Current Status and Energy Efficiency Improvement of China Cement Industry

- China Cement Association

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一、Current Status of China Cement Industry

Brief of China Cement Industry:

1. Economic Operation: Output: 1.36 billion tons, 9.7% growth rate comparing with last year.

Total output value: 410.4 billion RMB yuan, 23.1% growth rate comparing with last year.

Average Ex-factory cement price: about 245 RMB yuan, about 6 RMB yuan increased as comparing with last year.

Ratio of Production to Sale: 98.3%

2.Investment in Fixed Assets: Accumulated: 49.9 billion RMB yuan, 47.7% growth rate comparing with last year.

122 energy saving and mitigation projects, 670 million RMB yuan subsidies from the government.

3.Import & Export: 31.15 Mt of cement and clinker were accumulatively exported with 4.3% of reduction rate, among them 14.48Mt of cement was accumulatively export with 21.3% reduction rate.

二、Energy Efficiency of Cement Industry

Energy saving and emission mitigation of cement industry have been listed as a sector that the government concerns:

- One of key sectors in top-1000 enterprises energy saving action;
- Involving in an activity of key industrial energy efficiency benchmark；
- One of Ten Key Energy Saving Projects during the “11th Five-year” Plan;
- Involving in Energy use quota standards of 26 energy intensive product

All of these indicate that cement industry is a big energy user, and has a great potential to save energy

二、Energy Efficiency of Cement Industry

Since the "11th Five-year" Plan, cement industry have been on its own initiative to save energy and mitigate emission, obtaining a remarkable achievement:

- The growth rate of total energy use is lower than that of product output;
- Energy use of value added of 10 thousand RMB yuan is reduced;
- Comprehensive energy use per 10 thousand RMB yuan is dropped; and
- Solid waste use increases year by year.

Energy Use in Cement Industry from 2005 to 2006

Year	Total（10^8 tons）		Energy use of value added of 10^4 RMB yuan (tce)	Comprehensive energy use per unit product(tce)		Total solid waste used (10^4t）
	Cement	Energy use		Clinker	Cement	
2006	12.36	1.31	12.56	142	120	About 25000
2005	10.69	1.2	14.07	148	127	22906
Growth rate (%)	15.6	11.9	-12.0	-4.20	-5.80	9.10

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NDRC & NBS publicizes energy use of top-1000 enterprises in 2006.

- Based on that, energy use of unit product of cement enterprise listed in top-1000 enterprises is 10.8% higher than that of international advanced.
- There is a big gap among domestic average, 38% higher than that of top-1000 enterprises, and 53% higher than overseas advanced.
- There are 86 cement enterprises included in top-1000 enterprises energy saving activity, accounted for 8.6% of 998 cement enterprises, however energy saving only takes 2.5% of total.

Although it is unreasonable to make these comparison due to different industry, different scales and different energy use, it has somewhat reference for us in view of its average.

Energy Use Indicators and Energy Saving of Cement Enterprise listed in top-1000 Enterprises

Items	Average in 2006（tce）	Reduction compared with 2005（%）	Overseas advanced（tce）	Domestic average（tce）	Energy saving in 2006（10^4tce）
Comprehensive energy use per ton cement	113	2.1	102	156	38.05
Total energy saved of 1000 enterprises					1492.26

Source: NDRC & NBS（2007）

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三、Approaches to Improve Energy Efficiency of Cement Industry

1. Adjustment of Cement Industrial Structure

Core of cement industrial structure adjustment is to greatly deploy new dry production line, and eliminate backward production. China Cement Industry Development Plan proposes that percentage of new dry method cement will reach 70% by 2010, which means that it must at least eliminate backward cement 250 Mt during the "11th Five-year" Plan period (50 Mt cement each year), meanwhile all of which will be filled in by new dry method production line with capacity of 4000t/d.

As for elimination of 50 Mt each year, it is equal to 37 Mt clinker, in which 30 Mt clinker to be produced by vertical kiln, and 7 Mt by wet kiln and long dry kiln. In terms of eliminating backward production, it can obtain 2.34 Mtce energy saving per year according to the calculation, and mitigate 6.08Mt CO_2. 11.7 Mtce will be accumulatively saved in the “11th Five-year” period.

Energy Saving Achieved by Eliminating Backward

Structure of Elimination		Amount	Accumulated in the "11th Five-five"	Energy use of clinker
Cement（10^4t）		5000	25000	Backward vertical kiln：160kgce/t Long wet kiln & others：214kgce/t Large new dry kiln：107kgce/t
Clinker（10^4t）		3700	18500	
In which	Vertical Kiln(10^4t)）	3000	15000	
	Long wet kiln etc.(10^4万t）	700	3500	
Energy saving potential that can be realized (10^4tce)		234	1170	

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2. Power Generation by Residual Heat Recovered from New Dry Cement Production Line

Outlet Temperature of waste gas of domestic new dry clinker production line is generally at 330℃～350℃. Currently, residual heat cannot completely be recovered and re-used. The recovered residual heat can be used for power generation or heating supply, which is a realistic approach to save energy.Transforming recovered waste heat into power can greatly reduce energy use in cement production. At same time, the outlet temperature of waste gas that is reduced via boiler can effectively alleviate heat pollution of cement production with a good economic and social benefits.

Until the end of 2007, 120 new dry cement production lines of 81 enterprises have been installed power generation by using recovered low temperature residual heat, with total installed capacity of 725.9MW. Based on situation of cement industry, we select the average level, thus 4.86 TWh can be obtained in a year, which can save 1.78 Mtce, and mitigate 4.63 Mt CO_2.

Opinions on Accelerating Adjustment of Cement Industry Structure released by NDRC proposes that 40% of new dry production lines will be installed recovered low temperature residual heat power generator by 2010. It has predicted that there will be about 1000 new dry cement production lines by 2010. Based on this target, 280 production lines will be installed power generators from 2008 to 2010. Up to 2010, annual average power generation will be 3000MW, which can realize 20.1 TWh power generation annually. This can save 7.37Mtce, and reduce 18.93 Mtce CO_2.

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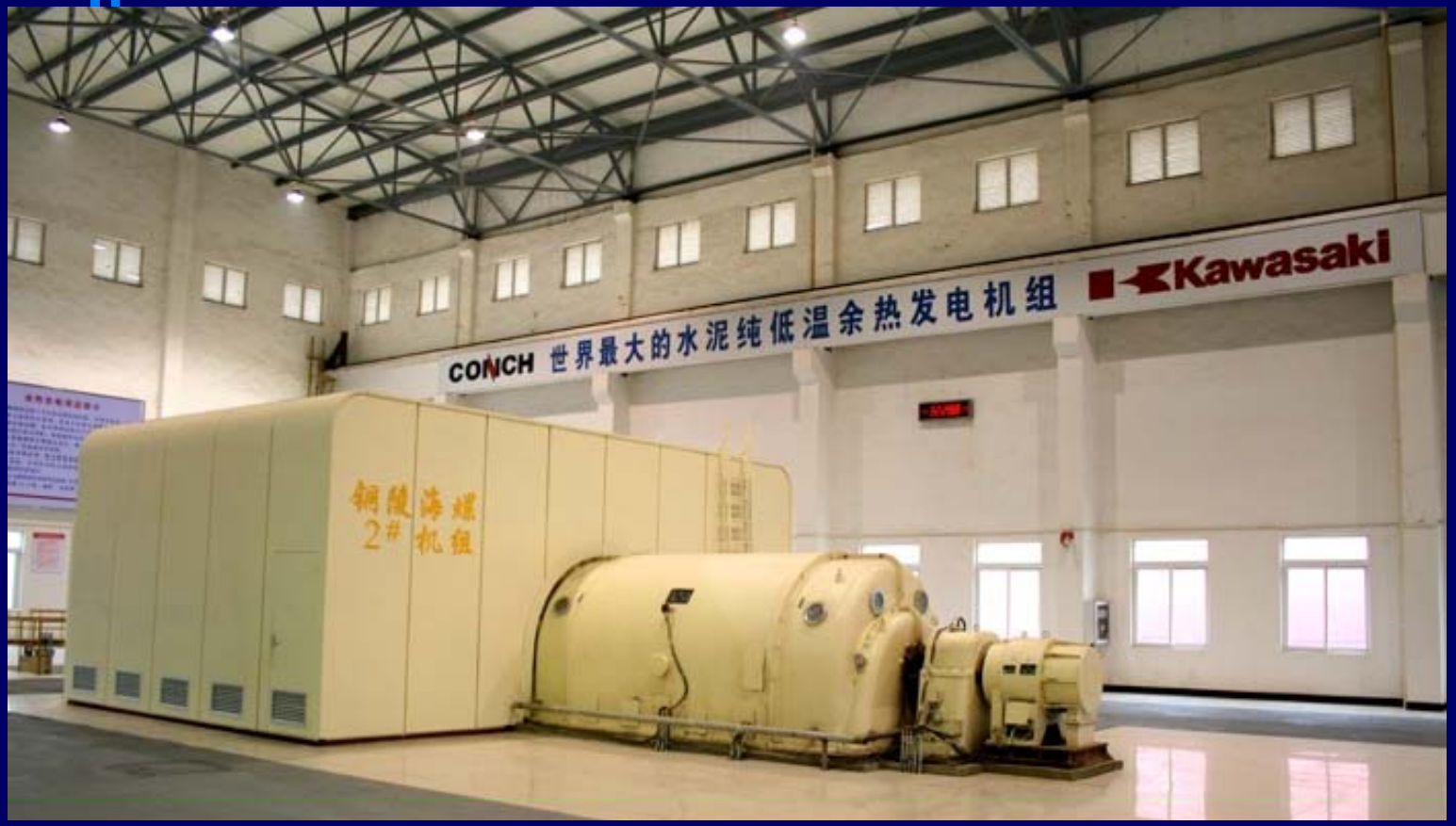

Tongling Conch Residual Heat Power Generator 2#
(30500kW)

3. Spread High Efficiency Grinding Facilities & Technology

Power use of Grinding facilities accounts for 62%-68% of comprehensive power use in cement production.

Currently, grinding facilities used in cement industry mainly consist of three types:

★ Vertical mill+Fan+Dust collector；

★ Ball (tube) mill + Dust collector + Fan；

★ Roller press + scattering facilities + classifier + dust collector; and roller press + ball mill + classifier + dust collector；

★ Horizontal roller mill + Fan + Dust collector.

Up to 2005, grinding facilities for production line with 2000 tons/day and above

(Unit:Set)

Items	Vertical Mill	Ball Mill	Roller Press	Horizontal roller mill	Total
Total	273	730	56	3	1062
Raw Materials Mill	220	150	4	0	374
Cement/Slag Mill	35	300	52	4	391
Coal Mill	18	280	0	0	298

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Characteristic Comparison of Different Grinding Facilities and System

Items	Raw materials	Vertical mill	Ball mill	Roller press	Horizonta roller mill
Grinding		Press/Grin ding	Collide/clash	Crush	Press/Gri ding
Grinding intensity(Mpa)		1.5	-	4.5	2.5
Allowed maximum water content of feedings(%)	Raw materials/ Slag	28	3~8	15	<10
Product Fineness（cm^2/g）	Cement	>6000	>6000	>5500	>5000
When producing various type of cement		Most flexible	Non-flexible	Middle	Middle
Average life-span of grinding facilities(year)	Cement	>2	>3	>2	>1.5
Land occupation		Minimum	More	Maximum	less
Rate of average annual operation（%）		85~90	80~95	80~85	75~80
When 3500cm^2/g,total power use（kWh/t）		21	35	20	22

Source: Analysis of Grinding Facilities Selection Trend of Cement Industry (Gao Char

In view of current different grinding system development trend, the approaches to save energy and reduce energy use mainly consist of: (1) replacing ball mill with vertical mill in raw material grinding system; (2) replacing ball mill with roller press combined mill system in cement mill system, especially to cement mill station with annual production of 1 Mt; (3) In coal mill system, replacing air swept mill with vertical mill.

If 20% of ball mill is replaced by vertical mill or roller press combined grinding system annually, it would get 760 GWh power saved, which is equal to save 280 thousand tce and mitigate 730 thousand tons CO_2.

4. Cement Grinding Auxiliary

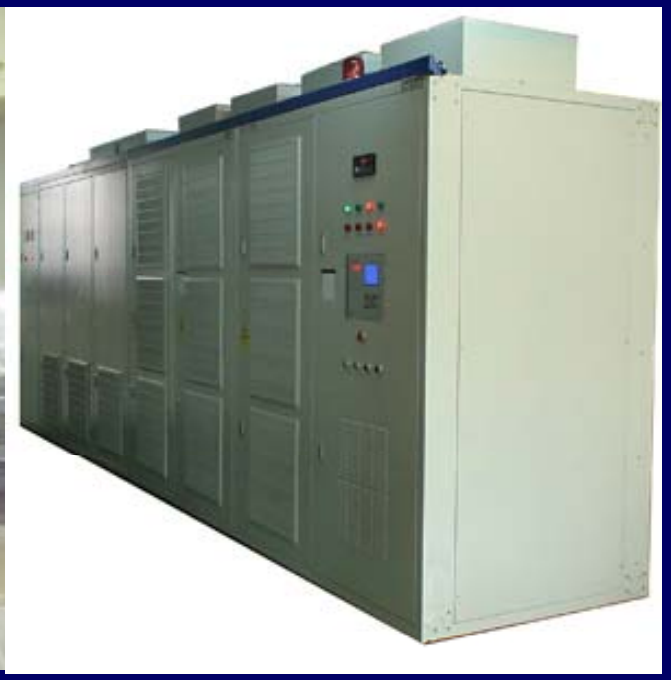
To add an appropriate amount of auxiliary into cement grinding can increase 10%-25% output of mill, reducing about 25% power use, meanwhile which can avoid over-grinding, optimize arrangement of cement particulate and improve coefficient of cement particulate round, so as to raise 3-5 Mpa of cement intensity, and improving the amount of blending .

At present, rate of auxiliary used in cement production of the Northern American region is 85%, meanwhile global average is about 60%, however it is only about 20% in China.

In 2007, output of cement was 1.36 billion tons in China. If rate of auxiliary used increases to 60% (world average) from current 20%, 1.8TWh power could be saved, equivalent to 660 thousand tce saved annually, and mitigation of 1.72 Mt CO_2.

5. ASD Retrofit of Motor Driving System

A great quantity of power consuming equipment (e.g. motor and fan) is used in cement production, which mainly applies in head of kiln, end of kiln, grinding facilities, large fan and transport facilities of rotary kiln. Through application of ASD, it can save energy, but more important make operation safety and stabilize production technical and product quality.



Guangzhou Zhiguang Electric applies ASD technology to change operation speed of equipment, regulate volume of air, so as to replace damper to adjust the opening of air flow, and average power saving is about 30 % .

Parameters of Large Fan and Installed Power of Different New Dry Cement Production Lines

Name	Parameters	1000t/d	2500t/d	5000t/d	10000t/d
Fan at Head of Kiln	Flux (m3/h)	180000	300000	620000	1150000
	Pressure (Pa)	2000	2000	2000	2000
	Power (kW)	160	250	710	1250
High Temperature Fan	Flux (m3/h)	210000	450000	860000	850000
	Pressure (Pa)	7500	7600	7700	7500
	Power (kW)	710	1250	2500	2500(2套)
Cycling Fan	Flux (m3/h)	220000	400000	860000	
	Pressure (Pa)	10000	10000	10000	
	Power (kW)	800	1000~1700	3550	
Fan at end of kiln	Flux (m3/h)	210000	450000	920000	1000000
	Pressure (Pa)	2000	2000	2000	11000
	Power (kW)	185	450	710~800	3800(2套)
Fan installed at cooling machine	Set（台）	8	12	15	24
	Power	457	800	1672	2994

Source: Power DSM Management Implementation Guidance in 2007

According to initial statistics, installed capacity of large and medium motor driving system of new dry cement production line in China is 3.5 GW, among them only 5%-7% adopts ADS. In coming 5 years, energy saving renovation of motor driving system in cement industry still takes ASD as a major approach, while making optimisation and upgrade for motor and fan itself, thus energy saving can reach over 30%. If 10% of large fan system is renovated each year, it could save 950GWh, equivalent to 350 thousand tce, and mitigation of 910 thousand tons CO_2.

6. Spread New High Efficiency Precalciner System

In recent two years, it has developed high efficiency precalciner system with outlet temperature dropped by about 30℃ than previous system, and energy efficiency of which increases to 57% from 55%. Due to energy efficiency raised by two percentage points, if calculated on the base of new clinker output is averagely 80Mt annually during the "11th Five-year" plan period, it could save 176 thousand tce in a year, and mitigate 460 thousand tons CO_2.

7. Refuse Incineration in Cement Kiln

Advantages:

- High temperature (about 1450℃ in kiln, gas temperature is nearly 2000℃）;
- Feedings can stay longer;
- Strong turbulent flow inside kiln that can make waste combustion completely;
- Cannot make a bad impact on environment;
- Poisonous and harmful waste becomes non-poisonous;
- Cannot greatly influence the quality of cement.

It cannot produce the secondary pollution as usual way to incinerate refuse.

Thus it is one of the best approaches to treat refuse by kiln. In the period of the "11th Five-year" plan, it will significantly increase treatment of waste via cement kiln as pilot projects of circling economy is gradually spread. If 100 thousand tce is saved each year, 260 thousand tons CO_2 emission would be mitigated.

8. Improve Quality of Cement, and Realize Energy Saving by “Taking Quality as Quantity”

As compared with developed countries, nearly 80kg cement is more used for one cube meter concrete in China. Thus to greatly improve average intensity of clinker can realize energy saving by “taking quality as quantity”. One ton high quality clinker can replace 1.3-1.5 tons low quality clinker. New cement standard will be implemented on 1st June, 2008, which has increase the percentage of mixture. If 5% of clinker is less used for one ton cement, it would save about 70 Mt clinker annually, and 8.05 Mtce would be saved and 51.78 Mt CO_2 emission mitigated.

Energy Saving Approaches of Cement Industry and Energy Savings

Items		Energy Saving
Structure Adjustment	New Dry Kiln Replacing Backward	Annual energy saving potential: 2.34Mt, mitigation of 6.08 Mt CO2.
Residue heat power generation		Annual average power generation: 4.9 TWh，equivalent to 1.78Mtce. Mitigation of CO_2 4.63Mt.
Renovation of Grinding System		Annual power saving: 2.27 TWh, equivalent to 833 thousand tce, mitigation of CO_2 2.17Mt.
Auxiliary		Annual power saving: 1.8 TWh, equivalent to 660 thousand tce, mitigation of CO_2 1.72Mt.
ASD Renovation		Annual power saving: 95 TWh, equivalent to 350 thousand tons, mitigation of CO_2 910 thousand tons.
High Efficiency Precalciner System		Annual energy saving potential: 176 thousand tce，mitigation of CO_2 460 thousand tons
Refuse Incinerator in Cement Kiln		Annual energy saving: 100 thousand tce, mitigation of CO_2 260 thousand tons
Improve clinker quality, increase of industrial waste input		Annual energy saving: 8.05 Mtce, mitigation of CO_2 51.78Mt
Total energy saving		Energy saving: 14.29 Mtce; mitigation of CO_2 37.15Mt

Note: tce is calculated on 367g of average coal use by power generation; as for CO2 emission mitigation, it is calculated on 2.6 tons produced by one tce combustion.

Through implementation of above-mentioned measures, it could save over 15 Mt (including improvement of management and other energy saving measures), mitigate more than 40 Mt CO_2 emission.

Thanks!

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