



# 1. Survey by Questionnaire

Data Boundaries are different among partner countries.



# 1.1 Commonwealth of Australia



**APP Questionnaire ( ver. 7.14 )**

Item	Input Cell	Other comments	Source
<b>1.General Information</b>			
Name of Country	<b>Australia</b>		
Representative Organization	Cement Industry Federation		
Respondent	Stuart Ritchie		
Contact ( Tel )	+61 2 6260 7222		
E-mail	<a href="mailto:sritchie@cement.org.au">sritchie@cement.org.au</a>		
Date	07 September 2006		
<b>2.Production and Future Prospects</b>			
Number of Companies	3		
Number of Plants	10		
Coverage Rate	100%	Excludes non-CIF member milling of some imported clinker	
<b>Number of Kilns by Type</b>			
NSP	Number of Kilns	5	Assumed preheater/ precalciner kilns
	Cement Production	Cannot relate cement production to kiln type	
	Clinker Production	3.758 Mt	
SP	Number of Kilns	2	
	Cement Production	Cannot relate cement production to kiln type	
	Clinker Production	1.972 Mt	
Dry	Number of Kilns	1	Lepol kiln
	Cement Production	Cannot relate cement production to kiln type	
	Clinker Production	0.090 Mt	
Semi-dry	Number of Kilns	0	
	Cement Production	n/a	
	Clinker Production	n/a	
Semi-wet	Number of Kilns	0	
	Cement Production	n/a	
	Clinker Production	n/a	
Wet	Number of Kilns	7	
	Cement Production	Cannot relate cement production to kiln type	
	Clinker Production	0.837 Mt	
Vertical Shaft	Number of Kilns	0	
	Cement Production	n/a	
	Clinker Production	n/a	



Others	Number of Kilns	0		
	Cement Production	n/a		
	Clinker Production	n/a		

Item	Input Cell	Other Comments	Source
------	------------	----------------	--------

**3.Cement Supply and Demand**

Production Data - Thousand Tonnes

(Fiscal) Year	2000	2001	2002	2003	2004	2005
Pure Clinker	6,557	6,425	6,354	6,566	6,492 (A)	6,657

Enter below according to the standard of each country.<sup>3</sup>

Cement	Portland	GP	5,193	5,074	5,036	5,266	5,680	5,876
		HE <sup>1</sup>	314	234	276	363	386	414
		SL <sup>1</sup>	642	551	634	784	870	997
		LH <sup>1</sup>	30	22	42	46	47	60
		SR <sup>1</sup>	13	7	8	13	11	3
		Others						
		Subtotal	6,192	5,888	5,996	6,472	6,994	7,350
	Blended	GB(S)	1,307	899	743	717	750	745
		GB(F)	558	499	519	651	601	644
		Off/White	368	351	363	396	397	425
		Oilwell	15	18	14	12	12	11
		Others	159	103	78	75	140	144
		Subtotal	2,407	1,870	1,717	1,851	1,900	1,969
	Total	8,599	7,758	7,713	8,323	8,894	9,319	
Exported Clinker and Others <sup>2</sup>		230	282	210	70	91	81	
Total <sup>4</sup>		7,984	7,306	7,497	7,929	8,324 (B)	8,473	
<u>Import/Export</u>								
Clinker	Import	191	254	293	501	751	996	
	Export	146	192	192	48	51	59	
Cement	Import	161	136	40	51	195	326	
	Export	84	90	18	22	40	22	

Projected production (not sure why "projected production" title here?)

- Notes:
- Note that HE, SL, LH and SR cements can be either Portland or blended cements – not differentiated through our survey.
  - Not sure what others might mean here apart from cements therefore export cells below should add to this (Japan data does not)
  - All information based on sales data rather than production data
  - Production basis (not sales basis)

Item	Input Cell	Other Comments	Source
------	------------	----------------	--------



4.CO2 Data ( Survey Year : 2004 FY )			
1) CO2 Calculation Boundary	<p>Production process within the boundaries of cement plant.</p> <p>Other emission sources</p> <ul style="list-style-type: none"> <li>• Mine ( Yes )</li> <li>• Import of raw material and fuels ( ? )</li> <li>• Export of products ( ? )</li> <li>• Electricity sales from on-site generation ( N/A)</li> </ul>	This survey covers only on-site production process, but if indivisible from other emission sources, circle "Yes" in the lefthand box.	
2) Fuel / Power Consumption and Total Energy, CO2 Emissions	<p>Complete Attachment-1.</p> <ul style="list-style-type: none"> <li>• Provide heating value according to common domestic practice.</li> <li>• For power produced externally, use energy conversion factor adopted in each country and identify source.</li> <li>• If power generated on-site is sold externally, provide only value representing fuel consumed on-site, determined pro rata to site consumption and electricity sales volumes. If indivisible, provide total consumption and identify it in other comments.</li> <li>• Provide CO2 emission factor adopted in each country and identify source.</li> </ul>		
3) CO2 emissions from raw materials	<p>Complete Attachment-2.</p> <ul style="list-style-type: none"> <li>• If using company-specific calculation methodologies, describe in the sheet.</li> </ul>		
4) Specific CO2 emissions from energy	<p>Complete following blanks based on the calculations conducted in Attachment-1.</p> <ul style="list-style-type: none"> <li>• Clinker-based Gross V/A <u>0.464</u> kg-CO2/kg-clinker Net U/A <u>0.449</u> kg-CO2/kg-clinker</li> <li>• Cement-based Gross V/B <u>0.362</u> kg-CO2/kg-cement Net U/B <u>0.350</u> kg-CO2/kg-cement</li> </ul>	<p>Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: national inventory / industry specific data</p>	
5) Total specific CO2 emissions	<p>Complete following blanks based on the calculations conducted in Attachment-1.</p> <ul style="list-style-type: none"> <li>• Clinker-based Gross (V+X)/A <u>0.999</u> kg-CO2/kg-clinker Net (U+X)/A <u>0.983</u> kg-CO2/kg-clinker</li> <li>• Cement-based Gross (V+X)/B <u>0.779</u> kg-CO2/kg-cement Net (U+X)/B <u>0.766</u> kg-CO2/kg-cement</li> </ul>	<p>Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: national inventory / industry specific data</p>	



6 ) Specific energy consumption	<p>Complete following blanks based on the calculations from Attachment-1.</p> <ul style="list-style-type: none"> <li>• Clinker-based Gross T/A <u>4,940</u> kJ/kg-clinker Net S/A <u>4,738</u> kJ/kg-clinker</li> <li>• Cement-based Gross T/B <u>3,852</u> kJ/kg-cement Net S/B <u>3,695</u> kJ/kg-cement</li> </ul>	<p>Gross: Inclusive of alternative fossil fuels and biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: Fuel on a Higher heating value basis / Fuel on a Lower heating value basis</p>	
Item	Input Cell	Other Comments	Source

**5. Recycling ( Consumption of Alternative Raw Materials and Fuels )**

Use of Alternative Raw Materials	Yes		
• Mineral components used to produce clinker	<p>Slag Consumption _____ t-wet/yr _____ t-dry/yr</p> <p>Fly-ash Consumption _____ t-wet/yr _____ t-dry/yr</p> <p>Other Consumption <u>50,071</u> t-wet/yr _____ t-dry/yr</p>		
• Mineral components used to produce Portland and blended cements	<p>Slag Consumption <u>289,783</u> t-wet/yr _____ t-dry/yr</p> <p>Fly-ash Consumption <u>151,265</u> t-wet/yr _____ t-dry/yr</p> <p>Gypsum by-product Consumption _____ t-wet/yr _____ t-dry/y</p> <p>Other Consumption <u>256,078</u> t-wet/yr _____ t-dry/yr</p>	"Other" counts limestone as a mineral addition	
• Future availability		Provide alternative raw material type and amount (if available).	
Consumption of Alternative Fuels	Yes		
• Alternative fossil fuels • Biomass	Provide amount and heating value etc. in Attachment-1.		
• Future Availability		Provide alternative fuel type and amount (if available).	

**6. Pollutants ( Survey Year : FY 2004 )**

1) Calculation Coverage	Exhaust gas from kiln exhaust gas dust collector		
2) SOx emissions	<p>Total emissions <u>962</u> t-SO2/yr Specific emissions <u>0.148</u> kg-SO2/t-clinker</p>		NPI
3) NOx emissions	<p>Total emissions <u>14,687</u> t-NO2/yr Specific emissions <u>2.26</u> kg-NO2/t-clinker</p>		CIF
4) Stack dust emissions	<p>Total emissions <u>694</u> t-dust/y Specific emissions <u>0.107</u> kg-dust/t-clinker</p>		CIF



Item	Input Cell	Other Comments	Source
<b>7. Voluntary Programs and Regulations</b>			
Voluntary Program	Greenhouse Challenge Plus		
• Index	Specific CO2 emissions from cement production on a per tonne cementitious basis		
• Target	n/a		
• Results Achieved	24% reduction per tonne cementitious product since 1990		
• Implementation level	Country		
• Period	Since 1997		
Emissions Trading System	No		
• Scope of Application	n/a		
• Implementation level	n/a		
• Period	n/a		
Applicable laws and regulations	Provide name of law, regulatory agency, scope of application, provisions, regulation values, frequency of measurement	Provide or attach specific regulatory values.	
• CO2 emissions	Fuel Tax Bill 2006 (Cwlth) administered by the Australian Tax Office requires Greenhouse Challenge Plus membership where corporations wish to claim more than \$3M in fuel excise credits.	N/a	
• Energy conservation	Energy Efficiency Opportunities Act 2006 (Cwlth), administered by the Department of Industry Tourism & Resources. Applicable to companies using > 0.5 PJ energy. Requires undertaking of energy efficiency opportunity assessments every 5 years	N/a	
• Air	State authorities set air quality requirements during operations permitting. Emissions limits will vary between jurisdictions and operations with the general intent of being guided by air quality objectives set out in the Ambient Air Quality NEPM ( <a href="http://www.ephc.gov.au/nepms/air/air_nepm.html">http://www.ephc.gov.au/nepms/air/air_nepm.html</a> )	Regulatory values vary between jurisdictions.	
• Water quality	State authorities set water quality requirements during operations permitting.	Regulatory values vary between jurisdictions.	
• Noise	State authorities set noise emissions requirements during operations permitting.	Regulatory values vary between jurisdictions.	
• Vibration	State authorities set vibration requirements during operations permitting.	Regulatory values vary between jurisdictions.	
• Waste	Waste classification systems and waste management varies between State jurisdictions. Movements of Controlled wastes between State jurisdictions are controlled by the Movement of Controlled Waste between States and Territories NEPM.	Classification and management varies between jurisdictions.	
• Location laws	Local Governments administer planning laws with assistance by State regulatory agencies – usually environmental departments/agencies	Planning requirements vary between jurisdictions.	
• Others			
Item	Input Cell	Other Comments	Source
<b>8. What do you think are examples of best practice in cement production technologies?</b>			
	<ul style="list-style-type: none"> <li>• Use of vertical roller mills for clinker/cement production</li> <li>• High efficiency separators on raw mill</li> <li>• low-energy transport of raw meal from mills to storage and storage to pre-heater/kiln</li> <li>• High efficiency blending silos</li> <li>• Additional pre-heater stages</li> <li>• Calciner in pre-heater</li> <li>• High efficiency coolers</li> <li>• Improved combustion efficiency</li> </ul>		



APP Questionnaire\_07.14 Australia 07sep06(Rev)

	<ul style="list-style-type: none"><li>• Advanced control systems for kiln processing</li><li>• High pressure roller mills for cement milling</li><li>• Use of high efficiency separators on cement mills</li><li>• Low-energy transport of cement from mills to storage and storage to dispatch</li><li>• Advanced control systems for cement milling</li><li>• Hot air recirculation to process</li><li>• High efficiency filter control of stack emissions</li><li>• Co-generation to utilize waste heat from kiln or cooler exhaust</li><li>• NOx reduction technologies</li></ul>		
--	---	--	--



## 1.2 Canada



## APP Questionnaire ( ver. 7.14 )

Item	Input Cell	Other comments	Source	
<b>1.General Information</b>				
Name of Country	<b>Canada</b>			
Representative Organization	Cement Association of Canada (CAC)			
Respondent	George J. Venta			
Contact ( Tel )	(613) 236-9471			
E-mail	gventa@cement.ca			
Date	April 15, 2008			
<b>2.Production (2004)</b>				
Number of Companies	8	7 grey & 1 white cement companies		
Number of Plants	16	15 grey & 1 white cement plants		
Coverage Rate	100%	data below exclude white cement production		
<b>Number of Kilns by Type</b>				
Precalciner Kilns	Number of Kilns	6	2004	PCA L&E
	Cement Production	7,108,167 tonnes	2004	PCA L&E
	Clinker Production	7,147,694 tonnes	2004	PCA L&E
Preheater Kilns	Number of Kilns	3 (plus 2 for white cement; no data)	2004	PCA L&E
	Cement Production	3,484,617 tonnes	2004	PCA L&E
	Clinker Production	3,933,867 tonnes	2004	PCA L&E
Long Dry Kilns	Number of Kilns	12	2004	PCA L&E
	Cement Production	2,447,814 tonnes	2004	PCA L&E
	Clinker Production	2,153,925 tonnes	2004	PCA L&E
Semi-dry	Number of Kilns	0		
	Cement Production	n/a		
	Clinker Production	n/a		
Semi-wet	Number of Kilns	0		
	Cement Production	n/a		
	Clinker Production	n/a		
Wet	Number of Kilns	2	2004	PCA L&E
	Cement Production	528,012 tonnes	2004	PCA L&E
	Clinker Production	472,889 tonnes	2004	PCA L&E



Vertical Shaft	Number of Kilns	0		
	Cement Production	n/a		
	Clinker Production	n/a		
Others	Number of Kilns	0		
	Cement Production	n/a		
	Clinker Production	n/a		



Item		Input Cell		Other Comments		Source	
<b>3.Cement Supply and Demand</b>							
<b>Production Data</b> - <b>Thousand Tonnes</b>						Statistics Canada Catalogue 44-001-XIB	
(Fiscal) Year	2000	2001	2002	2003	2004		
Pure Clinker	13,021	12,653	13,036	13,178	13,727	FY2004 ( A )	
Enter below according to the standard of each country.							
Cement	Portland	Portland cement	12,011	12,068	12,440	12,637	13,084
		Others					
		Subtotal	12,011	12,068	12,440	12,637	13,084
	Blended	Masonry and other cement	741	725	640	779	779
		Others					
	Subtotal	741	725	640	779	779	
	Total	12,752	12,793	13,080	13,416	13,863	
Exported Clinker and Others		806	661	681	981	639	
Total		13,558	13,454	13,761	14,397	14,502	FY2004 ( B )
<b>Import/Export</b>							
Clinker	Import	363	247	54	55	94	
	Export	806	661	681	981	639	
Cement	Import	643	760	783	770	690	
	Export	4,102	4,462	4,448	4,636	5,119	
Projected production			Not estimated				

PCA Annual Yearbook 2007, Tables 47 & 51, Source STC-International Trade Division



	Input Cell	Other Comments	Source
<b>4.CO2 Data ( Survey Year : 2004 FY )</b>			
1) CO2 Calculation Boundary	Production process within the boundaries of cement plant. Other emission sources <ul style="list-style-type: none"> <li>• Mine ( <b>Yes /No</b> )</li> <li>• Import of raw material and fuels ( <b>Yes /No</b> )</li> <li>• Export of products ( <b>Yes / No</b> )</li> <li>• Electricity sales from on-site generation ( <b>Yes / No</b> )</li> </ul>	This survey covers only on-site production process, but if indivisible from other emission sources, circle "Yes" in the lefthand box.	CAC / WBCSD Cement CO2 Protocol, V1.6, 2004
2) Fuel / Power Consumption and Total Energy, CO2 Emissions	Complete Attachment-1. <ul style="list-style-type: none"> <li>• Provide heating value according to common domestic practice.</li> <li>• For power produced externally, use energy conversion factor adopted in each country and identify source..</li> <li>• If power generated on-site is sold externally, provide only value representing fuel consumed on-site, determined pro rata to site consumption and electricity sales volumes. If indivisible, provide total consumption and identify it in other comments.</li> <li>• Provide CO2 emission factor adopted in each country and identify source.</li> </ul>		As per CAC / WBCSD Cement CO2 Protocol, V1.6, 2004
3) CO2 emissions from raw materials	Complete Attachment-2. <ul style="list-style-type: none"> <li>• If using company-specific calculation methodologies, describe in the sheet.</li> </ul>		As per CAC / WBCSD Cement CO2 Protocol, V1.6, 2004
4) Specific CO2 emissions from fuels	Complete following blanks based on the calculations conducted in Attachment-1.. <ul style="list-style-type: none"> <li>• Clinker-based                Gross V/A <u>  358  </u> kg-CO2/kg-clinker                Net U/A <u>  339  </u> kg-CO2/kg-clinker</li> <li>• Cement-based                Gross V/B <u>  306  </u> kg-CO2/kg-cement                Net U/B <u>  290  </u> kg-CO2/kg-cement</li> </ul>	Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: national inventory / industry specific data	As per CAC / WBCSD Cement CO2 Protocol, V1.6, 2004
5) Total specific CO2 emissions	Complete following blanks based on the calculations conducted in Attachment-1. <ul style="list-style-type: none"> <li>• Clinker-based                Gross (V+X)/A <u>  892  </u> kg-CO2/kg-clinker                Net (U+X)/A <u>  873  </u> kg-CO2/kg-clinker</li> <li>• Cement-based                Gross (V+X)/B <u>  763  </u> kg-CO2/kg-cement                Net (U+X)/B <u>  747  </u> kg-CO2/kg-cement</li> </ul>	Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: national inventory / industry specific data	As per CAC / WBCSD Cement CO2 Protocol, V1.6, 2004



6 ) Specific energy consumption	Complete following blanks based on the calculations from Attachment-1. <ul style="list-style-type: none"> <li>• Clinker-based Gross T/A <u>3,933</u> kJ/kg-clinker Net S/A <u>3,668</u> kJ/kg-clinker</li> <li>• Cement-based Gross T/B <u>3,367</u> kJ/kg-cement Net S/B <u>3,140</u> kJ/kg-cement</li> </ul>	Gross: Inclusive of alternative fossil fuels and biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: Fuel on a <b>Lower heating value</b> basis, both kiln and non-kiln fuels included.	As per CAC / WBCSD Cement CO2 Protocol, V1.6, 2004
---------------------------------	--	--	--

### 5. Recycling ( Consumption of Alternative Raw Materials and Fuels ) FY2004

Use of Alternative Raw Materials	<b>Yes</b>		
• Mineral components used to produce clinker	Slag Consumption <u>8</u> out of 16 plants Fly-ash Consumption <u>9</u> out of 16 plants Other Consumption <u>8</u> out of 16 plants	Alternative RM are used, but no quantitative data are collected or available	PCA Plant Information Summary. 12/31/2004
• Mineral components used to produce Portland and blended cements	Slag Consumption <u>2,962</u> t-dry/yr Fly-ash Consumption <u>6,254</u> t-dry/yr Gypsum by-product Consumption <u>6,254</u> t-dry/yr Other Consumption <u>6,254</u> t-dry/yr		CAC / WBCSD Cement CO2 Protocol, V1.6, 2004
• Future availability		Provide alternative raw material type and amount (if available).	
Consumption of Alternative Fuels	<b>Yes</b>		
• Alternative fossil fuels • Biomass	In 2004, the Canadian cement industry used 222,606 tonnes of alternative fossil fuels and 24,183 tonnes of biomass representing 3,263 and 397 TJ/yr, respectively		CAC / WBCSD Cement CO2 Protocol, V1.6, 2004
• Future Availability		Provide alternative fuel type and amount (if available).	

### 6. Pollutants ( Survey Year : FY 2004 )

1) Calculation Coverage	Exhaust gas from kiln exhaust gas dust collector		
2) SOx emissions	Total emissions <u>45,041</u> t-SO2/yr Specific emissions <u>3.281</u> kg-SO2/t-clinker		NPRI
3) NOx emissions	Total emissions <u>45,600</u> t-NO2/yr Specific emissions <u>3.322</u> kg-NO2/t-clinker		NPRI
4) Stack dust emissions	Total PM emissions <u>4,716</u> t-dust/y Specific PM emissions <u>0.344</u> kg-dust/t-clinker	TPM including fugitive emissions	NPRI



Item	Input Cell	Other Comments	Source
<b>7. Voluntary Programs and Regulations</b>			
Voluntary Program	<p><b>Program #1</b> From 2002 – 2006, the Canadian cement sector was in the process of negotiating a sectoral agreement on greenhouse gas emissions under the Federal Government’s “Large Final Emitters” Initiative.</p> <p><b>Program #2</b> As well, the sector was negotiating a voluntary “Code of Practice” to cover air emissions and other environmental issues.</p> <p><b>Program #3</b> Beginning in 2003, Canadian cement manufacturers began collecting CO2 data in accordance with the WBCSD Cement CO2 Protocol and on implementation of Cement Sustainability Initiative (CSI) agenda. A report on implementation progress was published. (See Cement Sustainability report at <a href="http://www.cement.ca">www.cement.ca</a>)</p>	With a new government coming to power in 2006, the voluntary initiative has been abandoned and has been replaced by the Federal Regulatory Framework for Air Emissions. This framework seeks to establish regulatory limits on GHG, SO2, NOx, and PM releases from the sector.	
• Index			
• Target			
• Results Achieved	Between 1990 and 2004, the Canadian cement industry reduced its gross and net CO2 emissions per tonne of cementitious product by 4.86% and 5.56%, respectively		As per CAC / WBCSD Cement CO2 Protocol, V1.6, 2004
• Implementation level	<b>Country</b> , Local Government, Region ( )		
• Period			
Emissions Trading System	<b>Yes</b> – for operations in the Province of Ontario only (8 of 16 cement manufacturing facilities in Canada).		
• Scope of Application	NOx and SO2 emissions NOx limits of 2.0 kg / t clinker by 2015 SO2 limits of 2.2 kg / t of clinker by 2015. Interim targets for both pollutants. Requirement to install continuous emissions monitoring systems (CEMs)		O. Reg. 194/05
• Implementation level	Province of Ontario		
• Period	As of 2005		
Applicable laws and regulations	Provide name of law, regulatory agency, scope of application, provisions, regulation values, frequency of	Provide or attach specific regulatory values.	



	measurement		
• CO2 emissions	As of 2007/8 Government of Canada (Environment Canada) is in a process of putting in place regulatory regime to cut industrial GHG emissions. Target is 18% reduction by 2010 from 2006 baseline of combustion emission intensities, with further 2% annual reductions between 2010 and 2020. Separate provincial initiatives are emerging as well.		Environment Canada / CARA
• Energy conservation	Voluntary challenge under the Canadian Industry Program for Energy Conservation (CIPEC) under the auspices of Natural Resources Canada (NRCan). According to the CIPEC 2007 Annual Report, cement industry energy intensity between 1990 and 2005 decreased by 9 percent to 5.11 GJ/tonne of clinker.  As of 2007, the sector is undertaking a comprehensive energy benchmarking project of all grey cement manufacturing facilities. The study will address energy management, technical best practices, and energy performance.		CIPEC / NRcan
• Air	Provincial / regional authorities set specific air quality requirements in the facility operating permit. Only the province of Ontario (see above) has in place a program to specifically cap the sector's emissions.		
• Water quality	Provincial / regional authorities set specific water quality requirements in the facility operating permit.		
• Noise	Provincial / regional authorities set specific noise requirements in the facility operating permit.		
• Vibration	Provincial / regional authorities set specific requirements in the facility operating permit.		
• Waste	Provincial / regional authorities set specific requirements in the facility operating permit., such as source reduction, on site waste management, use of alternative fuels and raw materials, cement kiln dust (CKD), etc.		
• Location laws	Facility siting is subject to both provincial and federal environmental assessment processes.		
• Others			
Item	Input Cell	Other Comments	Source
<b>8.What do you think are examples of best practice in cement production technologies?</b>			
	5-stage suspension preheater / precalciner Vertical roller mills for raw materials & coal State-of-the-art multi-fuel burners High efficiency coolers High efficiency separators Variable speed fan drives Advanced central process controls Closed-loop process optimization hardware / software system On-line analyzers State-of-the-art baghouses or ESP Low NOx burners, SNCR for NOx control Lime injection for SO2 control CEMs for emissions monitoring Use of alternative fuels and raw materials (AFR) Production of blended / composite cements		



9.Elaborate any barriers of plant operation below.				
Legal or regulatory barriers to or incentives for reducing the CO2 intensity and clean technology deployment				
Item		Input Cell	Other Comments	Source
The domestic legal and regulatory barriers	Reduction of greenhouse gases emissions		With the exception of the province of Quebec, operations in all other jurisdictions are strictly regulated in terms of their fuel use.  Efforts to utilize increased amounts of alternative and renewable energy sources face several regulatory and other barriers.	
	Energy conservation		None identified – barriers are internal.	
	Other pollutants	Air	Barriers on alternative fuels – as discussed above.	
		Water quality		
	Noise			
	Vibration			
	Location laws			
Relevant case studies	Sitting of a new Greenfield facility			
	Major expansion of an existing facility		The last two major modifications were undertaken in 1999 and 2000, respectively. A proposal is in place to consider a significant expansion of the Exshaw facility in province of Alberta.  As assessment and approval processes differ significantly from province to province, it is difficult to draw any relevant lessons from these specific and sporadic modifications.	
	Introduction of alternative fuels or raw materials		The Province of Quebec is working with the sector to further expand the use of alternative and renewable fuels, with a specific focus on providing the sector with 'tipping fees' for the treatment of hazardous wastes. Regulations are due imminently.	
	Gaining approval for blended cement		Canadian Standards Association (CSA) is in a process of increasing the limestone level in its A3000 Portland cement standard from 5% to 15%.	
	Any other scenario where legal or regulatory barriers have proven a barrier to clean development			
Item		Input Cell	Other Comments	Source



## 1.3 Republic of India



**APP Questionnaire ( ver. 7.14 )**

Item	Input Cell	Other comments	Source	
<b>1.General Information</b>				
Name of Country	<b>India</b>			
Representative Organization	Cement Manufacturers' Association(CMA)		CMA Database	
Respondent				
Contact ( Tel )	91-0120-2411955/ 57 /58			
E-mail	<a href="mailto:cmand@vsnl.com">cmand@vsnl.com</a> , cmand@rediffmail.com			
Date	July, 2007			
<b>2.Production and Future Prospects</b>				
Number of Companies	52			
Number of Plants	130			
Coverage Rate				
<b>Number of Kilns by Type</b>				
NSP	Number of Kilns	70	2004	CMA Database
	Cement Production	79788382 t/yr	2004	"
	Clinker Production	86403817 t/yr	2004	"
SP	Number of Kilns	9	2004	"
	Cement Production	3756484 t/yr	2004	"
	Clinker Production	3703293 t/yr	2004	"
Dry (Long without SP)	Number of Kilns	41	2004	"
	Cement Production	19127538 t/yr	2004	"
	Clinker Production	1566537 t/yr	2004	"
Semi-dry	Number of Kilns	8(Large) and 13 (Mini)	2004	"
	Cement Production	453180 t/yr	2004	"
	Clinker Production	440553 t/yr	2004	"
Semi-wet	Number of Kilns	2	2004	"
	Cement Production	NA	2004	"
	Clinker Production	NA	2004	"
Wet	Number of Kilns	26	2004	"
	Cement Production	447946 t/yr	2004	"
	Clinker Production	341280 t/yr	2004	"
Vertical Shaft	Number of Kilns	193	2004	"
	Cement Production	6.0 mln t/yr	2004	"
	Clinker Production	5.55mln t/yr	2004	"



Item	Input Cell					Other Comments	Source	
<b>3.Cement Supply and Demand</b>								
<u>Production Data</u> -						Thousand Tonnes		
(Fiscal) Year	2000	2001	2002	2003	2004			
Pure Clinker						FY2004 A		
Enter below according to the standard of each country.								
Cement	Portland	Ordinary Portland Cement	60636.85	57278.44	56729.18	53865.80	55125.35	CMA Database
		(OPC) -including						
		OPC-33						
		OPC-43 &						
		OPC-53						
		Grades						
		Others (SRC, IRST40)	789.89	560.41	528.84	599.35	614.71	
	Subtotal	61426.74	57838.85	57258.02	54465.15	55740.06		
	Blended	Portland-	24220	29191	4046	49813	58221	
		Pozzolana (PPC)						
		Portland-Slag (PSC)	10300	11320	1186	11141	11110	
		Subtotal	34522.75	40511.70	52329.36	60954.32	69331.04	
		Total	95949.49	98350.55	109587.38	115419.47	<b>125071.10</b>	
	Exported Clinker and Others		4585.89	5157.91	6311.61	8889.10	9640.59	
Total							FY2004 (B)	
<u>Import/Export</u>								
Clinker	Import	Nil	Nil	Nil	Nil	Nil	Nil	
	Export	1859.39	1806.86	2926.92	5268.74	5825.80		
Cement	Import	Nil	Nil	Nil	Nil	Nil	Nil	
	Export	2726.50	3351.35	3384.69	3620.35	3814.79		
Projected production								
Item	Input Cell					Other Comments	Source	
<b>4.CO2 Data ( Survey Year : 2004 FY )</b>								
Database							CMA	



<p>1) CO2 Calculation Boundary</p>	<p>Production process within the boundaries of cement plant. Other emission sources</p> <ul style="list-style-type: none"> <li>• Mine (<u>Yes</u> / <del>No</del>)</li> <li>• Import of raw material and fuels (<del>Yes</del> / <u>No</u>)</li> <li>• Export of products (<u>Yes</u> / <del>No</del>)</li> <li>• Electricity sales from on-site generation (<u>Yes</u> / <del>No</del>)</li> </ul>	<p>This survey covers only on-site production process, but if indivisible from other emission sources, circle "Yes" in the lefthand box.</p>	
<p>2) Fuel / Power Consumption and Total Energy, CO2 Emissions</p>	<p>Complete Attachment-1.</p> <ul style="list-style-type: none"> <li>• Provide heating value according to common domestic practice.</li> <li>• For power produced externally, use energy conversion factor adopted in each country and identify source..</li> <li>• If power generated on-site is sold externally, provide only value representing fuel consumed on-site, determined pro rata to site consumption and electricity sales volumes. If indivisible, provide total consumption and identify it in other comments.</li> <li>• Provide CO2 emission factor adopted in each country and identify source.</li> <li>• Total Coal Consumption</li> <li>• Total Petcoke consumption</li> <li>• Total Lignite consumption</li> <li>• Total Coal Consumption for Captive Power</li> </ul>	<p>Net Calorific Value (NCV) expressed in Kcal/Kg Nil</p> <p>Nil</p> <p>Tonnes of CO<sub>2</sub> per Tonne of Cement</p> <p>17.60 mln tonne</p> <p>1.87 mln tonne</p> <p>0.76 mln tonne</p> <p>3.63 mln tonne</p>	
<p>3) CO2 emissions from raw materials</p>	<p>Complete Attachment-2.</p> <ul style="list-style-type: none"> <li>• If using company-specific calculation methodologies, describe in the sheet.</li> </ul>	<p>Not Calculated</p>	
<p>4) Specific CO2 emissions from energy</p>	<p>Complete following blanks based on the calculations conducted in Attachment-1..</p> <ul style="list-style-type: none"> <li>• Clinker-based Gross V/A _____ kg-CO2/kg-clinker Net U/A _____ kg-CO2/kg-clinker</li> <li>• Cement-based Gross V/B _____ kg-CO2/kg-cement Net U/B _____ kg-CO2/kg-cement</li> </ul>	<p>Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: national inventory / industry specific data</p>	
<p>5) Total specific CO2 emissions</p>	<p>Complete following blanks based on the calculations conducted in Attachment-1.</p> <ul style="list-style-type: none"> <li>• Clinker-based Gross (V+X)/A _____ kg-CO2/kg-clinker Net (U+X)/A _____ kg-CO2/kg-clinker</li> <li>• Cement-based Gross (V+X)/B <u>0.944</u> kg-CO2/kg-cement Net (U+X)/B _____ kg-CO2/kg-cement</li> </ul>	<p>Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: national inventory / industry specific data</p>	



6 ) Specific energy consumption	<p>Complete following blanks based on the calculations from Attachment-1.</p> <ul style="list-style-type: none"> <li>Clinker-based Gross T/A _____ kJ/kg-clinker <b>734.34 kcal/kg</b> Net S/A _____ kJ/kg-clinker</li> <li>Cement-based Gross T/B _____ kJ/kg-cement <b>94.5</b> <b>kwh/tonne</b> Net S/B _____ kJ/kg-cement</li> </ul>	<p>Gross: Inclusive of alternative fossil fuels and biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: Fuel on a Higher heating value basis / Fuel on a Lower heating value basis</p>	CMA Database
---------------------------------	--	---	--------------

Item	Input Cell	Other Comments	Source
------	------------	----------------	--------

**5. Recycling ( Consumption of Alternative Raw Materials and Fuels )**

Use of Alternative Raw Materials	Yes / No		
<ul style="list-style-type: none"> <li>Mineral components used to produce clinker</li> </ul>	<p>Slag Consumption Nil t-dry/yr Fly-ash Consumption Nil -dry/yr Other Consumption _____ t-dry/yr</p>		
<ul style="list-style-type: none"> <li>Mineral components used to produce Portland and blended cements</li> </ul>	<p>Slag Consumption 6.00 mln tonnes/yr Fly-ash Consumption 15.00 mln tonnes /yr Gypsum by-product Consumption 4.00 mln tonnes /yr Other Consumption _____ t-dry/yr</p>	<p>Wet slag with +25% moisture Both wet and dry flyash  Wet with +25-30% moisture with byproduct gypsum</p>	CMA Database
<ul style="list-style-type: none"> <li>Future availability</li> </ul>	<p>Assured, as Indian Thermal plants generate more than 130 mln tonnes flyash annually, and hardly 30% is recycled, predominantly by cement industry Presently, about 6 mln t granulated slag is generated by steel plants, which will double in next 5 yeras</p>	<p>Provide alternative raw material type and amount (if available).</p>	
Consumption of Alternative Fuels	Yes / No		
<ul style="list-style-type: none"> <li>Alternative fossil fuels</li> <li>Biomass</li> </ul>	<p>Lignite and petcoke used based on limited availability  Biomass fuel use comprises less than 0.5% of total fuel use.  Hazardous Combustibles use is pending approval by statutory authorities, State Pollution Control Boards</p>	<p>Provide amount and heating value etc. in Attachment-1.</p>	
<ul style="list-style-type: none"> <li>Future Availability</li> </ul>	<p>5.5 mln tonnes of hazardous combustible wastes generated annually in India and can be co-processed, subject to statutory clearance and economic landed cost at plant</p>	<p>Provide alternative fuel type and amount (if available).</p>	Central Pollution Control Board (CPCB)

**6. Pollutants ( Survey Year : FY 2004 )**

1) Calculation Coverage	Exhaust gas from kiln exhaust gas dust collector		
-------------------------	--	--	--



2) SOx emissions	Total emissions -SO <sub>2</sub> /yr Not required as per present Rules on Air Pollution Control and hence not calculated Specific emissions _____ kg-SO <sub>2</sub> /t-clinker	Norms for Emission are yet to be finalised by The Regulatory Authority, hence not calculated.	
3) NOx emissions	Total emissions t-NO <sub>2</sub> /yr Not required as per present Rules on Air Pollution Control and hence not calculated Specific emissions _____ kg-NO <sub>2</sub> /t-clinker		
4) Stack dust emissions	Total emissions _____ t-dust/y Specific emissions _____ kg-dust/t-clinker	Average <50 mg/Nm <sup>3</sup>	
Item	Input Cell	Other Comments	Source
<b>7. Voluntary Programs and Regulations</b>			
Voluntary Program	Yes ( _____ ) / No		
• Index			
• Target			
• Results Achieved			
• Implementation level	Country, Local Government, Region ( _____ )		
• Period			
Emissions Trading System	Yes / No	Yes	
• Scope of Application			
• Implementation level			
• Period			
Applicable laws and regulations	Provide name of law, regulatory agency, scope of application, provisions, regulation values, frequency of measurement	Provide or attach specific regulatory values.	
• CO <sub>2</sub> emissions	Joint Charter with Ministry of Environment and Forests ON corporate Responsibility for Environmental Protection (CREP) Regulatory Agency : MoEF, CPCB and State PCBs Scope of Application : Greenhouse Gas, CO <sub>2</sub> also NO <sub>x</sub> and SO <sub>x</sub> Provisisons : Industry maintains its own Annual Inventory	MoEF-Ministry of Environment and Forests CPCB-Central Pollution Control Board SPCB- State Pollution Control Board	MoEF, CPCB
• Energy conservation	Agreement with Bureau of Energy Efficiency (BEE), Ministry of Power for following Norms of Energy Consumption fixed by the Expert Committee— Scope of Application: Energy Use Provisions: Appointment of Energy Manager, Compulsory Annual Energy Audit by BEE Approved Auditor(s) Submission of short and long term plan of reduction ranging from 0.25 to 1% in 2 to 3 years block, depending upon level of		BEE



	energy consumption		
• Air	The Air (Prevention & Control of Pollution) Act, 1981 and Rules, 1982 under Environment Protection Act and Rules, 1986 followed strictly Regulator : MoEF, CPCB, State PCBs Scope of Application : Ambient Air Quality, Major Equipments (mine, crusher, mills, kiln, cooler, packers)		MoEF, CPCB
• Water quality	The Water (Prevention & Control of Pollution) Act and Rules 1974, 1975 and Revised in 1977, 1978 under Environment Protection Act and Rules, 1986 followed strictly Regulatory Agency: MoEF, CPCB, State PCBs, Central Ground Water Board (CGWB), State Water Supply and Irrigation Deptts		MoEF, CPCB, CGWB
• Noise	Permissible Noise level (dB) under Environment Protection Act and Rules, 1986 followed strictly with prescribed noise levels permitted for industrial, commercial, Residential and silence zones ( hospital, monument, heritage sites)		MoEF, CPCB,
• Vibration	Vibration Regulation under Environment Protection Act and Rules, 1986 followed strictly		MoEF, CPCB
• Waste	Waste Disposal and Public Health controlled by state Ministries of Health, Town and City administration for Sanitation. Permission required for interstate movement of hazardous and toxic waste for their effective disposal. For facilitation of flyash recycling, Notification on Use of Flyash, 1999 makes its availability cost-free for end-users. This is under review by MoEF		MoEF, CPCB, SPCBs
• Location laws	A host of laws control location of mine and plant: Mineral Conservation and Development Rules (1988), Forest Conservation Rules, 1981, The Wild Life (Protection) Act, 1972, 1998; Act on Coastal Regulation Zones (CRZ), 1991, Environment Impact Assessment Notification, 1994		MoEF, CPCB, ministry of Mines, Indian Bureau of Mines (IBM)
• Others	Several Acts on -Mining Leases Rules, 1960 -Mineral Conservation Rules, 1960 -Labour Welfare and Safety Rules, 1952, 1966 -Public Liability Insurance Act, 1991		MoEF, CPCB, ministry of Mines, Indian Bureau of Mines (IBM)



Item	Input Cell	Other Comments	Source
<b>8.What do you think are examples of best practice in cement production technologies?</b>			
	1.Vertical Roller Mills 2.Prgrinders or High Pressure Grinding Rolls 3.Double Stream 6-stage Preheaters with In-line Calciners 4. On –Line Quality Control Systems 5. Advanced Kiln Control Systems 6. Low Cost Waste Heat based Cogeneration Plants		

REFERENCES:

**Cement Statistics** – An annual Publication by Cement Manufacturers’ Association(CMA), Volumes 1999, 2000, 2001, 2002, 2003, 2004, 2005 & 2006.

**Basic Data**– An Annual Publication by Cement Manufacturers’ Association (CMA), Volumes 1999, 2000, 2001, 2002, 2003, 2004, 2005 & 2006.

**Report of the Working Group on Cement Industry** for XI Five Year Plan (2007-’12) – Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, December 2006.

**India’s National Communication** to the United Nations Framework Convention On Climate Change – Ministry of Environment & Forests, Government of India, 2004.

**Charter on Corporate Responsibility For Environmental Protection** – Central Pollution Control Board and Ministry of Environment and Forests, Government of India, March 2003.

Proceedings of National Seminar And Exhibition - Cement Industry – Environment and Sustainable Development, 11-12 February, 2003, Mumbai, India, Published by Cement Manufacturers’ Association(CMA).

Environmental Management In Selected Industrial Sectors - Status And Needs – Central Pollution Control Board, Ministry of Environment and Forests, February, 2003.

**Report of the Working Group on Cement Industry For X Five Year Plan** (2002-’07) – Planning Commission, Government of India, 2002.

**Standard Methodology for Environmental Auditing of Cement Industry - Final Report** – Unpublished, Vol 1 & 2, September 1997.



## 1.4 Japan



## Status Report of Questionnaire Summary (Japan)

### 1. Sector overview

- 1) In Japan, there are 18 cement companies, 33 cement producing plants and 58 kilns (2004).
- 2) In Japan main products are Ordinary Portland cement and Blast-furnace slag cement, which account for 94% of total production.
- 3) The data boundary for Japanese cement industry covers only cement production departments within cement plants and does not include mining section.

### 2. Supply and demand

- 1) Japanese cement production reached the highest of 99.3 Mt in 1996, and domestic demand has reached 86.3 Mt in 1990. Thereafter, cement production is on the decrease year by year due to the suppressed public sector investment.
- 2) Exports have remained at the level of around 10Mt.
- 3) Due to its characteristics, blend cement such as blast-furnace slag cement has been used mainly for civil construction in Japan. Since 1970s the share of blend cement had increased, however, due to the suppression of public sector investment the share has been saturated in recent years.

### 3. Energy intensity

- 1) Japanese cement industry had adopted SP and NSP technologies for its clinker burning process since 1970s. The diffusion rate is 100% at present. As a result, thermal energy intensity of the clinker burning process had declined to nearly 60% by FY 1990 compared to that in FY 1970.
- 2) Electricity intensity had also declined to nearly 80% by FY 1990 compared to its peak as a result of diffusion of energy saving technologies. However, in recent years, electricity intensity has been on the increase to cope with increased ARF crushing and conveying within cement plants.

### 4. CO2 emission intensity

- 1) Japanese cement industry has joined "Voluntary Action Plan of Environment" of Japan Business Federation. The industry is making active contribution to decreasing energy intensity.
- 2) CO2 emission intensity has remained almost on a same level from FY 1990, when data collection began, to recent years. This reflects that the potential for energy intensity improvement is very limited in Japan as a result that energy saving technologies had been diffused by FY 1990.
- 3) Use of wastes as alternative energy source to reduce fossil fuel is a main measure in Japanese cement industry's effort to reduce CO2 emission.
- 4) In accounting for CO2 emissions, Japanese industry data boundary includes purchased power so that the effect of power intensity reduction by waste heat power generation, etc. can be evaluated.
- 5) Since 1990, Japanese cement industry has been increasing the use of wastes and industrial by-products. In 2004, the use of those amounted to 400kg per tonne of cement.

### 5. Air pollutants

In Japan, Air Pollution Control Law was introduced in 1968, under which emissions density of SO<sub>x</sub>, NO<sub>x</sub> and stack dust are controlled. In 2004, SO<sub>2</sub> intensity was at 22g/t-cli, NO<sub>2</sub> at 1500g/t-cli and stack dust at 30g/t-cli.



## APP Questionnaire ( ver. 7.14 )

Item	Input Cell	Other comments	Source
<b>1.General Information</b>			
Name of Country	Japan		
Representative Organization	Japan Cement Association		
Respondent	Toshio Hosoya		
Contact ( Tel )	+81-3-3523-2827		
E-mail			
Date	May/30/2006		
<b>2.Production and Future Prospects</b>			
Number of Companies	18		
Number of Plants	33		
Coverage Rate	100%	excl. white cement, eco-cement	
<b>Number of Kilns by Type</b>			
NSP	Number of Kilns	48	FY2004
	Cement Production	63,766,939 t/yr	FY2004
	Clinker Production	57,543,245t/yr	FY2004
SP	Number of Kilns	10	FY2004
	Cement Production	7,915,346 t/yr	FY2004
	Clinker Production	7,593,343 t/yr	FY2004
Dry	Number of Kilns	0	
	Cement Production	0	
	Clinker Production	0	
Semi-dry	Number of Kilns	0	
	Cement Production	0	
	Clinker Production	0	
Semi-wet	Number of Kilns	0	
	Cement Production	0	
	Clinker Production	0	
Wet	Number of Kilns	0	
	Cement Production	0	
	Clinker Production	0	

Vertical Shaft	Number of Kilns	0		
	Cement Production	0		
	Clinker Production	0		
Others	Number of Kilns	0		
	Cement Production	0		
	Clinker Production	0		

Fig.2.1 Clinker production by kiln type

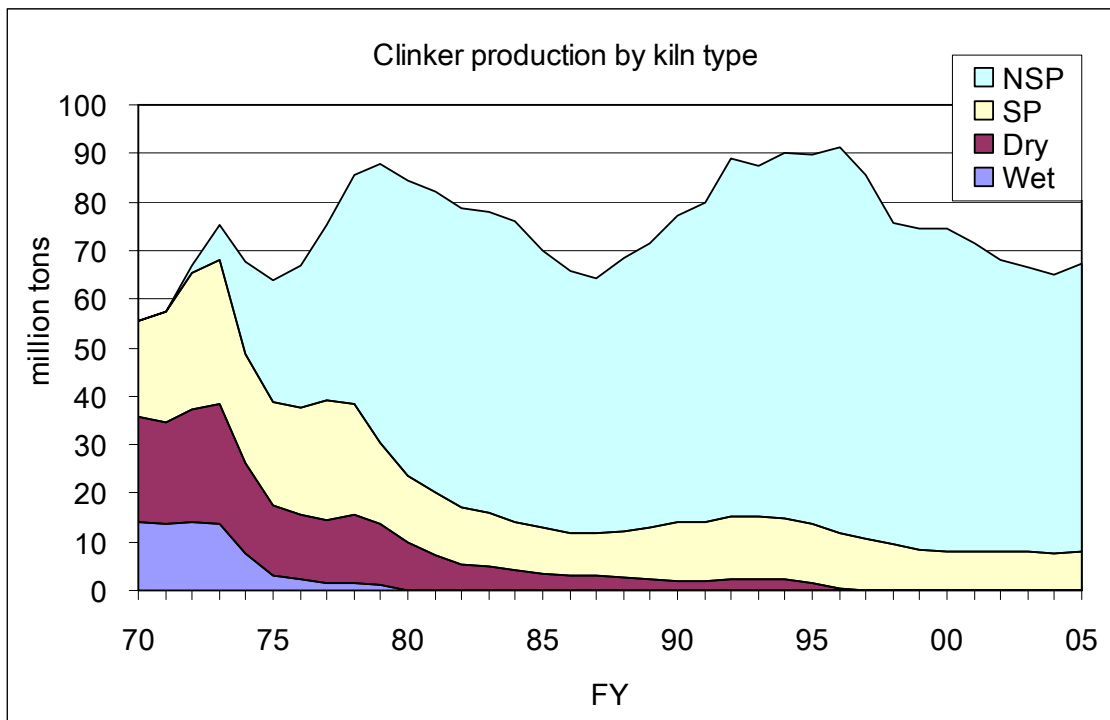
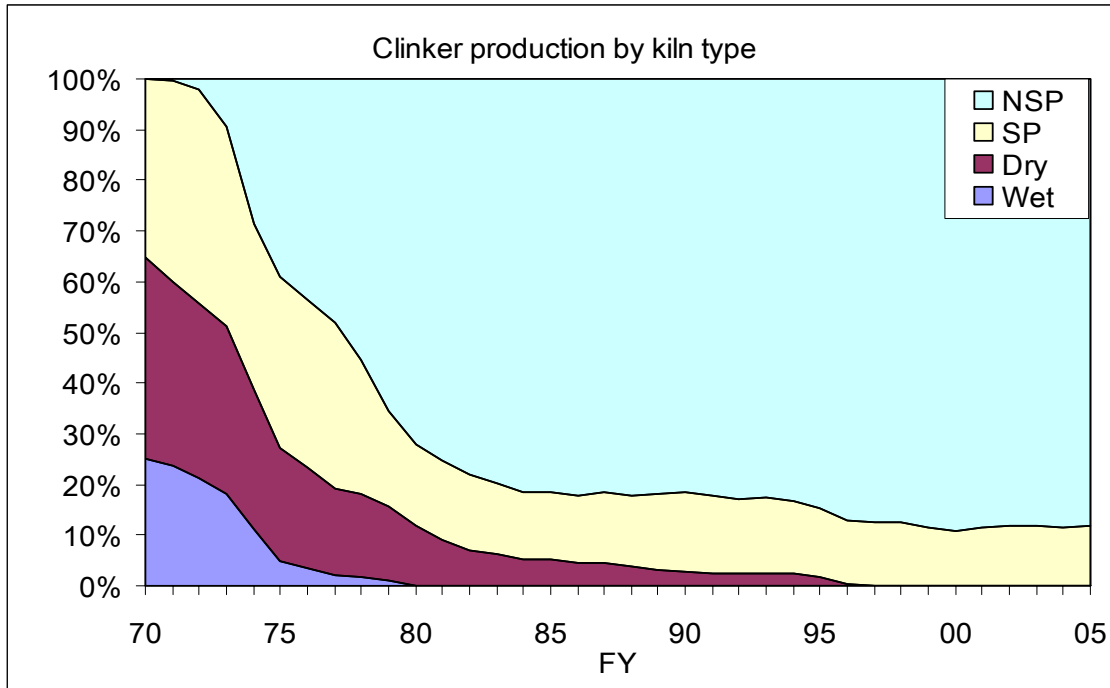


Fig. 2.2 Rate of clinker production by kiln type

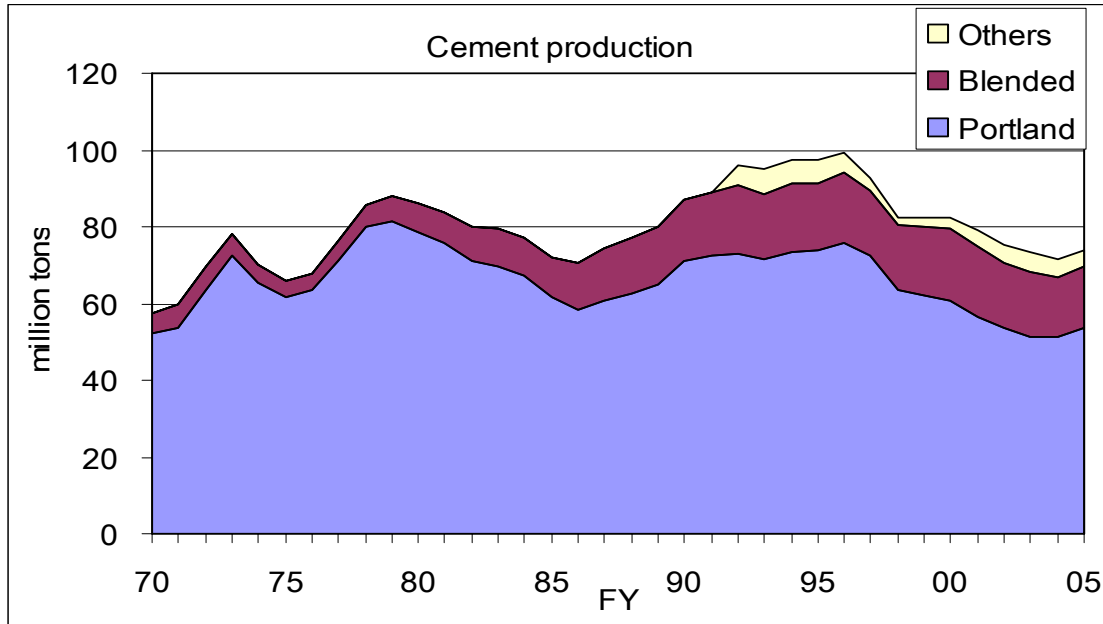


Item	Input Cell	Other Comments	Source
<b>3.Cement Supply and Demand</b>			



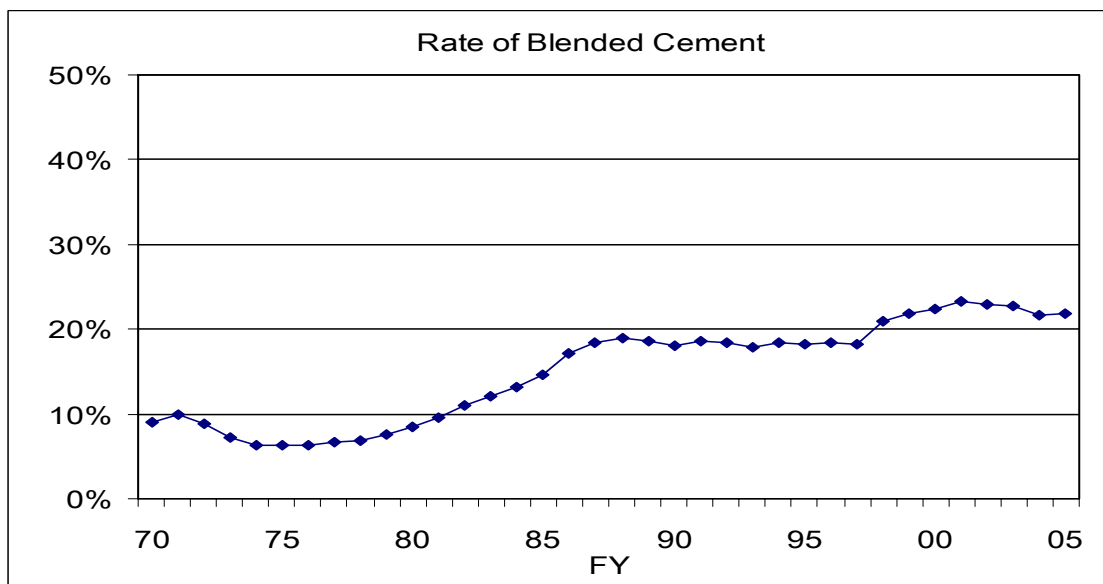
Production Data							Thousand Tonnes	
(Fiscal) Year	2000	2001	2002	2003	2004	April-March in Japan		
Pure Clinker		69,528	67,729	63,778	62,653	61,202	FY2004 (A)	
Enter below according to the standard of each country.								
Cement	Portland	Ordinary	56,766	52,483	49,448	47,786	47,622	minor additional constituents 5% by mass limestone, blast-furnace slag (dry) may be added
		High-early	3,483	3,324	3,247	2,940	2,777	
		Moderate Heat	447	539	509	512	621	
		Sulfate resisting	22	4	5	2	1	
		Others	176	184	232	189	128	
		Subtotal	60,893	56,534	53,442	51,429	51,150	
	Blended	Portland blast-furnace slag	17,631	17,791	16,760	16,109	14,914	Total of Class A (5 ~ 30%) Class B (30 ~ 60%) Class C (60 ~ 70%) Brackets indicate blast-furnace slag content
		Portland pozzolan	27	19	21	22	25	Total of Class A (5 ~ 10%) Class B (10 ~ 20%) Class C (20 ~ 30%) Brackets indicate pozzolan content
		Portland fly-ash	498	360	176	79	124	Total of Class A (5 ~ 10%) Class B (10 ~ 20%) Class C (20 ~ 30%) Brackets indicate fly-ash content
		Others	270	305	327	467	417	
		Subtotal	18,426	18,475	17,284	16,676	15,480	
	Total		79,319	75,009	70,726	68,105	66,630	
	Exported Clinker and Others		3,054	4,110	4,753	5,403	5,052	
	Total		82,373	79,119	75,479	73,508	71,682	FY2004 (B)
	<u>Import/Export</u>							
Clinker	Import							
	Export	2,765	3,778	4,378	5,057	4,703		
Cement	Import	1,286	1,065	774	831	828		
	Export	4,712	4,084	4,176	4,821	5,670		
Projected production		FY2010 : 71,000 thousand t (based on "Cement production + Clinker export")						

Fig. 3.1 Cement production



Note: Others include cement for soil stabilizer and clinker for export.

Fig. 3.2 Rate of blended cement





Item	Input Cell	Other Comments	Source
<b>4.CO2 Data ( Survey Year : 2004 FY )</b>			
1) CO2 Calculation Boundary	Production process within the boundaries of cement plant. Other emission sources <ul style="list-style-type: none"> <li>• Mine ( Yes / <input checked="" type="radio"/> No )</li> <li>• Import of raw material and fuels ( Yes / <input checked="" type="radio"/> No )</li> <li>• Export of products ( Yes / <input checked="" type="radio"/> No )</li> <li>• Electricity sales from on-site generation ( Yes / <input checked="" type="radio"/> No )</li> </ul>	This survey covers only on-site production process, but if indivisible from other emission sources, circle "Yes" in the left hand box.	
2) Fuel / Power Consumption and Total Energy, CO2 Emissions	Complete Attachment-1. <ul style="list-style-type: none"> <li>• Provide heating value according to common domestic practice.</li> <li>• For power produced externally, use energy conversion factor adopted in each country and identify source.</li> <li>• If power generated on-site is sold externally, provide only value representing fuel consumed on-site, determined pro rata to site consumption and electricity sales volumes. If the value cannot be separated, provide total consumption and identify it in other comments.</li> <li>• Provide CO2 emission factor adopted in each country and identify source.</li> </ul>		
3) CO2 emissions from raw materials	Complete Attachment-2. <ul style="list-style-type: none"> <li>• If using company-specific calculation methodologies, describe in the sheet.</li> </ul>		
4) Specific CO2 emissions from energy	Complete following blanks based on the calculations conducted in Attachment-1. <ul style="list-style-type: none"> <li>• Clinker-based                Gross V/A _____ kg-CO2/kg-clinker                Net U/A _____ kg-CO2/kg-clinker</li> <li>• Cement-based                Gross V/B _____ kg-CO2/kg-cement                Net U/B <u>0.294</u> kg-CO2/kg-cement                _____                Industry-specific data</li> </ul>	Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: national inventory / industry specific data	
5) Total specific CO2 emissions	Complete following blanks based on the calculations conducted in Attachment-1. <ul style="list-style-type: none"> <li>• Clinker-based                Gross (V+X)/A _____ kg-CO2/kg-clinker                Net (U+X)/A _____ kg-CO2/kg-clinker</li> <li>• Cement-based                Gross (V+X)/B _____ kg-CO2/kg-cement                Net (U+X)/B <u>0.722</u> kg-CO2/kg-cement                _____                Industry-specific data</li> </ul>	Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: national inventory / industry specific data	

<p>6 ) Specific energy consumption</p>	<p>Complete following blanks based on the calculations from Attachment-1.</p> <ul style="list-style-type: none"> <li>• Clinker-based Gross T/A _____ kJ/kg-clinker Net S/A _____ kJ/kg-clinker</li> <li>• Cement-based Gross T/B _____ kJ/kg-cement Net S/B <u>3,407</u> kJ/kg-cement <u>Fuel on a Higher heating value basis</u></li> </ul>	<p>Gross: Inclusive of alternative fossil fuels and biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: Fuel on a Higher heating value basis / Fuel on a Lower heating value basis</p>
--	--	---

Fig.4.1 Specific thermal energy consumption (Gross)

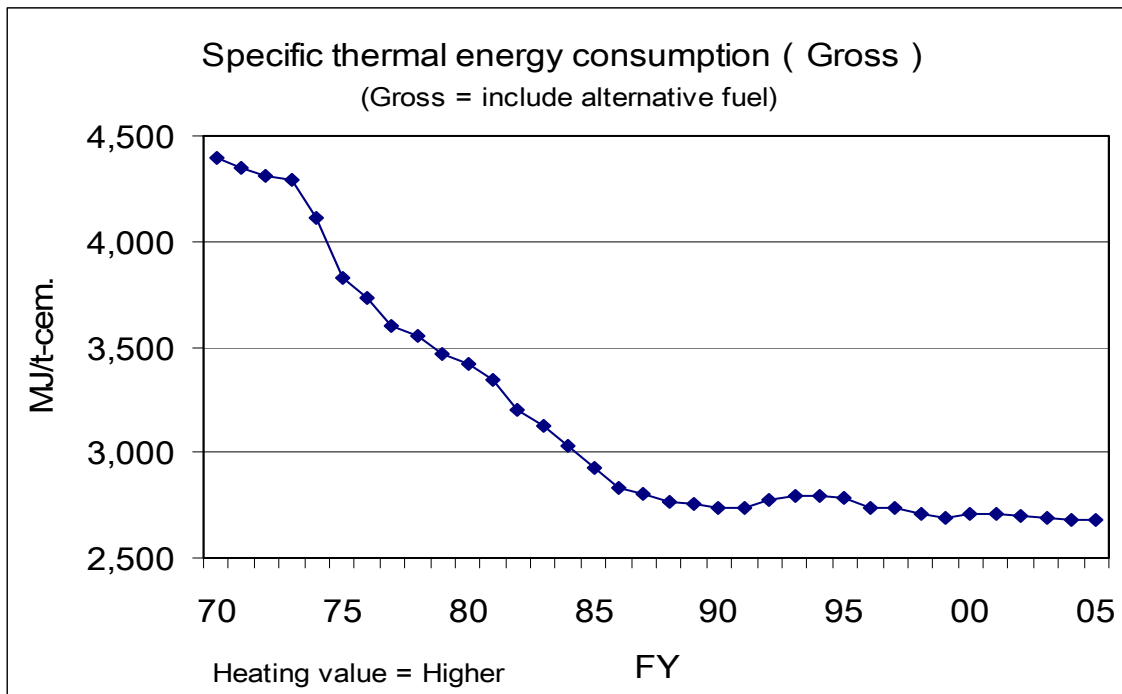


Fig. 4.2 Specific electric power energy consumption (Gross/Net)

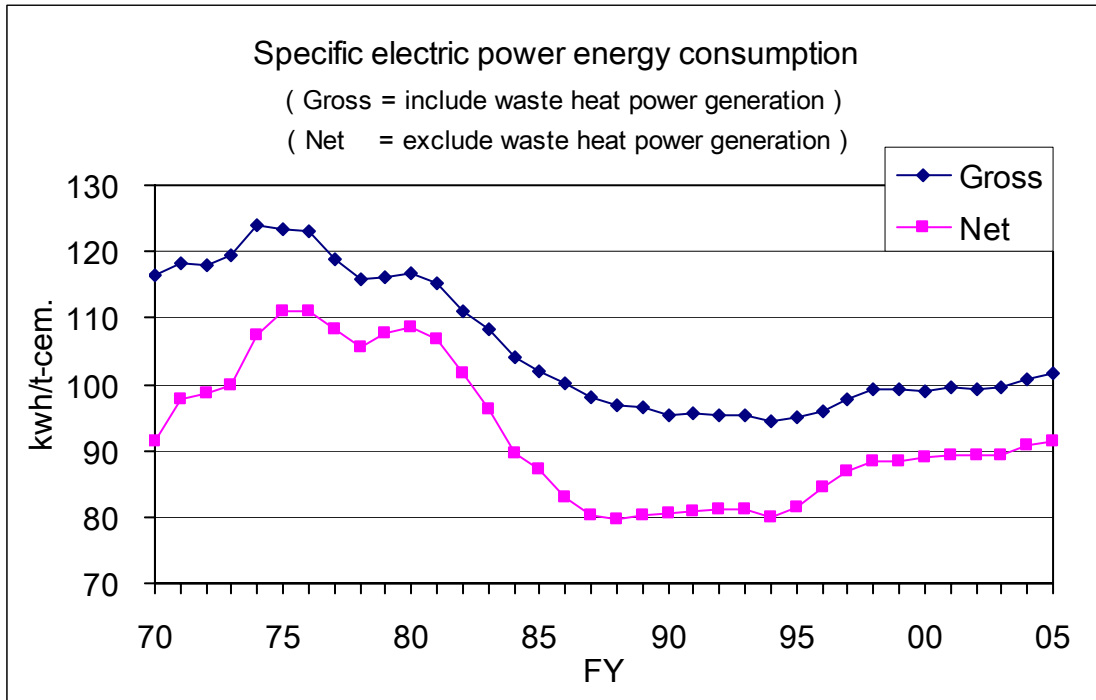


Fig. 4.3 Specific total energy consumption (Gross)

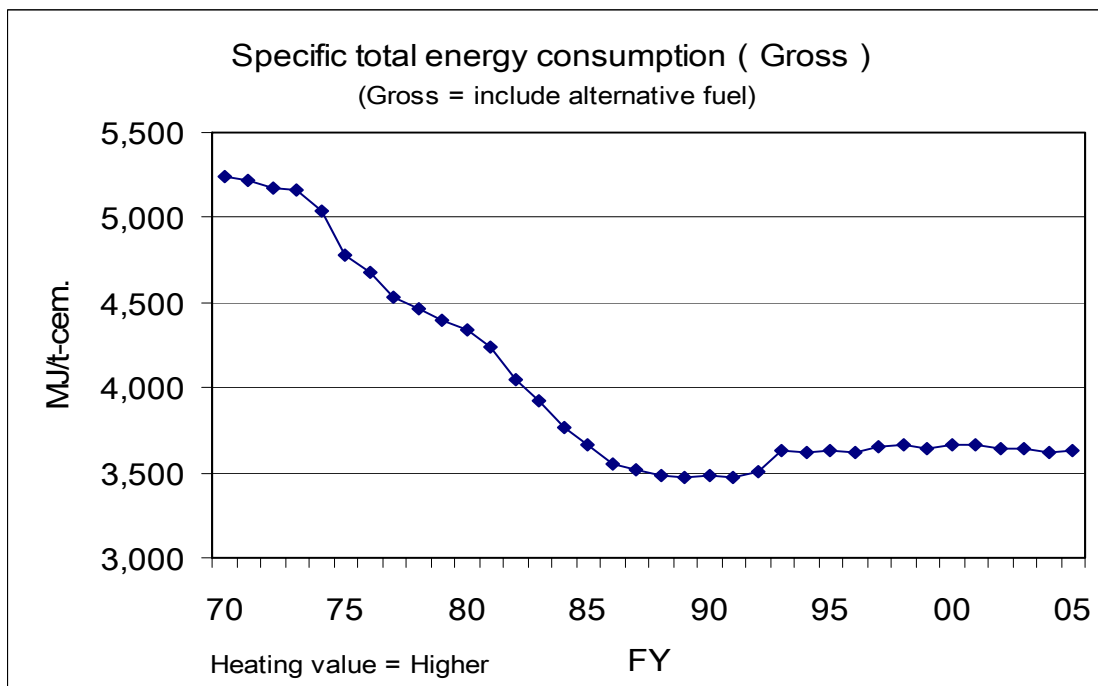


Fig. 4.4 Specific total energy consumption ( Net )

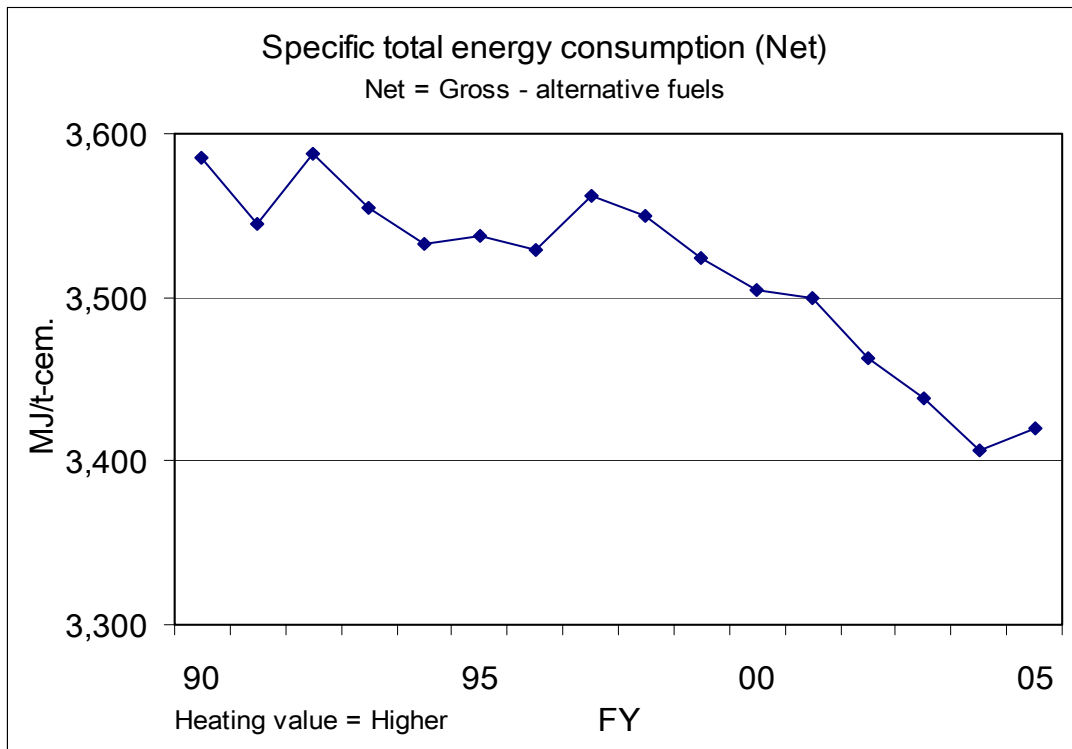


Fig. 4.5 Specific CO2 emissions from energy ( Net )

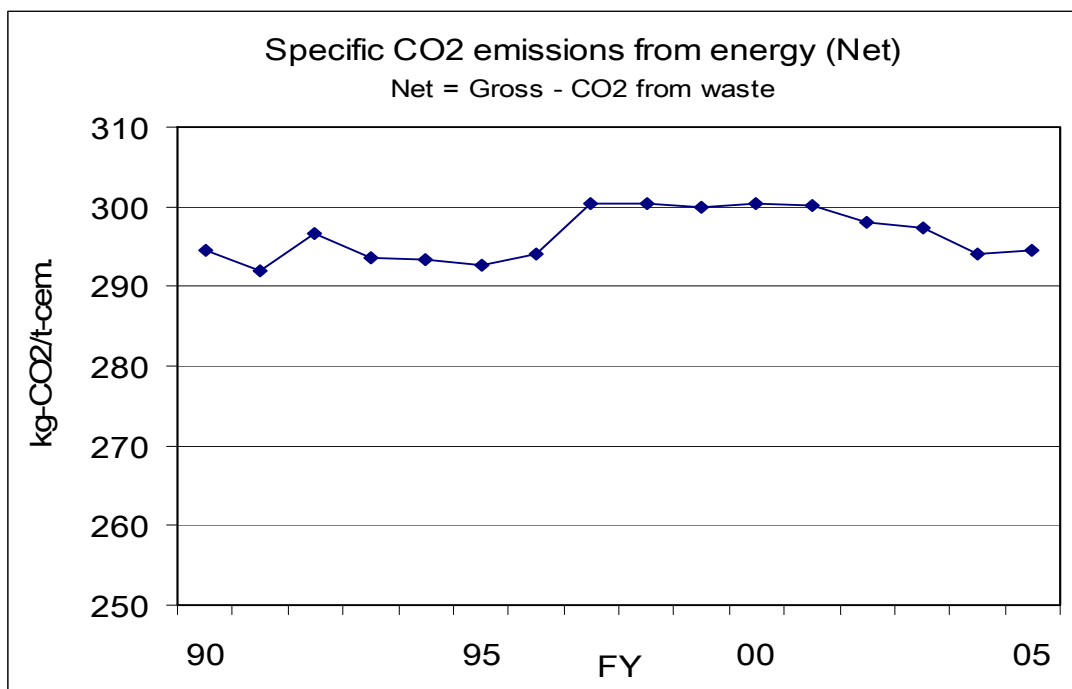
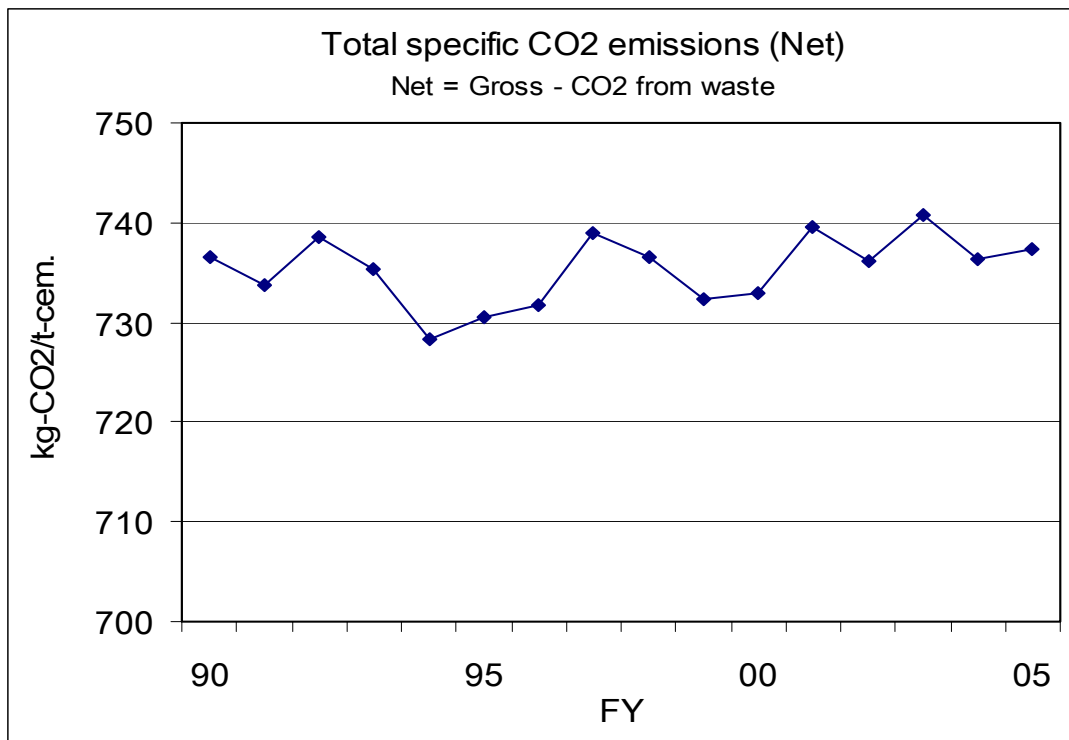


Fig. 4.6 Total specific CO2 emissions ( Net )



Item	Input Cell	Other Comments	Source
<b>5.Recycling ( Consumption of Alternative Raw Materials and Fuels )</b>			
Use of Alternative Raw Materials	<input checked="" type="radio"/> Yes / <input type="radio"/> No		
• Mineral components used to produce clinker	Slag Consumption <u>1,456,494</u> t-wet/yr _____ t-dry/yr		
	Fly-ash Consumption <u>6,837,110</u> t-wet/yr _____ t-dry/yr		
	Other Consumption <u>8,348,817</u> t-wet/yr _____ t-dry/yr		
• Mineral components used to produce Portland and blended cements	Slag Consumption <u>7,774,099</u> t-wet/yr _____ t-dry/yr		
	Fly-ash Consumption <u>100,078</u> t-wet/yr _____ t-dry/yr		
	Gypsum by-product Consumption <u>2,570,886</u> t-wet/yr _____ t-dry/y		
	Other Consumption _____ t-wet/yr _____ t-dry/yr		
• Future availability		Provide alternative raw material type and amount (if available).	



Consumption of Alternative Fuels	<input checked="" type="radio"/> Yes / No		
<ul style="list-style-type: none"> <li>• Alternative fossil fuels</li> <li>• Biomass</li> </ul>	Provide amount and heating value etc. in Attachment-1.		
• Future Availability		Provide alternative fuel type and amount (if available).	

Fig.5.1 Consumption of wastes and by-products for cement production

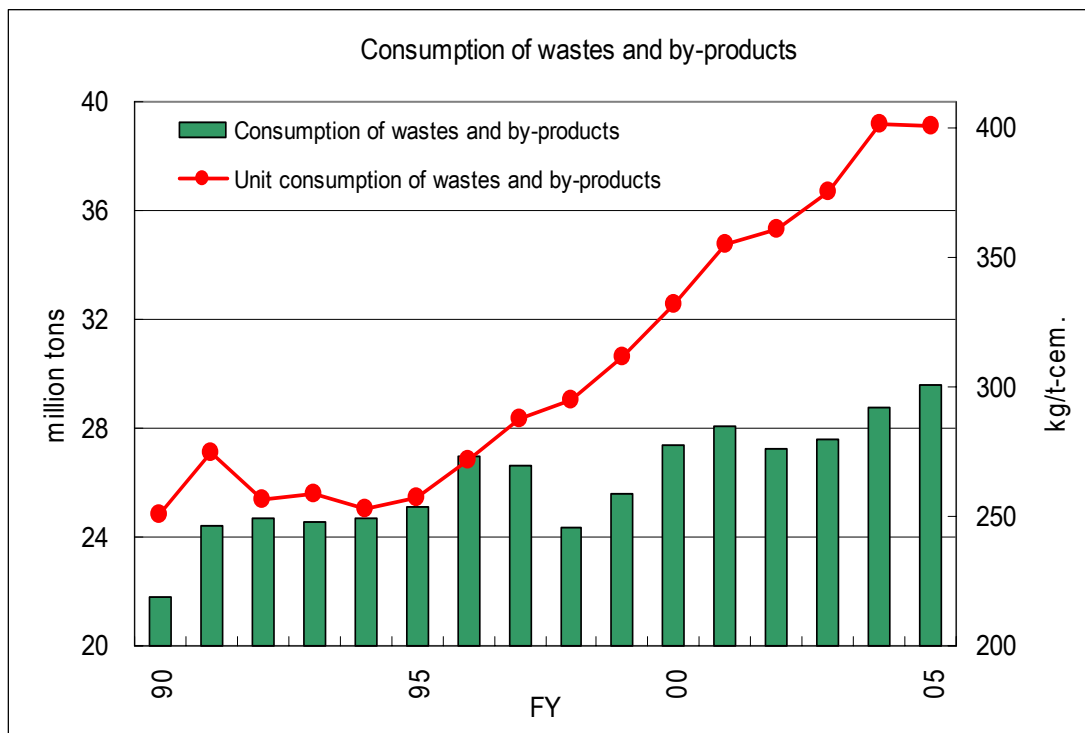


Fig.5.2 Specific alternative fuels and raw materials consumption for cement production

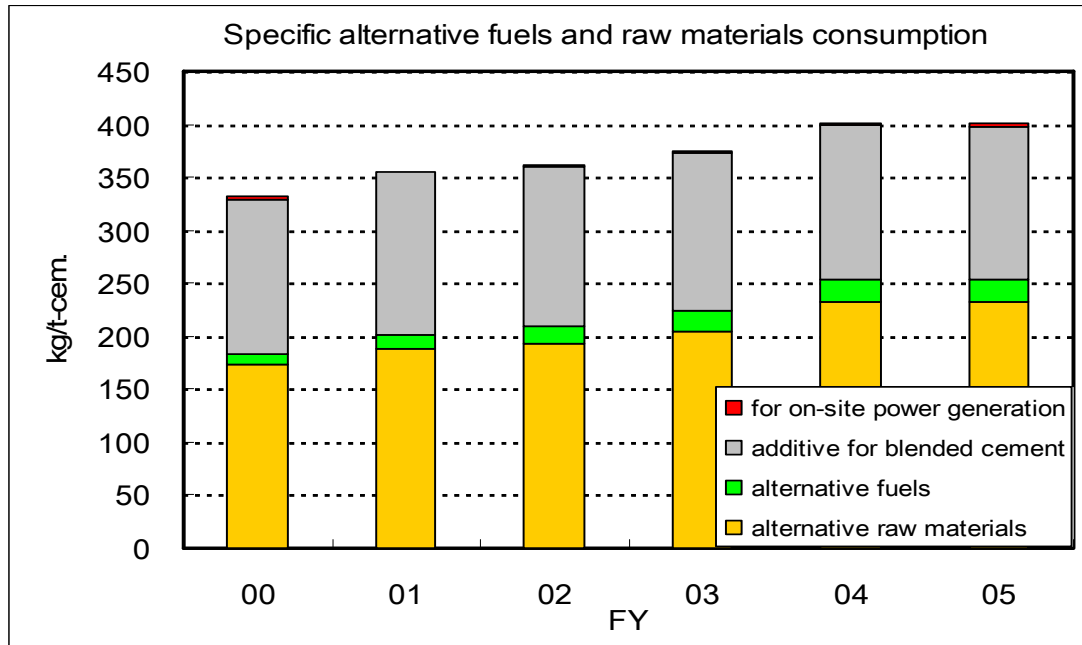
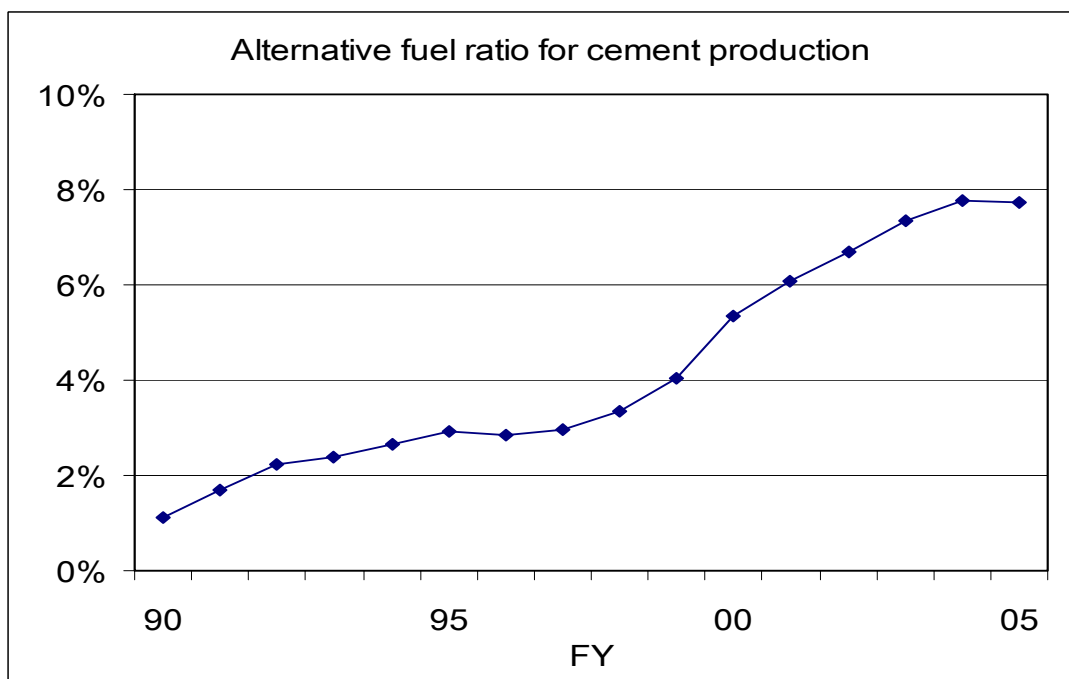


Fig. 5.3 Alternative fuel ratio for cement production





Item	Input Cell	Other Comments	Source
<b>6.Pollutants ( Survey Year : FY 2004 )</b>			
1)Calculation Coverage	Exhaust gas from kiln exhaust gas dust collector		
2) SOx emissions	Total emissions <u>1,363</u> t-SO2/yr		
	Specific emissions <u>0.0223</u> kg-SO2/t-clinker		
3) NOx emissions	Total emissions <u>93,147</u> t-NO2/yr		
	Specific emissions <u>1.5220</u> kg-NO2/t-clinker		
4)Stack dust emissions	Total emissions <u>1,848</u> t-dust/y		
	Specific emissions <u>0.0302</u> kg-dust/t-clinker		

Fig.6.1 Specific SO2 emission from kiln

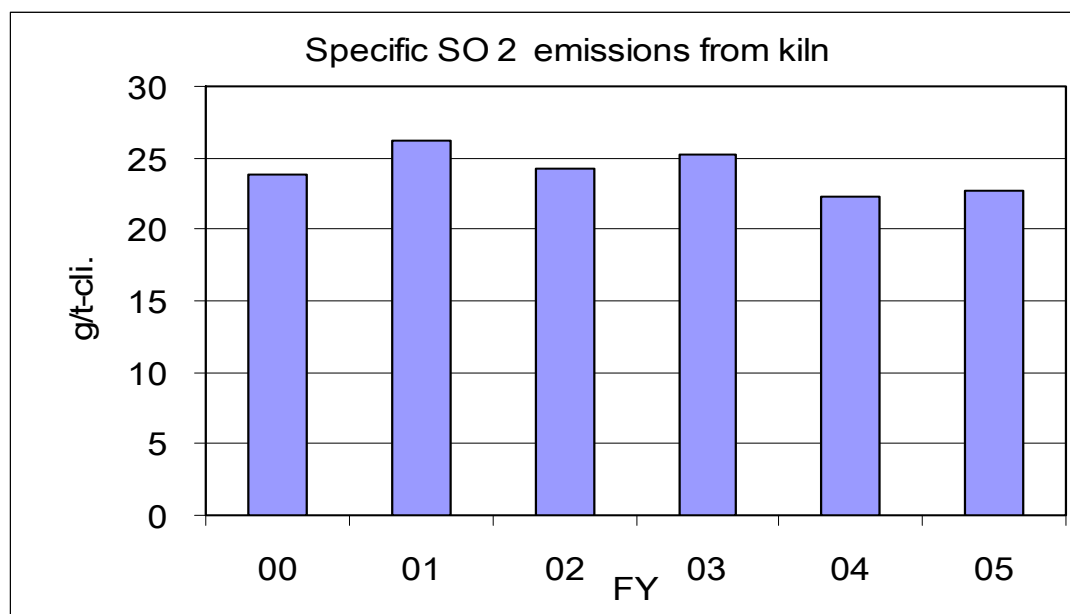


Fig. 6.2 Specific NO<sub>2</sub> emission from kiln

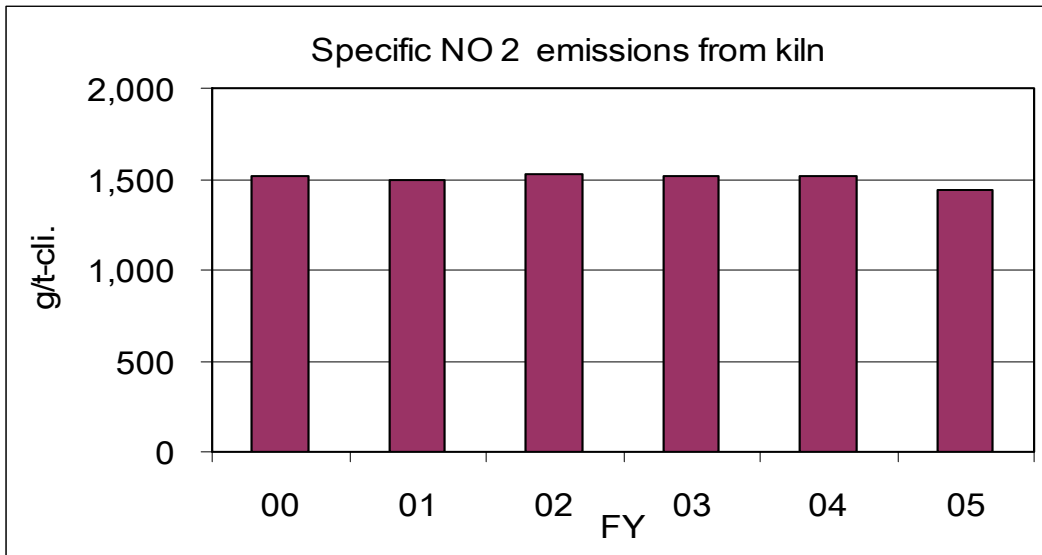
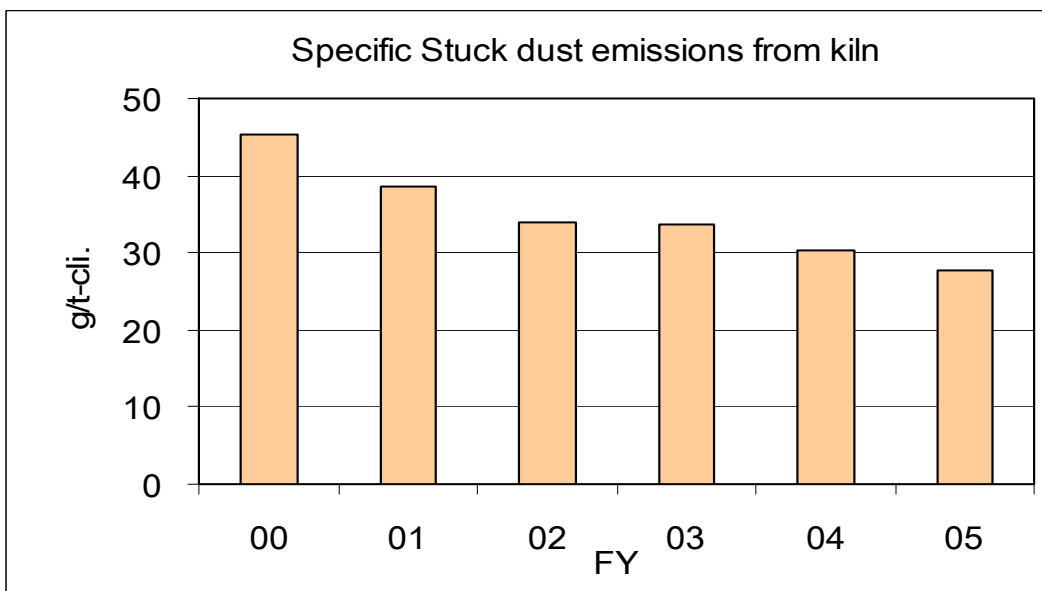


Fig. 6.3 Specific stuck dust emission from kiln





Item	Input Cell	Other Comments	Source
<b>7. Voluntary Programs and Regulations</b>			
Voluntary Program	Yes ( Keidanren Voluntary Action Plan ) / No		
• Index	Specific energy consumption for cement production		
• Target	3% decrease from 1990 levels in FY 2010		
• Results Achieved	5% decrease from 1990 levels in FY 2004		
• Implementation level	Country, Local Government, Region ( )		
• Period	Target year FY 2010		
Emissions Trading System	Yes / No		
• Scope of Application			
• Implementation level			
• Period			
Applicable laws and regulations	Provide name of law, regulatory agency, scope of application, provisions, regulation values, frequency of measurement	Provide or attach specific regulatory values.	
• CO2 emissions	<ul style="list-style-type: none"> <li>Law Concerning the Promotion of the Measures to Cope with Global Warming Regulatory Agency: <u>Ministry of the Environment</u> Scope of Application: <u>Greenhouse gases</u> Provisions: <u>Reporting GHG emissions (annually)</u></li> </ul>		
• Energy conservation	<ul style="list-style-type: none"> <li>Law Concerning the Rational Use of Energy Regulatory Agency: <u>Ministry of Economy, Trade and Industry</u> Scope of Application: <u>Energy Use</u> Provisions: <u>Appointment of an Energy Manager.</u> <u>Submission of a Medium to Long-term Plan (Annual reduction by 1%).</u> <u>Reporting on Conditions of Energy Consumption (Annually).</u></li> </ul>		
• Air	<ul style="list-style-type: none"> <li>Air Pollution Control Law Regulatory Agency: <u>Ministry of the Environment</u> Scope of Application: <u>Soot and Smoke Cement kilns ,boilers</u> <u>Particulates Stock yards, belt conveyers, grinders, sieves</u> Provisions: <u>Prefectural Stringent Standards where applicable</u> <u>Soot and smoke 100mg/Nm<sup>3</sup> ( O<sub>2</sub>10%equivalent )</u> <u>SOx <math>q=K \times 10^{-3} \cdot H e^2 \text{ Nm}^3/\text{hr}</math></u> <u>K value regionally determined</u> <u>He Height of Active Outlet</u> <u>NOx</u> <u>Existing facilities 480ppm( O<sub>2</sub>10%equivalent )</u> <u>New facilities 250ppm ( O<sub>2</sub>10%equivalent )</u> <u>Particulate Notification by designated facilities</u></li> <li>Waste Disposal and Public Cleansing Law Regulatory Agency: <u>Ministry of the Environment</u> Scope of Application: <u>Cement kilns which use waste</u> Provisions: <u>Dioxins 0.1ng-TEQ/Nm<sup>3</sup> ( O<sub>2</sub>12%0-e )</u></li> </ul>		



	<p style="text-align: center;"><u>Hydrogen Chloride 700mg/Nm<sup>3</sup> ( O<sub>2</sub>12%-e )</u></p> <ul style="list-style-type: none"> <li>• Law Concerning the Improvement of Pollution Prevention Systems in Specific Factories Regulatory Agency: <u>Ministry of the Environment</u> Scope of Application: <u>Factories with facilities emitting exhaust gases more than 10,000 m<sup>3</sup>/hr</u> Provisions: <u>Appointment of a Pollution Prevention Supervisor and Pollution Prevention Manager (national qualification) as part of a Pollution Prevention System.</u></li> </ul>		
• Water quality	<ul style="list-style-type: none"> <li>• Water Pollution Control Law Regulatory Agency: <u>Ministry of the Environment</u> Scope of Application: <u>Prefectural Stringent Standards where applicable Basically not applied to cement factories.</u></li> </ul>		
• Noise	<ul style="list-style-type: none"> <li>• Noise Regulation Law Regulatory Agency: <u>Ministry of the Environment</u> Scope of Application : <u>Factories with compressors, blowers, grinders</u> Provisions: <u>Regulatory values vary among local governments</u> e.g. Most stringent values stand at: <u>Daytime Under 50dB</u> <u>Nighttime Under 40dB</u></li> </ul>		
• Vibration	<ul style="list-style-type: none"> <li>• Vibration Regulation Law Regulatory Agency: <u>Ministry of the Environment</u> Scope of Application : <u>Factories with compressors, grinders, etc.</u> Provisions: <u>Regulatory values vary among local governments</u> e.g. Most stringent values stand at: <u>Daytime 60-65dB</u> <u>Nighttime 55-60dB</u></li> </ul>		
• Waste	<ul style="list-style-type: none"> <li>• Waste Disposal and Public Cleansing Law Regulatory Agency: <u>Ministry of the Environment</u> Scope of Application: <u>Waste processing</u> Provisions: <u>Permission required to run waste management service and for waste management facilities.</u> <u>Placement of a Technical Manager.</u> <u>Proper management.</u></li> </ul>		
• Location laws	<ul style="list-style-type: none"> <li>• Factory Location Law Regulatory Agency: <u>Ministry of Economy, Trade and Industry</u> Scope of Application: <u>Factories meeting following description: Site area 9000m<sup>2</sup>+; Building area 3000m<sup>2</sup>+</u> Provisions: <u>Restriction of production facility area to 15-40% of entire site 25% green area requirement.</u></li> </ul>		
• Others	<ul style="list-style-type: none"> <li>• Industrial Water Law Regulatory Agency: <u>Ministry of Economy, Trade and Industry and the Ministry of the Environment</u> Scope of Application: <u>Industrial use of groundwater collected from a well in designated areas</u> Provisions: <u>Permits to be granted by Governor</u></li> </ul>		



	<ul style="list-style-type: none"> <li>• <b>Offensive Odor Control Law</b>            Regulatory Agency: <u>Ministry of the Environment</u>            Scope of Application: <u>Areas designated by Governor</u>            Provisions:  <u>Establishment by governor of permissible concentration for 22 substances incl. ammonia in "regulation area", gas outlets and discharged water. In areas where concentration levels are deemed insufficient, establishment of maximum permissible values of odor indexes.</u> </li>   <li>• <b>Industrial Safety and Health Law</b>            Regulatory Agency: <u>Ministry of Health, Labour and Welfare</u>            Scope of Application: <u>Factories employing more than 50 people</u>            Provisions:  <u>Appointment of General Safety and Health Manager. Establishment of Safety Committee for the prevention of hazards to workers and Health Committee for the prevention of the impairment of workers' health. Regulations concerning special machines and hazardous substances to prevent infliction of danger or health impairment upon workers.</u> </li> </ul>		
Item	Input Cell	Other Comments	Source
<b>8.What do you think are examples of best practice in cement production technologies?</b>			
	<ul style="list-style-type: none"> <li>Vertical roller mill for raw materials</li> <li>Pre-grinding of roller mill system for raw materials</li> <li>SP / NSP kiln system</li> <li>5-stage system of suspension preheater</li> <li>Vertical coal mill</li> <li>Air beam type clinker coolers</li> <li>Improved separator</li> <li>Pre-grinding of roll press system</li> <li>Pre-grinding of roller mill system</li> <li>Higher efficiency blast-furnace slag grinding</li> <li>Power station by waste heat</li> </ul>		



## 1.5 Republic of Korea



**APP Questionnaire ( ver. 7.14 )**

Item	Input Cell	Other comments	Source
<b>1.General Information</b>			
Name of Country	Republic of Korea		
Representative Organization	Korea Cement Industrial Association		
Respondent	Lee, ki-seok		
Contact ( Tel )	82-2-538-2830		
E-mail	Kcia5@cement.or.kr		
Date	October/31/2006		
<b>2.Production and Future Prospects</b>			
Number of Companies	10		
Number of Plants	24		
Coverage Rate	100%	excl. white cement,	
<b>Number of Kilns by Type</b>			
NSP	Number of Kilns	39 (not operated : 4)	CY2004
	Cement Production		
	Clinker Production	44,675,001 t/yr	
SP	Number of Kilns	7 (not operated : 2)	CY2004
	Cement Production		
	Clinker Production	3,576,139 t/yr	
Dry	Number of Kilns		
	Cement Production		
	Clinker Production		
Semi-dry	Number of Kilns		
	Cement Production		
	Clinker Production		
Semi-wet	Number of Kilns		
	Cement Production		
	Clinker Production		
Wet	Number of Kilns	4 (not operated : 4)	CY2004
	Cement Production		
	Clinker Production	-	
Vertical Shaft	Number of Kilns		
	Cement Production		
	Clinker Production		



Others	Number of Kilns							
	Cement Production							
	Clinker Production							
Item		Input Cell				Other Comments	Source	
<b>3.Cement Supply and Demand</b>								
<u>Production Data</u>		-					Thousand Tonnes	
Civil Year		2000	2001	2002	2003	2004		
Pure Clinker		45,719	47,393	50,048	51,575	48,251	CY2004(A)	
Enter below according to the standard of each country.								
Cement	Portland	Ordinary	45,391	46,217	48,339	50,666	43,772	minor additional constituents □5% by mass limestone, blast-furnace slag (dry) may be added
		Moderate Heat	596	84	1,018	544	1,710	
		High-early	9	18	26	59	39	
		Sulfate resisting	162	108	71	24	6	
		Others	2	5	5	4	-	
		Subtotal	46,160	46,432	49,459	51,297	45,527	
	Blended	blast-furnace slag	5,074	5,568	5,979	5,847	8,736	blast-furnace slag content : 25~65%
		Others	21	46	76	50	67	
			Subtotal	5,095	5,614	6,055	7,897	8,803
	Total	51,255	52,046	55,514	59,194	54,330		
Exported Clinker and Others		940	1,645	905	535	1,420		
Total		52,195	53,691	56,419	59,729	55,750	CY 2004 (B)	
<u>Import/Export</u>								
Clinker	Import	162	96	3	70	22		
	Export	940	1,645	905	535	1,420		
Cement	Import	518	988	1,189	1,809	3,398		
	Export	3,946	3,001	2,488	2,612	2,640		
Projected production								



Item	Input Cell	Other Comments	Source
<b>4.CO2 Data ( Survey Year : 2004 FY )</b>			
1) CO2 Calculation Boundary	Production process within the boundaries of cement plant. Other emission sources <ul style="list-style-type: none"> <li>• Mine ( Yes / <input checked="" type="radio"/> No )</li> <li>• Import of raw material and fuels ( Yes / <input checked="" type="radio"/> No )</li> <li>• Export of products ( Yes / <input checked="" type="radio"/> No )</li> <li>• Electricity sales from on-site generation ( Yes / <input checked="" type="radio"/> No )</li> </ul>	This survey covers only on-site production process, but if indivisible from other emission sources, circle "Yes" in the lefthand box.	
2) Fuel / Power Consumption and Total Energy, CO2 Emissions	Complete Attachment-1. <ul style="list-style-type: none"> <li>• Provide heating value according to common domestic practice.</li> <li>• For power produced externally, use energy conversion factor adopted in each country and identify source..</li> <li>• If power generated on-site is sold externally, provide only value representing fuel consumed on-site, determined pro rata to site consumption and electricity sales volumes. If indivisible, provide total consumption and identify it in other comments.</li> <li>• Provide CO2 emission factor adopted in each country and identify source.</li> </ul>		
3) CO2 emissions from raw materials	Complete Attachment-2. <ul style="list-style-type: none"> <li>• If using company-specific calculation methodologies, describe in the sheet.</li> </ul>		
4) Specific CO2 emissions from energy	Complete following blanks based on the calculations conducted in Attachment-1.. <ul style="list-style-type: none"> <li>• Clinker-based                Gross V/A _____ kg-CO2/kg-clinker                Net U/A _____ kg-CO2/kg-clinker</li> <li>• Cement-based                Gross V/B _____ kg-CO2/kg-cement                Net U/B <u>0.282</u> kg-CO2/kg-cement</li> </ul>	Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: national inventory / industry specific data	
5) Total specific CO2 emissions	Complete following blanks based on the calculations conducted in Attachment-1. <ul style="list-style-type: none"> <li>• Clinker-based                Gross (V+X)/A _____ kg-CO2/kg-clinker                Net (U+X)/A _____ kg-CO2/kg-clinker</li> <li>• Cement-based                Gross (V+X)/B _____ kg-CO2/kg-cement                Net (U+X)/B <u>0.736</u> kg-CO2/kg-cement</li> </ul>	Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: national inventory / industry specific data	



6 ) Specific energy consumption	<p>Complete following blanks based on the calculations from Attachment-1.</p> <ul style="list-style-type: none"> <li>Clinker-based Gross T/A _____ kJ/kg-clinker Net S/A _____ kJ/kg-clinker</li> <li>Cement-based Gross T/B _____ kJ/kg-cement Net S/B <u>3,518</u> kJ/kg-cement Fuel on a Lower heating value basis _____</li> </ul>	<p>Gross: Inclusive of alternative fossil fuels and biomass fuels Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels Specify data source: Fuel on a Higher heating value basis / Fuel on a Lower heating value basis</p>	
Item	Input Cell	Other Comments	Source

**5. Recycling ( Consumption of Alternative Raw Materials and Fuels )**

Use of Alternative Raw Materials	<input checked="" type="radio"/> Yes / No		
• Mineral components used to produce clinker	<p>Slag Consumption _____ t-wet/yr _____ t-dry/yr</p> <p>Fly-ash Consumption <u>1,420,055</u> t-wet/yr _____ t-dry/yr</p> <p>Other Consumption <u>3,421,499</u> t-wet/yr _____ t-dry/yr</p>		
• Mineral components used to produce Portland and blended cements	<p>Slag Consumption <u>5,350,167</u> t-wet/yr _____ t-dry/yr</p> <p>Fly-ash Consumption <u>76,390</u> t-wet/yr _____ t-dry/yr</p> <p>Gypsum by-product Consumption <u>1,169,011</u> t-wet/yr _____ t-dry/y</p> <p>Other Consumption _____ t-wet/yr _____ t-dry/yr</p>		
• Future availability		Provide alternative raw material type and amount (if available).	
Consumption of Alternative Fuels	<input checked="" type="radio"/> Yes / No		
• Alternative fossil fuels • Biomass	Provide amount and heating value etc. in Attachment-1.		
• Future Availability		Provide alternative fuel type and amount (if available).	

**6. Pollutants ( Survey Year : FY 2004 )**

1) Calculation Coverage	Exhaust gas from kiln exhaust gas dust collector		
2) SOx emissions	<p>Total emissions <u>696</u> t-SO2/yr Specific emissions <u>0.0144</u> kg-SO2/t-clinker</p>		
3) NOx emissions	<p>Total emissions <u>62,192</u> t-NO2/yr Specific emissions <u>1.2889</u> kg-NO2/t-clinker</p>		
4) Stack dust emissions	<p>Total emissions <u>1,148</u> t-dust/y Specific emissions <u>0.0238</u> kg-dust/t-clinker</p>		



Item	Input Cell	Other Comments	Source
<b>7. Voluntary Programs and Regulations</b>			
Voluntary Program	<input checked="" type="radio"/> Yes ( Voluntary Agreement ) / No		
• Index	Specific energy consumption and greenhouse gas		
• Target	Voluntary target		
• Results Achieved	Reduction of specific energy consumption and greenhouse gas		
• Implementation level	Country, Local Government, Region ( <input checked="" type="radio"/> Plant )		
• Period	5 years from agreement contracting		
Emissions Trading System	Yes / <input checked="" type="radio"/> No		
• Scope of Application			
• Implementation level			
• Period			
Applicable laws and regulations	Provide name of law, regulatory agency, scope of application, provisions, regulation values, frequency of measurement	Provide or attach specific regulatory values.	
• CO2 emissions			
• Energy conservation			
• Air	<ul style="list-style-type: none"> <li>• Air Environment Preservation Law</li> <li>Regulatory Agency : <u>Ministry of Environment</u></li> <li>Scope of Application : <u>Kiln, Cooler, etc.</u></li> <li>Provisions: <ul style="list-style-type: none"> <li><u>Dust : Kiln - Existing facilities 50 mg/Sm<sup>3</sup> (O<sub>2</sub>13% )</u></li> <li><u>New facilities 40 mg/Sm<sup>3</sup> (O<sub>2</sub>13% )</u></li> <li><u>Cooler - 50 mg/Sm<sup>3</sup></u></li> <li><u>Grinder, Silo, etc - 100 mg/Sm<sup>3</sup></u></li> <li><u>NOx : 350ppm (O<sub>2</sub>13% )</u></li> <li><u>SOx : 30ppm (O<sub>2</sub>13% )</u></li> </ul> </li> </ul>		
• Water quality	.		
• Noise	<ul style="list-style-type: none"> <li>• Noise, Vibration Regulation Law</li> <li>Regulatory Agency: <u>Ministry of Environment</u></li> <li>Scope of Application : <u>Factories with compressors, blowers, grinders</u></li> <li>Provisions: <u>Regulatory values vary among area</u></li> <li>e.g. Most stringent values stand at: <ul style="list-style-type: none"> <li><u>06:00~18:00 Under 50dB</u></li> <li><u>18:00~24:00 Under 45dB</u></li> <li><u>24:00~06:00 Under 40dB</u></li> </ul> </li> </ul>		
• Vibration	<ul style="list-style-type: none"> <li>• Noise, Vibration Regulation Law</li> <li>Regulatory Agency: <u>Ministry of Environment</u></li> <li>Scope of Application : <u>Factories with compressors, grinders, etc.</u></li> <li>Provisions: <u>Regulatory values vary among area</u></li> <li>e.g. Most stringent values stand at: <ul style="list-style-type: none"> <li><u>Daytime Under 60dB</u></li> <li><u>Nighttime Under 55dB</u></li> </ul> </li> </ul>		
• Waste	<ul style="list-style-type: none"> <li>• Waste Control Law</li> <li>Regulatory Agency: <u>Ministry of Environment</u></li> <li>Scope of Application: <u>Waste processing</u></li> <li>Provisions: <ul style="list-style-type: none"> <li><u>Standard and method for a collection, transportation, custody, disposal of waste.</u></li> <li><u>Permission for waste disposal facilities.</u></li> </ul> </li> </ul>		



<ul style="list-style-type: none"> <li>• Location laws</li> </ul>			
<ul style="list-style-type: none"> <li>• Others</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Offensive Odor Prevention Law</b> Regulatory Agency: <u>Ministry of Environment</u> Scope of Application: <u>Areas designated by Governor</u> Provisions: <u>Establishment of permissible concentration for 12 substances incl. ammonia in "Offensive Odor area", gas outlets and discharged water.</u> <u>In areas where concentration levels are deemed insufficient, establishment of strict permissible values of odor indexes.</u></li> <li>• <b>Industrial Safety and Health Law</b> Regulatory Agency : <u>Ministry of Labor</u> Scope of Application: <u>Factories employing more than 50 people</u> Provisions: <u>Appointment of General Safety and Health Manager.</u> <u>Establishment of Safety and Health Committee for the prevention of hazards to workers and the impairment of workers' health.</u> <u>Regulations concerning special machines and hazardous substances to prevent infliction of danger or health impairment upon workers.</u></li> </ul>		
<p>Item</p>	<p>Input Cell</p>	<p>Other Comments</p>	<p>Source</p>
<p><b>8.What do you think are examples of best practice in cement production technologies?</b></p>			
	<ul style="list-style-type: none"> <li>Vertical roller mill for raw materials</li> <li>SP / NSP kiln system</li> <li>5-stage system of suspension preheater</li> <li>Vertical coal mill</li> <li>Air beam type clinker coolers</li> <li>Improved separator</li> <li>Pre-grinding of roll press system</li> <li>Pre-grinding of roller mill system</li> <li>Higher efficiency blast-furnace slag grinding</li> <li>Power station by waste heat</li> <li>Alternative fuel recycling system</li> </ul>		



# 1.6 United States of America

**Asia-Pacific Partnership on Clean Development and Climate Questionnaire  
(Based on Version 6.12)**

Item	Input Cell	Other comments	Source
<b>General Information</b>			
Name of Country	<b>UNITED STATES OF AMERICA</b>		
Representative Organization	<b>PORTLAND CEMENT ASSOCIATION</b>		
Respondent	<b>ANDREW O'HARE</b>		
Contact (Telephone)	<b>202-408-9494</b>		
E-mail	<b>aohare@cement.org</b>		
Date	<b>31-Oct-06</b>		
<b>Production and Future Prospects(FUTURE PROSPECTS ARE NOT INCLUDED IN THE RESPONSES)</b>			
Number of Companies	<b>33 CLINKER PRODUCING COMPANIES</b>		<b>PCA PIS TABLE 9</b>
Number of Plants	<b>107 CLINKER PRODUCING PLANTS WITH 186 KILNS</b>		<b>PCA PIS TABLE 1</b>
Coverage Rate	<b>100%</b>	<b>Question not understood</b>	
<b>Number of Kilns by Type</b>			
<b>Precalciner Kilns</b>	Number of Kilns	<b>44 kilns</b>	<b>PCA PIS</b>
	Production Capacity	<b>46,381,000 metric tons</b>	
<b>Preheater Kilns</b>	Number of Kilns	<b>39 kilns</b>	<b>PCA PIS</b>
	Production Capacity	<b>17,945,000 metric tons</b>	
<b>Long Dry</b>	Number of Kilns	<b>51 kilns</b>	<b>PCA PIS</b>
	Production Capacity	<b>13,885,000 metric tons</b>	
Semi-dry / Semi-wet	Number of Kilns	<b>Included with other categories</b>	
	Production		
Wet	Number of Kilns	<b>52 kilns</b>	<b>PCA PIS</b>
	Production Capacity	<b>15,574,000 metric tons</b>	
Vertical Shaft	Number of Kilns	<b>0 kilns</b>	
	Production	<b>0 metric tons</b>	
Others	Number of Kilns	<b>0 kilns</b>	
	Production	<b>0 metric tons</b>	

**Asia-Pacific Partnership on Clean Development and Climate Questionnaire  
(Based on Version 6.12)**

Item		Input Cell					Other Comments	Source
<b>Cement Supply and Demand</b>								
<u>Production Data</u>		Thousand <b>Metric Tons</b>						<b>USGS MYB Cement Table 1</b>
(Fiscal) Year		2000	2001	2002	2003	2004		
Pure Clinker		<b>78,138</b>	<b>78,451</b>	<b>81,517</b>	<b>81,882</b>	<b>86,658</b>		
<b>Enter below according to the standard of each country.</b>								
Portland Cements	<b>General use &amp; moderate heat (Gray Types I &amp; II)</b>	<b>90,644</b>	<b>96,970</b>	<b>90,800</b>	<b>89,500</b>	<b>91,800</b>		<b>USGS MYB Cement Table 16 (2002, 2003, &amp; 2004) and Table 15 (2005)</b>
	<b>High early strength (Type III)</b>	<b>3,815</b>	<b>3,830</b>	<b>3,820</b>	<b>3,750</b>	<b>3,820</b>		
	<b>Sulfate resisting (Type V)</b>	<b>4,453</b>	<b>4,870</b>	<b>7,300</b>	<b>10,600</b>	<b>15,800</b>		
	<b>Block</b>	<b>636</b>	<b>550</b>	<b>607</b>	<b>752</b>	<b>609</b>		
	<b>Oil well</b>	<b>1,039</b>	<b>1,150</b>	<b>889</b>	<b>1,090</b>	<b>1,310</b>		
	<b>White</b>	<b>894</b>	<b>870</b>	<b>952</b>	<b>985</b>	<b>1,130</b>		
	Subtotal	<b>101,481</b>	<b>108,240</b>	<b>104,368</b>	<b>106,677</b>	<b>114,469</b>	<b>Not included in USGS Table</b>	
Blended Cements	<b>Portland, natural pozzolans</b>	<b>194</b>	<b>192</b>	<b>187</b>	<b>142</b>	<b>49</b>		<b>USGS MYB Cement Table 16 (2002, 2003, &amp; 2004) and Table 15 (2005)</b>
	<b>Portland, granulated blast furnace slag</b>	<b>385</b>	<b>560</b>	<b>753</b>	<b>747</b>	<b>978</b>		
	<b>Portland, fly ash</b>	<b>405</b>	<b>391</b>	<b>218</b>	<b>240</b>	<b>343</b>		
	<b>Other blended cement</b>	<b>313</b>	<b>362</b>	<b>365</b>	<b>438</b>	<b>486</b>		
	Subtotal	<b>1,297</b>	<b>1,505</b>	<b>1,523</b>	<b>1,567</b>	<b>1,856</b>	<b>Not included in USGS Table</b>	
Other Cements	<b>Expansive and regulated fast setting</b>	<b>60</b>	<b>64</b>	<b>66</b>	<b>52</b>	<b>62</b>		<b>USGS MYB Cement Table 16 (2002, 2003, &amp; 2004) and Table 15 (2005)</b>
	<b>Misc.</b>	<b>111</b>	<b>110</b>	<b>55</b>	<b>88</b>	<b>32</b>		
	Subtotal	<b>171</b>	<b>174</b>	<b>121</b>	<b>140</b>	<b>94</b>		
<b>Grand Total</b>		<b>102,927</b>	<b>109,920</b>	<b>106,000</b>	<b>108,000</b>	<b>116,000</b>	<b>Not equal to above due to rounding differences</b>	

**Asia-Pacific Partnership on Clean Development and Climate Questionnaire  
(Based on Version 6.12)**

Item		Input Cell					Other Comments	Source
<b>Import/Export</b>								
(Fiscal) Year		2000	2001	2002	2003	2004		
Clinker	Import	3,673	1,782	1,603	1,808	1,630		<b>USGS MYB Cement Table 1</b>
	Export	Not provided	Not provided	Not provided	Not provided	Not provided		
Cement	Import	24,561	23,694	22,198	21,015	25,396		
	Export	738	746	834	837	818		
Projected production		Not estimated						
<b>CO2 Data (Survey Year: 2004 FY - Underdevelopment by PCA using the WBCSD Protocol)</b>								
1) CO2 Calculation Boundary	Production process within the boundaries of cement plant.						This survey covers only on-site production process, but if indivisible from other emission sources, circle "Yes" in the lefthand box.	
	Other emission sources							
	• Mine ( Yes /No )							
	• Import of raw material and fuels ( Yes /No )							
	• Export of products (Yes / No)							
	• Electricity sales from on-site generation (Yes / No)							
2) Fuel / Power Consumption and Total Energy, CO2 Emissions	Complete Attachment-1.							
	• Provide heating value according to common domestic practice.							
	• For power produced externally, use energy conversion factor adopted in each country and identify source..							
	• If power generated on-site is sold externally, provide only value representing fuel consumed on-site, determined pro rata to site consumption and electricity sales volumes. If indivisible, provide total consumption and identify it in other comments.							
	• Provide CO2 emission factor adopted in each country and identify source.							
3) CO2 emissions from raw materials	Complete Attachment-2.							
	• If using company-specific calculation methodologies, describe in the sheet.							

**Asia-Pacific Partnership on Clean Development and Climate Questionnaire  
(Based on Version 6.12)**

Item	Input Cell	Other Comments	Source
4) Specific CO2 emissions from energy	Complete following blanks based on the calculations conducted in Attachment-1.	Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels	
	• Clinker-based	Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels	
	Gross V/A _____kg-CO2/kg-clinker		
	Net U/A _____kg-CO2/kg-clinker		
	• Cement-based	Specify data source: national inventory / industry specific data	
	Gross V/B _____kg-CO2/kg-cement		
5) Total specific CO2 emissions	Complete following blanks based on the calculations conducted in Attachment-1.	Gross: Inclusive of alternative fossil fuels / exclusive of biomass fuels	
	• Clinker-based	Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels	
	Gross (V+X)/A _____kg-CO2/kg-clinker		
	Net (U+X)/A _____kg-CO2/kg-clinker		
	• Cement-based	Specify data source: national inventory / industry specific data	
	Gross (V+X)/B _____kg-CO2/kg-cement		
6) Specific energy consumption	Complete following blanks based on the calculations from Attachment-1.	Gross: Inclusive of alternative fossil fuels and biomass fuels	
	• Clinker-based	Net: Exclusive of alternative fossil fuels / exclusive of biomass fuels	
	Gross T'/A _____kJ/kg-clinker		
	Net S /A _____kJ/kg-clinker		
	• Cement-based	Specify data source: Fuel on a Higher heating value basis / Fuel on a Lower heating value basis	
	Gross T'/B _____kJ/kg-cement		
Net S/B _____kJ/kg-cement			

**Asia-Pacific Partnership on Clean Development and Climate Questionnaire  
(Based on Version 6.12)**

Item	Input Cell	Other Comments	Source
<b>Recycling ( Consumption of Alternative Raw Materials and Fuels)</b>			
Use of Alternative Raw Materials	Yes / No		
• Mineral components used to produce clinker	Slag Consumption(in 2004) 153,900 metric tons/yr	Not expressly stated as wet or dry	USGS MYB Slag Table 3
	Fly-ash Consumption(in 2004) 2,128,032 metric tons/yr Fly-ash Consumption(in 2005) 2,571,393 metric tons/yr	Not expressly stated as wet or dry	ACAA CCP
	Bottom Ash Consumption (in 2004) 558,092 metric tons/yr Bottom Ash Consumption (in 2005) 852,452 metric tons/yr	Not expressly stated as wet or dry	ACAA CCP
	Boiler Slag Consumption (in 2004) 30,395 metric tons/yr Boiler Slag Consumption (in 2005) 38,615 metric tons/yr	Not expressly stated as wet or dry	ACAA CCP
• Mineral components used to produce Portland and blended cements	Slag Consumption(in 2004) 3,735,100 metric tons/yr	Not expressly stated as wet or dry	USGS MYB Slag Table 3
	Fly-ash Consumption(in 2004) 12,811,143 metric tons/yr Fly-ash Consumption(in 2005) 13,598,661 metric tons/yr	Not expressly stated as wet or dry	ACAA CCP
	Gypsum by-product Consumption(in 2004) 741,372 metric tons/yr Gypsum by-product Consumption(in 2005) 672,443 metric tons/yr	Not expressly stated as wet or dry	ACAA CCP
	Bottom Ash Consumption (in 2004) 715,833 metric tons/yr Bottom Ash Consumption (in 2005) 925,926 metric tons/yr	Not expressly stated as wet or dry	ACAA CCP
• Future availability		Provide alternative raw material type and amount (if available).	
Consumption of Alternative Fuels	Yes / No		
• Alternative fossil fuels	Provide amount and heating value etc. in Attachment-1.		
• Biomass			
• Future Availability		Provide alternative fuel type and amount (if available).	

**Asia-Pacific Partnership on Clean Development and Climate Questionnaire  
(Based on Version 6.12)**

Item	Input Cell	Other Comments	Source
Pollutants ( Survey Year : FY 2004 - <b>NOT AVAILABLE</b> )			
1) Calculation Coverage	Exhaust gas from kiln exhaust gas dust collector		
2) SOx emissions	Total emissions <b>(2002) 161,000 metric tons SO2 / yr</b>		<b>USEPA Emissions</b>
	Specific emissions _____kg-SO2/t-clinker	<b>Not able to estimate</b>	
3) NOx emissions	Total emissions <b>(2002) 194,000 metric tons NOx/ yr</b>		<b>USEPA Emissions</b>
	Specific emissions _____kg-NO2/t-clinker	<b>Not able to estimate</b>	
4) Stack dust emissions	Total emissions <b>PM10 (2002) 28,000 metric tons PM10/ yr</b>		<b>USEPA Emissions</b>
	Specific emissions _____kg-dust/t-clinker	<b>Not able to estimate</b>	
Voluntary Programs and Regulations			
Voluntary Program	Yes / No		
• Index			
• Target			
• Results Achieved			
• Implementation level	Country, Local Government, Region(                    )		
• Period			
Emissions Trading System	Yes / No		
• Scope of Application			
• Implementation level			
• Period			
Applicable laws and regulations	Provide name of law, regulatory agency, scope of application, provisions, regulation values, frequency of measurement	Provide or attach specific regulatory values.	
• CO2 emissions			
• Energy conservation			
• Air			
• Water quality			
• Noise			
• Vibration			
• Waste			
• Location laws			
• Others			

**Asia-Pacific Partnership on Clean Development and Climate Questionnaire  
(Based on Version 6.12)**

Item		Input Cell	Other Comments	Source
What do you think are examples of best practice in cement production technologies?				
Elaborate any barriers of plant operation below.				

**REFERENCES:**

**PCA PIS** - "U.S. and Canadian Portland Cement Industry: Plant Information Summary, December 31, 2004," Economic Research Department, Portland Cement Association, Skokie, Illinois, USA, 2006.

**USGS MYB Cement** - "Minerals Yearbook: Volume I - Metals and Minerals: Cement," Hendrik G. van Oss, United States Geological Survey, United States Department of the Interior, Washington, District of Columbia, USA, 2002, 2003, 2004, & 2005.

**USGS MYB Slag** - "Minerals Yearbook: Volume I - Metals and Minerals: Slag—Iron and Steel," Hendrik G. van Oss, United States Geological Survey, United States Department of the Interior, Washington, District of Columbia, USA, 2005.

**ACAA CCP** - "Coal Combustion Product (CCP) Production and Use Survey," American Coal Ash Association, Aurora, Colorado, USA, 2005 & 2006.

**USEPA Emissions** - "1970 - 2002 Average Annual Emissions, All Criteria Pollutants in MS Excel," United States Environmental Protection Agency, Washington, DC, USA, July 2005. <http://www.epa.gov/ttn/chief/trends/index.html>



# 1.7 People's Republic of China

# Report on a Survey of 120 Chinese Cement Manufacturers in 2006

Survey Date: March 25, 2007

Report prepared by:

LIU Ming, Dept. of Industry, National Development and Reform Commission

KONG Xiangzhong, China Cement Association

LIU Zuoyi, China Digital Cement Network

SUI Tongbo, China Building Materials Academy

ZHANG Shaozhou, Productivity Center of Building Materials Industry

CHEN Molin, China Cement Association Consulting Company

Chief Authors:

KONG Xiangzhong, China Cement Association

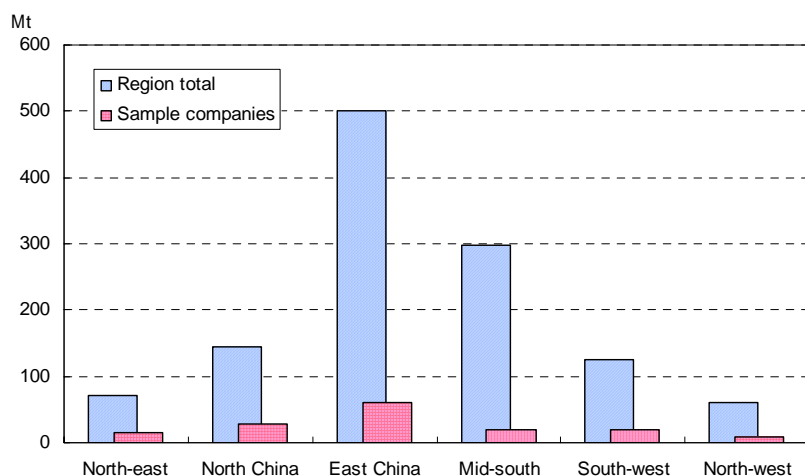
LIU Zuoyi, China Digital Cement Network

Introduction

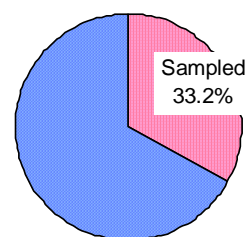
During January through March 2007, the Department of Industry of the National Development and Reform Commission (NDRC), People’s Republic of China, and the China Cement Association (CCA) jointly conducted a model survey of over 100 cement manufacturers in China representing various manufacturing capacities and process types on a nationwide basis, with the cooperation of the Ministry of Economy, Trade and Industry of the Government of Japan, and the Japan-China Economic Association. The surveyed companies were analyzed from various aspects based on the survey data returned, taking into consideration the series of industrial policies and legislations that have been promulgated by the PRC government in recent years with regard to the promotion and advancement of the cement industry, and statistical data related to China’s cement industry in 2006 as well as the business status of some of the large cement manufacturers.

As illustrated in the chart below (left), the surveyed companies are spread among all the regions in China. The surveyed companies account for 12.2% in terms of total cement production in China in 2006. It used to be that a large share of cement production in the country was generated from relatively inefficient vertical shaft kilns in the past. It is important to note, however, nowadays the switch from vertical shaft kiln to new dry type kiln has been increasing. The total share of cement production with the new dry type kilns now amounts to about 50% in 2006. In terms of clinker production capacity with new dry type kiln, the surveyed companies in this report represent 33.2% (see chart below, right). As energy efficiency is one of the prominent targets the NDRC has set, one can assume that the shaft kilns will continue to be replaced by new dry type kilns progressively.

Production of Cement in China  
by Region and the Companies Surveyed, 2006



Share in Clinker  
Production Capacity with  
New Dry Type Kiln



## **TABLE OF CONTENTS**

### Introduction

1. Survey method and process .....	65
2. An overview of the Chinese cement industry in 2006	
2.1 Industry development and performance summary .....	66
2.2 Major problem areas .....	67
3. Survey and analysis of the Chinese cement industry	
3.1 Cement production performance	
3.1.1 Cement production volume since the '90s and growth rate .....	68
3.1.2 Distribution of nationwide cement output .....	68
3.1.3 The national cement production ranking .....	70
3.2 Cement consumption	
3.2.1 Per capita cement consumption .....	72
3.2.2 Distribution of cities by scales of cement consumption .....	73
3.2.3 Notes on the city-wise cement consumption picture .....	73
3.3 Major economic indicators	
3.3.1 Cement sales revenues .....	75
3.3.2 Cement sales profit .....	77
3.3.3 Cement profit margins .....	79
3.3.4 Notes on the regional cement profit margin status .....	81
3.4 New dry type clinker manufacturing capacity	
3.4.1 New dry type clinker manufacturing capacity .....	81
3.4.2 Production capacity of the companies surveyed .....	82
3.5 Prioritized enterprise group with government support	
3.5.1 Growth rate .....	83
3.5.2 Production scale .....	84
3.5.3 Notes on 12 national enterprises with strategic support .....	85

3.6	Technical and economic indicators	
3.6.1	Coal and electricity consumption data .....	86
3.6.2	Limestone procurement .....	87
3.6.3	Coal procurement .....	87
3.6.4	Waste heat power generation .....	87
3.6.5	Waste utilization .....	88
3.7	Cement prices	
3.7.1	Cement prices in recent years .....	88
3.7.2	Cement prices in major cities in December 2006 .....	89
3.8	Cement exports .....	89
4.	Overall concept and supporting policies by the PRC government for advancement and development of the cement industry in China	
4.1	Overall concept for the cement industry development .....	90
4.2	Supporting measures .....	90
4.3	Goals for the cement industry development program .....	91

## 1. Survey method and process

### 1.1 Survey method

The survey was conducted January through March 2007. Prior to the survey, the CCA had experts draft survey procedures and then prepared a detailed survey form and explanatory notes to it. The Department of Industry of the NDRC and the CCA then jointly issued 76 notifications to the local branches of the Development and Reform Commissions and Cement Associations in the nationwide provinces and municipalities, as well as 216 notifications addressed to 158 cement companies across the country. In parallel to the above, an E-mail address ([shuinidiaochoa@sina.com](mailto:shuinidiaochoa@sina.com)) was established exclusively for use with the survey and necessary data exchanges. After the Lunar New Year celebrations in February, the companies started turning in survey forms from early March. As of this reporting on March 25, the number of responses collected is 120, representing 76% of the total survey subjects.

### 1.2 Development of the survey report

Concurrent with collection of the survey returns, the Chinese team of the APP Cement Task Force has attempted a review and analysis of the overall situation of the Chinese cement industry. Meanwhile, the CCA has dispatched several experts each to Jidong Cement Company in Hebei Province, Changzhou Pangu Cement Company in Jiangsu Province, Wannianqing Cement Company in Jiangxi Province, Fujian Cement Company in Fujian Province, Jinan Sunnsy Group Company in Shandong Province, and Anhui Conch Group Company in Anhui Province to inspect respective manufacturing facilities of the companies being surveyed so that the integrity and accuracy of the survey results are improved.

In drafting the survey report, because of time limitations, a number of experts from organizations such as China Building Materials Academy, China Digital Cement Network, China Cement Association Consulting Company and others have been mobilized in addition to the Chinese team of the APP Cement Task Force to classify, consolidate, and analyze the survey results collected.

Status of Production Lines at the Companies Surveyed

Manufacturing Process	Kiln Size t/d	Number of Kilns	Manufacturing Process	Manufacturing Scale, 10 <sup>3</sup> t/y	Number of Kilns
New Dry Type (NSP) Kilns 109 Companies	≥8,000~10,000	0	Vertical Shaft Kilns 11 Companies	≥20	4
	≥4,000~8,000	17		<10	20
	≥2,000~4,000	111			
	<2,000	59			
	Total	187		Total	24

## 2. An overview of the Chinese cement industry in 2006

### 2.1 Industry development and performance summary

(i) The scale of cement manufacturing has continued to expand

China's cement production in 2006 was recorded as 1.24 billion tons, up 71% from 2002, and marked the world-largest for 22 consecutive years.

(ii) Product composition has markedly improved

Cement produced via new dry type (i.e. preheated or pre-calcined) process reached 624 million tons, accounting for 50% of the total production volume, which is 34 percentage points higher than that in 2002.

(iii) Industry integration continues to progress

The combined production volume of the ten largest cement manufacturers in China now accounts for 15% of the total production, which is 11 percentage points higher than that in 2002. Among the top performers, the annual production by Anhui Conch Group is already in excess of 77 million tons.

(iv) New progress is seen in home-made key technologies and manufacturing facilities

The ratio of domestically built cement plants in the capacity range of 4,000 t/d and 5,000 t/d has now reached 95% or above. The number of new dry type cement manufacturing facilities built with domestic technology and engineering exceeded 700 at the end of 2006, thereby completely transforming the previous picture where China had depended on imported cement manufacturing technologies and facilities.

(v) Large scale export of cement manufacturing technology and facilities

Made-in-China cement manufacturing facilities and technology have made inroads to various countries including Russia, Saudi Arabia, the UAE, Iran, Vietnam, Laos, Thailand, Tajikistan, Kazakhstan, Italy and the European market. Notably among these countries, China has received orders from Saudi Arabia and the UAE for constructing a 10,000 t/d cement plant each on a turnkey basis. China-made cement manufacturing facilities presently enjoy a 30% share of the international market. Meanwhile, a great success is also seen in the pure low temperature waste heat power generation technology for cement plants and related hardware that were developed in China, where the number of new dry type cement manufacturing companies employing domestically developed waste heat power generation technology exceeded 50 nationwide at the end of 2006, which can be considered to be at an advanced international level. The aforementioned pure low temperature waste heat power generation technology and related hardware have already been exported to Thailand, and business discussions are under way with Australia and India for introduction of the technology and equipment. As of the end of 2006, the number of cement plants globally that are either in operation, under construction or on construction contracts based on Chinese cement technology and facilities reached 107, basically

consisting of the new dry type cement manufacturing system having daily manufacturing capacities of between 2,000 tons and 5,000 tons. All in all, Chinese cement manufacturing technology and facilities are leading the development of the cement industry worldwide.

(vi) Overall energy consumption of the cement industry is declining

Due to renewal and upgrading of facilities, energy consumption by the Chinese cement industry is noticeably declining. For reference, the specific energy consumption for cement manufacturing in China was 142 kg-standard coal per ton in 2006, representing a 15% drop from the 2002 figure.

(vii) Economic effects are growing substantially

Cement sales revenue in 2006 reached 321.7 billion Yuan, up 22.3% from the previous year, and the gross profit increased by 89.9% from a year earlier to as much as 15 billion Yuan, marking the highest in history.

(viii) Export of cement and clinker is increasing

The total volume of cement and clinker exported during 2006 was 36.13 million tons, consisting of 19.41 million tons of cement and 16.72 million tons of clinker. Export volume increased by 63% over the previous year, while the export revenue rose by 72.5% to US\$1.181 billion.

## 2.2 Major problem areas

(i) Outdated manufacturing processes still occupy a large proportion of the industry as a whole

Outdated manufacturing processes, including vertical shaft kilns, still account for about 48% of the total manufacturing capacity, bringing the technological structure of the entire Chinese cement industry to an unsound condition and unavoidably giving adverse effects on resource and environmental factors.

(ii) Due to the small size of many enterprises, labor productivity is low and low quality products occupy a majority portion

The average manufacturing capacity of the 5,000 or so cement manufacturing companies operating in China is 250,000 tons per year and the per head production performance is a mere 880 tons per year. In terms of the cement quality, 32.5 MPa class products account for approximately 85% of the total production.

(iii) Energy consumption is high, and environmental and resource base damage is serious

Average energy consumption rate remains high, and most small business enterprises are unable to meet environmental standards whereas as their utilization of lime stone resources is insufficient.

(iv) Overlapping markets is causing keen competition

In some parts of the nation, surplus capacity and overlapping markets are causing intense

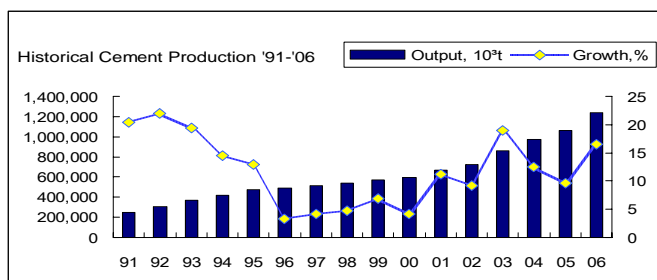
competition among cement manufacturers and low marketing prices are forcing some enterprises to operate in the red.

### 3. Survey and analysis of the Chinese cement industry

#### 3.1 Cement production performance

##### 3.1.1 Cement production volume since the '90s and growth rate

China's Cement Production Since 1991



Year	Nationwide Data	
	Output, 10 <sup>3</sup> t	Growth, %
91	252,609	20.46
92	308,217	22.01
93	367,880	19.36
94	421,190	14.49
95	475,606	12.92
96	491,189	3.28
97	511,738	4.18
98	536,000	4.74
99	573,000	6.90
00	597,000	4.19
01	664,000	11.22
02	725,000	9.19
03	862,000	18.90
04	970,000	12.53
05	1,064,000	9.69
06	1,240,000	16.54

Cement production in China has continued to increase since 1991. In particular, after the period of the “10th 5-year Development Plan” (2001-2005) rapid economic growth and expansion in fixed asset investments brought a substantial increase in the cement production, which rose from 597 million tons in 2000 to 1,064 million tons in 2005, registering an average annual increase of 93.4 million tons or an average annual growth rate of 12.31%. Meanwhile, the volume of cement produced via the new dry process also increased from 60.6 million tons to 425.6 million tons during the same period, representing an average annual increase of 73.0 million tons or an average growth rate of 47.67% per year. As a result, the proportion of cement produced by the dry type process increased from 11.1% in 2000 to 40% in 2005.

Average since 1991	11.91
Average 8th 5-Yr Pla	17.85
Average 9th 5-Yr Pla	4.66
Average 10th 5-Yr PI	12.31
Average 12th 5-Yr PI	16.54

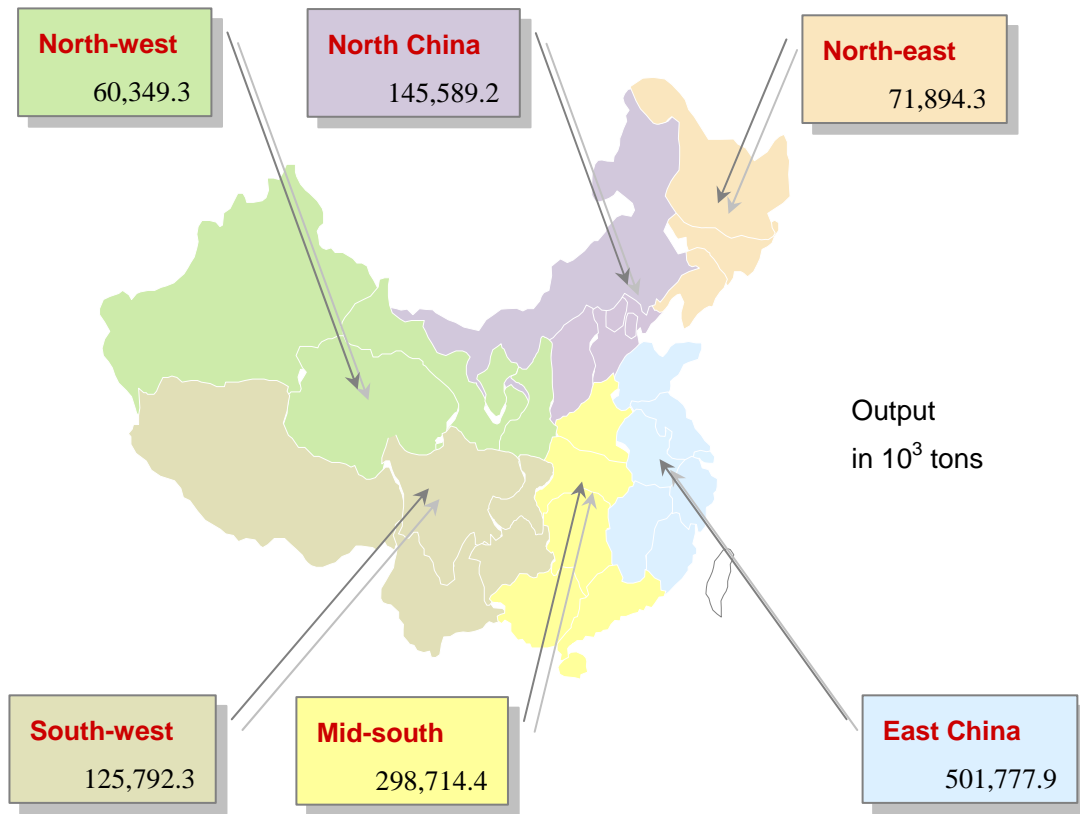
With regard to the year 2006, which is the first year of the “11th 5-year Development Plan” period (2006-2010), the volume of cement production reached 1,240 million tons, registering a still high growth rate of 16.5%.

##### 3.1.2 Distribution of nationwide cement output

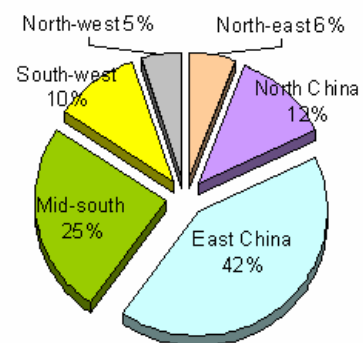
The volume of cement produced locally is linked closely to the degree of regional economic development, attested to by the fact that the economically active regions of Eastern China and Mid-south China account for approximately 65% of the national production. In the 2006 cement production picture, East China had 42% of the share, followed by Mid-south China with 25%, North

China with 12%, five provinces in Southwest China with 11%, and a mere 11% for the economically lagging Northwest China and Northeast China combined.

Distribution of 2006 Cement Output by Region



Region	Output, 10 <sup>3</sup> t	Share, %
North-east	71,894	6.0
North China	145,589	12.1
East China	501,778	41.7
Mid-south	298,714	24.8
South-west	125,792	10.4
North-west	60,349	5.0



As the Chinese economy continues to expand there are a number of new growth points appearing in regional economies, impacting on the cement production at respective regions as summarized below

- Northeast China: The central government’s policy measure to place a special emphasis on developing and promoting the northeast region started working since the latter half of the “10th











































