Monitoring Report

of

Mysore Cements Limited Portland Slag Cement project

for the period

January1, 2001 to December 31, 2006

UNFCCC Reference No: 0711

Version 1

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SECTION 0

Project Title:	*Mysore Cements Limited Portland Slag Cement Project*
UNFCCC Reference no:	*0711*
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SECTION 1

1.1 Introduction

Mysore Cements Limited is an indirect subsidiary of the Heidelberg Cement Group, one of the largest cement manufacturers in the world. The company was earlier one of the leading companies of the SK Birla group and had established its first unit at Ammasandra in 1962. The plant manufactures Portland Slag Cement (PSC). PSC is manufactured as per IS-455/1989 by intergrinding clinker, gypsum and granulated slag in suitable proportion and marketed under the brand name Birla Power and Diamond Super.

1.2 Purpose

The purpose of the project activity is to increase the share of slag in the Portland Slag Cement (PSC) production at Mysore Cements Limited (MCL). This reduces clinker use in the PSC production, thus reduces associated greenhouse gas (GHG) effect with clinker production, lowering CO_2 emissions per ton of cement production.

Manufacturing of clinker consists of grinding and pyro processing of raw materials. The reduction in clinker percentage in the blended cement results in conservation of limestone. This displaces calcinations of certain amount of limestone used for clinker production and its associated greenhouse gas (GHGs) emissions into the atmosphere. This also reduces thermal and electrical energy used in the production of clinker and its associated indirect GHGs emissions.

1.3 Project Location

The existing “slag and clinker grinding - mixing unit” is located at Ammsandra, Taluka: Turvekre, District Tumkur, state: Karnataka, India. The site is at a distance of 46 kms from Tumkur, 125 kms from Bangalore City by road. The nearest railway station is Ammasandra, while nearest airport / airstrip is Bangalore.

1.4 Current status of the project activity

The project activity is registered with UNFCCC as CDM activity under ***"Sector 4 – Manufacturing industries"***. The UNFCCC reference number is 0711

1.5 Baseline methodology

Title: Consolidated Baseline Methodology for Increasing the Blend in Cement Production

Reference: Approved consolidated baseline methodology ACM0005 / Version 03, Sectoral Scope: 4, 19 May 2006

SECTION 2

2 Monitoring

2.1 Monitoring methodology

Title: Consolidated Baseline Methodology for Increasing the Blend in Cement Production

Reference: Approved consolidated baseline methodology ACM0005 / Version 03, Sectoral Scope: 4, 19 May 2006

2.2 Monitoring period

The monitoring of parameters is done for the baseline emissions, project emissions, and leakage calculations. Monitoring period for the project activity is chosen from 1st January 2001 to 31st December 2006. Parameters monitored during the period and their recording frequency is given in the ensuing paragraph. Data of all the relevant years have been archived for the verification purpose, and shall be kept for a minimum of two years after the crediting period.

2.3 Monitoring parameters

2.3.1 Data monitored for the Baseline Emission Calculations

ID No	Data variable	Data unit	Recording frequency	Reference
1.1	$InCaO_{BSL}$	%	Daily	Appendix-I
1.2	$OutCaO_{BSL}$	%	Daily	Appendix-I
1.3	$InMgO_{BSL}$	%	Daily	Appendix-I
1.4	$OutMgO_{BSL}$	%	Daily	Appendix-I
1.5	Quantity of clinker raw material	Kilo tonnes	Annually	Appendix-I
1.6	$CLNK_{BSL}$	Kilo tones of clinker	Annually	Appendix-I
1.7	$FF_{i\_,BSL}$	Tonnes of	Annually	Appendix-I

		fuel i		
1.8	EFF_i	tCO2/tonne of fuel i	Annually	Appendix-I
1.9	$BELE_{grid\_CLNK,BSL}$	MWh	Monthly	Appendix-I
1.10	EF_{grid_BSL}	t CO2/MWh	Once	Appendix-I
1.11	$BELE_{sg\_CLNK,BSL}$	MWh	Monthly	Appendix-I
1.12	EF_{sg_BSL}	t CO2/MWh	Monthly	Appendix-I
1.13	ADD_{BSL}Quantity of additives	Kilo tonnes	Monthly	Appendix-I
1.14	$BELE_{grid\_BC,BSL}$	MWh	Monthly	Appendix-I
1.15	$BELE_{sg\_BC,BSL}$	MWh	Monthly	Appendix-I
1.16	$BELE_{grid\_ADD}$	MWh	Monthly	Appendix-I
1.17	$BELE_{sg\_ADD,BSL}$	MWh	Monthly	Appendix-I
1.18	$F_{i\ ,j,\ BSL}$	Tonnes of fuel i	Monthly	Appendix-I
1.19	$COEF_{i,j\ BSL}$	tCO_2/tonne of fuel i	Annually	Appendix-I
1.20	$GEN_{j,BSL}$	MWh	Annually	Appendix-I
1.21	$BE_{calcin,BSL}$	t CO_2/tonne clinker	Annually	Appendix-I
1.22	$BE_{fossil\_fuel,BSL}$	t CO_2/tonne clinker	Annually	Appendix-I
1.23	$BE_{ele\_grid\_CLNK,BSL}$	t CO_2/tonne clinker	Annually	Appendix-I
1.24	$BE_{ele\_sg\_CLNK,BSL}$	t CO_2/tonne clinker	Annually	Appendix-I
1.25	$BE_{ele\_grid\_BC,BSL}$	t CO_2/tonne blended cement	Annually	Appendix-I
1.26	$BE_{ele\_sg\_BC,BSL}$	t CO_2/tonne blended cement	Annually	Appendix-I
1.27	$BE_{ele\_grid\_ADD,BSL}$	t CO_2/tonne blended cement	Annually	Appendix-I
1.28	$BE_{ele\_sg\_ADD,BSL}$	t CO_2/tonne blended	Annually	Appendix-I

		cement		
1.29	$B_{blend,y}$	Tonne of additives/tonnes of blended cement	Annually	Appendix-I
1.30	$EF_{OM,y}$	tCO2/MWh	Once	Appendix-I
1.31	$EF_{BM,y}$	tCO2/MWh	Once	Appendix-I

2.3.2 Data monitored for the Project Emission Calculations

ID No	Data variable	Data unit	Recording frequency	Reference
2.1	$InCaO_Y$	%	Daily	Appendix-I
2.2	$OutCaO_Y$	%	Daily	Appendix-I
2.3	$InMgO_Y$	%	Daily	Appendix-I
2.4	$OutMgO_Y$	%	Daily	Appendix-I
2.5	Quantity of clinker raw material	Kilo tonnes	Annually	Appendix-I
2.6	$CLNK_Y$	Kilo tones of clinker	Annually	Appendix-I
2.7	$FF_{i\_,Y}$	Tonnes of fuel i	Annually	Appendix-I
2.8	EFF_i	tCO2/tonne of fuel i	Annually	Appendix-I
2.9	$PELE_{grid\_CLNK,Y}$	MWh	Monthly	Appendix-I
2.10	EF_{grid_BSL}	t CO2/MWh	Once	Appendix-I
2.11	$PELE_{sg\_CLNK,Y}$	MWh	Monthly	Appendix-I
2.12	EF_{sg_Y}	t CO2/MWh	Monthly	Appendix-I
2.13	ADD_YQuantity of additives	Kilo tonnes	Monthly	Appendix-I
2.14	$PELE_{grid\_BC,Y}$	MWh	Monthly	Appendix-I
2.15	$PELE_{sg\_BC,Y}$	MWh	Monthly	Appendix-I
2.16	$PELE_{grid\_ADD}$	MWh	Monthly	Appendix-I

2.17	$PELE_{sg\_ADD,Y}$	MWh	Monthly	Appendix-I
2.18	$F_{i,j,Y}$	Tonnes of fuel i	Monthly	Appendix-I
2.19	$COEF_{i,j\,Y}$	tCO_2/tonne of fuel i	Annually	Appendix-I
2.20	$GEN_{j,Y}$	MWh	Annually	Appendix-I
2.21	$PE_{calcin,Y}$	t CO_2/tonne clinker	Annually	Appendix-I
2.22	$PE_{fossil\_fuel,Y}$	t CO_2/tonne clinker	Annually	Appendix-I
2.23	$PE_{ele\_grid\_CLNK,Y}$	t CO_2/tonne clinker	Annually	Appendix-I
2.24	$PE_{ele\_sg\_CLNK,Y}$	t CO_2/tonne clinker	Annually	Appendix-I
2.25	$PE_{ele\_grid\_BC,Y}$	t CO_2/tonne blended cement	Annually	Appendix-I
2.26	$PE_{ele\_sg\_BC,Y}$	t CO_2/tonne blended cement	Annually	Appendix-I
2.27	$PE_{ele\_grid\_ADD,Y}$	t CO_2/tonne blended cement	Annually	Appendix-I
2.28	$PE_{ele\_sg\_ADD,Y}$	t CO_2/tonne blended cement	Annually	Appendix-I
2.29	$B_{blend,y}$	Tonne of additives/tonne of blended cement	Annually	Appendix-I
2.30	$EF_{OM,y}$	tCO2/MWh	Once	Appendix-I
2.31	$EF_{BM,y}$	tCO2/MWh	Once	Appendix-I

2.3.3 Data to be monitored for Leakage Calculations

ID No	Data variable	Data unit	Recording frequency	Reference
3.1	TF_{cons}	kg of fuel/kilometre	Annually	Appendix-I
3.2	D_{add_source}	km	Per trip	Appendix-I
3.3	TEF	kg CO_2/kg of	Annually	Appendix-I

		fuel		
3.4	Q_{add}	Tonnes of additive /vehicle	Per trip	Appendix-I
3.5	$ELE_{conveyor\_ADD}$	MWh	Monthly	Appendix-I
3.6	EF_{grid}	Tonnes of CO_2/MWh	Annually	Appendix-I
3.7	α_y	Tonnes of additive	Annually	Appendix-I

2.3.4 Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

The plant is operated by Company's operating personnel. The DGM (Finance) has been assigned the responsibility of the project management as also for monitoring, measurement and reporting. The deputy general managers of the relevant departments (stores, laboratory, costing and sales) are assigned with the responsibilities of archiving the respective data for pre-determined monitoring parameters as given in the monitoring plan with actual readings being taken by the Shift In-charges and Engineers.

The personnel are adequately trained and highly competent enough to carry out the necessary work.

The QA & QC procedures are practiced and implemented in order to:

1. Secure a good consistency through planning to implementation of this CDM project and,
2. Stipulate who has responsibility for what and,
2. Avoid any misunderstanding between people and organization involved.
3. Calibration of the relevant instruments and meters

ID number	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.

1.1-1.31 & 2.1-2.31	Low	These data is collected as part of normal plant level operations. QA/QC requirements consist of cross – checking these with other internal company reports. Local data and where applicable IPCC data has been used.
3.1-3.7	Medium	These data is collected at the ***purchase (stores)*** and ***costing*** department.

Calibration/Maintenance of Measuring Instruments and meters

Monitoring of parameters, which involve measurements, was done with necessary equipments according to the pre-determined intervals mentioned in the monitoring plan as per the monitoring methodology adopted for the project activity.

The calibration of the monitoring equipments is done regularly. The calibration certificates for the relevant instruments and meters are available at the plant for the verification

2.3.5 Environmental Management Plan

The plant possesses the valid consent to operate from the Karnataka State pollution Control Board. Internal Environmental Audit Reports are prepared regularly and submitted to the State pollution control board and are available at the project site.

Environmental monitoring is carried out regularly in the plant. There are four ambient air monitoring stations at the cement manufacturing unit. The parameters like NO_x, CO and HC are being monitored by a MoEF approved external agency once in three months. The plant executes the pollution control measures, as part of environment management plan. Installations of Bag filters replacing the Electrostatic Precipitators have been implemented in the year 2006, as a pollution control measure, in order to control and maintain the emission levels below the specified standard limits

SECTION 3

GHG Emission Reductions

The project activity entails the reduction of clinker content of Portland Slag Cement (PSC) production by increasing the percentage of slag and thereby replacing the equivalent amount of clinker at MCL's cement manufacturing units at Ammasandra, Karnataka. This reduces clinker use in the PSC production, thus reduces associated greenhouse gas (GHG) effect with clinker production, lowering CO_2 emissions per ton of cement production. The formula for calculations of emission reductions is as below:

$$ER_y = \{ [BE_{BC,y} - PE_{BC,y}] * BC_y + L_y \} * (1 - \alpha_y)$$

Where:

ER_y = Emissions reductions in year y due to project activity (thousand tonnes of CO2)

$BE_{BC,y}$ = Baseline emissions per tonne of BC (t CO2/tonnes of BC)

$PE_{BC,y}$ = Project emissions per tonne of BC in year y (t CO2/tonnes of BC)

BC_y = BC production in year y (thousand tonnes)

α_y = amount (tonnes of) additive used in year y/ total additional additives used in year y

Year wise Emission reductions achieved during the monitoring period (January 2001 to December 2006) are presented in the following Table 3.1. The detailed calculations, including those of the baseline emissions, project emissions, and leakages are given at the Appendix I

Table 3.1: **Emission Reductions during the period January, 2001 to December 2006**

Year	Emission Reductions (tCO2e)
2001	12406.2
2002	34365.9
2003	30294.3
2004	29226.9
2005	17150.5
2006	17983.3

SECTION 4

APPENDIX-I

Baseline emissions

$$BE_{BC,y} = [BE_{clinker} * B_{Blend,y}] + BE_{ele\_ADD\_BC} \text{-----------------(1)}$$

Where:

$BE_{BC,y}$ = Baseline CO_2 emissions per tonne of blended cement type (BC) (t CO_2/tonne BC)

$BE_{clinker}$ = CO_2 emissions per tonne of clinker in the baseline in the project activity plant (t CO_2/tonne clinker) and defined below

$B_{Blend,y}$ = Baseline benchmark of share of clinker per tonne of BC updated for year y (tonne of clinker/tonne of BC)

$BE_{ele\_ADD\_BC}$ = Baseline electricity emissions for BC grinding and preparation of additives (tCO_2/tonne of BC)

Table 4.1 (Baseline emissions for the period January 2001 to December 2006)

Year	**$BE_{clinker}$** (tCO_2/tonne of clinker)	**B_{Blend}** (tonne of clinker/tonne of BC)	**$BE_{elec\_sg\_BC}$** self generated electricity emissions for BC grinding (tCO_2/tonne of BC)	**$BE_{BC,y}$** (tCO_2/tonne BC)
2001	1.0307	0.597840424	0.0599	0.63934775
2002	0.98513	0.590106586	0.0441	0.63153337
2003	0.95986	0.582372748	0.0445	0.62371892
2004	0.98001	0.57463891	0.0485	0.61590450
2005	0.96619	0.566905072	0.0546	0.60233801
2006	1.01041	0.559171234	0.0541	0.61909220

Project emissions

$$PE_{BC,y} = [PE_{clinker,y} * P_{Blend,y}] + PE_{ele\_ADD\_BC,y} \text{---------------------(2)}$$

Where:

$PE_{BC,y}$ = CO_2 emissions per tonne of BC in the project activity plant in year y(t CO_2/tonne BC)

$PE_{clinker,y}$ = CO_2 emissions per tonne of clinker in the project activity plant in year y (t CO2/tonne clinker) and defined below

$P_{Blend,y}$ = Share of clinker per tonne of BC in year y (tonne of clinker/tonne of BC)

$PE_{ele\_AD,D\_BC,y}$ = Electricity emissions for BC grinding and preparation of additives in year y (tCO_2/tonne of BC)

$$PE_{clinker,y} = PE_{calcin,y} + PE_{fossil\_fuel,y} + PE_{ele\_grid\_CLNK,y} + PE_{ele\_sg\_CLNK,y} \text{ -------- (2.1)}$$

Where:

$PE_{clinker,y}$ = Emissions of CO_2 per tonne of clinker in the project activity plant in year y (t CO_2/tonne clinker)

$PE_{calcin,y}$ = Emissions per tonne of clinker due to calcinations of calcium carbonate and magnesium carbonate in year y (t CO_2/tonne clinker)

$PE_{fossil\_fuel,y}$ = Emissions per tonne of clinker due to combustion of fossil fuels for clinker production in year y (t CO_2/tonne clinker)

$PE_{ele\_grid\_CLNK,y}$ = Grid electricity emissions for clinker production per tonne of clinker in year y (t CO_2/tonne clinker)

PEele_sg_CLNK,y = Emissions from self-generated electricity per tonne of clinker production in year y (t CO_2/tonne clinker)

$$PE_{calcin,y}=0.785*(OutCaOy - InCaOy)+1.092*(OutMgOy - InMgOy)/[CLNKy* 1000] \text{ ---(2.1.1)}$$

Where:

$PE_{calcin,y}$ = Emissions from the calcinations of limestone (tCO_2/tonne clinker)

0.785 = Stoichiometric emission factor for CaO (tCO_2/t CaO)

1.092 = Stoichiometric emission factor for MgO (tCO_2/t MgO)

$InCaO,_y$ = CaO content (%) of the raw material * raw material quantity (tonnes)

$OutCaO,_y$ = CaO content (%) of the clinker * clinker produced (tonnes)

$InMgO,_y$ = MgO content (%) of the raw material * raw material quantity (tonnes)

$OutMgO,_y$ = MgO content (%) of the clinker * clinker produced (tonnes)

Table 4.2 (Project emissions from the calcinations of limestone for the period January 2001 to December 2006)

Year	**InCaO** (CaO content % of the raw material)-year average	**OutCaO** (CaO content % of the clinker)-year average	**InMgO** (MgO content % of the raw material)-year average	**OutMgO** (MgO content % of the clinker	**Annual raw material quantity** (tones)	**CLKN** (Annual clinker produced, tones)	**$PE_{calcin,y}$** (Annual Emissions from the calcinations of limestone ,tCO_2/tonne clinker)
2001	0	63.28	0	4.79	250397	160514	0.53955
2002	0	63.78	0	3.44	348090	226134	0.53823
2003	0	63.82	0	3.66	302753	205957	0.5405
2004	0	63.43	0	4.72	287134	195332	0.5395
2005	0	63.00	0	4.01	283369	192772	0.53833
2006	0	62.04	0	4.68	317611	216061	0.53812

$$PE_{fossil\_fuel,\,y} = [\ \sum FF_{i\_,y} * EFF_i]\ /CLNK_{,y} * 1000 \text{ ------------(2.1.2)}$$

Where:

$FF_{i\_,y}$ = Fossil fuel of type i consumed for clinker production in year y (tonnes of fuel i)

EFF_i = Emission factor for fossil fuel i (tCO_2/tonne of fuel)

$CLNK_y$ = Annual production of clinker in year y (kilotonnes of clinker)

Table 4.3 (Project emissions from fossil fuel consumption for the clinker production during the period January 2001 to December 2006)

Year	**Quantity of coal consumed annually FFi** (MT)	**PE_{fossil_fuel}** (tCO_2/tonne of clinker)
2001	33767	0.42826
2002	33197	0.38499
2003	29828	0.36299
2004	42649	0.37090
2005	44317	0.36755
2006	49521	0.40101

$$PE_{ele\_grid\_CLNK,y} = [PELE_{grid\_CLNK,y} * EF_{grid\_y}] / [CLNK_y * 1000] \text{ --------(2.1.3)}$$

Where:

$PELE_{grid\_CLNK,y}$ = Grid electricity for clinker production in year y (MWh)

EF_{grid_y} = Grid emission factor in year y(t CO_2/MWh)

$CLNK_y$ = Annual production of clinker in year y (kilotonnes of clinker)

Table 4.4: Project emissions from grid electricity consumption for the clinker production

Year	$PELE_{grid\_CLNK}$ (Annual grid electricity for clinker production , MWh)	EF_{grid} Grid emission factor (t CO_2/MWh)	$PE_{ele\_grid\_CLNK}$ Annual grid electricity emissions for clinker production per tonne of clinker (tCO2/tclinker)
2001	137.601	0.997	0.00085468
2002	186.806	0.997	0.00823607
2003	345.808	0.997	0.00167399
2004	714.02	0.997	0.00364445
2005	1044.265	0.997	0.0048187
2006	1375.434	0.997	0.0063469

$$PE_{elec\_sg\_CLNK,y} = [PELE_{sg\_CLNK,y} * EF_{sg\_y}] / [CLNK_y * 1000] \text{ --------------(2.1.4)}$$

Where:

$PELE_{sg\_CLNK,y}$ = Self generation of electricity for clinker production in year y (MWh)

EF_{sg_y} = Emission factor for self generated electricity in year y (t CO_2/MWh)

$CLNK_y$ = Annual production of clinker in year y (kilotonnes of clinker)

Table 4.5: Project emissions from self generated electricity consumption for clinker production

Year	**$PELE_{sg\_CLNK}$** (self generated electricity for clinker production , MWh)	**EF_{sg}** Self generated electricity emission factor (t CO_2/MWh)	**$PE_{elec\_sg\_CLNK}$** Annual emissions from self generated electricity per tonne of clinker (tCO2e/tclinker)
2001	12164.840	0.818	0.06206
2002	16834.532	0.820	0.061078
2003	13863.540	0.811	0.054650
2004	15651.967	0.823	0.065964
2005	14691.282	0.816	0.05548
2006	17654.842	0.79	0.06494

Table 4.6: Project emissions from clinker production

Year	**$PE_{clinker}$** (tCO2/tclinker)
2001	1.0307
2002	0.98513
2003	0.95986
2004	0.98001
2005	0.96619
2006	1.01041

$$PE_{ele\_ADD\_BC,y} = PE_{ele\_grid\_BC,y} + PE_{ele\_sg\_BC,y} + PE_{ele\_grid\_ADD,y} + PE_{ele\_sg\_ADD,y} \text{ ----------(2.2)}$$

Where:

$PE_{ele\_grid\_BC}$ = Grid electricity emissions for BC grinding in year y (tCO_2/tonne of BC)

$PE_{ele\_sg\_BC}$ = Emissions from self generated electricity for BC grinding in year y (tCO_2/tonne of BC)

$PE_{ele\_grid\_ADD}$ = Grid electricity emissions for additive preparation in year y (tCO_2/tonne of BC)

$PE_{ele\_sg\_ADD}$ = Emissions from self generated electricity additive preparation in year y (tCO_2/tonne of BC)

$$PE_{ele\_grid\_BC,y} = [\, PELE_{grid\_BC,}y * EF_{grid\_BSL,y}] / [BC_y * 1000] \text{ ----------------------(2.2.1)}$$

Where:

$PELE_{grid\_BC,y}$ = Baseline grid electricity for grinding BC (MWh)

EF_{grid_y} = Grid emission factor in year y (t CO_2/MWh)

BC_y = Annual production of BC in year y (kilotonnes of BC)

Table 4.7: Project emissions from grid electricity consumption for the blended cement production

Year	**$PELE_{grid\_BC}$** (MWh)	**EF_{grid}** (t CO_2/MWh)	**BC** Annual production of BC in year y (kilotonnes of BC)	**$PE_{ele\_grid\_BC}$** Grid electricity emissions for BC grinding (tCO_2/tonne of BC)
2001	0	0.997	245967	0
2002	0	0.997	354345	0
2003	0	0.997	374138.39	0
2004	0	0.997	379126.01	0
2005	0	0.997	333000.85	0
2006	0	0.997	336559.00	0

$PE_{elec\_sg\_BC,y}$ = [$PELE_{sg\_BC,y}$ * EF_{sg_y}] / [BC_y* 1000] ------------------(2.2.2)

Where:

$PELE_{sg\_BC,y}$ = Self generated electricity for grinding BC in year y (MWh)

EF_{sg_y} = Emission factor for self generated electricity in year y (t CO_2/MWh)

BC_y = Annual production of BC in year y (kilo tonnes of BC)

Table 4.8: Project emissions from self generated electricity consumption for the grinding of blended cement

Year	**$PELE_{sg\_BC}$** (MWh)	**EF_{sg}** (t CO_2/MWh)	**BC** Annual production of BC in year y (kilotonnes of BC)	**$PE_{elec\_sg\_BC}$** self generated electricity emissions for BC grinding (tCO_2/tonne of BC)
2001	18005.227	0.818	245967	0.0599
2002	19049.458	0.820	354345	0.0441
2003	20525.134	0.811	374138.39	0.0445
2004	22371.917	0.823	379126.01	0.0485
2005	22283.464	0.816	333000.85	0.0546
2006	23066.683	0.79	336559.00	0.0541

$PE_{ele\_grid\_ADD}$ = [$PELE_{grid\_ADD}$ * EF_{grid_y}] /[BC_y* 1000] -------------(2.2.3)

Where:

$BELE_{grid\_ADD}$ = Baseline grid electricity for grinding additives (MWh)

EF_{grid_y} = Grid emission factor in year y(t CO_2/MWh)

BC_y = Annual production of BC in year y (kilotonnes of BC)

Table 4.9 (Project emissions from grid electricity consumption for the grinding of additives during the period January 1, 2001 to December 31, 2006)

Year	**$PELE_{grid\_ADD}$** (MWh)	**EF_{grid}** (t CO_2/MWh)	**BC** Annual production of BC in year y (kilotonnes of BC)	**$PE_{ele\_grid\_ADD}$** grid electricity emissions for BC grinding tCO_2/tonne of BC)
2001	0	0.997	245967	0

2002	0	0.997	354345	0
2003	0	0.997	374138.39	0
2004	0	0.997	379126.01	0
2005	0	0.997	333000.85	0
2006	0	0.997	336559.00	0

$$\mathbf{PE_{elec\_sg\_ADD,y} = [PELE_{sg\_ADD,y} * EF_{sg\_y}] / [BC_y * 1000]} \text{ -----------(2.2.4)}$$

Where:

$PELE_{sg\_ADD,y}$ = Baseline self generation electricity for grinding additives (MWh)

EF_{sg_y} = Emission factor for self generated electricity in year y (t CO_2/MWh)

BC_y = Annual production of BC in year y (kilotonnes of BC)

Table 4.10: Project emissions from self generated electricity consumption for the grinding of additives

Year	**$PELE_{sg\_ADD}$** (MWh)	**EF_{sg}** (t CO_2/MWh)	**BC** Annual production of BC in year y (kilotonnes of BC)	**$PE_{elec\_sg\_ADD}$** grid electricity emissions for BC grinding tCO_2/tonne of BC)
2001	0	0.818	245967	0
2002	0	0.820	354345	0
2003	0	0.811	374138.39	0
2004	0	0.823	379126.01	0
2005	0	0.816	333000.85	0
2006	0	0.79	336559.00	0

****$PE_{elec\_sg\_ADD}$*** *is taken as zero because in the project activity, additives are grinded with the clinker*

Table 4.11: Project emissions from BC grinding and preparation of additives

Year	$PE_{ele\_ADD\_BC}$ (tCO_2/tonne of BC)
2001	0.0599
2002	0.0441
2003	0.0445
2004	0.0485
2005	0.0546
2006	0.0541

Project emissions

$$PE_{BC,y} = [PE_{clinker,y} * P_{Blend,y}] + PE_{ele\_ADD\_BC,y} \text{ ---------------------------(2)}$$

Table 4.12 (Project emissions per tonne of BC during the period January 1, 2001 to December 31, 2006)

Year	$PE_{clinker}$ (tCO_2/tonne of clinker)	P_{Blend} tonne of clinker / tonne of blended cement)	$PE_{ele\_ADD\_BC}$ (tCO_2/tonne BC)	PE_{BC} (tCO_2/tonne BC)
2001	1.0307	0.5132	0.0599	0.58891
2002	0.98513	0.4978	0.0441	0.53455
2003	0.95986	0.5191	0.0445	0.54283
2004	0.98001	0.5003	0.0485	0.53891
2005	0.96619	0.5137	0.0546	0.55093
2006	1.01041	0.5064	0.0541	0.5658

**P_{blend} is share of clinker per tonne of BC produced in year y (tonne of clinker / tonne of BC) and Pblend is calculated using following formulae*

= clinker consumed in PSC / PSC production

Clinker consumed in PSC = PSC production- Gypsum consumption in PSC – Slag consumption in PSC

Leakages

$$L_{add\_trans} = [(TF_{cons} * D_{add\_source} * TEF) * 1/Q_{add} * 1/1000 + (ELE_{conveyor\_ADD} * EF_{grid}) * 1/ADD_Y] \text{—(3.1)}$$

Where:

L_{add_trans} = Transport related emissions per tonne of additives (t CO2/tonne of additive)

TF_{cons} = Fuel consumption for the vehicle per kilometre (kg of fuel/kilometre)

D_{add_source} = Distance between the source of additive and the project activity plant(km)

TEF = Emission factor for transport fuel (kg CO2/kg of fuel)

$ELE_{conveyor\_ADD}$ = Annual Electricity consumption for conveyor system for additives (MWh)

EF_{grid} = Grid electricity emission factor (tonnes of CO_2/MWh)

Q_{add} = Quantity of additive carried in one trip per vehicle (tonnes of additive)

ADD_Y = Annual consumption of additives in year y. (t of additives)

And leakage emissions per tonne of BC due to additional additives are determined by

$$\mathbf{L_y = L_{add\_trans} * [B_{blend,y} - P_{blend,y}] * BC_y} \text{ ----------------------(3.2)}$$

Where:

L_y = Leakage emissions for transport of additives (kilotonnes of CO_2)

BC_y = Production of BC in year y (kilotonnes of BC)

$B_{blend,y}$=Baseline benchmark share of additives per tonne of BC updated for year y (tonne of additives/tonne of BC)

$P_{blend,y}$ = Share of additives per tonne of BC in year y (tonne of additives/tonne of BC)

α_y = x tonnes of additives in year y / total additional additives used in year y

Another possible leakage is due to diversion of additives from existing uses. The project proponents (PPs) shall demonstrate that the additional amounts of additives used are surplus. If the PPs do not substantiate that the amount of additives, used in the project

activity, are surplus, the project emission reductions are reduced by the factor α, α is defined as follows;

α = tonnes of additive used in year y / total additional additives used in year y

Table 4.13: Percentage and quantity of additives used

Year	**Quantity of BC produced(tonnes)**	**Additive (%)**	**Additive (tonnes)**
2001	245967	45.74	112517
2002	354345	46.88	166111
2003	374138.39	44.21	165425
2004	379126.01	46.03	174521
2005	333000.85	44.63	148618.28
2006	336559.00	46.01	154850.8

Table 4.14: Transport related emissions per ton of additives

Year	**Quantity of Additives** (tonnes)	**Number of truck trips**	**Number of Kilometer trips**	**Diesel Consumption** (Litres)	**Fuel consumption** (tonnes)	**Total Co2** (tonnes)	L_{add_trans} Transport related emissions per ton of additives (t CO2/tonne of additive)
2001	112517	6618.647059	2316526	579131.6	0.485023	1453.274	0.012916
2002	166111	9771.235294	3419932	854983.1	0.716048	2145.496	0.012916
2003	165425	9730.882353	3405809	851452.2	0.713091	2136.635	0.012916
2004	174521	10265.94118	3593079	898269.9	0.752301	2254.119	0.012916
2005	148618.28	8742.251765	3059788	764947	0.640643	1919.559	0.012546
2006	154850.8	9108.870588	3188105	797026.2	0.667509	2000.058	0.017776

Table 4.15: Leakage emissions due to transportion of additives

Year	L_{add_trans} Transport related emissions per tonne of additives (t CO2/tonne of additive)	B_{blend} Baseline benchmark share of additives per tonne of BC updated for year y (tonne of additives/tonne of BC)	P_{blend} Share of additives per tonne of BC in year y (tonne of additives/tonne of BC	**BC** (kilotonnes of BC)	L_y (kilotonnes of CO_2)
2001	0.012916	0.597840424	0.51319	245.967	0.2688
2002	0.012916	0.590106586	0.49785	354.345	0.4222
2003	0.012916	0.582372748	0.51913	37413.839	30.561

2004	0.012916	0.57463891	0.50034	37912.601	36.383
2005	0.012546	0.566905072	0.49	33300.085	32.130
2006	0.017776	0.559171234	0.48	33655.900	47.365

Emission Reductions during the period January 1, 2001 to December 31, 2006

$ER_y = \{ [BE_{BC,y} - PE_{BC,y}] * BC_y + L_y \} * (1 - \alpha_y)$

Where:

ER_y = Emissions reductions in year y due to project activity (thousand tonnes of CO2)

$BE_{BC,y}$ = Baseline emissions per tonne of BC (t CO2/tonnes of BC)

$PE_{BC,y}$ = Project emissions per tonne of BC in year y (t CO2/tonnes of BC)

BC_y = BC production in year y (thousand tonnes)

Table 4.16: Baseline emissions, Project emissions and Leakage emissions

Year	$BE_{BC,y}$ Baseline emissions per tonne of BC (t CO2/tonnes of BC)	PE_{BC} Project emissions per tonne of BC (tCO_2/tonne BC)	BC (tonnes of BC)	L_y (kilotonnes of CO_2)	α (tonnes of additive used in year y / total additional additives used in year y)
2001	0.639347753	0.58891	245967	0.2688	0
2002	0.631533337	0.53455	354345	0.4222	0
2003	0.623718921	0.54283	374138.39	30.561	0

2004	0.615904504	0.53891	379126.01	36.383	0
2005	0.602338011	0.55093	333000.85	32.130	0
2006	0.619092206	0.5658	336559.00	47.365	0

Table 4.15: Emission Reductions during the period January 1, 2001 to December 31, 2006

Year	$BE_{BC,y}$ Baseline emissions (tCO_{2e})	PE_{BC} Project emissions ($t\ CO_{2e}$)	L_y Leakage Emissions (tCO_{2e})	ER_y Emissions reductions (tCO_{2e})
2001	157258.4	144852.4	0.2688	12406.2
2002	223780.6	189415.1	0.4222	34365.9
2003	233357.1	203093.5	30.561	30294.3
2004	233505.4	204314.8	36.383	29226.9
2005	200578.6	183460.2	32.130	17150.5
2006	208361.05	190425.1	47.365	17983.3