jan. 15, 2007 Letter to J Geier from Amarjit Gill

Cemex SNCR - Cost Analysis

Capital Costs

Direct Equipment Cost \$ 600,000

Direct Installation Cost

Indirect Costs

Total Capital Costs \$ 600,000

Capital Recovery Costs \$ 56,636 7%, 20 years

O&M Costs

annual (@50% control) \$ 1,580,000

Total O&M Costs \$ 1,580,000

Total Annualized Costs: \$ 1,636,636

Baseline NOx Emissions: 1,747.1 [tpy]

NOx Reduction from SNCR: 48.43%

NOx Reduction from SNCR: 846.1 [tpy]

SNCR Controlled NOx Emissions: 901.0 [tpy]

SNCR Control Cost: \$ 1,934 [\$ /ton]

Source: Jan. 15, 2007 Letter to J Geier from Amarjit Gill

Cemex LNB w/SNCR - Cost Analysis

Capital Costs

Direct SNCR Equipment Cost	\$	600,000
LNB Cost	\$	527,150
Indirect Costs		
Total Capital Costs	\$	1,127,150

estimated based on total annual cost provided by cemex

Capital Recovery Costs \$ **106,395**

7%, 20 years

O&M Costs

annual (@50% control)	\$	1,580,000
Total O&M Costs	\$	1,580,000

Total Annualized Costs: \$ 1,686,395

Source: from Monica Sowders 27 OCT 2010 email

Baseline NOx Emissions:	1,747.1	[tpy]
NOx Reduction from SNCR w/LNB:	55.00%	*
NOx Reduction from SNCR w/LNB:	960.9	[tpy]
SNCR w/LNB Controlled NOx Emissions:	786.2	[tpy]

* Source: from Monica Sowders 27 OCT 2010, with caveat that LNB may actually increase NOx emissions

SNCR w/LNB Control Cost: \$ 1,755 [\$ /ton]