

Grasim Cement -Rawan-Raipur
Clinker cooler modification Project data for Baseline

	Parameter		For Oct-2003				For Nov-2003			
			09-Oct-03	16-Oct-03	23-Oct-03	27-Oct-03	06-Nov-03	13-Nov-03	20-Nov-03	27-Nov-03
1	Clinker production	tpd	4188	4318	3561	3586	3537	3601	3254	3566
	Inlet temperature of the clinker in cooler	C	1400	1400	1400	1400	1400	1400	1400	1400
	Specific heat of clinker	kcal/kg C	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260
	Heat from clinker	kCal/hr	63499081	65470161	53992414	54371468	54011101	54598900	49337634	54068225
2	Inlet temperature of the cooling air in cooler	C	28.0	29.0	27.0	29.0	25.0	23.0	24.0	22.0
	Flow rate of cooling air in cooler	M3/min	6840	6605.2	5714.7	5824.0	5760.2	6069.2	5493.6	5289.4
	Flow rate of cooling air in cooler	kg/hr	457590	440415	383578	388323	389227	412878	372461	361045
	Specific heat of cooling air	kcal/kg C	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239
	Heat from cooling air	kCal/hr	3064969	3055495	2477308	2694093	2327270	2270882	2137796	1899327
3	Power delivered by cooler fans	kWh/Day	24605	22174	18819	19490	19391	20186	18370	18173
	Power delivered by cooler fans	kCal/hr	881679	794568	674348	698392	699801	723332	658258	651199
1a	Temperature of cooler exhaust flue gases	C	331	342	305	299	307	295	301	303
	Power Drawn by Cooler ESP Fan	kWh/Day	1452	1475	899	860	1055	1201	1051	910
		kWh/hr	60.5	61.5	37.5	35.8	44.3	50.0	43.8	37.9
	Flow rate of Cooler exhaust fan	m3/hr	420648	424651	365753	370690	372925	375846	343462	356221
	Flow rate of Cooler exhaust fan	Kg/hr	233729	231732	212368	217493	215786	222071	200815	207552
	Cp of Cooler Exit Air	kcal/kg/deg.C	0.245	0.245	0.245	0.245	0.245	0.244	0.245	0.245
Heat through cooler vent fan	kcal/hr	18973456	19456303	15847514	15901989	16211107	16013690	14783477	15383779	
2a	Total Clinker from Cooler	tpd	4187	4317	3560	3585	3536	3600	3253	3565
	Temp. of Clinker from Cooler	Deg.C	180.0	183.0	165.0	168.0	172.0	169.0	175.0	180.0
	Cp of Clinker from Cooler	kcal/kg/deg.C	0.196	0.196	0.194	0.195	0.195	0.195	0.195	0.196
	Heat from Clinker Cooler	kcal/hr	6148363	6454506	4754470	4882657	4976501	4935119	4632241	5234924
3a	Total Clinker Dust from Cooler ESP	tpd	0.975	1.154	1.142	1.142	0.919	0.961	0.961	1.026
	Temp. of from Clinker dust to ESP	Deg.C	331.0	342.0	305.0	299.0	307.0	295.0	301.0	303.0
	Cp of from Clinker dust to ESP	kcal/kg/deg.C	0.209	0.210	0.207	0.206	0.207	0.206	0.207	0.207
	Heat from Clinker dust to ESP	kcal/hr	2809	3447	3002	2936	2452	2433	2488	2676

4a	Radiation Losses	kcal/hr	873	900	742	747	742	750	678	743
	Heat Losses	kcal/hr	25125500	25915155	20605727	20788330	21190802	20951993	19418884	20622122
	Cooler Efficiency	%	62.75	62.62	63.94	64.01	62.85	63.62	62.75	63.58
	Total heat input	kCal/hr	67445729	69320224	57144069	57763952	57038171	57593114	52133688	56618750
	Kiln running hours	hrs	24.00	24.00	24.00	24.00	23.83	24.00	24.00	24.00
			63.33%				63.20%			

For Dec-2003		For Jan-2004				For Feb-2004			For Mar-2004				
02-Dec-03	29-Dec-03	07-Jan-04	14-Jan-04	21-Jan-04	28-Jan-04	09-Feb-04	16-Feb-04	23-Feb-04	13-Mar-04	17-Mar-04	24-Mar-04	31-Mar-04	07-Apr-04
3573	4377	4369	4400	4397	4377	4437	4447	4313	3836	3695	3668	3576	3641
1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400
0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260
54174360	66364728	66243430	66713457	66667971	66364728	67274457	67426078	65394350	58162005	56024142	55614764	54219846	55205386
19.0	19.0	24.0	25.0	26.0	24.0	21.0	27.0	28.0	29.0	28.0	28.0	34.0	31.0
5643.0	6847.2	6797.2	6908.7	6943.2	6776.8	6991.3	6752.5	6452.9	6281.6	6108.2	6071.0	6285.1	6327.4
389139	472184	460848	466832	467595	459464	478843	453234	431689	418839	408626	406141	412247	419113
0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239
1767611	2144829	2645106	2791287	2907876	2637162	2404358	2927175	2891485	2905805	2737009	2720360	3354334	3108667
18706	22077	21923	22610	22569	21671	22244	21727	20948	19232	18945	19013	17773	19315
670298	791093	785574	810192	808723	776544	797077	778551	750637	689147	678863	681299	636866	692121
298	315	341	346	335	326	331	327	324	321	319	324	330	334
915	1511	1310	1504	1512	1394	1334	1342	1506	1152	957	1046	1028	1108
38.1	63.0	54.6	62.7	63.0	58.1	55.6	55.9	62.8	48.0	39.9	43.6	42.8	46.2
357275	428321	414720	420987	429698	406610	401998	407616	422529	392882	370650	361929	356546	368752
209989	244468	226866	228248	237186	227814	223366	228187	237726	221975	210300	203460	198439	204048
0.245	0.245	0.245	0.246	0.245	0.245	0.245	0.245	0.245	0.245	0.245	0.245	0.245	0.245
15300585	18858223	18961589	19395107	19494013	18205613	18132213	18264215	18847649	17458905	16408031	16156624	16058628	16693029
3572	4376	4368	4399	4396	4376	4436	4446	4312	3835	3694	3667	3575	3640
178.0	186.0	184.5	188.0	183.0	201.0	205.0	214.0	186.0	178.0	174.0	172.0	168.0	169.5
0.196	0.196	0.196	0.197	0.196	0.198	0.198	0.199	0.196	0.196	0.195	0.195	0.195	0.195
5181930	6660612	6589356	6773937	6572788	7251106	7511103	7892188	6562944	5563271	5227357	5124321	4869349	5006097
0.802	0.802	1.115	1.115	1.046	0.939	1.050	1.050	0.972	0.922	1.021	0.910	0.913	0.913
298.0	315.0	340.5	346.0	335.0	326.0	331.0	326.5	323.5	321.0	318.5	324.0	330.0	333.5
0.206	0.208	0.209	0.210	0.209	0.208	0.209	0.208	0.208	0.208	0.208	0.208	0.209	0.209
2055	2186	3314	3374	3051	2658	3025	2979	2729	2567	2817	2559	2621	2652

744	912	910	917	916	912	924	926	899	799	770	764	745	759
20485315	25521933	25555169	26173335	26070769	25460288	25647265	26160308	25414221	23025542	21638975	21284268	20931342	21702536
63.81	63.17	63.32	62.78	62.96	63.51	63.61	63.22	63.19	62.72	63.60	63.94	64.04	63.22
56612269	69300649	69674110	70314936	70384569	69778434	70475891	71131803	69036472	61756956	59440013	59016423	58211046	59006173
24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
63.49%		63.14%				63.34%			63.57%				
													63.4%

For Apr-2004			For May-2004				For June-2004				For July-2004		
14-Apr-04	21-Apr-04	28-Apr-04	03-May-04	06-May-04	17-May-04	24-May-04	08-Jun-04	16-Jun-04	22-Jun-04	29-Jun-04	06-Jul-04	12-Jul-04	19-Jul-04
3869	3671	4386	4492	4388	4440	4461	4324	4189	4291	4275	4130	4261	4266
1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400
0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260
58662356	55660250	66501187	68108375	66531511	67319943	67638348	65561134	63514244	65060783	64818188	62619677	64605918	64681729
32.0	31.0	32.0	33.0	36.0	40.0	41.0	40.0	39.0	40.0	29.0	29.0	30.0	31.0
6241.0	6118.6	6182.1	6262.0	6134.5	6180.2	6365.4	6190.4	6206.7	6254.0	6240.0	6172.0	6258.4	6252.6
412036	405287	408145	412068	399762	397593	408206	398251	400577	402341	416059	411528	415911	414161
0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239	0.239
3154971	3006113	3125182	3254044	3444564	3807586	4007231	3813886	3739991	3853053	2886520	2855083	2985193	3071934
19316	18568	21356	22069	22354	21810	22103	21173	20706	22031	21433	21343	20894	20030
692157	665353	765257	790806	801018	781525	792024	758699	741965	789444	768016	764791	748702	717742
329	325	346	355	364	361	351	334	352	357	346	356	359	358
1166	1131	998	1429	1363	1214	1262	1172	1045	1141	1253	1133	1111	1094
48.6	47.1	41.6	59.5	56.8	50.6	52.6	48.8	43.5	47.5	52.2	47.2	46.3	45.6
388442	378604	398096	424291	414263	422781	426048	413320	396555	413461	416330	399062	395347	391829
216551	212656	216012	226743	218428	223798	229141	228522	213109	220254	225724	212921	209938	208400
0.245	0.245	0.246	0.246	0.246	0.246	0.246	0.245	0.246	0.246	0.246	0.246	0.246	0.246
17469559	16913687	18327950	19784931	19531149	19869081	19761532	18724095	18405897	19330574	19180584	18632953	18531869	18343119
3868	3670	4385	4491	4387	4439	4460	4323	4188	4290	4274	4129	4260	4265
164.0	171.0	196.0	186.0	180.0	191.0	193.0	187.5	178.0	186.0	184.0	174.0	179.0	182.5
0.194	0.195	0.197	0.196	0.196	0.197	0.197	0.197	0.196	0.196	0.196	0.195	0.196	0.196
5132439	5096027	7068039	6835838	6441814	6954991	7068144	6637348	6074784	6528933	6428142	5842505	6217119	6357795
0.653	0.914	0.914	0.674	1.136	1.136	1.093	1.236	1.307	1.319	1.319	1.319	1.319	1.102
329.0	324.5	345.5	355.0	363.5	361.0	351.0	334.0	351.5	357.0	346.0	356.0	359.0	358.0
0.209	0.208	0.210	0.210	0.211	0.211	0.210	0.209	0.210	0.211	0.210	0.211	0.211	0.211
1867	2575	2761	2098	3630	3603	3362	3595	4026	4132	3990	4119	4158	3465

806	765	914	936	914	925	929	901	873	894	891	860	888	889
22604671	22013054	25399664	26623803	25977508	26828600	26833968	25365939	24485581	25864533	25613607	24480437	24754034	24705268
63.84	62.90	63.92	63.10	63.30	62.69	62.96	63.83	63.99	62.89	62.59	63.04	63.78	63.92
62509483	59331716	70391625	72153225	70777093	71909054	72437604	70133719	67996199	69703280	68472724	66239551	68339813	68471405
24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
63.47%			63.01%				63.33%				63.65%		

For Aug-2004					
26-Jul-04	02-Aug-04	09-Aug-04	16-Aug-04	23-Aug-04	30-Aug-04
4261	3794	3815	4231	4220	4209
1400	1400	1400	1400	1400	1401
0.260	0.260	0.260	0.260	0.260	0.260
64605918	57525195	57843600	64151054	63984270	63882873
30.0	27.0	31.0	27.0	29.0	30.0
6280.7	6255.8	6201.8	6280.3	6359.3	6389.1
417392	419899	410798	421543	424015	424600
0.239	0.239	0.239	0.239	0.239	0.239
2995828	2711884	3046988	2722503	2941719	3047558
20875	19556	20489	21428	20458	20717
748021	700757	734189	767837	733078	742359
348	329	335	349	333	341
1128	1021	1120	1082	1097	1087
47.0	42.5	46.7	45.1	45.7	45.3
404789	359657	376843	405019	410270	406893
218759	200504	208011	218708	227209	222404
0.246	0.245	0.245	0.246	0.245	0.245
18699729	16175008	17096139	18723050	18559109	18616745
4260	3793	3814	4230	4219	4208
173.0	186.0	177.5	172.0	183.0	173.5
0.195	0.196	0.196	0.195	0.196	0.195
5990429	5773038	5515768	5910952	6308196	5936084
1.102	0.962	0.978	0.978	1.008	1.008
348.0	329.0	335.0	348.5	333.0	341.0
0.210	0.209	0.209	0.210	0.209	0.210
3357	2751	2853	2982	2922	3001

Heat Cap - Coefficients					
Gas/Mat	*T^0	*T^1	*T^2	*T^3	*T^4
O2	0.2130	7.796E-05	-7.563E-08	4.074E-11	-8.183E-15
CO2	0.1906	1.771E-04	-1.733E-07	9.315E-11	-1.894E-14
N2+Ar	0.2465	-3.284E-06	4.366E-08	-2.750E-11	5.504E-15
H2O,steam	0.4445	2.910E-05	6.887E-08	-3.726E-11	6.472E-15
H2O, liq.	1.0000				
Rawmeal	0.2060	1.014E-04	-3.673E-08		
Clinker	0.1742	1.414E-04	-1.283E-07	5.074E-11	

O2	mass %	23.0
CO2	mass %	0.0
N2	mass %	77.0
H2O	mass %	0.0

CV Fan Flow	m3/min	9500
Fan Power Drawn		180

888	790	795	881	879	877
24694404	21951587	22615555	24637865	24871106	24556706
63.87	63.98	63.30	63.58	63.24	63.71
68349767	60937835	61624777	67641394	67659068	67672790
24.00	24.00	24.00	24.00	24.00	24.00
	63.52%				
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Grasim Cement -Rawan-Raipur

Clinker cooler modification Project data for after project

	Parameter		For Oct-2004				Monthly	F	
			06-Oct-04	13-Oct-04	20-Oct-04	27-Oct-04		02-Nov-04	09-Nov-04
1	Clinker production	tpd	4289	4336	4366	4354		4388	4329
	Inlet temperature of the clinker in cooler	C	1400	1400	1400	1400		1400	1400
	Specific heat of clinker	kcal/kg C	0.260	0.260	0.260	0.260		0.260	0.260
	Heat from clinker	kCal/hr	65030458	65743080	66197944	66015998		66531511	65636944
2	Inlet temperature of the cooling air in cooler	C	29.0	28.0	27.0	26.0		25.0	25.0
	Flow rate of cooling air in cooler	M3/min	6280.9	6284.2	6309.2	6370.0		6225.2	6282.8
	Flow rate of cooling air in cooler	kg/hr	418787	420399	423484	428993		420647	424542
	Specific heat of cooling air	kcal/kg C	0.239	0.239	0.239	0.239		0.239	0.239
	Heat from cooling air	kCal/hr	2905444	2815863	2735039	2667819		2515136	2538427
3	Power delivered by cooler fans	kWh/Day	17440	18665	19225	20941		19847	20778
	Power delivered by cooler fans	kCal/hr	624933	668829	688896	750386		711184	744545
1a	Temperature of cooler exhaust flue gases	C	295	330	306	311		325	335
	Power Drawn by Cooler ESP Fan	kWh/Day	1102	1022	1043	1002		937	921
		kWh/hr	45.9	42.6	43.5	41.8		39.0	38.4
	Flow rate of Cooler exhaust fan	Nm3/hr	417543	410303	408412	404266		397977	388362
	Flow rate of Cooler exhaust fan	Kg/hr	246707	228358	236728	232319		223350	214370
	Cp of Cooler Exit Air	kcal/kg/deg.C	0.244	0.245	0.245	0.245		0.245	0.245
Heat from Cooler Exit Air	kcal/hr	17790260	18479791	17724860	17687003		17792470	17618732	
2a	Total Clinker from Cooler	tpd	4288	4335	4365	4353		4387	4328
	Temp. of Clinker from Cooler	Deg.C	135.0	139.0	132.0	125.0		129.0	122.0
	Cp of Clinker from Cooler	kcal/kg/deg.C	0.191	0.192	0.191	0.190		0.190	0.190
	Heat from Clinker Cooler	kcal/hr	4608778	4808304	4579437	4307179		4490221	4171914
3a	Total Clinker Dust from Cooler ESP	tpd	0.967	0.967	0.902	0.781		0.781	1.151
	Temp. of from Clinker dust to ESP	Deg.C	295.0	330.0	306.0	311.0		325.0	335.0
	Cp of from Clinker dust to ESP	kcal/kg/deg.C	0.206	0.209	0.207	0.207		0.208	0.209
	Heat from Clinker dust to ESP	kcal/hr	2450	2776	2380	2098		2204	3360

4a	Radiation Losses	kcal/hr	894	903	910	907		914	902
	Heat Losses	kcal/hr	22402382	23291774	22307587	21997188		22285810	21794907
	Cooler Efficiency	%	67.32	66.35	67.96	68.32		67.49	68.05
	Total heat input	kCal/hr	68560836	69227772	69621879	69434203	69211172.30	69757831	68919916
	Kiln running hours	hrs	24.00	24.00	24.00	24.00		24.00	24.00
	Baseline Efficiency	%					63.40		
	Increase in Cooler Efficiency	%					4.09		
	Saving in heat output due to increase in cooler efficiency	Kcal/hr					2830390.908		
	Saving in heat input due to increase in cooler efficiency	Kcal/hr					4193824		
	Total energy saved	Million Kcal					2717.60		
	Average calorific value of petcoke	Kcal/ kg					0		
	Average calorific value of Coal	Kcal/ kg					4851		
	tCO ₂ emission per ton of Petcoke	t CO ₂ /TJ					100.80		
	tCO ₂ emission per ton of Coal	t CO ₂ /TJ					96		
	Quantity of petcoke consumed	tons/month					0.00		
	Quantity of fine coal consumed	tons/month					19336.00		
	Total heat supplied by fuels	Million Kcal/month					93792.3316		
	Average emission factor of fuel used	t CO ₂ /TJ					96		
	Average emission factor of fuel used	kgCO ₂ /Million Kcal					401.28		
	Emission Reduction	tons/month					1090.52		

For Nov-2004			Monthly	For Dec-2004				Monthly	For Jan-2005				Monthly
16-Nov-04	23-Nov-04	30-Nov-04		07-Dec-04	14-Dec-04	21-Dec-04	28-Dec-04		04-Jan-05	11-Jan-05	18-Jan-05	25-Jan-05	
4269	4268	4329		4275	4345	4378	4350		4315	4184	4271	4224	
1400	1400	1400		1400	1400	1400	1400		1400	1400	1400	1400	
0.260	0.260	0.260		0.260	0.260	0.260	0.260		0.260	0.260	0.260	0.260	
64727216	64712053	65636944		64818188	65879539	66379890	65955350		65424674	63438433	64757540	64044919	
24.0	22.0	22.0		20.0	21.0	19.0	23.0		24.0	25.0	25.0	24.0	
6270.5	6292.3	6340.9		6378.0	6176.1	6252.0	6186.2		6150.1	6135.6	6222.4	6282.9	
425133	429505	432820		438328	423008	431139	420835		416973	414593	420461	425975	
0.239	0.239	0.239		0.239	0.239	0.239	0.239		0.239	0.239	0.239	0.239	
2440112	2259471	2276909		2095976	2124001	1958389	2314647		2393278	2478936	2514021	2444946	
20917	21230	21522		22503	18441	19874	19569		19033	19043	18799	19119	
749526	760742	771205		806358	660803	712152	701223		682016	682374	673631	685098	
341	330	347		344	350	323	329		315	296	283	278	
856	905	872		858	689	785	742		757	689	805	909	
35.7	37.7	36.3		35.8	28.7	32.7	30.9		31.5	28.7	33.5	37.9	
379338	384755	376012		372327	366319	395476	383370		391170	382789	410204	417082	
207342	214139	203535		202520	197334	222691	213723		223263	225775	247602	254038	
0.245	0.245	0.246		0.246	0.246	0.245	0.245		0.245	0.244	0.244	0.244	
17356013	17329131	17346731		17106265	16968350	17627569	17241446		17222520	16337487	17109951	17236800	
4268	4267	4328		4274	4344	4377	4349		4314	4183	4270	4223	
120.5	124.0	122.5		118.5	128.5	122.5	129.0		131.0	133.0	126.0	123.0	
0.189	0.190	0.190		0.189	0.190	0.190	0.190		0.191	0.191	0.190	0.190	
4059876	4185486	4190254		3993341	4427699	4238062	4451124		4488965	4424227	4261172	4106708	
1.151	1.149	1.149		1.149	0.771	0.771	0.982		0.982	0.969	0.969	0.930	
341.0	330.0	347.0		344.0	350.0	323.0	329.0		315.0	296.0	283.0	278.0	
0.210	0.209	0.210		0.210	0.210	0.208	0.209		0.208	0.206	0.205	0.205	
3427	3298	3489		3455	2364	2161	2809		2676	2464	2344	2204	

889	889	902		891	905	912	906		899	872	890	880	
21420205	21518804	21541376		21103952	21399318	21868705	21696285		21715061	20765050	21374357	21346592	
68.46	68.23	68.64	68.35	68.84	68.83	68.33	68.54	68.64	68.30	68.82	68.54	68.22	68.47
67916853	67732266	68685058	68602385.11	67720522	68664342	69050431	68971219	68601628.35	68499968	66599743	67945192	67174963	67554966.37
24.00	24.00	24.00		24.00	24.00	24.00	24.00		24.00	24.00	24.00	24.00	
			63.40					63.40					63.40
			4.95					5.24					5.07
			3396818.263					3591972.09					3425789.712
			4969635					5233366					5003263
			3220.32					3391.22					3242.11
			7590					0					0
			4739					4799					4805
			100.80					100.80					100.80
			96					96					96
			1227.00					0.00					0.00
			17896.00					19875.00					19792.00
			94115.13135					95385.37517					95108.81669
			96.47498515					96					96
			403.2654379					401.28					401.28
			1298.65					1360.83					1301.00

For Feb-2005					Monthly	For Mar-2005					Monthly	Oct04-Mar05
01-Feb-05	04-Feb-05	08-Feb-05	15-Feb-05	22-Feb-05		01-Mar-05	08-Mar-05	15-Mar-05	22-Mar-05	29-Mar-05		
4175	4237	4260	4145	4232		4285	4347	4254	4323	4319		
1400	1400	1400	1400	1400		1400	1400	1400	1400	1400		
0.260	0.260	0.260	0.260	0.260		0.260	0.260	0.260	0.260	0.260		
63301973	64242027	64590756	62847109	64166216		64969810	65909863	64499783	65545972	65485323		
22.0	24.0	28.0	28.0	28.0		29.0	28.0	29.0	34.0	33.0		
6315.4	6199	6169.5	6236.6	6166.1		6125.5	6144.8	6120.1	6221.0	6198.3		
431082	420304	412729	417217	412500		408431	411077	408070	408042	407881		
0.239	0.239	0.239	0.239	0.239		0.239	0.239	0.239	0.239	0.239		
2267766	2412398	2764491	2794550	2762956		2833598	2753422	2831094	3320119	3220980		
19312	19313	19099	20216	19407		18890	18654	20432	20409	20121		
692013	692049	684381	724407	695418		676892	668435	732147	731323	721003		
284	286	284	279	273		289	301	277	302	320		
879	880	765	862	922		789	699	896	805	866		
36.6	36.7	31.9	35.9	38.4		32.9	29.1	37.3	33.5	36.1		
394235	408645	402505	404597	413269		400670	392268	398205	391717	408202		
237536	245338	242519	245988	254021		239266	229351	242982	228631	231020		
0.244	0.244	0.244	0.244	0.244		0.244	0.245	0.244	0.245	0.245		
16473828	17137796	16819410	16752087	16918047		16893532	16884232	16425818	16888661	18112047		
4174	4236	4259	4144	4231		4284	4346	4253	4322	4318		
131.0	128.0	129.0	132.0	128.0		134.0	142.0	148.0	131.0	145.0		
0.191	0.190	0.190	0.191	0.190		0.191	0.192	0.192	0.191	0.192		
4343342	4299409	4359015	4347506	4294207		4567655	4933177	5048504	4497270	5013058		
0.930	0.930	0.978	0.978	1.055		1.055	0.726	0.726	1.001	1.001		
284.0	286.0	284.0	279.0	273.0		289.0	301.0	277.0	302.0	320.0		
0.205	0.205	0.205	0.205	0.204		0.206	0.207	0.205	0.207	0.208		
2257	2275	2374	2327	2452		2613	1879	1713	2602	2776		

870	883	888	864	882		893	906	886	901	900		
20820298	21440363	21181687	21102784	21215587		21464693	21820194	21476921	21389434	23128780		
68.58	68.16	68.87	68.20	68.63	68.49	68.66	68.53	68.45	69.27	66.69	68.32	
66261753	67346474	68039628	66366065	67624589	67127701.94	68480299	69331720	68063024	69597414	69427306	68979953	
24.00	24.00	24.00	24.00	24.00		24.00	24.00	24.00	24.00	24.00		
					63.40						63.40	
					5.09						4.92	
					3415626.26						3391370.104	
					4987171						4964207	
					3231.69						3216.81	19019.75
					0						7672	
					4641						4570	
					100.80						100.80	
					96						96	
					0.00						2313.00	
					17104.00						16902.00	
					79383.99183						94980.37711	
					96.00						96.89681044	
					401.28						405.0286676	
					1296.81						1302.90	7650.70

Heat Cap - Coefficients					
Gas/Mat	*T^0	*T^1	*T^2	*T^3	*T^4
O2	0.2130	7.796E-05	-7.563E-08	4.074E-11	-8.183E-15
CO2	0.1906	1.771E-04	-1.733E-07	9.315E-11	-1.894E-14
N2+Ar	0.2465	-3.284E-06	4.366E-08	-2.750E-11	5.504E-15
H2O,steam	0.4445	2.910E-05	6.887E-08	-3.726E-11	6.472E-15
H2O, liq.	1.0000				
Rawmeal	0.2060	1.014E-04	-3.673E-08		
Clinker	0.1742	1.414E-04	-1.283E-07	5.074E-11	

O2	mass %	23.0
CO2	mass %	0.0
N2	mass %	77.0
H2O	mass %	0.0

CV Fan Flow	m3/min	9500
Fan Power Drawn		180

Grasim Cement -Rawan-Raipur

Clinker cooler modification Project data for after project

	Parameter		For Apr-2005				Monthly	For May-2005		
			05-Apr-05	12-Apr-05	19-Apr-05	26-Apr-05		03-May-05	10-May-05	17-May-05
1	Clinker production	tpd	4317	4376	4309	4381		4375	4448	4177
	Inlet temperature of the clinker in cooler	C	1400	1400	1400	1400		1400	1400	1400
	Specific heat of clinker	kcal/kg C	0.260	0.260	0.260	0.260		0.260	0.260	0.260
	Heat from clinker	kCal/hr	65454999	66349565	65333701	66425376		66334403	67441240	63332298
2	Inlet temperature of the cooling air in cooler	C	32.0	31.0	31.0	32.0		30.0	35.0	38.0
	Flow rate of cooling air in cooler	M3/min	6205.0	6228.0	6315.9	6201.9		6249.3	6298.6	6146.9
	Flow rate of cooling air in cooler	kg/hr	409661	412530	418355	409453		415306	411788	397997
	Specific heat of cooling air	kcal/kg C	0.239	0.239	0.239	0.239		0.239	0.239	0.239
	Heat from cooling air	kCal/hr	3136788	3059839	3103038	3135199		2980856	3449388	3620377
3	Power delivered by cooler fans	kWh/Day	20334	19999	20631	20106		19734	20222	19510
	Power delivered by cooler fans	kCal/hr	728635	716631	739278	720465		707135	724622	699108
1a	Temperature of cooler exhaust flue gases	C	311	306	302	308		344	299	326
	Power Drawn by Cooler ESP Fan	kWh/Day	880	1138	1150	1049		972	1044	1017
		kWh/hr	36.7	47.4	47.9	43.7		40.5	43.5	42.4
	Flow rate of Cooler exhaust fan	Nm3/hr	394515	403484	406091	395321		375901	415839	385009
	Flow rate of Cooler exhaust fan	Kg/hr	226715	233871	237020	228351		204465	243983	215712
	Cp of Cooler Exit Air	kcal/kg/deg.C	0.245	0.245	0.245	0.245		0.246	0.245	0.245
	Heat from Cooler Exit Air	kcal/hr	17260374	17510978	17508371	17212557		17270502	17838790	17238456
2a	Total Clinker from Cooler	tpd	4316	4375	4308	4380		4374	4447	4176
	Temp. of Clinker from Cooler	Deg.C	136.0	134.0	142.0	134.0		146.0	138.0	134.0
	Cp of Clinker from Cooler	kcal/kg/deg.C	0.191	0.191	0.192	0.191		0.192	0.191	0.191
	Heat from Clinker Cooler	kcal/hr	4675874	4664821	4889820	4670281		5116178	4894489	4452815
3a	Total Clinker Dust from Cooler ESP	tpd	1.001	0.925	0.925	0.804		0.804	0.763	0.763
	Temp. of from Clinker dust to ESP	Deg.C	311.0	306.0	302.0	308.0		344.0	299.0	326.0
	Cp of from Clinker dust to ESP	kcal/kg/deg.C	0.207	0.207	0.207	0.207		0.210	0.206	0.208
	Heat from Clinker dust to ESP	kcal/hr	2689	2439	2404	2136		2417	1961	2159

4a	Radiation Losses	kcal/hr	899	912	898	913		911	927	870
	Heat Losses	kcal/hr	21939836	22179149	22401493	21885887		22390008	22736167	21694300
	Cooler Efficiency	%	68.35	68.37	67.62	68.86	68.30	68.02	68.25	67.93
	Total heat input	kCal/hr	69320422	70126035	69176017	70281041	69725878.52	70022395	71615250	67651783
	Kiln running hours	hrs	24.00	24.00	24.00	24.00		24.00	24.00	24.00
	Baseline Efficiency	%					63.40			
	Increase in Cooler Efficiency	%					4.90			
	Saving in heat output due to increase in cooler efficiency	Kcal/hr					3416342.646			
	Saving in heat input due to increase in cooler efficiency	Kcal/hr					5001989			
	Total energy saved	Million Kcal					3241.29			
	Average calorific value of petcoke	Kcal/ kg					7740			
	Average calorific value of Coal	Kcal/ kg					4568			
	tCO ₂ emission per ton of Petcoke	t CO2/TJ					100.80			
	tCO ₂ emission per ton of Coal	t CO2/TJ					96			
	Quantity of petcoke consumed	tons/month					1632.00			
	Quantity of fine coal consumed	tons/month					18269.00			
	Total heat supplied by fuels	Million Kcal/month					96091			
	Average emission factor of fuel used	t CO2/TJ					96.63			
	Average emission factor of fuel used	kgCO2/Million Kcal					403.92			
	Emission Reduction	tons/month					1309.21			

Heat Cap - Coefficients

Gas/Mat	*T ⁰	*T ¹	*T ²	*T ³	*T ⁴
O2	0.2130	7.796E-05	-7.563E-08	4.074E-11	-8.183E-15
CO2	0.1906	1.771E-04	-1.733E-07	9.315E-11	-1.894E-14
N2+Ar	0.2465	-3.284E-06	4.366E-08	-2.750E-11	5.504E-15
H2O,steam	0.4445	2.910E-05	6.887E-08	-3.726E-11	6.472E-15
Rawmeal	0.2060	1.014E-04	-3.673E-08		
Clinker	0.1742	1.414E-04	-1.283E-07	5.074E-11	

		Monthly	For June-2005				Monthly	For July-2005				Monthly
24-May-05	31-May-05		07-Jun-05	14-Jun-05	21-Jun-05	28-Jun-05		05-Jul-05	12-Jul-05	19-Jul-05	29-Jul-05	
4464	4465		4515	4408	4288	4362		4403	4394	4371	4334	
1400	1400		1400	1400	1400	1400		1400	1400	1400	1400	
0.260	0.260		0.260	0.260	0.260	0.260		0.260	0.260	0.260	0.260	
67683835	67698997		68457104	66834754	65015296	66137295		66758944	66622484	66273755	65712755	
41.0	38.0		38.0	39.0	40.0	29.0		29.0	31.0	32.0	30.0	
6092.4	6153.5		6266.5	6204.3	6143.3	6232.0		6289.4	6310.6	6357.4	6238.8	
390699	398423		405738	400421	395220	415532		419355	418002	419723	414607	
0.239	0.239		0.239	0.239	0.239	0.239		0.239	0.239	0.239	0.239	
3835363	3624247		3690788	3738539	3784859	2882861		2909384	3100422	3213836	2975837	
22076	20896		21793	21391	20179	20228		21082	21127	21457	20378	
791057	748773		780916	766511	723081	724837		755438	757051	768876	730212	
322	318		293	328	294	314		301	298	290	309	
1047	1049		1187	975	1234	1014		1215	1245	1289	1185	
43.6	43.7		49.5	40.6	51.4	42.3		50.6	51.9	53.7	49.4	
403823	405314		419403	391967	400783	392119		403393	420246	427778	403738	
227774	230162		248682	218879	237223	224186		235856	247000	255000	232813	
0.245	0.245		0.244	0.245	0.244	0.245		0.245	0.245	0.244	0.245	
17972414	17928705		17807857	17602117	17046779	17237227		17363093	17997402	18068372	17607402	
4463	4464		4514	4407	4287	4361		4402	4393	4370	4333	
141.0	143.0		148.0	144.0	135.0	135.0		131.5	127.5	126.0	138.0	
0.192	0.192		0.192	0.192	0.191	0.191		0.191	0.190	0.190	0.191	
5027202	5105399		5358025	5078436	4607796	4687332		4599454	4439751	4360715	4768462	
0.959	0.959		0.959	0.844	0.880	0.880		0.880	1.219	1.219	1.274	
322.0	318.0		293.0	328.0	294.0	314.0		301.0	298.0	290.0	309.0	
0.208	0.208		0.206	0.209	0.206	0.208		0.207	0.206	0.206	0.207	
2678	2641		2411	2407	2222	2391		2281	3122	3029	3397	

930	930		941	918	893	909		917	915	911	903	
23003223	23037676		23169233	22683879	21657690	21927858		21965744	22441190	22433027	22380164	
68.19	68.04	68.09	68.23	68.20	68.85	68.56	68.46	68.81	68.16	68.07	67.76	68.20
72310254	72072017	70734339.62	72928808	71339804	69523237	69744993	70884210.38	70423765	70479957	70256466	69418804	70144748.07
24.00	24.00		24.00	24.00	24.00	24.00		24.00	24.00	24.00	24.00	
		63.40					63.40					63.40
		4.69					5.06					4.80
		3314979.886					3587028.222					3366794.456
		4868776					5239566					4936665
		3154.97					3395.24					3198.96
		7679					7681					7671
		4544					4424					0
		100.80					100.80					100.80
		96					96					96
		3331.00					4169.00					2338.00
		14426.00					13009.00					17469.00
		91133.71871					89571.87039					17934.44613
		97.34717984					97.7159552					100.8
		406.9112117					408.4526927					421.344
		1283.79					1386.79					1347.86

O2	mass %	23.0
CO2	mass %	0.0
N2	mass %	77.0
H2O	mass %	0.0

CV Fan Flow	m3/min	9500
Fan Power Drawn		180

For Aug-2005				Monthly	For Sept-2005					Monthly	For Oct-2005	
05-Aug-05	12-Aug-05	19-Aug-05	26-Aug-05		02-Sep-05	09-Sep-05	16-Sep-05	23-Sep-05	30-Sep-05		07-Oct-05	14-Oct-05
4417	4358	4362	4418		4289	4220	4341	Kiln Shutdown			Kiln S/D	4018
1400	1400	1400	1400		1400	1400	1400					1400
0.260	0.260	0.260	0.260		0.260	0.260	0.260					0.260
66971214	66076647	66137295	66986376		65030458	63984270	65818890					60921516
25.0	31.0	25.0	29.0		32.0	28.0	29.0					28.0
6188.0	6119.6	6079.5	6189.8		6140.6	6127.7	6225.4					6162.1
418135	405352	410799	412717		405404	409932	415088					412232
0.239	0.239	0.239	0.239		0.239	0.239	0.239					0.239
2500115	3006594	2456253	2863332		3104196	2745758	2879786					2761161
20099	19136	18539	19276		19781	19509	20545					19617
720214	685707	664314	690723		708819	699073	736196					702943
318	304	312	315		321	301	305					296
792	1031	911	942		805	852	990					853
33.0	43.0	38.0	39.3		33.5	35.5	41.3					35.5
377414	401424	393000	402903		381873	396765	410002					390663
214319	233484	225458	229960		215755	231980	238061					230420
0.245	0.245	0.245	0.245		0.245	0.245	0.245					0.244
16694569	17364553	17221467	17739118		16969694	17077785	17764770					16673556
4416	4357	4361	4417		4288	4219	4340					4017
152.0	137.0	140.5	143.5		135.0	131.0	126.0					123.0
0.193	0.191	0.192	0.192		0.191	0.191	0.190					0.190
5394881	4757584	4893322	5070544		4608697	4389632	4330552					3906155
1.274	1.123	1.123	1.123		1.042	1.444	1.444					1.165
318.0	304.0	312.0	315.0		321.0	301.0	305.0					296.0
0.208	0.207	0.207	0.208		0.208	0.207	0.207					0.206
3507	2941	3027	3060		2900	3741	3796					2963

920	908	909	920		894	879	904					837
22093878	22125986	22118726	22813643		21582185	21472037	22100024					20583510
68.52	68.29	68.06	67.66	68.13	68.65	68.16	68.17			68.33		68.03
70191542	69768947	69257862	70540431	69939695.72	68843473	67429101	69434872			68569148.70		64385619
24.00	24.00	24.00	24.00		24.00	24.00	24.00					24.00
				63.40						63.40		
				4.73						4.93		
				3310283.645						3377730.224		
				4858558						4943549		
				3148.35						3203.42		
				7681						7681		
				4577						4548		
				100.80						100.80		
				96						96		
				2942.00						3533.00		
				7189.00						8847.00		
				55500.86611						67375.88126		
				97.95443233						97.93320227		
				409.4495271						409.3607855		
				1289.09						1311.35		

ct-2005		Monthly	For Nov-2005				Monthly	Yearly
21-Oct-05	28-Oct-05		04-Nov-05	11-Nov-05	18-Nov-05	25-Nov-05		
4107	4007		4230	4347	4226	4303		
1400	1400		1400	1400	1400	1400		
0.260	0.260		0.260	0.260	0.260	0.260		
62270947	60754732		64135892	65909863	64075243	65242729		
27.0	29.0		26.0	23.0	23.0	24.0		
6216.5	6226.1		6194.0	6283.9	6149.2	6257.1		
417257	415138		417140	427483	418320	424224		
0.239	0.239		0.239	0.239	0.239	0.239		
2694821	2880128		2594107	2351208	2300811	2434896		
20019	20034		20482	21300	20472	20865		
717348	717885		733938	763250	733580	747663		
275	301		312	281	292	302		
1060	951		1045	1322	1253	1170		
44.2	39.6		43.5	55.1	52.2	48.8		
401435	390521		382904	414645	406189	392148		
245847	228330		219667	251186	241274	228882		
0.244	0.245		0.245	0.244	0.244	0.245		
16496562	16809045		16779068	17231844	17216806	16907212		
4106	4006		4229	4346	4225	4302		
129.0	121.0		130.0	125.5	128.5	139.0		
0.190	0.190		0.191	0.190	0.190	0.192		
4202231	3827561		4364186	4318160	4305825	4771332		
1.165	1.184		1.184	1.348	1.348	1.300		
275.0	301.0		312.0	281.0	292.0	302.0		
0.204	0.207		0.207	0.205	0.206	0.207		
2730	3068		3193	3234	3375	3379		

856	835		881	906	880	896		
20702378	20640508		21147329	21554144	21526886	21682820		
68.48	67.93	68.15	68.65	68.77	67.92	68.31	68.42	
65683116	64352746	64807160.09	67463937	69024321	67109634	68425287	68005794.67	
24.00	24.00		24.00	24.00	24.00	24.00		
		63.40					63.40	
		4.75					5.02	
		3075814.044					3410743.55	
		4513558					4985347	
		2924.79					3230.50	25497.51
		7573					7573	
		4403					4428	
		100.80					100.80	
		96					96	
		4787.00					4892.00	
		13089.00					12997.00	
		93883.61578					94595.94736	
		97.85343567					97.87981957	
		409.0273611					409.1376458	
		1196.32					1321.72	10446.14

IRR calculations for Cooler Upgradation in Grasim Cement Raipur																
Year	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Expenditure																
Initial investment (INR in millions)	22.00															
Recurring cost																
Administrative cost (3% Annual Escalation)		1.00	1.03	1.06	1.09	1.13	1.16	1.19	1.23	1.27	1.30	1.34	1.38	1.43	1.47	1.51
Maintenance Cost @ 1% of cost of project with 3% escalation every year.		0.22	0.23	0.23	0.24	0.25	0.26	0.26	0.27	0.28	0.29	0.30	0.30	0.31	0.32	0.33
Production Loss due to plant shutdown during commissioning (10 days)		30.10														
Cost of insurance (1.5% of project cost) every year		0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Income Tax on Fuel Cost Saving		3.01	3.10	3.19	3.29	3.39	3.49	3.59	3.70	3.81	3.92	4.04	4.16	4.29	4.42	4.55
Total cashflow out (A)	22.00	34.66	4.68	4.82	4.95	5.09	5.23	5.38	5.53	5.69	5.85	6.01	6.18	6.36	6.54	6.73
Income																
WDV		22.00	16.50	12.38	9.28	6.96	5.22	3.92	2.94	2.20	1.65	1.24	0.93	0.70	0.52	0.39
Depreciation		5.50	4.13	3.09	2.32	1.74	1.31	0.98	0.73	0.55	0.41	0.31	0.23	0.17	0.13	0.10
Saving in income tax due to depreciation (33.66% of depreciated amount)		1.85	1.39	1.04	0.78	0.59	0.44	0.33	0.25	0.19	0.14	0.1	0.08	0.06	0.04	0.03
Fuel saving based on Coal cost Rs. 1400/MT with 3% escalation per year		8.94	9.20	9.48	9.76	10.06	10.36	10.67	10.99	11.32	11.66	12.01	12.37	12.74	13.12	13.52
CER credits		2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	0.00	0.00	0.00	0.00	0.00
Total project income without considering CER credits(B)		10.79	10.59	10.52	10.54	10.65	10.80	11.00	11.24	11.51	11.80	12.11	12.45	12.80	13.16	13.55
Total project income with considering CER credits(C)		13.66	13.47	13.40	13.42	13.52	13.67	13.88	14.12	14.39	14.67	12.11	12.45	12.80	13.16	13.55
Net cash flow without considering CER Credits	-22.00	-23.87	5.91	5.70	5.59	5.56	5.57	5.62	5.71	5.82	5.95	6.10	6.27	6.44	6.62	6.82
Net cash flow with considering CER Credits	-22.00	-21.00	8.78	8.58	8.47	8.43	8.44	8.50	8.59	8.70	8.83	6.10	6.27	6.44	6.62	6.82
IRR of the project without considering CER credits	8.28%															
IRR of the project with considering CER credits	15.34%															