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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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UNIDO contract No.: 03/032
UNIDO project No.: EG/CPR/99/G31
Activity code: 450D32
P.O. No.: 16000393

Final Report

to

The United Nations Industrial Development Organization (UNIDO)

for the Contract Entitled

Cement Sub-sector Survey

for the Project

Energy Conservation and GHG Emissions Reduction in Chinese TVEs-Phase II

Prepared by

Institute of Technical Information for Building Materials Industry (ITIBMI)

On Sep. 9, 2004

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Contents

1. Introduction

This report is the Final Report submitted to the United Nations Industrial Development Organization (UNIDO) prepared by the Institute of Technical Information for Building Materials Industry (ITIBMI) as the contractor according to the requirements of contract of "Cement sub-Sector Survey in P. R. China" between UNIDO and ITIBMI, related to the project of "Energy Conservation and GHG Emissions Reduction in Chinese TVEs-Phase Ⅱ".

2. Summary of Progress

According to the requirement of the contract, there are six parts tasks for the sub-contract in sub-contract proposal.

Task 1: To provide a profile of the cement industry in China, including number of establishments, volume of production, output value, and type of products and technologies (by kilns types, i.e. 88,000 tons of cement /kiln/year);

Task 2: To compile an inventory of recent national and provincial /local (particularly in Hubei, Zhejiang and Shandong Provinces) government policies and regulations related to cement industry;

Task 3: To assess the impact of government policies, regulations, and incentive measures on the cement industry and prospects of its future development;

Task 4: To conduct a market survey of supply and demand of cement, focusing on the Zhejiang, Hubei and Shandong provinces including their market capacity, types of consumers and products, as well as product marketing channels for both export and local consumption;

Task 5: To compile an inventory of major Chinese and international cement equipment manufacturers, as well as design institutes, industrial associations, and other support institutions focusing on their expertise.

Task 6: To provide at least 10 case studies of energy-efficient technologies and best practices of

the cement industries.

According to the working plan, Final Report will be finished based on the Draft Final Report.

3. Final Report progress

The Final report has been completed after the three weeks of Draft Final Report submitted.

Members of the project team:

Mr. Cui Yuansheng, Ms. Fu Lijuan, Mr. Rong Peikang

Ms. Li Qinna, Ms. Li Yanping, Ms. Shen Wanxiu

Mr. Lie Qianzhi, Mr. Li Taoping, Mr. Qin Zhigang

Mr. Ding Kangsheng, Mr. Cong Peijiang, Mr. Li Hai

4. Final Report

According to the working plan and investigation results, Final Report will be completed based on the Draft Final Report, among which some data has been amended and perfected.

At present, the Final Report has been finished according to the contents of contract. Please leaders of Project Office and CTA clear it.

Appendix

UNIDO Contract No. 03/032/ML, P.O. No. 16000393

Final Report on Cement Survey

Institute of Technical Information for Building Materials Industry (ITIBMI)

Appendix 1:

Part 1 Present Conditions and Development Forecast of China's Cement Industry

1-1 Brief introduction to China's cement industry

1-1.1 Cement output

Since the reform and opening-up, China's cement industry has been developing in a fairly high speed. From 1980 to 2002, the average increase rate of China's annual cement output was 16.12%; the total output has increased from 79.86 million tons to 720 million tons, which accounted for almost 40% of the world's total output. Besides, Chinese cement output has kept the world's number one for 18 years.

Chinese cement output between 1950 ~ 2002 are showed in table 1, and their changes can be seen from Fig.1.

The accumulated cement output reached 7.20 million tons in 2002, up 16.12% than that in 2001. Of which, the output of large and medium-sized enterprise is 334 million tons, increased 10.4% than that in 2001. Just as Fig. 2 shows, the proportion of output produced by shaft kiln was still high, up to 70.2%, only around 16% by new dry process production technology (NSP/SP process or PC process).

The cement output reached 863.00 million tons in 2003, which increased by 18.9% compared with the same term last year. The cement output produced by new dry process production technology takes 23.95% of the total in 2003, reaching 206.70 million tons, increasing by 81.63% compared with the same term last year. The fast increase of cement output is closely related to that of China's national economy.

Table 1 Chinese cement output in 1950-2003 (Unit: ten thousand ton)

Years	1950	1952	1957	1962	1965	1970	1975	1978	1980	1985	1987	1988	1989
Output	62	286	686	600	1634	2575	4626	6524	7986	14595	18625	21014	21029
Years	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Output	25261	30822	36788	42118	47561	49119	51174	53500	57300	57600	62000	72000	86300

Table 2 The output structure according to different production processes in China (Unit: 10 thousand tons)

Year	Total output	Output by shaft kiln	Output by NSP/SP kiln	Output by other kinds of rotary kiln
2001	62000	46700	7820	7480
2002	70500	50900	13140	7960
2003	86300	58100	20600	7530

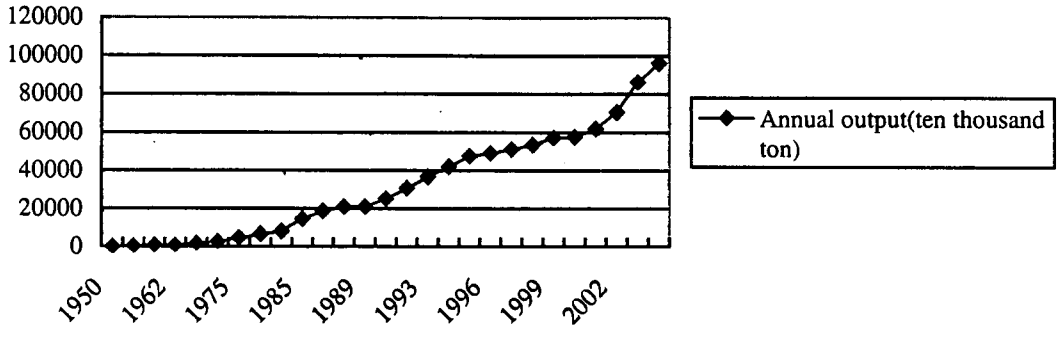


Fig 1 Changes in Chinese cement outputs since 1950 ~ 2002

1-1.2 The number and types of China's cement enterprises and the basic conditions of economic operations of China's cement industry

1-1.2.1 The number and types of China's cement enterprises

(1) The enterprise types according to the cement production processes

The production capacity of rotary kilns in 2002 was 250 million tons, accounting for 27.8% of total output. The production capacity of shaft kilns in 2002 was 600 million tons, accounting for 72.2% of total output. The cement output produced by NSP/SP kilns with production capacity more than 700t/d was about 100 million tons, that is, the cement output produced by NSP/SP kilns accounted for about 17%. The output of rotary kilns in 2003 was 282.3 million tons, accounting for 32.7% of total output. The output of shaft kilns in 2003 was 600 million tons, accounting for 67.3% of total output. (see table 3).

Table 3 The basic condition of China's cement industry in 2003 according to the production processes

Enterprise type		Number		Output (Mt)		Percentage of total output %	
Rotary kiln	NSP/SP kiln	1453	326	282.3	199	32.71	23.05
	Other kinds of rotary kilns		1127		83.3		9.65
Shaft kiln		13580		581		67.32	
Total		15033		863		100	

(2) The enterprise types according to the enterprise scale

Among 4626 of all overscaled enterprises (i.e. state-owned enterprises and non state-owned enterprises with annual sales revenue of and above 5 million yuan, similarly hereinafter) in 2002, the number of large-sized enterprises is 134, medium-sized enterprises 835, small-sized ones 3657 according to the statistics classified by enterprise scales (see in Table 4 and Fig 2).

Table 4 Basic conditions of Chinese Cement Industry In accordance with Sizes of Enterprises

Enterprises classified by sizes	Number of enterprises	Annual capacity (Mt)	Annual output (Mt)	Gross Industrial output Value (Billion Yuan)	Annual sales (Billion Yuan)	Profit Realized (Billion Yuan)	The proportion of total profit %
Large-sized enterprises	134	1.15	149.37			2.70	58.1
Medium-sized enterprises	835	0.30	183.66			1.14	24.5
Small-sized enterprises	3657	0.10	371.68			0.81	17.4
Total	4626	–	704.71	154.45	144.01	4.65	100

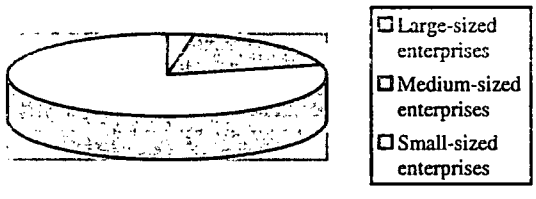


Fig 2 Classification of Chinese Cement Enterprises In Accordance with Scales

(3) The enterprise types according to the systems of ownership of enterprises

The 4626 overscaled enterprises are divided into state-owned 792, collective enterprises 1184, private enterprises 1098, and other types of domestically invested enterprises 1387, foreign-invested enterprises 165 according to the system of ownership of enterprises (see Table 5 and Fig. 3).

Table5 Basic conditions of Chinese Cement Industry In Accordance with the Ownership of Enterprises

Enterprises classified by ownerships	Number of enterprises
State-owned enterprises	792
Joint-ventures	1387
Collective and TVEs	1184
Private enterprises	1098
Exclusive-funded	165
Total	4626

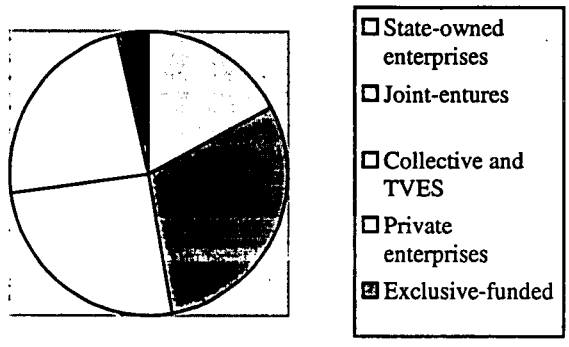


Fig 3 Basic conditions of Chinese Cement Industry in Accordance with the Ownership of Enterprises

1-1.2.2 The economic operations on cement industry in the recent years

Exercising in high speed development within 1992 ~ 1995, the cement industry fell into dire straits because of the unprecedented overmuch production with low technological level in the second half of 1995. The entire national cement industry was in deficit in 1998 and 1999, while it started to make profit in 2000. The output increase in 2001 and 2002 was respectively 10.7% and 9.7%, and the sales income increase was 9% and 14.6% respectively with a benefit increase of 290% and 55% respectively. The increase pace of sales income and benefits was higher than that of output, the cement price was basically stable. The conditions of development speed, quality, structure and benefits in the cement industry started to improve.

Effected by the state macro-economic policies, the general condition of cement production and management is that the sales income was increased steadily and economic benefit was remarkably improved in 2002. The national fixed asset investment topped 4.32 trillion yuan in 2002, and the cement consumption was stimulated and increased by a big margin.

The number of all state-owned enterprises and non state-owned enterprises with sales revenue above 5 million yuan is 4626 with an employment of 1.49 million people. The total accumulated realized industrial output value was 154.4 billion yuan, up by 17.66 billion yuan over the same period of previous year, sales revenue of products was 144.01 billion yuan, increased by 17.23 billion yuan.over 2001. The sale rate of cement was 98 percent. The total volume of profits reached 4.65 billion yuan in 2002, increased by 1.60 billion yuan, 55 percent increase in comparison with that in 2001. The realized industrial increment was 48.3 billion yuan.

The large-sized enterprises are the main profits making ones in the cement industry. The outputs and profits of large, medium and small-sized enterprises in 2002 are showed in Table 4. The annual average production scales of large, medium and small-sized enterprises were 1.15 million tons, 0.3 million tons and 0.1 million tons, and profits earned by them accounted for 58.1%、24.5%、17.4% of total profits respectively. It is clear that the production scale is playing an important role in making economic benefit.

The number of enterprises in cement sector was 4780 in the first half of 2003, of which, the number of deficit enterprises was 1978, accounting for 41.38% of total and deficit volume of them was 1.689 billion yuan, decreased by 5.76% over the same period of last year. The total number of staff and workers was 1.4457 million, decreased by 2.61% (see Fig 4 and Fig 5 and Table 6). The average ex-factory prices in 2001 and January ~ October of 2002 are listed in Table 7.

Economic operation condition in Chinese cement industry in the first half of 2003 is showed in Table 6. The accumulated output of cement was 37049.66 million tons, increased by 15.04% over the same period of last year. The gross product value of the industry reached 82.062 billion yuan, increased by 15.75% over the same period of 2002. The total industrial sales (present price) stood at 79.167 billion yuan, increased by 16.04% over the same period of 2002. The total volume of profits in the whole sector reached 1.834 billion yuan, increased by 1.48 times over the same period of last year (0.741 billion yuan) and the total taxes stood at 5.352 billion yuan, up by 18.92% over the same period of last year. Economic operation condition in whole sector was better than ever, the profit and quality of economic operations have been improved greatly.

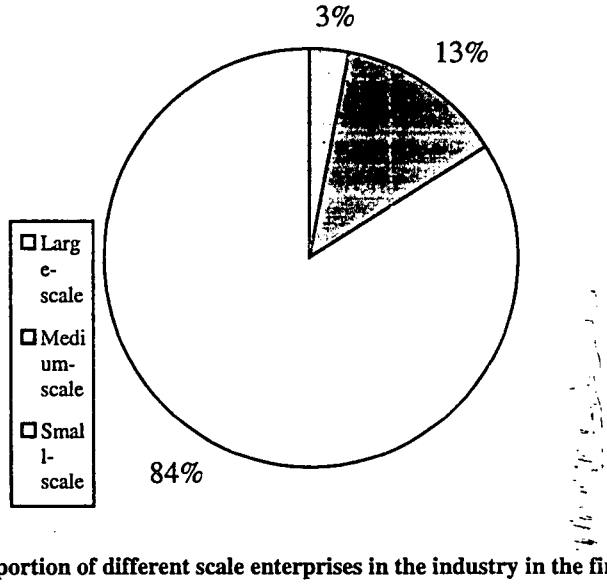


Fig. 4 The proportion of different scale enterprises in the industry in the first half of 2003

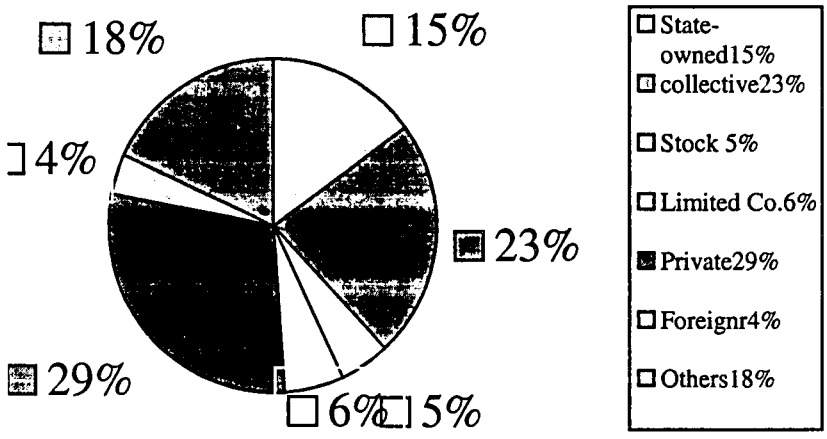


Fig. 5 The proportion of different scale enterprises in the total enterprises in the first half of 2003

Table 6 Economic operations of Chinese cement industry in the first half of 2003

Classification of Enterprises	Enterprises		Profit		Deficit enterprises		Deficit volume	
	Number Of Enterprises	percentage (%)	Profit 100 million yuan	Increase rate (%)	Number (PCs)	Percentage (%)	Deficit volume 100 million yuan	Increase rate (%)
Total	4780		18.34	147.67	1978	41.38	16.89	-5.76
By scale								
Large-sized	125	2.62	10.09	59.52	39	31.20	2.93	-1.71
Medium-sized	600	12.55	3.69	295.98	256	42.67	4.19	-4.24
Small-sized	4055	84.83	4.57	2914.70	1683	41.50	9.78	-7.54
By economic types								
State-owned	732	15.31	-0.30	85.93	394	53.83	5.26	-1.70
Collective	1095	22.91	2.66	116.11	397	36.26	1.96	-24.00
Limited cooperative	257	5.38	0.07	131.43	105	40.86	0.67	-9.36
Limited co.	266	5.56	4.45	14.87	106	39.85	1.47	-2.68
Private co.	1368	28.62	3.32	150.87	509	37.21	2.43	-3.39
Foreign-funded Hong Kong-funded Macao-funded, Taiwan-funded	180	3.77	4.16	151.76	77	42.78	1.21	-15.63
Others	882	18.45	4.01	134.72	390	44.22	3.89	2.56

Table 7 The average ex-factory cement price in China (unit: yuan/t)

Year	Cement by rotary kiln				Mixed Portland cement	Cement by shaft kiln			
	P.O42.5	P.O32.5	P.S42.5	P.S32.5		P.O42.5	P.O32.5	P.S42.5	P.S32.5
2001	264.87	239.13	248.26	220.67	220.32	229.94	211.65	-	198.54
2002 (1-10)	242.61	228.24	218.53	217.75	226.78	216.30	211.65	201.12	191.47

The ex-factory price of cement Grade 42.5 was within 225 ~ 245 yuan/t. The average scale of 15 new dry process production lines of precalcinating kilns of Conch Group is more than 4000t/d. The average cost of clinker is only 82 yuan/t. The 28 days strength of clinker can be greatly higher than 70MPa for the best new dry process kiln in China.

Since 2003, the price of rotary kiln cement was 15-20 yuan/t higher than that of shaft kiln cement of the same quality grade. The price difference is larger in economic developed regions. This showed that the part of regulation and controlling of the government is significant.

1-1.2.3 An analysis of economic operational conditions in cement industry in 2003 and economic operational conditions in cement industry for the first half of 2004

1-1.2.3.1 An analysis of economic operational conditions in cement industry in 2003

(1) The growth of cement outputs in 2003

The accumulated cement outputs of the whole country in a period from Jan. to Nov. of 2003 were 737.46 mil. t, increased by 16.91% comparing with the same period of 2002, creating a new historic high since 1994. The cement outputs of Shandong, Jiangsu, Zhejiang, Guangdong, Hebei and Henan Provinces stood in the first 6 places of the country. They are continuously keeping a position of large cement producing provinces, the total outputs of which reached 383.37 mil. t, exceeding more than half the country's total, up to 52.0%. The provinces, the growth rate of cement output of which exceeded 30% are Jiangxi and Ningxia. They reached up to 40.2% and 32.7% respectively.

(2) The total production value in 2003 increased synchronously with the sales incomes.

Up to the end of November 2003, the total production value of cement industry is 169.419 bil. Yuan (the same year's price), up 20.59% comparing with the same period of the last year; the

product sales incomes reach 158.88 bil. yuan, up 22.7% comparing with the same period of last year.

The total production value of cement industry in Shandong, Zhejiang, Jiangsu, Guangdong and Hebei provinces exceeded separately 10 bil.yuan. Among them that of Shandong Province reached 22.9 bil. yuan, accounting for 13.5% of the total production value of cement industry of the country. The cement product sales incomes of Shandong and Zhejiang provinces were 21.62 bil. yuan and 16.84 bil. yuan respectively. The sum of them accounts for 24.2% of the country's total.

(3) In a period from Jan. to Nov. of 2003, the accumulated realized profits of the cement industry were 8.426 bil.yuan, up 136.27% comparing to the same period of 2002. The profits for the whole year are expected to break 10 bil. yuan, creating a historic new high. According to the earnings, Zhejiang and Anhui provinces were in the forefront among 26 provinces, municipalities and autonomous regions. The total profits of the two provinces were 1.944 bil. yuan and 1.346 bil. yuan respectively. The sum of them accounted for 39% of the total profits of the cement industry of the country. The total profits of the state-owned enterprises increased by 1813.81% in comparison with the same period of 2002. That was the highest profit increase rate among the enterprises of various economic types.

(4) The total amount of taxes increased steadily. Up to November 2003, the total accumulated amount of taxes was 11.711 bil. yuan, up 24.93% comparing with the same period of 2002. The sum of taxes paid by the Zhejiang, Shandong, Jiangsu, Guangdong, Hebei and Anhui provinces accounted for about 50% of the country's total. Taxes paid in all provinces, municipalities and autonomous regions, except for Heilongjiang Province, the taxes paid decreased in comparison with the same period of 2002, increased in comparison with the same period of the year of 2002. The increase rate in Anhui Province reached 57.4%, which was the highest in the whole country.

(5) In a period from Jan. to Nov. of 2003, the total number of enterprises in cement industry was 4821, among which the deficit enterprises amounted to 1682, constituted 34.89%, down by 7.53% from the same period of 2002, deficit volume was 2.215 bil. yuan. The proportions of deficit enterprises were the lowest in the Zhejiang and Shandong provinces, and were 11.20% and 11.25% respectively.

According to the economic scales, the proportion of deficit enterprises was the lowest of 25.81%

for the large-sized cement enterprises (see tab.8). The proportions of deficit enterprises were decreased by 11.54% and 4.98% for the medium and small-sized enterprises, comparing with the same period of 2002.

Tab. 8 The number and deficits of deficit enterprises in accordance with production scales

Production scale	Number (enterprise)	Proportion (%)	Number of deficit Ent.	Proportion (%)	Deficits (100 mil. yuan)	Increase/decrease (%)
Whole country	4821	100	1682	34.89	22.15	-7.53
Large-sized	124	2.57	32	25.81	3.79	-11.00
Medium-sized	600	12.45	220	36.67	4.98	-11.54
Small-sized	4097	84.98	1430	34.90	13.38	-4.88

According to property ownership (see tab.9), the proportion of deficit state-owed-enterprises was the largest, accounting for 47.87%, the proportion of deficit enterprises for the foreign capital and collective ones decreased in a larger extent in comparison with the same period of 2002, and they were 25.8% and 23.18% respectively.

Tab. 9 The number and deficits of deficit enterprises in accordance with property ownership

Property ownership	Number (enterprise)	Proportion (%)	Number of deficit Ent.	Proportion (%)	Deficits (100 mil. yuan)	Increase/decrease (%)
Stated-owned	727	15.08	348	47.87	7.41	-0.11
Collective	1094	22.69	337	32.63	2.81	-23.18
Stock collective	257	5.33	86	33.46	0.73	-4.35
Joint stock	266	5.52	83	31.20	1.86	-3.38
Private	1398	29.00	412	29.47	2.87	-15.68
Foreign capital and Hong Kong, Macao capital	182	3.78	67	36.81	1.66	-25.80
Miscellaneous	897	18.61	329	36.68	4.81	5.71

(6) The import and export of cement clinker increased by a big margin

In a period from Jan. to Oct. of 2003, the accumulated amount of cement export was 4.24 mil.t, down 1.1% comparing with the same period of 2002. The earning of foreign currency was US$135.7 mil., up 0.8% comparing with the same period of 2002. The accumulated amount of exported cement clinker was 0.27 mil.t, up 27.18% comparing with the same period of 2002. The earning of foreign currency was US$ 8.97 mil., up 152.1% comparing with the same period of 2002. The accumulated import of cement clinker was 1.63 mil.t, up 3.7% comparing with the same period of 2002. Amount of foreign currency paid was US$ 36.11 mil., up 11.9% comparing with the same period of 2002.

Generally speaking, The cement output in the whole country in 2003 was 863 million tons, up by 18.9% comparing with the last year. The cement production of enterprises with production capacities over 200,000 tons occupies 57.0% of the total national cement production. The total cement production of six provinces (Shandong, Guangdong, Jiangsu, Zhejiang, Hebei and Henan provinces)occupies 52% of the national total cement production. Their production in the first quarter of 2004 was 180.04 million tons, up by 23.8% comparing with the same period of the last year.

The production and sales in the cement markets in 2003 were both vigorous. The cement sales volume in the whole year of 2003 was 857 million tons. The production-sales ratio was 99.2%. The production-sales ratio in the first quarter of 2004 was 96.9%.

The cement export in 2003 was 1.95 million tons and the cement import was 0.65 million tons. The export of cement clinker was 0.35 million tons and the import of cement clinker was 1.88 million tons. The cement products were mainly exported to the USA, Republic of Korea, Hong Kong and Taiwan, the exported volume of which accounted for 81% of the total export.

The cement prices on the market in 2003 were relatively smooth in general. From January to September the average cement price in the whole country has fluctuated within a narrow range of about 275 yuan/t basically, and it has gone steeply up by a big margin afterwards, reaching 300 yuan/t, which has never happened in the recent years. And in the individual regions the sales price of cement has gone up to about 600 yuan/t. In the first quarter of 2004, the average cement price was higher by about 40 yuan/t in comparison with the same period of the last year. Taking an example of market price of bulk cement of grade P.042.5, the regional average price was: 300 yuan/t in North China, 408 yuan/t in North-east China, 392 yuan/t in Central Southern China, 384 yuan/t in Eastern China, 378 yuan/t in South-west China and 332 yuan/t in North-west China.

The total realized profits of over-scaled enterprises in the cement manufacturing industry in 2003 were 10.884 billion yuan, creating the historical highest level. The turnover rate of circulating fund was speeded up. The stockpiling rate decreased. The fund utilizing result improved, and the assets liabilities rate decreased. In the first quarter of 2004 a 3.05 billion yuan profit realized, up

by 63.95% comparing with the same period of the last year.

In 2003, 30.316 billion yuan of fixed assets investment realized in the cement manufacturing industry, up by 90% comparing with the previous year. The total investment amounted to 80.9 billion yuan, up by 92.8% in comparison with the previous year. 98 cement production lines with precalciner kiln put into production in 2003 with the annual cement clinker production capacities up to 63.72 million tons. In the first quarter of 2004, 6.027 billion yuans of fixed assets investment have been realized, up by 90.5% comparing with the same period of the last year. The planned investment scale for the whole year is 55.8 billion yuans, down by 31% in comparison with the investment scale of the last year.

An analysis of economic operational conditions in 2003:

(1) The investment in capital assets brought up the rapid increase of cement output.

The economic growth rate in 2003 reached about 8.5%. The domestic consumption increased smoothly. In case of remarkable decrease of favorable balance, the main factor for drawing economic development is the increase of investment, the contribution rate of which is about 60%. This was the direct cause of rapid growth of cement outputs in 2003.

(2) The quality of economic operation totally upgraded.

An integration of growth in outputs and benefits realized. In a period from Jan. to Nov. of 2003, 136.27% of corresponding increase of accumulated profit realized. In the same time with the enlargement of total cement outputs, the cement mix was improved greatly. The increase of new dry process cement became the principal. The ability of development of the industry has been growing successively. The competitiveness of the enterprises strengthened remarkably, and the increase of investment was speeded up.

(3) The investment in cement industry was increased rapidly.

According to statistics of invested projects over 5 mil.yuan in urban areas of the whole country, in a period from Jan. to Oct. of 2003, the number of invested cement projects under construction (including cement manufactured products projects) in the whole country was 1044, increased by 301 in comparison with the corresponding period of 2002. The planned total investment reached up to 78.609 bil. Yuan, increased by 133%. In a period from Jan. to Oct. of 2003 the accumulated realized investment reached 28.838 bil. Yuan, increased by 115% comparing with the same period

of 2002.

(4) The production capacity of new dry process cement clinker increased rapidly.

The number of production lines put into operation in 2003 is 98. The newly increased production capacity of new dry process cement clinker is 63.72 mil.t, among which the number of production lines with a production capacity of 2000t/d and above is 46, the production capacity of cement clinker is 45.66 mil. t, accounting for 72% of the total capacity of production lines put into operation; 42 production lines with a capacity of 2500t/d and above, the total production capacity of cement clinker of which is 43.09 mil.t, accounting for 68% the total capacity; 11 production lines with a production capacity of 5000t/d and above, the production capacity of which is 17.98 mil.t, accounting for 28% of the total production capacity.

Nevertheless, the shortage of power supply and the retardation by the transportation are the major problems existing in economic operation of cement industry in 2003.

1-1.2.3.2 The economic operational conditions during the first half of 2004

It is illustrated by the newest data from the State Statistic Bureau that the accumulated sales rate of whole nation's industrial products was 97.20% from January to June 2004, which has increased by 0.19% in comparison with the same period of the last year. Among them, the cement production was 424.6696 million tons, which has increased by 17.9% comparing with the same period of the last year. The increase rate of cement production in China in the second quarter of 2004 has dropped remarkably.

The accumulated cement production output of over-scaled enterprises in the first half of the year is 424.67 million tons, increased by 17.19% comparing with the same period of the last year, of which the cement production outputs in the first and second quarters were 180.30 and 244.37 million tons and increased by 23.8%and 13.8% comparing with the same periods of the last year respectively. Some 10% decrease occurred in the second quarter from the first quarter of the year.

The statistics show, that the profits and taxes of cement enterprises have increased by a big margin and their losses have deduced in the first half of the year. The realized sales incomes of the over-scaled cement enterprises in a period from January to May were 83.4 billion yuans, increased by 41.66% in comparison with the same period of the last year. Though the prices of raw materials, fuels and power, as well as the cost of transportation have all gone up somewhat, the benefits

brought about by the rise in prices of cement and expansion of sales were more remarkable. In a period from January to May the accumulated realized profits were 6.363 billion yuans, increased by approximately 5 times in comparison with the same period of the last year. The profit rate of cost expenditures reached up to 8.2%, raised by 6.4% in comparison with the same period of the last year. The taxes turned over to the state were 6.047 billion yuans, increased by 47.34% in comparison with the same period of the last year. The total losses of loss-incurred enterprises were 1.258 billion yuans, decreased by 17.03%. The turnover rate of circulating fund was 1.76 times raised by 0.25 times in comparison with the same period of the last year.

The linkage of production with sales of cement was good. From January to May, 333.82 million tons of cement was sold accumulatively in the whole country. 38.85 million tons of cement was stockpiled at the end of May. The production-sales rate was 97.65%, up by 0.55% in comparison with the same period of the last year. The days for sales of stockpiled cement products were 5.9 days longer the same period of the last year. In the first half of the year the ex-factory prices of cement have been relatively stable. Nevertheless, the export amount has been reduced in comparison with the same period of the last year. From January to May 2004 some 2.03 million tons of cement was exported accumulatively, down by 7.2% comparing with the same period of the last year. The cement export volume accounts for only 0.6% of output at present.

The increase rate of investment in the cement industry is tending to slow down. At present, the banks are strictly controlling the loans to the cement industry. At the end of May, the domestic loans in the total investment of fixed assets in the cement manufacturing industry have been reduced by 823million yuans, down by 18.8% in comparison with the same period of the last year. As the loans can not be obtained, a set of projects for large-scaled cement production lines with precalciner kilns under the construction, which conform with the industrial policies and benefit the readjustment of structure, is forced to be suspended or stopped, and even the regular loans for the circulating funds of the enterprises have been affected. Additionally, at the other side, a phenomenon of revival of the backward technology ought to be eliminated is presented.

The main factors for cement price climb in 2004

First of all, the operation of Chinese economy is in the fast growth stage of a new growth period. The operation of economy is still in a situation of climbing. The investment confidence of the enterprises and consuming confidence of civilians are enhanced gradually. From a view of current

development trends, the economic growth in 2003 will reach up to about 8.6%. The growth rate of economy in 2004 will not lower than that in 2003. The macroscopic economic environment will promote a stable increase of demand for cement and benefit the cement price climb.

Secondly, the economic benefits of enterprises have gone up by a big margin. In a period from Jan. to Oct. in 2003, the sales income of overscaled industrial enterprises in the whole country has increased by 27.9%, up by 12.2% over the same period of the last year. After compensation of the loss by the profits in the industrial enterprises, the realized sum of profits increased by 46.0%. The increase rate was 40% up over the same period of the last year. A large increase of economic benefits of enterprises strengthened their own development capacity so as to promote an increase in investment of enterprises, benefiting the climb of cement prices in 2004.

Thirdly, the number of projects under construction, especially the new starting projects in 2003 was large, adding the continuous construction of national key construction projects symbolizing by the large-scale engineering projects of Qinghai-Tibet Rail Road, West to East Electricity Transmitting Project and South to North Water-Transfering Project, assigned in "Tenth Five-year Plan" as well as the investment hot point in real estates and other factors will promote fast increase of fixed assets investment in 2004. At the same time, since the economic growth has entered into a fast growth stage, the investment of state debts will incline further to the infrastructure and ecological construction projects in the west China so as to speed up the process of infrastructure and ecological environmental construction in the western China. Furthermore, according to the requirement of programme of great development of the western China and the condition of progress of preliminary work, a series of key engineering projects including key water control project, state main trunk lines and key sections of arterial highways developed in the western China, started to construct in 2004, will also greatly promote the increase of fixed assets investment and furthermore the even larger demand for cement production, that will to some extent, support the climb of cement prices.

Fourthly, the short supply of electricity will affect the production and supply of cement. It will produce partly the contradiction of "Supply falls short of demand", that, in turn, will lead to climb of cement price. The prices of electricity and coal will possibly go up further in 2004. They will push the cement price going up.

In general, in the whole year of 2004, the price of cement will be basically stable with a slightly

climb, as the main trends. However, the prices of different varieties of cement in different regions and different times will have possibly a slight difference. Since incoordination between demand and supply structure, the prices of high-quality and high-grade cement will go up somewhat, while the prices of low-grade, poor quality cement will basically stable or have slight fluctuation. Because of the difference of seasons, the price of cement in the construction peak seasons will go up somewhat and will be in a relative equilibrium or even go down slightly in the construction dull seasons.

1-1.3 Current conditions and development of technological structure trend of China's cement industry

1-1.3.1 Current conditions of technological structure of cement industry

Restructuring the industrial structure must be done in order to realize the upgrading of cement industry. The course of China's cement industry restructuring is the course of successive optimization of cement production technology. At present, there are 12 varieties kiln types, from NSP to the old-style traditional shaft kiln (VSK), operating in China, but the industrial structure is developing towards localization (in cement manufacturing machinery building) and optimization.

From table 10 we can see that the proportion of cement output produced by large- and medium-sized NSP/SP kiln rose from 6.4% in 1997 to 15.1% in 2002. Up to date, there are three types shaft kilns in China. The first type is called as improved shaft kiln, which was upgraded with varieties of advanced technologies and equipment, and the quality of cement product from which is stable, and where environment protection and production management are in good conditions. These improved shaft kiln enterprises are the example to the other shaft kilns. There are 500 improved shaft kiln enterprises with cement output accounting for 8.2% of the total cement output in 1997 and up to 16.4% in 2002. The second type is the mechanical shaft kiln, between which and the improved one there is a great gap in technical and economic indexes, cement qualities, environment protection indexes. But the number of this type of shaft kiln enterprises is the biggest, and their cement outputs amount to over 2/3 of the total output by shaft kilns. There are about 6000 mechanical shaft kiln enterprises with cement output accounting for 58.8% in 1997 and down to 48.2% in 2002. The third type is ordinary shaft kiln. The cement output produced by ordinary shaft kilns in 2002 was 55 million tons, accounting for 7.8% of the total. The enterprises with ordinary shaft kilns have some problems with disorderly use and wasting the ore resources, the poor quality of cement product, high energy consumption and the severe environmental pollution etc.. The governments at all levels should strictly supervise, control and finally eliminate these enterprises according to the industrial and environmental regulations and laws.

Table10 Changes in outputs and scale structure of kilns in China's cement industry in 1997 ~ 2003

No.	Kiln type of Production line	Capacity of kiln t/d	1997		1998		1999		2000		2001		2002		2003	
			Output		Output		Output		Output		Output		Output		Output	
			Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%	Mt	%
1	L & M NSP/SP kilns	700-10000	32.6	6.4	34.5	6.4	45.4	7.9	55.5	9.6	71	11.4	121	16.8	19.9	23.0
2	S NSP/SP kilns	300-600	1.0	0.2	1.4	0.2	6	1.1	6.5	1.1	7.2	1.1	8	1.1	5.8	0.7
3	Cyclone pre-heater kilns	100-1000	2	0.4	2.0	0.4	2.4	0.4	2.4	0.4	2.4	0.4	2.4	0.3	1.9	0.2
4	Shaft pre-heater kilns	200-400	8	1.6	7.6	1.4	9.7	1.7	9.6	1.7	9.5	1.5	9.3	1.3	4.8	0.6
5	Semi-dry process kilns	700-2000	3	0.6	3	0.6	3.1	0.5	3.5	0.6	5	0.8	5.8	0.8	6.7	0.8
6	Cogenerative kilns	500-1000	10	2	10.7	2	11	1.9	11	1.9	13	2	13.7	1.9	13.5	1.6
7	Lepol kilns	400-600	3	0.6	3	0.6	3	0.5	3	0.5	3	0.5	3	0.4	2.9	0.3
8	Small. dry-process hollow kilns	50-400	9	1.8	8.9	1.7	8.2	1.4	8	1.4	8.1	1.3	8	1.1	7.7	0.9
9	Wet-process kilns	400-800	31.6	6.2	32.6	6.1	33.5	5.9	33.5	5.8	33.8	5.5	40	5.6	40	4.6
10	Improved shaft kilns	250-350	41.8	8.2	44.2	8.3	64.2	11.2	75	13	91	14.7	115	16	145	16.8
11	Mechanical shaft kilns	100-250	30.0	58.8	30.4	57.3	30.9	54.1	30.1	52.3	31.2	50.4	33.9	47.1	37.2	43.1
12	Ordinary shaft kilns	50-150	6.8	13.2	8.7	15.0	7.6.6	13.4	6.7	11.7	6.4	10.4	5.5	7.6	6.4	7.4
	Total	-	51.0	100	53.5	100	57.3	100	57.6	100	62.0	100	72.0	100	86.3	100

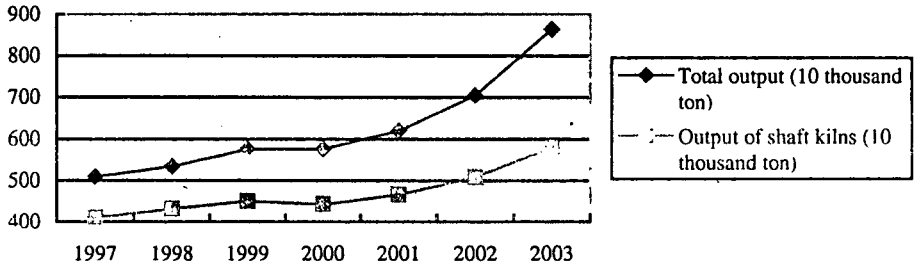


Fig. 6 Changes in total cement output and those of shaft kilns during the past years

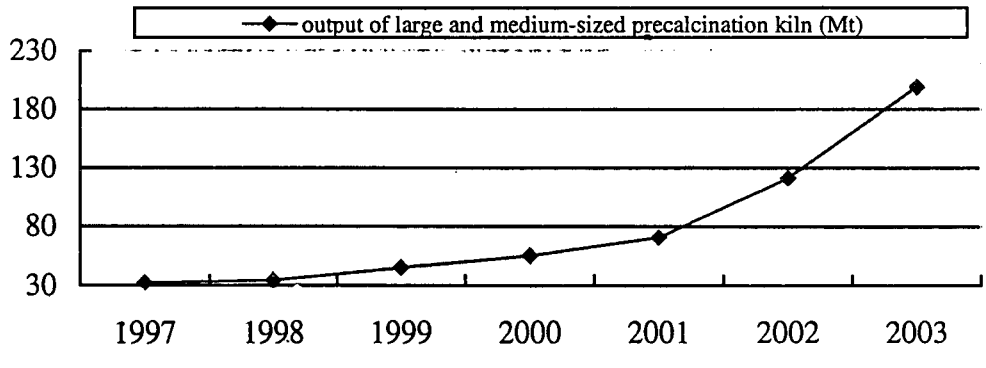
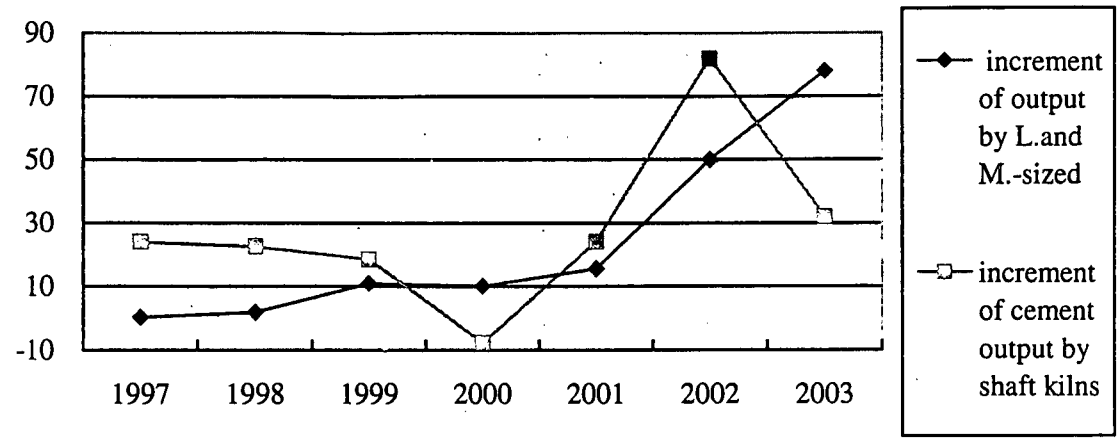


Fig. 7 The changes in output of cement produced by large and medium-sized NSP/SP kilns over the years



in China's cement industry in 2001 – 2004F

No	Kiln type of Production line	Capacity of kiln t/d	2001			2002			2003			2004F		
			kilns	Output		kilns	Output		kilns	Output		kilns	Output	
				Mt	%		Mt	%		Mt	%		Mt	%
1	L & M NSP/SP kilns	700-10000	151	71	11.4	228	121	16.8	326	199	23.0	566	319	33.1
2	S NSP/SP kilns	300 – 600	101	7.2	1.1	101	8	1.1	101	5. 8	0.7	66	3.8	0.4
3	Cyclone pre-heater kilns	100 – 1000	72	24	0.4	72	24	0.3	64	1. 9	0.2	34	1.0	0.1
4	Shaft pre-heater kilns	200 – 400	290	95	1.5	280	9.3	1.3	226	4. 8	0.6	148	3.0	0.3
5	Semi-dry process kilns	700 – 2000	12	5	0.8	14	5.8	0.8	16	6. 7	0.8	16	6.7	0.7
6	Cogenerative kilns	500-1000	113	13	2	115	13.7	1.9	121	13. 5	1.6	150	16.5	1.7
7	Lepol kilns	400-600	20	3	0.5	20	3	0.4	19	2. 9	0.3	19	2.9	0.3
8	Small. dry-process hollow kilns	50-400	330	8.1	1.3	320	8	1.1	320	7.7	0.9	170	4.1	0.4
9	Wet-process kilns	400-800	206	33.8	5.5	250	40	5.6	250	40	4.6	250	40	4.2
10	Improved shaft kilns	250-350	850	91	14.7	885	115	16	1150	145	16.8	1240	155	16.1
11	Mechanical shaft kilns	100-250	8400	312	50.4	8350	339	47.1	9280	372	43.1	9060	363	37.7
12	Ordinary shaft kilns	50-150	3000	54	10.4	2800	5.5	7.6	3150	64	7.4	2400	48	5.0
	Total	–	13545	620	100	13435	720. 2	100	15033	863	100	14119	963	100

At present, the cement quality and technical & economic indexes among the current over 500 improved shaft kiln enterprises differ greatly. Of which the proportion of improved shaft kiln enterprises with quality of cement produced and part of technical-economic indexes comparable with those of large- and medium-sized NSP/SP kiln enterprises is less than 10% by output. The proportion of ordinary shaft kiln enterprises with poor quality products is about 10% also. The quality of products of more than 80% of shaft kiln enterprises is just in the P Ⅱ 32.5 level of standard of GB175-1999. It is clear that in general, the quality of shaft kiln cement is rather poor. The total cement output and output of shaft kiln enterprises, large- and medium-sized NSP/SP kiln enterprises and their changes from 1997 to 2002 are showed in Table 10 and Fig. 6, 7 and 10.

In recent years, thanks to increased state investment in infrastructure construction step by step, the cement consumption demand was drew up and the growth of cement output was speeded up. The accumulated cement output was 0.62 billion tons in 2001, increased by 11.1%. The cement output in 2002 topped to 0.7 billion tons, stood at 0.705 billion tons, increased by 13.28% over the same period of last year, setting a new record in the cement production history. Here not only a growth of output appeared, but also the deepening further of the industrial readjustment and reform, and improvement of cement quality was seen at the same time.

The cement production capacity was about 0.85 billion tons in 2002, of which that of rotary kiln enterprises was 0.25 billion tons, accounting for 29% of the total capacity. The capacity all NSP/SP kiln production lines with capacities of above 700t/d was near 0.15 billion tons, accounting for about 15%. In 2002 cement output was 0.705 billion tons with the per capita cement consumption 564 kg and the cement output by NSP/SP kiln enterprises exceeded 0.2 billion tons, accounting for 28% of the total. But output by shaft kiln enterprises was 0.505 billion tons, accounting for 72% of the total, and still took the dominant position in China (see table 10). However, the cement output produced by NSP/SP kiln enterprises, which is standing for the development trend, accounted for about 10%. On the contrary, in the foreign countries, especially in developed countries, NSP/SP kiln technology is used ordinarily, and the cement output by this technology accounts for 60% of the world total 1.6 billion tons. For example, the proportion of output by NSP/SP kiln technology in Korea, Thailand, Japan, and Germany account for 100%、97%、94% and 90% respectively.

1-1.3.2 Investment and the readjustment of industrial structure in cement industry

Because the cement demand has been growing luxuriantly in the whole country, the economic results of the industry had gone up again. Enthusiasm of enterprises, society, and banks in investment to cement industry has been vigorous, especially in the regions of rapid growth of economy.

1-1.3.2.1 The investment in large-scale cement production is the mainstream of investment

Since Jidong Cement Plant put into production, the results of large-scale production were very obvious. However, there were only 19 production lines with a capacity of above 4000t/d which were constructed mainly depending on foreign funds (see table 11).

As showed in table 12, over 2000t/d capacity accounts only for 69% of the total capacity of NSP kilns, average scale is only 1660t/d, equal to the scale of Taiwan in 1986. This shows that not only the proportion of shaft kiln cement is overlarge, but also that of small-scale NSP/SP kiln is high in Chinese mainland's cement industry.

The total investment on 51 NSP/SP kiln production lines amounts to 9.2 billion yuan, up by 2 time over 2001. Up to the August 2003, total investment on 242 planed and being on the stream production lines is 56.6 billion yuan. According to the statistics 'Investment Items list in the first half of 2003 from National Bureau of Statistics of the People's Republic of China", list of "Investment projects on cement industry in the first half of 2003" shows that the investment on technical renovation of shaft kiln accounted for about 5%, and almost half of those projects are those continuing from 2002.

Table12 Conditions of NSP/SP kiln in operation by the end of 2002

No.	Scale (t/d)	Number (PCs)	Clinker capacity(t/year)
1	5000 ~ 7200	9	1463
2	4000	10	1240
3	2000 ~ 3200(including 2000)	76	5183
4	700 ~ 1500(including 700)	127	3543
Total		222	11429

Statistics shows that the proportion of 1000t/d production lines to the whole precalicination kiln (NSP/SP kiln or so-called "new dry process kiln) production lines built and put into production in 2002 was larger. On the contrast, 2000t/d precalciation kiln production lines took larger proportion to the whole precalicination kiln production lines built and put into production in 2003, of which, those of above 4000t/d accounted for more than 50% of the total. The large-scale trend is obvious from the project listed in table 13 ~ 15. 184 precalicination kiln production lines have been built and put into production in 2003, of which there are 3 of 10000t/d , 1 of 8000t/d, 31 of 5000t/d, 3 of 4000t/d precalination production lines. Large-scale line has become the investment mainstream in 2003. The capacity of less than 2000t/d production lines accounts for 12.33% of the total. There will be 130 projects with capacity of over 2000t/d, and their capacity will account for 87.6% of the total. After these projects will be built, the average scale of single production line will be enhanced from 1660t/d in 2002 to 2700t/d (see table16).

When the enterprise plans to construct the NSP/SP production lines, they should pay attention to large-scale equipment made in China in order to reduce the investment of basic construction and production costs, improve economic results, and strengthen the enterprise competitive power.

Table 13 Projects built and put on stream in 2002 by scales

	Number (line)	Volume of investment (Million yuan)	Proportion of Investment (%)	Clinker capacity (Mt)	Proportion (%)
1000t/d	22	1965.20	21.3	6.91	21.8
2000t/d	23	4322.96	46.9	16.18	50.9
Above 4000t/d	6	2927.29	31.8	8.68	27.3
Total	51	9215.45	100	31.78	100

Table 14 Projects being constructed in 2003 by scales

	Number (line)	Volume of investment (Million yuan)	Proportion of Investment (%)	Capacity (Mt)	Proportion (%)
1000t/d	29	2544.16	14.0	9.83	13.4
2000t/d	43	8866.50	48.7	34.08	46.6
Above 4000t/d	17	6786.00	37.3	29.30	40.0
Total	89	1819.66	100	73.21	100

Table15 Projects planed to be constructed in 2004 by scales

	Number (line)	Volume of investment (Million yuan)	Proportion of Investment (%)	Capacity (Mt)	Proportion (%)
1000t/d	23	2215.63	5.8	8.18	5.3
2000t/d	71	14732.37	38.4	54.93	35.4
Above 4000t/d	59	21428.30	55.8	92.23	59.4
Total	153	38376.30	100	155.34	100

Table 16 NSP/SP kiln production lines being constructed and put on stream in 2003

No.	Single line scale (t/d)	Number (line)	Capacity (Mt)	Proportion (%)
1	10000	3	9.30	6.02
2	8000	1	2.48	0.16
3	5000	31	48.05	31.11
4	4000	3	3.72	2.41
5	3000	10	9.30	6.02

6	2500	75	58.13	37.64
7	2000 ~ 2300	7	4.45	2.87
8	1500	6	2.79	1.81
9	1000 ~ 1300	48	16.25	10.52
Total		184	154.45	

1-1.3.2.2 The investment was concentrated mainly on the economy developed regions

At present, East China, Central and South China are the most vigorous and energetic in the country where economy develops quickly, and cement demand is the largest. Besides, the proportion of NSP/SP kiln cement there is rather low and the task of industrial structure readjustment is quite heavy. It can be seen from Table 17~19, that the investment in cement industry has been doubled and redoubled concentrating year by year mainly on these regions.

Table 17 Distribution of finished projects by regions in 2002

Regions	Number (line)	Volume of investment (Million yuan)	Proportion of Investment (%)	Capacity (Mt)	Proportion (%)
North China	7	1325.14	14	4.53	14
North East	1	187.93	2	0.78	2
East China	25	3845.96	42	16.71	53
Central South	4	606.66	7	2.33	7
South West	7	2238.67	24	3.72	12
North West	7	1011.09	11	3.72	12
Total	51	9215.45	100	31.78	100

Table 18 Distribution of projects being constructed in 2003 by regions

Regions	Number (line)	Volume of investment (Million yuan)	Proportion of Investment (%)	Capacity (Mt)	Proportion (%)
North China	12	2870.00	15.8	9.73	13.3
North East	3	910.00	5.0	2.70	3.7
East China	48	10421.22	57.3	46.67	63.7
Central South	10	1705.41	9.4	5.95	8.1
South West	8	994.23	5.5	3.04	4.1
North West	8	1295.80	7.1	5.12	7.0
Total	89	18196.66	100	73.21	100

Table 19 Distribution of projects planed to be constructed in 2004 by regions

	Number (line)	Volume of investment (Million yuan)	Proportion of Investment (%)	Capacity (Mt)	Proportion (%)
North China	9	2501.55	6.5	8.80	5.7
North East	5	1330.71	3.5	5.27	3.4
East China	77	20896.37	54.5	91.14	58.7
Central South	29	7265.07	18.9	28.92	18.6
South West	17	3368.15	8.8	11.63	7.5
North West	16	3014.45	7.9	9.58	6.2
Total	153	38376.30	100	155.34	100

1-1.3.2.3 The main body of investment on new projects tends to be diversified

The tendency of diversification of main body of investment is another remarkable feature of development of cement industry in recent years. Private funds has been poured in the field of NSP/SP kiln cement development. At the same time investment from abroad, Taiwan and Hong Kong funds to be invested in China's cement industry show stronger. The investment circs in cement industry in 2003 is showed in table 20.

Table 20 The investment structure in cement industry in 2003 (unit: million yuan)

	Investment volume (million yuan)	Number of projects	Total	Sources of total funds				
				Budget	Loan	Foreign funds	Funds self-collected	Other funds
State-owned	10719.74	117	2577.39	203.00	798.77	0	1258.26	317.63
collective	942.60	19	272.23	0	81.27	5.00	180.96	5.00
Joint venture	634.57	8	341.62	0	40.50	0	289.62	11.50
Stock Co.	29827.26	257	10543.20	77.01	3910.02	43.09	6080.86	432.22
Private-owned	2512.78	62	830.27	0	223.14	39.00	515.66	52.47
Hong Kong, Macao, Taiwan funds	5378.50	12	314.80	0	0	73.87	240.93	0
Foreign funds	1488.84	2	583.19	0	0	503.19	80.00	0
Others	782.22	5	125.39	0	78.99	0	43.40	3.00
Total	52277.51	482	15588.09	280.01	5132.69	664.15	8689.69	821.55

Note: Here only the enterprises with sales revenue above 5 million yuan counted up

Table 20 shows that among the investment sources, the budget funds accounts for 1.80%, bank loans 32.93%, the two together account for only 34.73%, self-collected funds accounts for 55.75%, becoming the main channel of investment. So, the government has no investment risk and the risk of bank is very small.

The main reasons why different investors pour their funds to NSP/SP kiln cement development are that the NSP/SP kiln technology is proven, the cost of investment and production cost have advantage over these for shaft kiln technology, quality of cement products is better, and the scale results are remarkable. Furthermore, the correct direction of the government though the industrial and supporting policies plays an important role. A large number of statistic data and sites survey show that the investment in large-scale NSP/SP kiln production line development has become the mainstream and hot spot of investment today.

The total investment in construction of 51 NSP/SP kiln production lines in 2002 was 9.22 billion yuan, of which, bank loans were 3.98 billion yuan, accounting for 43.23%; self-collected funds 3.74 billion yuan, accounting for 40.5%, foreign funds used were 1.42 billion yuan, accounting for 15.4%.

The volume of investment in construction of 242 projects being constructed and planed to be constructed within 2003 ~ 2004 totaled 56.57 billion yuan. The bank loans and the other funds took around a half of the total separately.

Of all invested projects of NSP/SP kiln production lines being constructed and put on stream in 2003, 55 are invested by listed enterprises and large Groups which are ranked as first 10 largest investors. The proportion of investment by them only accounts for 29.89%, but total increased capacities of their projects account for 46.48% of the total (see table 21).

Table 21 First 10 enterprises by investment scales

No.	Name of enterprises	Production lines (line)	Capacity (clinker)		Proportion of total newly added production capacity (%)
			(t/d)	(Mt/year)	
1	Couch Group	14	74000	22.940	14.85
2	Bohai Group	7	26200	8.122	5.26
3	Shanshi Group	6	17500	5.425	3.51
4	Shanshui Cement Group	4	15000	4.650	3.01
4	Zhejiang Guangyu Group	3	15000	4.650	3.01
5	China Lianhe Group	4	12500	4.030	2.61
6	Guangdong hengdeli Group	3	13000	3.875	2.51
7	Huaxin Group	3	12500	3.534	2.29
8	Tianshan Share Group	2	11400	3.100	2.00

8	Tianrui Group	2	10000	3.100	2.00
8	Jiangxi Wannianqing Group	3	10000	3.100	2.00
9	Yatai Group	2	10000	2.790	1.81
10	Yantai Dongyuan Group	2	9000	2.480	1.61
Total		55	8000	71.796	

The clinker production capacity of Bohai Group will reach 14.60 billion tons, cement production will be 22.30 billion tons in 2004. The clinker production capacity of Huaxin Group will reach 12.00 billion tons, and its cement production will be 20.00 billion tons in 2004. The clinker production capacity of Tianshan Group, Shanshi Group, China Lianhe, Yatai Group, Qilian Group, Qinling Group and Tianrui Group will be possible to top to 10.00 million tons separately in 2004. The production concentration degree of China's 10 strongest cement enterprises will be raised from 10% by the end of 2002 to 25% in 2004.

1-13.2.4 The technological structure readjustment in cement industry

With the quick development of NSP/SP kiln process in recent years, the proportion of output produced by NSP/SP kiln lines to the total national output has increased from 10% in 2000 to 16.7% in 2002. It's expected that the clinker production capacity will increase by 70.00 million tons, thus the proportion will reach up to 23%-24%. The industrial structure of cement industry will be further optimized. Though the developing speed of NSP/SP kiln cement in different regions is not the same, and there is some difference in progress of readjustment of industrial structure, improvement in industrial structure still existed to some extent. General trend leads towards advanced technology development according to the proportions of NSP/SP kiln process in every region in 2000 and 2002 showed in table 22, is general trend can be clearly seen.

Table22 Proportion of NSP/SP kiln technology in different regions in 2000 and 2002

Regions	Proportion of NSP/SP cement capacity in 2000 (%)	Proportion of NSP/SP cement capacity in 2002 (%)	Increase rate of NSP/SP cement between 2000 ~ 2002 (%)
Total	10.0	16.7	34.5
North China	15.0	24.5	35.9
North East	16.4	27.2	37.5
East China	12.7	19.4	28.8
Central South	6.7	8.7	15.2
South West	4.0	11.7	79.7
North West	9.2	27.4	93.1

The quick development of NSP/SP kiln technology creates favorable conditions for quickening the eliminating of backward production technology and resolving the environmental pollution and high energy consumption problems. All of shaft kilns have been cut off in Shanghai, Shenzhen. Beijing plans to eliminate all shaft kilns in 2003. The output of shaft kilns in Tianjin, Liaoning, Jilin in 2002 had begun to decline. It's expected that the output of shaft kilns in Zhejiang, Gansu will further decline in 2003, and the increase momentum of shaft kilns cement in these regions has been effectively inhibited. But in some regions, especially in large cement production provinces, such as Hebei, Shangdong and Jiangsu, the increase rate of NSP/SP kiln cement could not be comparable with the increase rate of market demand, that resulted in large increase of output of shaft kiln cement. This made the work of eliminating of shaft kiln more difficult.

1-1.3.2.5 Outstanding contradictions and problems existed in readjustment of cement structure at present

(1) Development is not balanced. The investment is overheated in some regions. There is lack of scientific decision in selection of projects. According to statistics, there are 153 NSP/SP kiln production lines planed to be constructed, which will increase 155 million tons clinker production capacity, accounting for more than 25% of present national cement clinker output. In case of existence of capacity of backward technology, it is possible that the overgrowth of cement production in the near time may cause excessive competition in cement market.

(2) The resource and power problems have already appeared in a part of regions. There is lack of research and investment into resources of raw materials, prerequisites for plant construction and market potentiality. For example, the cement output in Zhejiang province will reach 70 million tons by the end of 2003. At present, there are 36 NSP/SP kiln production lines being been constructed, planed to start production or are planned to be constructed, and a capacity of about 40.00 million tons will be newly added. The total reserves of limestone in Zhejiang are about 19.5 billion tons, but the proven mineral reserve is only 2.1 billion t, and the proven reserves can only be used for some 20 years. The shortage of resources will restrict the sustainable development of Zhejiang cement industry and becomes a limiting factor for development of cement industry in the south east coast areas.

(3) New projects in west China excessively depend on bank loan, the debt burden is too heavy so that the financial cost increases and the cost of cement products increases either after the projects put into production. This makes the products short of market competitiveness. When the market changes, the business of enterprises will encounter difficulties so as to cause the fatal competition in the market, and the enterprises will face some risk.

(4) Of projects constructed in past two years, there are some small-sized ones, and attention on improvement of technological standard was somewhat overlooked. For instance, there are 54 production lines with production capacity below 1000t/d among the 91 production lines constructed within 2001-2002, and their capacity accounts for 35% of the total capacity of all projects. So, if the development of small-scale NSP/SP kiln would not be guided and controlled, some enterprises had to face the results to upgrade again or be eliminated because of short of competitiveness.

1-1.3.3 The development trend of technological structure of China's cement industry

According to the forecast on conditions of China's national economy development and readjustment of industrial structure, output of enterprises produced by the first –type improved shaft kiln will reach more than 30% in around 2010.the second-type shaft kilns are about 6000 now. It's expected that prospect of these shaft kilns will face two selection under the conditions of reasonable competition of market within 8-10 years, one will be that 30% of them will be upgraded to be improved shaft kilns through technology renovation, or be transfered into NSP/SP kiln (of 51 percalcination kiln production lines built in 2002, 28 production lines were built by shaft kiln enterprises investment. The another 40%-50% of shaft kiln enterprises will be eliminated in the market competition because of low technology, poor quality, high cost, excessive emission that can not meeting national environmental protection standard. Little enterprises will keep on using shaft kiln production technology. From long-term view, these shaft kilns will be eliminated within around 15 years. The third-type ordinary shaft kiln using backward production technology will be cut off completely within future three years.

In recent 2 years a large number of shaft kilns in Zhejing, Guangdong, Shandong, Jiangsu and other provinces has transformed into new NSP/SP kilns. It's occurred about when the per capita GDP in these provinces has reached 15 thousand yuan. The period of time required for the other most less-developed provinces in the country to start to make this transformation can be estimated in accordance with this. It needs about 10 years for them in case when other external conditions remain unchanged, that is, in about 2015 at most, the second type of mechanical kilns will die out basically in China, and the output of improved shaft kilns will correspondently occupy less than 20% of the total and they will continuously transform into NSP/SP kilns in a large scale. And the process of this transformation may last about 10 years. In a sum, in the process of sustained economic development for the all-round construction of well-being society in China, up to 2020, the cement shaft kilns will leave very little, and the NSP/SP kilns and other even newer cement

clinker firing systems will account for more than 90%, occupying a absolute leading position in the industry.

The forecast of changes of kiln types structure in China's cement industry before 2030 is showed in table 23. This reflects in one side the course of restructure of Chinese cement industry and it's development by the path of new type of industrialization.

Table 23 Forecast on the structure changes of cement kiln in China's cement industry before 2030 (according to percentage of the cement output)

Year	Large- and medium NSP/SP kiln	Improved Mechanical shaft kiln	Mechanical shaft kiln	Ordinary shaft kiln	Other Rotary kiln
2002	15.1	16.5	48.2	7.8	12.5
2010	40 ~ 50	35 ~ 40	About 10	0	5 ~ 10
2015	70 ~ 75	15 ~ 20	<5	0	<5
2020	>90*	<10	0	0	<3
2030	>95*	<3	0	0	<2

Note: * except NSP/SP kiln, it will be possible that more advanced calcining systems come out.

1-1.4 The cement quality and products in China

1-4.1 Cement quality

Carrying out the integration of cement industry quality standard and international standard is the important way of sustainable development of China's cement industry. To upgrade the whole cement quality of China's cement industry, the GB / T17671 – 1999 national standard used for cement test was integrated with the international standard and was formulated in 2001. The standard is equal to the ISO679 international standard, and has been implemented starting from 1 January, 2002, the old one ceased at the same time. There are some other cement test standards, for instance, GB1750-1999 standard used for Portland cement and ordinary cement, GB1344 – 1999 standard used for slag, fly ash and tarras cement; GB12958 – 1999 standard used for compound cement.

The structure of cement products is still unreasonable, high-grade cement (over ISO42.5, ISO52.5) accounting for 15%, and quality grade of the remaining mostly part of cement is at ISO32.5. This causes the shortage of high quality cement in the market, but the low quality cement supply exceeds demand.

The contrast between the quality of clinker and heat consumption of clinker respectively produced by different production processes are shown in Tab. 24.

Tab. 24 The contrast between the quality of clinker and heat consumption of clinker respectively produced by different production process

Production process	Heat consumption, kJ/kg			Quality according to ISO standard MPa
	Lowest	Highest	Average	
NSP/SP	2888	3553	3300	Over 42.5, 52.5
Other rotary kilns (wet process、hollow、Lepol kiln)	3700	8485	6295	Over 42.5, 52.5
Shaft kilns (mechanical and ordinary shaft kiln)	3970	6270	5260	Mainly 32.5,little 42.5, 52.5

According to the classification in the part of 1.3.1, the enterprises with first type improved mechanical shaft kiln amount to more than 500, and their cement quality and techno-economic indexes are not the same, and the differences between the good quality and the bad one are very large. Of which, the good quality ones accounts for less than 10%, the bad quality ones accounts for about 10%. More than 80% of the total output is produced by shaft kiln and their quality reaches the standard of GB175-1999.P Ⅱ 32.5, the just up to grade. It is clear that, in general, the quality of cement produced by shaft kiln is lower.

The quality of cement product, clinker, and the content of C_3S+C_2S of clinker should be upgraded in the future. The quality of clinker is up to 60Mpa, so as to carry out replace the quantity of cement with the quality of cement, and the production is decided by quality.

1-1.4.2 Varieties of cement

There are mainly 6 varieties of general cement (Portland cement, Common, Scoria, volcanic ash, powered coal ash, and Compound Portland Cement). Others are special cement; the series of silicate cement (including medium heat, low heat, rapid hardening, oil well, anti-sulfate, road, self=stressing and white cement), the series of sulphoaluminate cement, the series of aluminoferrite, swelling cement, steel slag cement, high-alumina cement, building cement, and molding sand cement. At present, there are more than 60 kinds of special cement and their output is about 12 million tons (excluding building cement).

1-1.5 Waste emission and Environmental control in cement industry of China

1-1.5.1 Waste emission in cement industry

The waste materials emitted from cement production are mainly dust, waste gases, waste water and noise. In the process of cement production a lot of dust and waste gases of CO_2, CO, SO_2 and

No_x emerge, which bring about pollution to the environment of existence.

(1) Emission of flue dust and dust powder is very heavy

The limit of emission of dust set in the National Standard for the cement industry in China is 100 mg/Nm^3, which is much higher than the level of 30~50 mg/Nm^3 set in international advanced standard.

The total amount of flue dust and dust powder emitted from cement enterprises all over the country in 1997 was in the range of 6.9~7.5 million tons, accounting for 24.9%~27.1% of 27.7mil.t of total industrial flue dust and dust powder emission in the country (see Table 25 and 26). The emission of dust from the cement industrial enterprises above the county level were 6.27 million tons, accounting for 50.85% of 12.33 million tons of the total dust discharges from the industrial enterprises above the county level in the country. To count up the flue dust and dust powder emission separately: the amount of flue dust emitted from enterprises of cement industry above county level was 0.42 million tons accounting for 6.1% of 6.85 million tons of flue dust emission from industrial enterprises above county level in whole country, and emission of dust powder from the cement enterprises is 5.847 million tons, that from the industrial enterprises above county level (including of village and township enterprises) in whole country is 5.48 million tons. Thus, it can be seen, that the flue dust emerged from firing fuel has already been mixed into clinker in the process of clinker firing, as a result, there is rather few flue dust discharged. However, emission of dust powder is heavy because of lack of perfect dust collecting equipment, especially it is even worse or there is no dust collecting equipment wholly in the small-scale village and township shaft kiln enterprises. It can be clearly seen from the data that among 15.05 million tons of the total amount of dust powder emission from the industrial enterprises over all the country 5.48 million tons, accounting for 36.4%, were emitted from enterprises above the county level and 9.57 million tons, accounting for 63.6%, were emitted from village and township enterprises. As regards emission of dust powder, the cement output in China in 2000 was about 600 million tons, and emission of cement dust was 10-12 million tons corresponding to annual cement production of 7~8 production lines with a capacity of 4000t/d. Calculating by a population of 1.3 billion, per capita dust load is 7.9~9.2 kg. At present, dust emission norm in China is 150 mg/Nm^3 (it is 100 mg/Nm^3 designed for few specific economically developed regions), whereas in Germany, Norway, Switzerland and Chinese Taiwan the dust emission limit is 50 mg/Nm^3, and in their practice of production the dust discharge is controlled within 25 mg/Nm^3. In developed countries and regions, the total amount of dust powder emission accounts for 0.01% of total cement output, whereas it reaches over 2% in China, corresponding to as much as 200 times of

that in developed countries.

The total amount of flue dust and dust powder emitted from cement enterprises in China was 8.09 million tons in 2002, most of which was emitted from medium and small-sized cement enterprises. Calculating by 1.3 billion population, per capita dust load was up to 6.2 kg.

(2) Outcome and discharge of solid wastes from cement industry are rather small.

The outcome and discharge of solid wastes from industrial enterprises above county level in 1997 were 657.49 million tons and 15.49 million tons respectively (see table 25 and 26). Those from enterprises of cement industry above county level were 4.91 million tons and 0.2 million tons respectively, accounting for 0.75% and 1.29% of total outcome and discharge from industrial enterprises above county level correspondently. Thus, it can be seen, that the outcome and discharge of solid wastes from cement industry were relatively rather small. Furthermore, judging by accumulated amount of industrial solid wastes, it has been as much as 6.583 billion tons in whole country, whereas for cement industry it has been just 1.26 million tons, 0.019% of the total. Judging by industrial sectors, the largest amount of solid wastes was emerged from the mining, metallurgical, chemical, non-ferrous metallurgical and power industries. The cement industry not only runs out and discharges little amount of solid wastes, but also can absorb and utilize comprehensively coal gangue, slag, fly ash, etc., discharged from coal, metallurgical and electrical industries as the functional and regulative materials to alleviate the environmental pollution by these industrial sectors.

(3) There is no outcome of solid wastes from cement industry, moreover it can absorb and degrade dangerous solid wastes discharged by other industrial sectors.

The outcome and discharge volumes of dangerous solid wastes from industrial enterprises above county level all over the country in 1997 were 10.10 million tons and 0.46 million tons respectively, whereas there were no outcome and discharge of dangerous solid wastes from cement industry (see table 25 and 26). The volumes of dangerous solid wastes come out from chemical, mining, metallurgical, petroleum and some other industries are the largest, and the volumes of dangerous solid wastes discharged from mining, chemical, non-ferrous metal metallurgical and etc. industrial sectors are the largest. Ccment industry, not only doesn't run out and discharge dangerous solid wastes itself, but also can degrade some combustible dangerous solid wastes in cement rotary kilns as combustible materials.

(4) Discharge of waste water from cement industry is rather little

The discharge volume of industrial waste water all over the country in 1997 was 22.7 billion tons,

of which, that from industrial enterprises above county level was 18.8 billion tons, and that from cement industrial enterprises was 0.3 billion tons. The latter accounted for 1.32% and 1.6% of total discharge volume from all industrial enterprises and all industrial enterprises above county level respectively (see table 25 and 26). Judging these figures, we see that the discharge volume of industrial waste water from cement industry is rather little. Furthermore, the main pollutants in industrial waste water are sulfides,cyanides, aluminium and petroleum, etc.. The amount of these pollutants in waste water of cement industry is little, whereas large in waste water of chemical, petroleum, paper and some other industrial sectors.

(5) Emission amount of carbon dioxide from cement industry is large

The emission volume of carbon dioxide from cement industry all over the country in 1997 was 0.36 billion tons, that in 1998 was 0.39 billion tons (see table 25 and 26). The carbon dioxide is mainly produced from combustion of fuel and decomposition of carbonates during the process of burning of cement clinker. Using high-efficient dust collecting equipment, reduction of the consumption of cement meal and decrease of heat consumption of clinker by using high and new technology, can reduce emergence of CO_2. Generally, the emergence of CO_2 from burning every kilogram of cement meal is about 0.346 kg. Burning of every kilogram of coal powder produces about 2.42 kg of CO_2. Running out of every kilogram of cement clinker emerges 1 kilogram of CO_2. So, we can see, that lowering the coal consumption for clinker burning is the key point to reduce the production and emission of CO_2 in cement industry. At the same time, reduction of comprehensive energy consumption for cement production, improvement of clinker quality to increase the amount of added industrial wastes in cement or in concrete, are the important measures for reduction of use of clinker or cement and reduction of emission of CO_2 in cement industry as well.

(6) The concentration limitation of emission of sulfur dioxide (SO_2) in cement industry is comparably higher

In national standard GB 4915-1996, the emission concentration of SO_2 is limited to 400 mg/Nm^3 (for the areas of second category) and 800 mg/Nm^3 (for the areas of third category), whereas that in developed countries is controlled below 400-500 mg/Nm^3.

The emission volume of sulfur dioxide (SO_2) in cement industry all over the country in 1997 was 0.86 million tons, accounting for 4.85% of 17.72 million tons of total SO_2 emission from industrial sectors of whole nation (see table 25 and 26). The source of SO_2 in the waste gases of cement industry is compositional elements of sulfides in fuel. In the process of calcinations of cement clinker, though part of sulfur is absorbed into clinker, some parts of sulfur emission enter

into emerged waste gases. Taking desulfurizing measures before emergence of waste gases or applying low-sulfur fuel can reduce the emission volume of SO_2.

(7) Discharge of nitrogen oxides (NO_x) in cement industry

In national standard GB4915-1996, the limitation of concentration of No_x emission is 800 mg/Nm^3 (for the areas of second category) and 1600 mg/Nm^3 (for the areas of third category). The concentration NO_x of emission in relatively developed countries is controlled between 500~800 mg/Nm^3.

The emission volume of nitrogen oxides (NO_x) from cement industry in 1997 is about 0.44-0.62 million tons (see table 25 and 26). In the process of burning of cement clinker in cement industry, two types of NO_x: high temperature NO_x and fuel NO_x emerge. The former NO_x is produced as a result of chemical combination of N_2 with O_2 in the air under the high temperature. Consequently, it has a close relation with temperature, whether it is high or low. The latter is formed in the chemical combination of N in fuel with O_2 in air under low temperature of burning of volatile elements. Consequently, it is closely related with concentration of O_2 in the firing jet stream of fuel. Since the most part of fuel is added for firing through calcination furnace in the NSP/SP kiln process, and the mixture burns under the low temperature. For some type of kilns (for example PR-LOW NO_x and DD types, etc.) a low NOx nozzle is fixed in the lower part of calcination furnace, that makes part of burning is carried out under the reduction atmosphere, benefiting the reduction of NO_x in kiln waste gases. Furthermore, as new-type multi-channel burner (for instance, Pyro. Jet burner, etc.) is applied, that helps to reduce the emergence of NO_x. The energetic development of new dry process cement production can not only save energy, but also benefit reduction of emission and environment protection.

The cement output in China in 2002 was 0.705 billion tons. According to statistics by experts, that 1 ton of harmful gases emites to atmosphere from every ton of cement clinker production. So, the emission volume of CO_2 from cement industry in our country is about 0.6 billion tons, that of SO_2 is about 0.8 million tons, that of NO_x is about 1.0 million tons.

1-1.5.2 Environmental control in cement industry

The comparison of national standard for cement industry BG4915-1996 "The atmosphere pollutant emission norm" with norms in advanced countries is shown in table 25:

Table 25 Comparison of pollutant emission norm limitation

for the cement plants in China with those in advanced countries

Country	Dust (mg/Nm^3)			SO_2	NO_2	Notes
	Kiln	Cooler	Others			
Germany	50	50	50	400	500	
U.K	40	50	50	200	900	
Malasia	100	100	100	200	2000	
Japan	50	50	50	750	500	
Italy	15 – 30	20	10	400	700	
Turkey	120	50	50	300	400	
USA	70	40		750	900	
China	100	100	50	400	800	Second grade, Rotary kilns
China	150	150	150	800	1600	Second grade, Rotary kilns
China	100	100	50	600	400	Shaft kilns

Developing bulk cement can reduce effectively the discharge of dust

As regard to bagged cement, in the process from mills to application sites the dust emission from the damage of cement bags constitutes more than 5%. Judging by 11.0 million tons of bulk cement output in 2000, the cement industry emitted 0.55 million tons of cement dust less to the atmosphere in that years, which is equal to the total annual output of 3.6 production lines with a capacity of 4000 t/d. So, to raise the rate of bulk cement is one of important ways to save energy and to reduce the emission of dust.

1-1.6 The general situation of resource and energy consumption in Chinese cement industry

The cement industry is a resource and energy consuming industrial sector. The limestone, clay and coal it uses are the unreclaimable resource. Furthermore, a lot of clay is taken from farm-fields. Consumed coal is also the most important disposable energy source of the country.

In the "China Environment statistics 1998" published by state Statistics Bureau in August 1999, the situations of energy production and consumption and emission control of three wastes in whole country in 1997 are collected and reviewed (see table 27). In 1999, the former State Administration for Building Materials Industry distributed "China Cement Industry Statistics in 1998", the situations of resource and energy consumption and three wastes emission related to cement industry are shown in table 26.

(1) The consumption of fuel (normal coal) in Chinese cement industry was higher by 41% compared to average standard of fuel consumption abroad.

The total fuel consumption of cement industry in whole country in 1997 was 59.4 million tons, accounting for 4.5% of 1.31989 billion tons of normal coal of total coal production. 6.5% of 0.98068 billion tons (13.1989 ×0.743), of total coal production. The normal coal consumption for 1 ton clinker for large and medium-sized cement enterprises in China was 161.32 kg (heat consumption is 4720 kJ/kg clinker or 1129 kcal /kg clinker). Comparing with the average standard abroad of 114.28 kg/t clinker (heat consumption is 3344 kJ/kg clinker or 800 kcal /kg clinker), it was higher by 41%. From here it is seen, that the potentiality for reducing fuel consumption in Chinese cement industry is enormous.

The coal consumption in Chinese cement industry in 2002 was 93.6 million tons, accounting for 8.5% of the total national production.

(2) Power consumption is higher by 20% to 30% than the average standard abroad

The power consumption in whole cement industry in China in 1997 was 55.0 billion kWh, accounting for 6.54% of 840.2 (1124.8×0.747) billion kWh of total industrial power consumption. The comprehensive power consumption of large and medium-sized cement enterprises was 107.14 kWh/t. Comparing with the advanced standard abroad (application of five-stage precalicner kiln, vertical raw meal mills, high pressure roller mills for semi-final powder milling, etc.) of 90-95 kWh/t cement, it was higher by 13% to 19%. At the same time, though the comprehensive power consumption of 107.14 kWh/t was reduced considerably from 114 kWh/t in 1995, in statistics part of shaft kiln enterprises were covered (since the standard of mechanization and automation in shaft-kiln enterprises is lower, the power consumption there is lower either). If to use data for NSP/SP kiln lines with a production capacity of 700-4000t/d, their comprehensive power consumption was generally in a range between 115 and 120 kWh/t, which is higher by 20% to 30% in comparison with the international advanced standard. It is seen, that the potentiality for power saving in Chinese cement industry is also huge.

The heat consumption and comprehensive power consumption for the NSP/SP kiln production lines with a capacity of 2000t/d and above are 3428 kJ/kg clinker and 115 kWh/t respectively. Converting clinker burning by shaft kilns into heat consumption of 1 kg clinker, it will be 4598kJ/kg clinker. The comprehensive power consumption of cement is 95 kWh/t. Converting all heat consumption and power consumption into consumption of normal coal, the comprehensive

power consumption for per ton of cement for NSP/SP kiln process is 144.2 kg, that for mechanical kiln lines is 168.6 kg, 14.5% higher than the former.

Comparing NSP/SP kiln lines put into operation or being constructed in China in recent years with several old production lines, in the former some advanced energy-saving equipment, such as vertical mills, high pressure roller mill, grate cooler with air beam of third generation, etc. have been mostly applied. The heat consumption for 1 kg clinker burning has been reduced to about 3177 kJ. The comprehensive power requirement of cement nears to 105 kWh/t. The comprehensive energy consumption of cement has reduced to 135 kg normal coal/t, lower by about 20% comparing with that for shaft kiln cement.

Table 26 Consumption of resources and energy and emission of "three wastes" in Chinese cement industry

Items		Unit	1997	1998	Remarks
Number of enterprises		PCs	6403	4506	
Cement output		$\times 10^4$t	51276	52706	
Clinker output		$\times 10^4$t	36799	39374(38777)	
Of which: clinker from rotary kiln		$\times 10^4$t		9763	
Large and medium-sized enterprises	Average grade of clinker from rotary kiln	Grade	610	618	
	Average grade of clinker from shaft kiln	Grade	589		
	Average grade of cement	Grade	481	474	
	Consumption of normal coal for clinker	kg/t	161.32	160.75	Number of kilns counted: 1997 447 kilns and 248 kilns in the nest yea
	Comprehensive power requirement for cement	kWh/t	107.14	100.37	Total number of kilns counted 1997 871 kilns 1998 762 kilns
	Comprehensive energy consumption for cement	kg/t	181.04	172.46	
Total amount of normal coal consumption		$\times 10^4$t normal coal	5940	6720	Calculated in accordance with related data (the same hereinafter)
Total power requirement for cement		$\times 10^4$kWh	550	564	
Total energy consumption for cement		$\times 10^4$t	9280	9090	
Consumption of limestone		$\times 10^4$t	48000	51000	
Emission of carbon dioxide CO_2		$\times 10^4$t	36000	39000	
Emission of sulfur dioxide (SO_2)		$\times 10^4$t	86		
Emission of nitrogen dioxide (NO_X)		$\times 10^4$t	44-62		Emission of NO_X in kiln gases is 500-700PPm
Emission of fuel dust and process dust		$\times 10^4$t	690-750		

Table 27 Production and consumption of energy and emission of "three wastes" in China in 1997

Items		Unit	Quantity Data	Remarks
Energy	Total production Total consumption	x 10 4 t Nomal coal	131 989 142 000	Of which: 74.3% of raw coal, 73.5% of energy consumed is coal, 72.4% of total consumed is for industrial use in 1996
Electricity	Energy production Energy for social use	x 10^4kWh	11 356 11 248	74.7% of total consumed for industrial use in1996
Emission of gases and flue dust in industrial waste by fuel burning	Total Of which: industrial enterprises above county level Village and township enterprises Cement enterprises above county level	x 10^4t	1 772 1 363 409 80	Number of industrial enterprises data of which were collected is 54, 909. Number of cement enterprises counted is 4, 205.
Emission of flue dust into industrial waste gases by burning	Total Of which: industrial enterprises above county level Village and township enterprises Cement enterprises above county level	x 10^4t	1 265 685 580 42	Number of industrial enterprises, data of which were collected is54, 909. Number of cement enterprises, data of which were data of which were collected is 4, 205.
Emission of dust into industrial waste gases during technological process	Total Of which: industrial enterprises above county level Viillage and township enterprises Cement enterprises above county level	x 10^4t	1 505 548 957 585	Number of industrial enterprises, data of which were collected is54, 909. Number of cement enterprises, data of which were collected is 4, 205.
Emission of industrial waste water	Total Of which: industrial enterprises above county level Village and township enterprises Cement enterprises above county level	x 10^8t	227 188 38 3	Number of industrial enterprises, data of which were collected is54, 909. Number of cement enterprises, data of which were collected is 4, 205.

Production of industrial solid wastes	Total Of which: industrial enterprises above county level Village and township enterprises Cement enterprises above county level	$\times 10^4$t	105 849 65 749 40 100 491	Number of industrial enterprises, data of which were collected is54, 909. Number of cement enterprises, data of which were data of which were collected is 4, 205.
Emission of industrial solid wastes	Total Of which: industrial enterprises above county level Viillage and township enterprises Cement enterprises above county level	$\times 10^4$t	18 412 1 549 16 863 20	Number of industrial enterprises, data of which were collected is54, 909. Number of cement enterprises, data of which were data of which were collected is 4, 205.
Accumulated storage of industrial solid wastes	Total Cement enterprises above county level	$\times 10^4$t	658 309 126	Number of cement enterprises, data of which were data of which were collected is 4, 205.
Production of industrial dangerous wastes	industrial enterprises above county level Cement enterprises above county level	$\times 10^1$t	1010 0	Number of industrial enterprises, data of which were collected is54, 909. Number of cement enterprises, data of which were data of which were collected is 4, 205.
Emission of industrial dangerous wastes	industrial enterprises above county level Cement enterprises above county level	$\times 10^1$t	46 0	Number of industrial enterprises, data of which were collected s54, 909. Number of cement enterprises, data of which were data of which were collected is 4, 205.

Note: Data in table 24 are selected from "China Environment statistics 1998"published by the State Statistics Bureau.

(3) Consumption of limestone is huge

Chinese cement industry needs to consume about 0.7 billion ton of limestone ore every year. Limestone is important and unreclaimable resource, and should be mined and comprehensively utilized rationally. For instance, coal ganque, slag, fly ash, phosphogypsum, red mud, chromium

slag, copper slag, tourmaline sludge, some low-content ores, tailings and other industrial waste slag can be used to widen the source of raw materials for cement production and to save consumption of traditional resources and energy, so as to make the resources comprehensively utilized and environment protected at the same time.

(4) Proportion of bulk cement in rather low, consuming a lot of timber resources

Energetically developing bulk cement is one of important ways to save resources in cement production. Bulk cement is one of new production patterns, which emerged together with the progress of human society, more strict requirement to resources and energy saving and environmental protection and improvement of work efficiency. In world developed countries, by the end of 1960's of 20 century the transformation from bagged package of cement to bulk cement has been completed, realizing over 90%of bulk cement proportion from the total output. Moreover, the bulk cement rate in USA, Japan, Germany and some other countries and regions is ever high, over 95%.

Judging the bulk cement rate abroad at present, over 70% is considered as the international standard, over 90% – international advanced standard. Whereas, backward paper-bag package is mostly applied in Chinese cement industry. The bulk cement rate is only about 20%, which is far behind from the international standard.

The paper bags for cement package are manufactured from wood. It not only requires a lot of wood, consuming precious wood resources, but also a lot of fresh water and produces a large amount of polluted water. According the statistics, every 1000 tons of cement requires 33 m^3 of wood of superior quality in paper making for cement paper-bags. The wood consumed for cement package every year is corresponding to 2.5 timber cut amount of whole Daxinganlin. The fresh water consumption is near 0.8 billion m^3. The reduction of wood decreases its absorbing function for CO_2, increasing GHG affection. Consequently, developing bulk cement and realizing high bulk rate is one of important measures for resources conservation and environment protection.

1-2 Number of kiln types operating in China at present and comparison of their technical-economic indexes of production

As it is shown in table 28, consumption of normal coal for clinker of advanced NSP/SP kiln lines in China is 110-115 kg/t. Comprehensive power consumption for cement is 120-130 kWh/t. However, the cement output by NSP/SP kiln lines in China just is 60 million tons, accounting for only one tenth of total output. So, energetic development of NSP/SP kiln process is an essential way to save energy and reduce discharge in cement industry in China.

Table 28 An estimation of number of kilns of different types operating in China at present and Comparison of their technological indexes

Kiln type	Number (kiln)	Capacity Mt	Heat consumption for clinker kJ/kg clinker	Comprehensive power requirement for cement kWh/t	Annual operating rate of kiln %	Quality of clinker MPa
Rotary kiln	1183	18	157	105		53~60
NSP/SP kiln	158	75	110-125	120~130	85	53~60
Pre-heater kiln	208	30	130-140	120~340	83	53~60
Shaft pre-heater kiln	140	8	155-165	120~130	82	53~60
Lepol kiln	20	4.5	160-170	115~125	82	53~60
Waste heat power generation kiln	88	15	170-180	100~110	85	53~60
Wet process kiln	254	35	200-205	95~105	85	53~60
Dry process hollow kiln	383	20	225-235	100~110	85	53~60
Shaft kiln	5118	400	95.65-150	95~100	80 – 85	Over 53
Total kilns	6261	590			80	

1-3 Comparison of cement production technology in China with that of international advanced level

To analysis the present situation of China's cement industry, the energy-savings potential in China's cement industry will be further researched and analyzed by the comprehensive contrast of the cement technologies level and the indexes of energy consumption, environmental protection indexes.

Tab. 29 The contrast of the China's cement technologies with the world advanced level

Items	World advanced level	Average level in China
Percentage of NSP/SP (%)	Japan 98.3%; Italy 96.5%	About 10%, NSP/SP 180 lines
The average scale of enterprises (10 thousand tons)	World: 60-100; Europe:70-80; Japan:256.	10
Labour productivity (kg/person. Year)	France: 3273; Germany:3015; Japan: 15000	Local cement: 160; National average: 284
Running rate of equipment (%)	92%	85%
Heat consumption of clinker (kJ/kg clinker)	2900 kJ/kg clinker (Japan)	51 2 1kJ/kg clinker (average of rotary kilns)
Coal consumption of clinker (kg normal coal/t clinker)	100	155
Heat consumption of NSP/SP (kJ/kg clinker)	2888	3555
Cement comprehensive power consumption (kWh/t cement)	92	114
Dust emission (mg/Nm^3)	20-50 or <1kg/t cement	100-150 or 10. 2 kg/t cement
Main pollutants (NO_x,SO_2,CO_2 etc.)	Restricted strictly	Not restricted strictly
Discharge of heavy metals and rare elements etc.	Restricted strictly	Not restricted strictly
Bulk cement rate (%)	Over 9 0%	About 2 0%

1-4 Current conditions of China's cement supply and demand market and future development forecast

1-4.1 Chinese cement consumption

The cement is one of basic raw materials which have a close relationship to national economic development. Practice has proved that the growth of cement has close relationship with the growth of GDP of country, fixed assets investment and the growth of population, especial there is a close relationship to the fixed assets.

The increase speed of cement output is accordant with the consumption. The cement output and consumption share a high relativity. In 2002, Chinese cement output was 705 million tons while its consumption was 693 million tons. The rate of output to sales has always been kept between 95% and 98% over the past years.

1-4.1.1 The relation of China's Cement Consumption with Gross Domestic Product (GDP)

With the growth and decline of GDP, cement consumption volume fluctuates accordingly. Before 1990, China's cement output growth excessed the GDP growth, but after 1990, the cement output growth showed obviously stagnation. The relationship between cement industry development and GDP growth in China is showed in Fig 9, and 10.

From 1980 to 2002, China's GDP increased at average rate of 9.4%. In 2002, it reached 10240 billion yuan.

The cement consumption increased from 1980's 81.4kg per capita to 2002's 565kg per capita. The accumulated cement consumption from 1980 to 2002 was 692kg per capita.

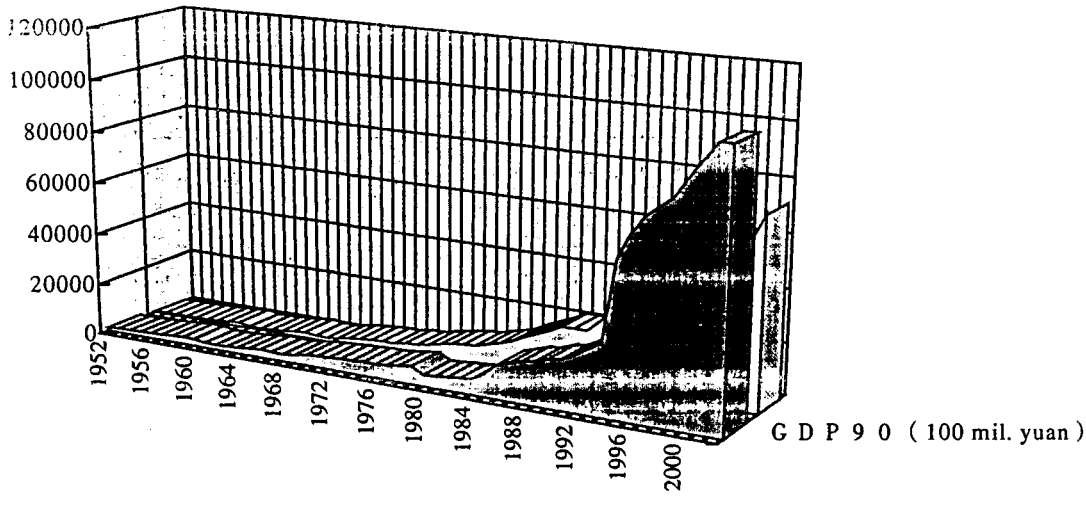


Fig.9 The relationship between cement industry development and GDP growth in China

Table 30 GDP and cement output

units: GDP: (100 million YUAN), output: (10 thousand tons)

	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002
GDP	4518	8964	18548	58478	67885	74463	78345	82067	89442	95933	102398
Cement output	7986	14595	20971	47561	49119	51174	53600	57300	57600	62000	72000

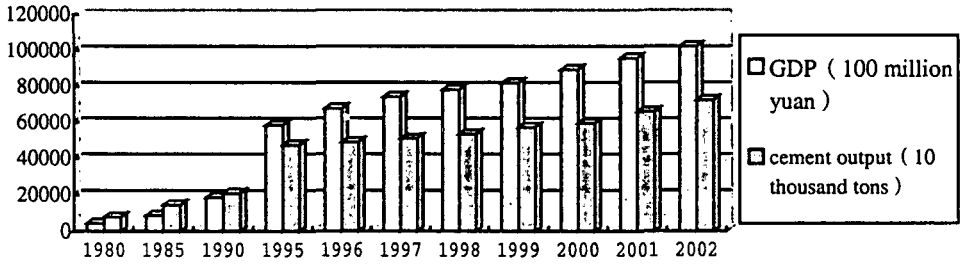


Fig. 10 The relationship between GDP and cement output during 1990-2002

1-4.1.2 The relationship between China Cement Consumption and Fixed Assets Investment volume

Cement consumption volume is firmly related to the fixed asset investment, that is, with the growth of fixed asset investment, cement consumption will rise accordingly.

There is a good correlation between the growth of cement consumption and the increase of fixed assets investment, ie. the cement consumption will definitely and correspondently increase with the increase of fixed asset investment. From 2000 to 2002, the increase rate of social fixed assets investment for the whole country has exceeded 10% in successive 3 years, and the increase rate of social fixed assets investment in 2002 was as high as 16.1%. The continuous expansion of investment scale, especially, the increase of investment to key engineering projects and infrastructure construction and the steady heating of real estate industry, made the increase rate of real estate investment in 2001 as high as 27% and 28% in 2002, that directly drew up the market demand for cement.

The cement consumption for the infrastructure construction, real estates, productive construction for various industrial sectors, productive construction for agriculture and the public service in China in 2001 accounted for 30%, 25%, 15%, 15% and 15% of the total respectively. The statistics of cement consumption in China is shown in table 31.

Table 31 Cement consumption in China (unit: 10,000t)

	2000	2001	2002	2003*
Cement consumption	58500	62000	64000	68000
Increasing rate %	+2.6	+5.7	+3.1	+6.6
Output: Cement	58600	62000	64000	66000
Clinker	32800	36700	39600	44000
Export: Cement	586	591	600	400
Clinker	-	10	-	-
Import: Cement	–	-	6	-
Clinker	98	224	400	350

Note: * estimated

1-4.2 Cement market in 2003

Domestic and international experts as well as World Bank experts predict that SARS may cause 0.5% decline of China's GDP growth, and the 7% GDP growth can be ensured. As recently predicted by Asia Development Bank, "This year among the East-Asian countries China has the highest economic increase rate, which is expected to reach 7.5%." Among the Eight Measures issued by the State Council of China to ensure stable and fast development of the national economy, some measures have become cement industry's driving factors, such as "further enlarge investment, adjust investment structure, step up approved key project's construction;" and "foster new consumption hot areas, further enlarge the supply of common living buildings and economic convenient buildings" and so on. The issue of 140 billion national bonds in China also initiates the fixed asset investments. Moreover, the construction of 80,000 kilometer's highway attracts 100 bullion yuan investments. Those factors, as a whole, can ensure 16% increase of fixed asset investment in China. The first half year's GDP of 2003 in China grew by 8.2% and reached to 5005.3 billion yuan; State fixed asset investment increased by 31.1%, and amounted to 19734.8 billion yuan. Those statistics indicate that cement industry's growth will maintain at a rate of 8% and the total cement production volume will achieve about 730 million tons and consumption volume about 660 million tons. For instance, engineering project of water conveying from South China to North China, the project of electricity transmission from the west to the east, the second construction period of Three Gorges, Qinghai-Tibet Railway project, Step Electricity Power Station on the upper reaches of the Yangtze River, Beijing Olympic Games in 2008, construction projects for Shanghai World Fair, all will play great role in the fixed assets increase.

The effecting factors of market of cement demand in 2003 are as follows

(1) The situation of cement export is not optimistic because of the world economic depression

The cement export in China in 2002 was 4.97 million tons, decreased by 17.05% over the same period of 2001. It is expected that the cement export in 2003 will present the downward trend. The main factor is that the increasing speed of world economy has slowed down. On the same extent, the cement export volume will be effected by many factors, such as, growth of international construction scale is not large, international cement market is at the depression. In addition, by carving out the international market at low price the Giant Transnational Groups from Indonesia, Thailand, Turkey, Philippine, Mexico, as well as Lafarge、CEMEX、Heidelberg plays even greater role.

(2) The concrete technologies development makes the total demand volume of cement in 2003 relatively reduced.

The high performance concrete mixed up with the super fine concrete admixture (ground slag and fly ash) of various properties can replace the cement demand by 30%-40%. The concrete demand in 2001 in Beijing and Shanghai was about 18-20 million cubic meter, of which the commercial concrete accounted for 60%-70% of the total (that is, 12-13 million cubic meter). If the all concrete will mixed with the super fine concrete admixture, which reach 3-4 million tons/year, and then the 1.6-1.8 million tons cement will be replaced. At present, the demand of slag exceeds supply in Beijing and Shanghai. So, the total demand of cement is effected by the concrete admixture and concrete technologies.

The total cement output in China in 2002 was 705 million tons. With the promoting of quickly economic growth, the technological development of small-scale enterprises will be further quickened, and the per hour cement production of kiln will be upgraded obviously. The net increasing capacities of NSP/SP kilns is expected to reach over 40 million tons in 2003, on the basis of the net increasing capacities of 30 million tons in 2002, so the total supply of cement shows the upward trend, the situation of supply exceeding demand still exists.

1-4.3 Future development forecast China's cement

1-4.3.1 A rapid development period and a strong dragging of new dry process cement

The effecting factors of market of cement demand in 2003 are as follows

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1-4.3 Future development forecast China's cement

1-4.3.1 A rapid development period and a strong dragging of new dry process cement

production will inevitably emerge as the economic development reaches a certain stage.

In accordance with the common law of economic development of different countries in the world, the relevant international organization reached a conclusion, that when the per capita GDP reached US$ 1000~3000 for a country, a rapid growth stage of economic development for it will arise. It is because when the per capita GDP hasn't reached US$1000 for a country, it can have some development, but it can not enter into a rapid stage of development due to its weak economic strength, numerous restricting factors and lack of necessary conditions for the development in the various aspects. However, as the per capita GDP exceeds US$3000, the resources disposition achieves a relative limit, the various demands tend to smoothing down, the space of development is relatively narrowed and the new emerged demand and basic necessity are reduced, the development speed will gradually slow down.

Since the reform and opening up in China, the economy has kept a continuously rapid development, the growth rate of GDP has kept at a 7%~8% level, so as the Chinese economy has obtained a rapid development prerequisite. Though the per capita GDP in China in 2002 was US$890, less than US$1000, the per capita GDP in some provinces and municipalities, the development speed of which was faster, exceeded the base line of US$1000. The per capita GDP in Shanghai in 2002 reached US$4000. In some provinces along southeast coast line the per capita GDP has already exceeded long before this base line (of course, the lowest per capita GDP in the remote less-developed provinces and autonomous regions is only US$400), the economic development has long before entered into the rapid development stage. The objective requirement of economic development after entrance into the rapid development stage has drawn the economic development of the whole country and has also made the absolute consumption of cement in the country increase year by year. In the recent 3 years it has increased by more than 10% on an average every year. Under the condition of yearly increase of absolute consumption of cement, the state has already clarified, as the industrial policies, that the new dry process is the main technology in the development of cement industry at present and the development of other technologies has been inhibited and restricted by the policies, that has been strongly drawing the development of new dry process cement production.

1-4.3.2 The law for the development of market economy offers even wider space for the development of new dry process cement production.

The market economy inherent laws of supply and demand, prices and competition dictate that the market is an economy of basic regulating role in the resources disposition, and efficiency preference economy, a credit and law-ruled economy and is not a power-ruled an officer-commanding economy.

The development process and law of market economy shall inevitably abide by the law of "survival of the fittest". The resources shall inevitably be disposed to the departments or fields with advanced technology, reliable quality of products, bright development prospects and well-managed property and to the industrial sectors and products which conform with the guide lines and industrial policies of the state and are capable to develop enduringly. Because of good prospects and large demand in market, not only the state capital, but also the joint-stock, private and foreign-funded enterprises allocate the investment into development of new dry process cement production. Some small-scale cement enterprises with backward technology initially speed up the pace to merge into the large-scale cement enterprises seeking survival and development with the aid of powerful cement enterprises with new dry process. Some cement enterprises with new dry process of preliminary scale speed up the pace of development of scaled management to strengthen their own competitiveness to obtain a faster development and stronger strength. This multiple investment, multi-layer co-operation and multi-directional development situation is not formed by the subjective desire of some leading cadres but is determined by the objective development law of market economy.

Since the new dry process cement production is the contemporary advanced productive forces, its development and further development should have a new start point and a new target and isn't a simple repeated process. In the process of development of new dry process cement production, not only the constant innovation of technology and scaled production should be upheld, preventing recurrence of small-scale production, but also to create new achievements in utilization of natural resources, conservation of energy, in particular, in reduction of environmental pollution.

To complete the historic tasks of elimination of backward cement production technology, in the process of undertaking and development of new dry process cement production in China, the management standard and operational benefits should be further improved in general. At present, the economic conditions for full elimination of backward technology haven't been yet gotten ready, the historic task of thorough replacement of backward production technology should be accomplished through technological innovation and improvement of management standard.

1-4.4 Analysis and forecasting of cement output and market demand in China

1-4.4.1 Analysis and forecasting of market demand for cement in CHINABMI

Several forecasting methods are applied to forecast the cement outputs and market demands in China in 2005,2010 and 2020.

(1) Determination of saturation point of cement consumption

In the development of national economy cement serves as a kind of means of production and a kind of means of subsistence either, and the cement output and the level of per capita cement consumption reflect from one side the development and changes of national economy in the various periods of every country in the world.

It is indicated from the statistics, that the cement output presents a negative increase and the demand for cement stands firmly at a certain level in the main developed countries, when the cement production and the national economy have reached a certain level, that is, the saturation point of cement consumption appears.

The saturation point of cement consumption in the developed countries appeared around the 1970's, that is, the per capita accumulated consumption of 10-12 t serves as a reference standard of saturation. Referring to the practical experiences of the developed countries, the cement output is growing in pace with the development of national economy before the cement output reaches the saturation point, and the regression analysis method can be applied for forecasting of cement consumption. And after the saturation point of cement consumption reaches, the cement output will not grow in pace with the increase of national economy, the linear relationship between them will no longer exist, and the market demand will not be able to be forecasted using regression analysis and other mathematic methods.

The development program of cement industry can be scientifically formulated in accordance with this law of development. In case, when the industrial policy of "control of total cement output, restructuring of structures" is firmly carried out, the saturation point of cement output in China will occur later.

(2) Analysis of relationship between GDP and cement output in China using regression method with one unknown

According to GDP in every year from 1952 to 2000 and their respected cement outputs in China, a regression equation is attained by analysing and calculation: Y=a+bX, where a=-2239.07, b=1.20. X is GDP in a certain year(in constant value of 1990), bil. yuan; Y is the cement output in the same year, in 10000t. Therefore, the regression equation with one unknown is as follows: Y=2239.07 + 1.20X, with which the linear relationship between GDP and cement output can be analyzed.

According to GDP (in constant values of 1990) predicted by the Chinese Academy of Social Sciences and the regression equation with one unknown obtained above and 1% of population growth rate between 2001 and 2010, with which the population is 1.36921 bil. in 2005 and 1.43906 bil. in 2010 (these figures are basically correspondent with those planned in the national "Ninth Five-year Plan And Perspective Program To 2010"), the cement outputs can be estimated as follows:

For 2005, Y_{2005}=-2239.07+1.20X=-2239.07+1.20×64245=748.5493mil.t

For 2010, Y_{2010}=-2239.07+1.20X=-2239.07+1.20×86271=1012.8613mil.t

For 2020, Y_{2020}=-2239.07=1.20X=-2239.07+1.20×140346=1661.7613mil.t

Tab.32 Determination of saturation point of cement consumption by regression equation

Year	GDP		Cement demand (10 thousand tons)	Population (100 million person)	Per capita consumption (kg/person, year)	Accumulated per capita consumption (kg/person)
	GDP 100 million yuan	Growth rate %				
2000	89404***	8.0%		13.0376	412	5094
2001	95933	7.1%		13.1579	437	5484
2002	102398	8.0%		13.2895	462	5892
2003		8.2%		13.4223	489	6321
2004		7.5%	70081.33	13.5566	517	6776
2005		7.5%	74854.93	13.6921	547	7255
2006		7.5%	79536.13	13.8291	569	7759
2007		7.5%	84502.93	13.9674	605	8287
2008		7.5%	89770.93	14.1070	641	8842
2009		7.5%	95358.13	14.2481	669	9423
2010		7.5%	101286.13	14.3906	704	10034

Note: *: calculated by the constant price in 1970; **: calculated by the constant price in 1980; ***: calculated by the proportion price.

As shown in Tab.32, the saturation point will attain around 2010 in China according to calculation by this forecasting method. So, before 2010 a linear relationship between GDP and cement output in China presents, and it will not exist after 2010, thus, the regression analysis method can not be used to forecast cement output, otherwise, it will mislead the development of cement industry. The Chinese cement industry will enter into a stable saturation period around 2010. Therefore, the said method can't be applied to forecast cement output in 2020.

(3) Forecasting of demand for cement in China using method of "synchronous development of economy"

Using 7.5% of growth rate of national economy as growth rate of cement industry between 2000 and 2010, demand for cement in 2005will be:

$M_{2005}=0.553(1+0.075)^5=0.794$ bil.t

The demand for cement in 2010 will be:

$M_{2010}=o.553(1+0.075)^{10}=1.140$ bil.t

The results obtained by method of synchronous development of economy are indicated in tab.33.

Tab.33 Determination of saturation point of cement consumption by method of synchronous development of economy

Year	Economic growth rate (%)	Cement output (10 thousand tons)	Population (100 million person)	Per capita consumption (kg/person, year)	Accumulated per Capita consumption (kg/person)
2000	8.0%	57600.00	13.0376	412	5094
2001	7.1%	62000.31	13.1579	437	5484
2002	8.0%	70500.01	13.2895	462	5892
2003	8.2%	73100.38	13.4223	489	6321
2004	7.5%	73804.00	13.5566	517	6776
2005	7.5%	79339.30	13.6921	547	7255
2006	7.5%	85289.75	13.8291	569	7759
2007	7.5%	91686.48	13.9674	605	8287
2008	7.5%	98562.96	14.1070	641	8842
2009	7.5%	105955.19	14.2481	669	9423
2010	7.5%	113901.82	14.3906	704	10034

As it is indicated in tab.33, that the per capita accumulated cement consumption in 2010 will reach 10 to 12 t, near the saturation point, if the development of cement industry is in pace with development of national economy. The result is similar with that obtained by regression analysis method.

Such a large cement output is unfavorable either to the cement industry itself, or to the environmental protection, economic and social development. So, the total output should be controlled and the structure should be restructured for the cement industry to meet the requirement of sustainable development.

(4) Forecasting cement consumption in China by comparison with part of developed countries and regions

Some economic experts consider per capita accumulated cement consumption as one of major indexes of economic strength of a country. The experience of economically developed countries verified this. There was a period of sustained rapid development of cement industry in these countries (except for the USA). In a period when the per capita accumulated cement consumption has reached 10~12t, the cement consumption keeps on stably or starts to go down. The USA hasn't been hit by war, its economy has kept developing steadily and smoothly. The per capita accumulated cement consumption has reached 5t in 1949. Afterwards, the per capita cement consumption has changed very limited, keeping around 350 kg. In 1972, per capita accumulated cement consumption for USA, France and Germany was 11.9t, 10.4t and 10.5t respectively and per capita cement consumption in that year was 353, 566 and 680 kg respectively. Thus, their cement industry entered into a quite steady development stage. The trajectory of development speeds of cement industry in Japan, Chinese Taiwan and Chinese Mainland is very similar; there was a stage of rapid development, and then it developed steadily and smoothly or went down somewhat. The per capita cement consumption in Japan in 1950 was 91 kg, and that was 705 kg in 1979, when the per capita accumulated cement consumption was 11t. There was a stage of rapid development in the 30 years' period, beyond which it entered into a steady development stage, when the annual per capita cement consumption fluctuated in a range of 550 to 650 kg. The per capita cement consumption in Chinese Taiwan in 1950 was 25kg, and it reached the top, 1350 kg, when the per capita accumulated cement consumption reached up 18t. Afterwards, the annual per capita cement consumption started to decrease. The per capita and per capita accumulated cement consumption in Chinese Mainland in 2002 was 564 kg and 7.04t respectively.

(5) Forecast of cement output in China referring to proportional relationship between steel production and cement output of medium- and large-sized cement enterprises

As cement produced by shaft kilns is mainly used in rural areas, and the amount of steel used in countryside is generally very little, there is a certain relationship between cement production by rotary kilns and steel production in China referring to experience in the developed countries.

The ratios of cement production by rotary kilns to steel production since the founding of the People's Republic of China are shown in Tab. 34. It is shown from tab.33, that the ratios of cement production to steel production are on the low side. This is relevant to the state policies. For example, after the so-called "Great Leap" in 1958 the shaft kilns started to flourish so as to lower the proportion of cement production by rotary kilns, and the development pace of shaft kilns has been even larger after the guideline of "all-out to develop building materials industry" was put forward since implementation of reform and opening policy, that brought about an irrational condition of extra little proportion of rotary kilns' cement and extra large proportion of shaft kilns' cement in the output structure of cement in the country.

According to experience of developed countries, the ratio of cement production to steel production in the range of 0.8 to 1.2 is proper. Since the proportion of rotary kilns' cement production is over 95% of the total output in the developed countries, this ratio of rotary kilns' cement production to steel production is also applicable for us. Judging the concrete situation, that the buildings in our country are mainly of brick and concrete construction and those in the developed countries are mainly of steel construction, the ratio of cement production to steel production in a range of 2 to 3 for our country is more applicable.

Nevertheless, it is seen that the results obtained by this method can hardly reflect the real condition of development, and they can only serve as a reference.

Tab.34 Ratios of rotary kilns' production to steel production in China

Year	Ratio of cement output produced by large-scale kiln to output of steel	Year	Ratio of cement output produced by large-scale kiln to output of steel	Year	Ratio of cement output produced by large-scale kiln to output of steel
1949	3.81	1964	0.93	1979	0.72
1950	2.28	1965	0.90	1980	0.69
1951	2.68	1966	0.86	1981	0.70
1952	2.12	1967	0.87	1982	0.70
1953	2.15	1968	0.82	1983	0.68
1954	2.03	1969	0.83	1984	0.67

1955	1.54	1970	0.85	1985	0.68
1956	1.38	1971	0.83	1986	0.60
1957	1.25	1972	0.76	1987	0.61
1958	1.13	1973	0.70	1988	0.60
1959	0.73	1974	0.75	1989	0.58
1960	0.54	1975	0.80	1990	0.60
1961	0.50	1976	0.86	1991	0.60
1962	0.76	1977	0.80	1992	0.50
1963	0.88	1978	0.71	1993	0.47

(6) Forecast of cement output using the coefficient of elasticity of cement consumption

For the forecasting method using the coefficient of elasticity, the increase rates are applied in calculation. This method can only serve as a supplementary method, and the results obtained are just the secondary reference.

Tab.35 Growth rates of national economy and cement output in China

Year	GDP		Cement outout		coefficients of elasticity
	Times of growth	Annual growth rate%	Times of growth	Average growth rate annual %	
1950~1954	2.2207	17.3	7.0757	47.9	2.77
1955~1959	1.6739	10.8	2.5634	20.7	1.92
1960~1964	0.8506	-3.2	0.9623	-0.8	0.25
1965~1969	1.4168	7.2	1.4582	7.8	1.08
1970~1974	1.5151	8.7	1.9273	14.0	1.61
1975~1979	1.3730	6.5	1.9395	14.2	2.18
1980~1984	1.5480	9.1	1.6157	10.1	1.11
1985~1989	1.5561	9.2	1.6749	10.9	1.18
1990~1994	1.6333	10.3	1.9767	14.6	1.42
1950~1977	7.7145	7.6	71.8314	16.5	2.17
1978~1994	1.7534	9.6	7.0849	12.2	1.27
1950~1994	36.6705	8.3	508.9174	14.9	1.80

It is seen from tab.35, that in different periods in 45 years since the establishment of new China,

except for a few exceptional ones, the national economy has developed normally in general, and the cement production has been stable. Nevertheless, a strong fluctuation in coefficients of elasticity in different periods has been seen. It indicates the sensibility or inaccuracy of coefficient of elasticity. At the same time, it is seen, that the coefficient of elasticity in almost every period is more than 1, that is, the cement production is in the lead of growth of economy. It is correspondent to the real condition of development in the first 40 years after establishment of new China.

Entering the 1970's, the economy in developed countries has fluctuated, but the development of cement industry there has reached a higher stage and entered into a stable development period. It is inadvisable to follow their example for the development of economy in China. The coefficients of elasticity of cement consumption in the developed countries in a period from 1952 to 1972 are shown in tab. 36. They can serve as a reference for us.

Tab.36 Coefficients of elasticity of cement consumption during 1952 to 1972 in developed countries

Period	52 ~ 57	57 ~ 62	62 ~ 72	67 ~ 72	52 ~ 72
USA	1.60	0.71	40	0.94	0.84
Japan	2.02	1.38	1.10	0.91	1.24
West Germany	1.18	1.38	0.55	1.20	1.13
France	1.27	1.17	1.52	0.76	
U.K	0.37	1.20	1.42	0.20	0.78

There is a comparability of growth rate of cement consumption with that of GDP. Generally speaking, the coefficients of elasticity of cement consumption in the 1960's for several developed countries are higher than 1 mostly, i.e., the development of cement is in the lead of development of economy. In the 5 years around 1970, the coefficients of elasticity for these countries are all lower than 1, i.e., the saturation point occurred, and the development of cement lagged behind development of economy. Furthermore, in a period of 20 years, for Japan, the national economy has increased by more than 4 times, the coefficient of elasticity has kept between 1.24 and 1.30, for West Germany and France, economy has increased by 3 times, the coefficient of elasticity has kept between 1.13 and 1.17, for the U.S.A and U.K, economy has increased by less than 2 times, since cement production has increased steadily, the coefficient of elasticity has been below 1, between 0.78 and 0.84. According to the state " Tenth Five-year Plan" and " Perspective Program to 2010", referring to the relevant forecasted figures provided by the Academy of Social Sciences, that the growth rate of national economy between 2001 and 2010 is 7.5%, and that between 2010

and 2020 is 5%, in a period between 2001 and 2010, a target of quadrupled GDP in 2000 should be achieved. This period attributes to a balanced increase stage. It will be proper to take 1.05 as a coefficient of elasticity before 2009, when the saturation point will occur. So, the demand for cement in 2009 will be: o.58× (1+1.05× 7.5%)^9=1.147bil.t, and for 2010-2020, take 0.7 as the coefficient of elasticity, we have the cement demand in 2010 : 1.147×(1+0.7×7.5%)=1.207bil.t, the cement demand in 2020 : 1.207×(1+0.7×7.5%)=1.702bil.t.

To sum up, the "coefficient of elasticity" method can hardly forecast the reality after 2010. Judging the recent condition, that the annual cement demand around 2000 was 0.53to 0.57 bil.t, of which 0.13 bil.t were rotary kilns' cement, and the per capita cement consumption was 420 kg. China will reach the saturation point of cement consumption around 2010. The per capita cement consumption will near 700 kg, and the total cement output will approach or exceed 1 bil. t in case out of control. Afterwards the cement output will go down by a big margin, the figure of which will be similar to that estimated by method of "synchronous development of economy".

According to achieved above results, we come to the conclusion:

Judging the results obtained by various forecasting methods, the demands for cement will be very high, especially before 2010, when the saturation point will occur, it will be as high as more than 0.8 bil.t in every year. The demand in 2005 will be 0.7 bil.t, and it will be over 1.2 bil.t in 2010. Formally, it is consistent with the general economic development requirement, that is, as GDP will double from 2000 to 2010, the demand for cement also will double. Nevertheless, according the principle of sustainable development, the total output should be controlled, the structure should be restructured and the quality of cement should be improved, and it will be ideal to control the cement output to around 0.6 bil. t. But it has exceed 0.7 bil. t at present.

1-4.4.2 Analysis and forecast of China's cement output

1-4.4.2.1 Total output hard to control

From the current situation, we can see that though the industrial policy of "Controlling Total Output and Adjusting Structure" has been put forward by Chinese cement industry, the ideal target of total output controlled within 600 million tons is hard to be realized in a short term. Breaking through 700 ~ 800 million tons of cement output is an inevitable matter.

Starting from the year 2000, the State has mainly taken two measures in carrying out the policy of "Controlling Total Output and Adjusting Structure". One is by means of executive directive to close 3940 mini cement plants; the other is to re-encourage the construction of new large-scale cement production lines with the NSP kilns. In 2001, there are more than 40 cement production lines with NSP kilns putting into operation one after another. There are still 50 plus production lines with the capacity of 2000 tpd or more in the process of construction.

1-4.4.2.2 Output of Shaft Kiln higher than that of Rotary Kiln

Though the efforts have been made, the cement output from shaft kilns is still increased by 15.8 % according to the actual statistical data in 2002. It is higher than the growth from rotary kilns (10.5%).

Though great effort has been taken, the net increase of output of rotary kiln cement amounted to about 36 million tons in the total net increase cement of 103 million tons, that of shaft kiln cement was about 67 mil. t. Though the increasing speed of rotary kiln cement exceed that of shaft kiln cement, the increasing volume of rotary kiln is less than that of shaft kiln. When the output of rotary kiln cement was increased by 10.53% over the same period of last year, the output of shaft kiln cement was raised by 15%, which was high than that of the rotary kiln cement.

Since 2003, though the development of NSP/SP kiln production lines is faster, and their increasing speed has exceeds the average increasing speed of cement sector, the quick growth of them can't meet the market demand on cement. During Jan. to May 2003, the total cement output was 290 million tons, the net increase output of cement was 35.744 million tons, of which, that of NSP/SP production lines was 7.113 million tons, accounting for only 19.9%, the net increase which was still lower than that of other processes. At the same time, the increase speed of cement output of large- and medium-sized enterprises was lower by 1.6 % than the average increase speed. The increase rate of cement output of small-sized enterprises rose from 8.8% in 2000 to 16% in the first months of 2003.

1-4.4.2.3 Quantity growth is not at the top yet

Just showed in Table 1 and Fig.1, since the founding of P. R. China in 1949, the cement output has been increasing all the way. The main reason of this came from the pulling of rapid growth of

population and economy. At present, use two pulling factors haven't shown any signs to be stopped or slowed down.

China is still one of developing countries with the largest population. The annual per capita GDP is only around US$1000, ranking behind 128 in the world. And the growth of population has not yet reached the top, and it's expected that the population will top to 1.6 billion until 2040. This kind of situation urges Chinese government to develop economy at high speed to meet various material and cultural needs because of the growth of population in the future 20 years. The striving target put forward by CPC at its 16th national congress was: GDP will be increased by another 3 times in the next 20 years. According to this requirement, the central government must maintain an economic growth rate of 7.2% per year at least from now on. So, the cement industry owing to its correlation to the growth of population and economy must be pulled forward strongly in the future.

In the past over 50 years, the relationship between cement industry and economic growth in China is shown in Fig. 9.

Based on our study, the growth of cement output has a good correlation with the economic growth when the accumulated consumption of cement is below 10 to 12 tons per capita. At present, the cement accumulated consumption for per capita in China is quite small, which is only about 6 tons, and it has more than a half a room to fill up. The linear relationship between the economic and cement industry growths in China, therefore, will remain, and will strongly influence the development of cement industry in the next 20 years, especially the first 10 years.

After 10 to 20 years, Chinese cement industry will finish its restructuring target in general, which can be seen in Fig. 13. Owing to measures taken in technology progress, quality improvement, productivity enhancement and the strategy of sustainable development, the growth of Chinese cement industry will transit from quantity-oriented type to the profit and quality-improving one.

Currently, the government and the industry are all intending to make efforts to control the total output of cement production, but it is a very hard work. It is determined by the condition of China and it is needed to be changed by developing economy at a full speed.

1-4.4.2.4 Natural Development of output

According to our forecast, if not to control and let the Chinese cement industry go naturally, it will develop as the Fig. 11 indicated. Here the economic growth rate is 7.2%. This is not a result that people hope to see.

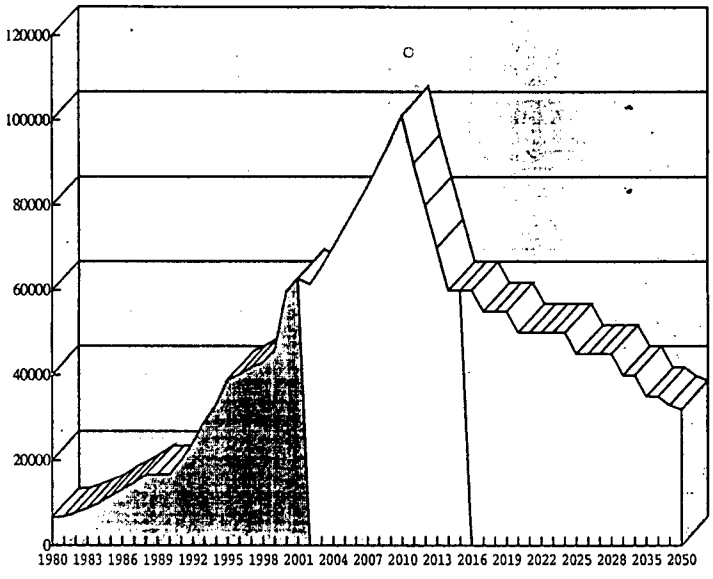

Fig.11 Forecast value of cement output for a natural development in China (Unit: 10 thousand t)

1-4.4.2.5 An Ideal Model or Target of Controlling Total Output

If taking coerced administrative order to continuously to close mini cement works and strengthen the construction of SP and NSP kilns, the ideal model or target should be like that as shown in Fig. 10 or leaned to the upshot as Fig.11 indicates. But it is not practical in fact. The first reason is that we have adopted the market economy, taking the market force as a dominating tool for the restructuring of cement industry. The second cause comes from the need of social stability. At present, the total cement output in China has breached this ideal model or design unfortunately.

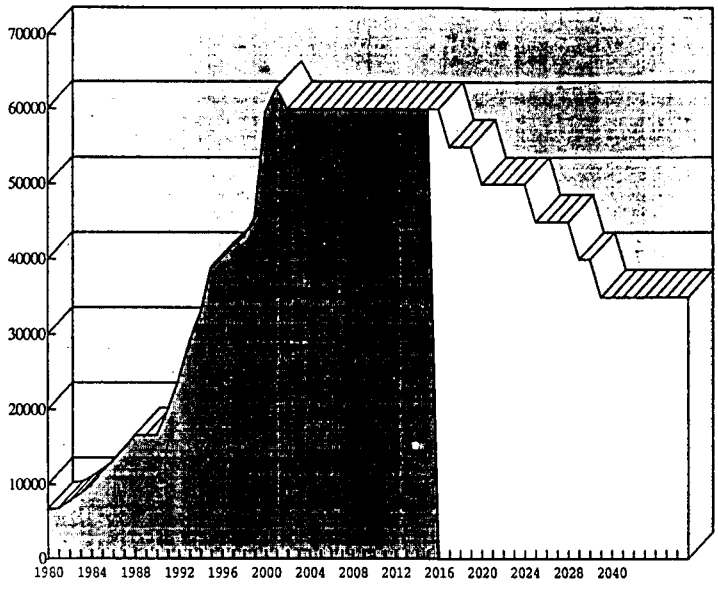

Fig.12 China's cement output controlling line (Ideal Model of Strategy Selection) (In 10 thousand t, Year)

1-4.4.2.6 The final developing trend

Natural development and ideal model are all not the final upshot, and the most possible result would be a mixture of the former and the latter. If the government and industry make the efforts better, it would be leaned to the ideal model, and the total output could be controlled under 700 million tons or 800 million tons. If it is failed, half or completely lost controlling, a trend as Fig. 11 indicated would be seen.

We believe the final result will be a combined situation of the first case and the second (as indicated in Fig.13), and we hope it would take the ideal model as Fig.11 indicated though.

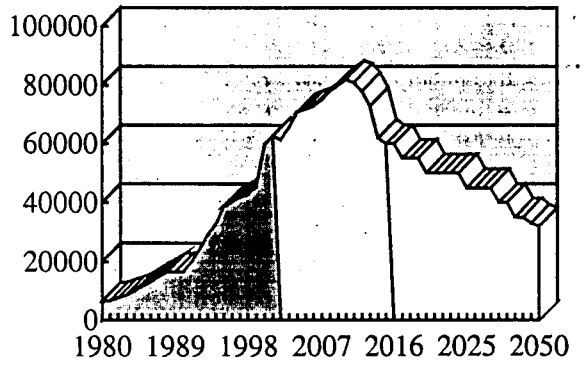

Fig.13 the possible actual result of cement output in next years (In 10 thousand t, Year)

Part two: Main Industrial Policies, Regulations and administrative Measures on Cement Industry, and Comments on their influence on the Cement Industry

2-1 Main Industrial Policies, Regulations and Administrative Measures on Cement Industry

With the rapid development of Chinese economy, the State has issued a series of laws and regulations, formulated related industry policies and administrative regulations, which have played an active promoting role in readjustment structure of the cement industry, technological progress, improvement product quality, environmental protection and application and development of energy-saving technology. The table 37 demonstrates the main laws, regulations and industrial policies and administrative measures related to cement industry in China in recent years.

Tab. 37 The influences of main industrial policies, regulations and administrative measures related to cement industry in China on the technological progress, cement quality upgrading, energy-savings, environmental protection of enterprises.

Title of the main industrial policies, regulations and administrative measures on cement industry	Effect on Technology			Effect on Environmental protection and energy-savings			Effect on Promoting the development of the sector		
	S	M	W	S	M	W	S	M	W
"Circular of the State Council on issuing of 'trial regulation on production licence for industrial products"(Guofa [[1984]No.54)	√			√			√		
Circular of the State Economic and Trade Commission, State Bureau for Environmental Protection and Ministry of Machine Building Industry issuing of first batch of eliminated technologies and equipment, severely polluting environment (atmosphere) (Guojing maozi [1997]No. 367)		√		√			√		
Circular of department of industrial management under the State Administration for Building materials Industry and Construction Management Department under the Ministry of Construction on issuing of catalogues of backward cement production technology and equipment and backward flat glass production technology and equipment and list of enterprises which are to be eliminated. (First batch) (Jiancai Hengguangzi [1998]No. 060	√			√			√		

Circular of the State Administration for Building Materials Industry and State Bureau Quality and Technical Supervision on issuing of withdrawing production licences from cement enterprises of ordinary shaft kiln, mechanical shaft kiln with kiln diameters less than 2 m (First batch)(Jiancai shengcanfa[1998]No.256)	√			√			√		
Circular of the State Economic and Trade Commission on publishing and distributing "some suggestions on 'Total output control and structure readjustment for building materials industry" (Guojing mao canye[1998]No.572)	√			√			√		
Circular of the State Planning Commission and State Administration for Building Materials Industry on issuing" Temporary regulation on being good at curbing illegistimate behaviour of small cement, dumping plate glass at a very low price" (Jijiaguan[1998]No.094)	√			√			√		
Circular of General Office of the State Council for transmitting suggestions of State Economic and Trade Commission concerning clean-up and consolidation of small glass and small cement factories" (Guobanfa[1999]No.49)	√			√			√		
Emergent Notice of the State Administration for Building Materials Industry on curbing of blind repeated construction in part of localities (JiancaiGuihuafa[1999]No.35)	√			√			√		
Circular of the State Administration for Building Materials Industry on issuing of "Supplementary regulation on new construction (expansion), reconstruction of cement grinding plants" (Jiancaiguihuabianzi [1999]No.98)	√			√			√		
Circular of the State Administration for Building Materials Industry on issuing "Notice for the Implementation of the Policy of 'The total output control and structure readjustment of Building Materials Industry (JiancaiGuihuafa[1999]No.105)	√			√			√		
Notice of China Industry and Commence Bank on transmitting "Circular of General Office of the State Council for transmitting suggestions of State Economic and Trade Commission concerning clean-up and consolidation of small glass and small cement factories" (Gongyifa[1999]No.147)	√			√			√		
Circular of the State Bureau of Environment Protection on doing well relevant works for closing or ceasing small thermal power generating units, clean-up and consolidation of small glass and small cement factories and small refineries, etc. (Huanfa[1999]No.151)	√			√			√		

Circular of Ministry of Construction, State Economic and Trade Commission, State Bureau of Quality and Technical Supervision, State Administration for Building Materials Industry on elimination of backward products in residential construction (Jianzhufang[1999]No.295)	√			√			√		
Circular of State Administration of Building Materials Industry on issuing control targets of cement outputs for different provinces (autonomous regions) and municipalities (JiancaiGuiHuafa[1999]No.181)	√			√			√		
Circular of State Administration of Building Materials Industry on issuing of "Regulation on new construction (expansion), reconstruction of cement grinding plants"(JiancaiGuihua[1999]No.218)	√			√			√		
Circular of State Administration of Building Materials Industry , State Bureau of Environment Protection on doing well relevant environment protection management works in clean-up and consolidation of small glass and small cement factories (JiancaiHangguanfa[1999]No.275)	√			√			√		
Circular of Ministry of Construction and State Administration for Building Materials Industry on ban on purchase and use of products of small cement and small glass factories issued to be eliminated (Jianjian[1999]No.290)	√			√			√		
Order No.6 of State Economic and Trade Commission "Catalogue of backward production capacities technologies and products subjected to be eliminated (First batch)"	√			√			√		
Order No.14 of State Economic and Trade Commission Catalogue (First batch) of repeated constructions subjected to be curbed in industry and commerce investment field.	√			√			√		
Order No.14 of State Economic and Trade Commission Catalogue (Second batch) of backward production capacities, technologies and products subjected to be eliminated"	√			√			√		
Circular of State Administration for Building Materials Industry and Ministry of Construction on issuing of catalogue (first batch) of building materials products which are recommended (JiancaiHangguanfa[1999]No.330	√			√			√		
Circular of State Administration for Building Materials Industry on issuing "Scheme for implementation of technology innovation design optimization, domestication of equipment manufacture and low investment cost for new dry process cement production lines"(Jiancai guihuafa[1999]No.346)	√			√			√		

Circular of State Administration for Building Materials Industry and State Administration for Industry and Commerce on cancel, and withdraw of business licenses of small cement and small glass factories enlisted in list of enterprises subjected to be banned or closed (Jiancai guihuafa[1999]No.24)	√			√			√		
Circular of State Administration for Building Materials Industry and State Bureau of Quality and Technical Supervision on withdrawing of production licence from small cement factories, enlisted in list of enterprises to be closed (Jiancai guihuafa[1999]No.43)	√			√			√		
Circular of State Administration for Building Materials Industry on issuing "Directory suggestions on readjustment of industrial structure of building materials industry in "Tenth Five-year Plan" period (Jiancai Guihuafa[2000]No.138)	√			√			√		
Circular of State Economic and Trade Commission on issuing examination and acceptance procedures for clean-up and consolidation of small glass and small cement factories" (GuoJingmaoJiancai[2000]No.155)	√			√			√		
Circular of State Administration for Building Materials Industry and State Administration of Machine-building Industry on issuing name list of cement production equipment subjected to be banned for production. (Jiancai Guihuafa[2000]No.186)	√			√			√		
Circular of State Administration for Building Materials Industry on issuing of "some suggestions on technological transformation of mechanical shaft kiln cement enterprises" (Jiancai Guihuafa[2000]No.212)	√			√				√	
Clean production promoting law of the People's Republic of China	√			√			√		
The financial policies of the Government for enlarging domestic demands.	√				√		√		
"Regulation on quality control for cement enterprises"	√				√		√		
"Basic conditions for test laboratories in cement enterprises"	√						√		
"The comparison testing inspecting and control methods for product quality in cement enterprises	√			√			√		
Suggestions on implementation of renovation and up-grade of traditional industries by using new and high technologies and advanced applicable technologies.		√			√			√	

Note: S—strong; M—Medium; W—weak

(1) "Circular of the State Council concerning issuing 'trial regulation of licence for production of industrial products'"(Guofa [1984] No. 54). The relevant stipulation of the circular states, that all

the cement producing enterprises without production licence should be banned without exception. The circular requires that all enterprises employing indigenous kilns, ordinary shaft kilns and mechanical kilns with diameters less than 2.2 m, violating relevant stipulations in "Circular concerning issuing of the first batch of list of eliminated technologies and equipment, which heavily pollute environment" (Guoyimaozi [1997]No. 367) should be banned with exception.

(2) Circular General Office of the State Council for transmitting suggestions of State Economic and Trade Commission concerning clean-up and consolidation of small glass and small cement factories" (Guobanfa [1999]No.49) states, that according to "Environmental Protection law of the People's Republic of China", "Atmosphere Pollution Prevention Law of the People's Republic of China", "Catalogue of Backward Production Capacities, Technologies and Products Subjected to be Eliminated (First batch)" (Order of the state Economic and Trade Commission in June, 1999), closing down or elimination should be undertaken to the ordinary cement shaft kilns production lines and mechanical shaft kilns with kiln diameter smaller than 2.2 m (2.2m included). This policy promote to the greatest extent the steps of readjustment of structure of Chinese cement industry. "Catalogue of Backward Production Capacities, Technologies and Products Subjected to be Eliminated (second batch)" (Order of the State Economic and Trade Commission in October, 1999) enrolled dry hollow kilns with kiln diameters of 2.5 m and less and cement milling equipment with diameters less than 1.83 m in a list of backward production equipment subjected to be eliminated.

(3) The government's financial policy on enlargement of domestic demands: Since 1993, the total cement output has been overproduced and the contradictions of cement products structure are serious. The cement products of NSP/SP kiln process occupied too little proportion, while those from backward shaft kilns held 85%. With issuing of a series of policies for readjustment of industrial structure by the state, by the end of 2001, more than 3000 shaft or other backward kilns, equivalent to about 100 mil. t of cement production capacities, have been eliminated. In 2001, for the first time the increase rate of cement output of NSP/SP kiln surpassed that of shaft kilns. Nevertheless, afterwards, as government has implemented in successive 2 years energetic financial policies on enlarging domestic demands, the total investment on fixed assets has been steadily and rapidly increased. This clearly drew up the cement industry, especially during a period from January to October 2002, the development speed of cement output reached 13%. In the same time the net growth of cement was over 50 mil. t over the same period of the last year..

With the expansion of demands of cement, those superseded backward enterprises rebounded. Some small—sized shaft kilns started to operate again. Several newly established shaft production lines and enterprises reappeared in many locations. Not only the increase of outputs of these small-sized enterprises has surpassed those of large-sized enterprises, but also the number of these small-sized enterprises has increased by 3.1% comparing with the same period of the last year. The main reason was that when NSP/SP kiln process enterprises raised the net production capacity by 30 mil. t, the market demands on cement have expanded by 50 mil. t. Therefore, we may conclude that the State policy has strongly influenced the cement market. Due to the enlarging of domestic demands, the rebounded shaft kilns severely polluted the environment, wasted the resources and energy. On the other hand, enlarging domestic demands has done greatly to the development NSP/SP kiln process.

(4) "Our opinions for upgrading traditional industry by applying new and high technologies and advanced applicable technologies" (Guojingmou Technology [2002] 247) This document requires that by the end of "Tenth five year plan", a batch of world famous large-sized group enterprises with stronger creative capability and essential competitiveness should be cultivated, meanwhile, upgrade of mass of medium- and small-sized enterprises should be intensified, raising the concentration and professional standard of the industry by a big margin, undertaking research and development of a batch of techniques and technologies with autonomous intellectual property, developing a series of key complete sets of technological equipment and leading products to provide technical back-ups for transformation and upgrading of traditional industrial sectors, so as to make the technological equipment, major techno-economical indexes of key back bone enterprises in traditional industrial sectors of our country approach to or reach international advanced standard of middle-stage of 1990's, those of part of industrial sectors reach or approach international advanced standard, to explore a new way and successful experience of transformation and upgrading traditional industrial sectors by using new and high technologies and advanced applicable techniques to promote the Chinese cement and concrete industry technology and technology of comprehensive utilization of resources for using industrial wastes and urban daily garbage and construction waste as raw materials, to study application and development of complete sets of equipment for production of cement clinker with daily capacities of 5000-8000t and NSP/SP kiln process, etc.

(5) The "Quality control regulations for cement enterprises", "The basic conditions of chemical laboratory of cement enterprises", "The comparison verification test control regulations on quality

of products of the cement enterprises" was revised by the relevant departments organized by the State Economic and Trade Commission correlative departments modified formally implemented on April 1st, 2003. Issue and implementation of these three regulations will play an important role in carrying out new cement standards and further enhancement of quality control in cement enterprises.

(6) <<Promoting law for clean Production of the People's Republic of China >> has been implemented starting form January 1st, 2003. The state encourages and promotes clean production. The State Council and local people's government at county level and above should bring clean production into national economy and social development plan, and programs for environmental protection, resource utilization and exploitation of industrial development zones. The law states: "Enterprises, pollutant discharge of which comes up to or exceeds discharge standard stipulated by the state and local authorities or exceeds local governments' controlled norms of total pollutant discharge volume, should be undergone clean production examination". The regulations provide lawful rewards and punishment basis for the cement industry in implementing clean production. In order to carry out the law, the State focuses on popularizing "Catalogue for Building Materials Industry clean Production Technical Orientation", to direct the building materials industry to employ advanced technology to improve the products quality, save recourses, reduce pollutant discharge and realize clean production. Since the law has just been implemented, the effects will be seen step by step.

2-2 Suggestions at policies on promoting of technical progress

2-2.1 Some industrial policies on emphatically supporting and encouraging rational distribution of development of new dry process kilns (NSP/SP kilns) in cement industry should be formulated and implemented by the State.

(1) To arrange continuously the development of new dry process (NSP/SP kiln) of cement production as one of state supported key projects. To energetically develop cement production by large- and medium-sized new dry process kilns through "national debt" and other special programs and financial support, putting emphasis on supporting the development of large groups, to raise the concentration of production of the industry. To support the development of western China, the technological transformation projects of old enterprises and development of large- and medium-sized new dry process kilns (NSP/SP kilns) by jointly collected funds of private capitals

to speed up the elimination of shaft kiln and other backward production technologies.

(2) To simplify the appraisal procedures to speed up the development of advanced technology of new dry –process kilns.

(3) To formulate taxed and charges policies on encouraging utilization of low-grade mineral resources and daily garbage and comprehensive utilization of industrial wastes for cement production so as to upgrade the capacity of rational utilization of resources and protect the ecological environment of the earth.

(4) To intensify the strength of environmental control and treatment

To control and normalize strictly operating cement enterprises in accordance with "Norm on pollutant discharge to atmosphere by cement" and "Norm on pollutant discharge to atmosphere by industrial furnaces and kilns", and intensify administrative law and regulation enforcement strength. Those enterprises, which have no sound environment protection facilities and discharge of which exceeds norm, should be subjected to be severely punished or compelled to cease production, to switch to other production, and treated by other ways. Furthermore, stricter environmental norms for cement industry should be formulated as soon as possible, which should be compatible with international norms. To energetically spread ISO 14000 Environment System Attention, to implement it as a necessary production prerequisite for the enterprises.

2-2.2 To enhance the seriousness of industrial policies

To modify and perfect industrial policies. To further clarify the cement technologies, techniques and products which are supported, restricted or eliminated by the State. To restrict firmly and strictly and new construction or expansion of cement projects with technologies other than NSP/Sp kiln process. To formulate as soon as possible policies and regulations on environment protection, land reclaimation, resources conservation and so on for limestone quarries.

With deepening the reform of investment system, the state will relax the examination of projects. The examine and appraisal system for construction projects will be converted into piling system. At the same time the government will enhance the implementation and control over the industrial policies to enhance the seriousness of industrial policies, and will impose necessary sanction to industrial policy violators with the help of certain taxes regulations to lead enterprises to develop soundly to meet the requirement of industrial policies.

2-2.3 To modify and perfect the production standards and application norms for cement production

As regards to modification and perfection of cement production standards, the members of material science department of Academy of Engineering have called several times the relevant departments of the government for attention, and put forward concrete projects. However, since cancellation of administrative department for building materials industry, it has been unclear who would be responsible for that. It is suggested that the State Development Commission consults with the Ministry of Construction to organize relevant departments to accomplish jointly this job.

2-2.4 To support and to tackle key problems to raise successively the rate of domestic production of large technological equipment

Targeting on manufacturing of production lines with a daily capacity of 10 thousand ton, to raise continuously the rate of domestic production. It is hopeful, that the government continuously support the cement industry in financial, material supply, policy formulation and implementation aspects to organize key problems tackling on the following topics to constantly facilitate technical progress of NSP/SP kiln process:

(1) Burning technology centering on energy-saving and environmental protection.
(2) Milling technology and equipment;
(3) High-efficient grate cooler technology and equipment;
(4) Filter film coating technology and materials in high-efficient dust collectors;
(5) High-grade refractory and chromeless high-grade refractory;
(6) Technology and equipment for information and automatic control;

2-2.5 Control of total output of cement clinker produced by NSP/SJP kiln process

According to general requirements on developing by the way of new industrialization put forward by the Sixteenth Congress of Communist Party of China, renovation of traditional industries with modern scientific and technological achievements must be enforced. Thanks to the possibility of making full use of industrial wastes in cement industry, it is possible to satisfy the market demands by adding different proportion of blending components into clinker to produce a variety of grades of cement under the condition of controlled total clinker production.

2-2.6 The government should enhance the guide to development of new dry process kiln

(1) In verifying of construction of a cement project, the government should strictly control and verify environment load capacity, mineral resources and land availability.

(2) To strengthen information service means to lead investors, especially investors to shaft kiln enterprises and investors from other industrial sectors, to attaching importance to investigation on market, transportation, energy and resource conditions of construction projects to perfect scientific decision, eliminate blindness in decision.

(3) In respect of shortage of professional talents in current situation of rapid development of new dry process kilns, to suggest relevant governmental departments, associations, educational institutes and enterprises jointly train technical and managerial personnel and strengthen training of technical workers.

(4) To study and formulate the outlet system and channel for backward small-sized cement enterprises.

2-2.7 Suggestion for modifying cement statistical manner

Due to adding of more and more blending components into cement and different proportions of added mixtures, the confusion is easy to happen. So, it is suggested to take production capacity for clinker as the basis of statistics.

2-2.8 To revise concrete construction standard as soon as possible

Cement is a important kind of materials in construction engineering. Application standard of construction directly influence the consuming variety and quality of cement. At present, many large-sized enterprises are able to produce high-grade cement, but the amount of high grade cement produced by them practically is not large. It occupies generally only about 20% and even less. The reason of it is mainly because of lack of demands. Recently, the grades of concrete used in most of constructions in our country are rather low. Most of them are C20 and C30 (in foreign countries most of them are C50 and C60). So, cement of lower grades can already meet the

requirement. It, in some extent, played a negative role in protecting low-grade cement and restricting development of high-grade cement.

Existed studies have verified, that there are large differences between service life of constructions built with shaft kiln cement and rotary kiln cement of the same grade. Since there is no requirement on service life to construction in our country except for some important engineering, this offers objectively not a little space for existence to shaft kiln cement. Thus, a requirement of service life to the construction engineering should be put forward.

2-2.9 To formulate unified fair environment protection norms

At present the norms of environmental protection for cement enterprises in China are un-unified. Those for new dry process kilns are stricter, whereas lower for the old types of kilns. Under the present condition when the development of the cement industry is aimed at structure readjustment and the supply of cement is abundant, carrying out of revision of environmental protective norms as soon as possible, implementing unified environmental protective norms for whole cement industry and elimination of all cement enterprises, which are not up to the environmental protective norms, are recommended.

2-2.10 Every department in charge of micro-administration, finance, and taxation manage, supervises together for the rational development of cement industry

Recently in the individual regions the distribution of small-sized production lines is relatively concentrated. According to this situation, besides pre-alarming system set up by micro-controlling administrative departments and directive information issued through economic circulars, to control the development of the cement industry by adjustment of loan rate and taxation policies is suggested. For instance, to the enterprises which pay no attention on resources conservation, quarrying mineral resources without planning and wasting resources severely, to impose extra faxes for punishment. To the projects, the scale of which is economically irrational and which un-conform with the state encouraging industrial policies, to impose taxes for investment direction of fixed funds and to raise bank's loan rates so as to heighten their costs on investment and founds collection and circulation and reduce their capacity of competitiveness.

2-2.11 Continuously adhere to industrial policy of "Equivalent elimination"

The elimination of shaft kiln cement should be constantly undertaken. It concerns protection of resources and environment and is an important course concerning sustainable, healthy development of the cement industry in the future and creating sound environment for future existence, which problems to be paid high importance by governments at different levels and should be controlled and supported by administrative, environment protective, financial and other departments, so as to make the policy come to the practice.

Part 3 The leading cement equipment manufacturers at home and abroad and their technical survey

3-1 The leading cement equipment manufacturers abroad and main techniques

3-1.1 Polysius Company

Polysius AG is one of the world's leading engineering companies, providing equipment for the cement and minerals industries. Present in all regions of the world, Polysius supplies innovative, proven and customized plants and systems. Polysius constructs complete production lines, supplies systems for individual process sections and performs plant modernizations to achieve lower operating costs and to meet stricter environmental regulations.

The Polysius Group, headquartered in Beckum in Germany, with subsidiaries on all continents is a highly-capable partner providing top-class performance covering the whole spectrum from consultation, project elaboration, engineering and design, delivery, erection and commissioning including after sales service. Impressive strengths of the company are product development and professional project and contract administration management.

Polysius, founded as long ago as 1859, has designed and supplied more than 1,000 cement kilns and 2,500 grinding plants just between 1950 and today. Polysius offers leading products and is at the forefront of R&D in the cement sector. In pyroprocessing the DOPOL® high performance cyclone preheater and PREPOL® calciner as well as the POLRO® 2 support kiln and REPOL® reciprocating grate cooler have become the benchmark within the industry. POLYTRACK® is the latest wearless cooler generation made by Polysius, which is suited for new lines and cooler modernisations. Polysius rotary kilns are designed for production capacities up to 10000 tpd, with high specific throughput which results in smaller dimensions and reduced capital costs. Four different calcining systems can be chosen to satisfy the most different pyroprocessing requirements, including waste-fired and low-grade fuel systems with lowest emission.

The good relationship between China and Polysius goes back to the installation of a complete cement factory in the year 1908. Since then Polysius has successfully commissioned a number of plants. An example is the Daewoo (Shandong) Cement Company's factory, designed by Polysius for a cement output of 2.5 million tonnes per year. The state-of the art plant is in operation since June 1997 in Shandong province. The recent Polysius activities were:

- Anhui Conch Cement Comp. Ltd., selected Polysius in the year 2002 as their partner for the construction of China's first 10,000 tpd kiln line, in the province Anhui. Polysius's vast experience and highly-proven competence in the engineering and construction of large kiln lines worldwide were a crucial decision criterion for Conch.
- In March 2003, Anhui Conch Cement Comp. decided to build another 10,000 tpd kiln line and again contracted Polysius - just 9 months after the first order - to supply a second 10,000tpd clinker production plant designed to the highest emission-reducing environmental standards.

  For the new line, to be installed in Xuzhou City in the province of Jiangsu, Polysius is supplying a 2-string, 5-stage DOPOL® '90 pre-heater with PREPOL®-MSC calciner and a 6 m x 90 m rotary kiln.
- In 2001 Polysius received the first order for a roller mill for granulated blast furnace slag grinding from China – from the Angang Group Slag Development Company. This mill went into operation in summer 2002 at the Anshan Iron & Steel Group Complex in the province of Liaoning. The grinding plant has a rated capacity of 90 tph of ground blast furnace slag at a Blaine fineness of 4,000 cm^2/g
- Shanghai Baotian New Building Material Co. Ltd., decided in 2002 to increase the grinding capacity at their Shanghai plant by adding a Polysius grinding system. Thanks to excellent credentials in the field of granulated blast furnace slag grinding, Polysius was contracted to supply a roller mill for producing 80 tph of ground blast furnace slag with a Blaine fineness of 4,300 cm^2/g.
- In January 2003, Capital Steel Co. Ltd. contracted Polysius to supply a roller mill for producing 90 tph of ground blast furnace slag with a fineness of 4,200 Blaine.

Add: Graf-Galen-Straße 17 59269 Beckum/Deutschland

Tel: +49- (0) 25 25-99-0 Fax: +49- (0) 25 25-99-2100

http://www.polysius.com

E-mail:Polysius@tkt-pol.thyssenkrupp.com

3-1.2 HOMBOLOT-WEDAG AG (KHD, Germany)

Drawing on more than 140 years of experience in mechanical plant and process engineering, today's KHD Humboldt Wedag AG is one of the leading suppliers in the fields of cement technology, mineral processing technology and aluminum technology offering basic and detail engineering, plant and equipment for complete plants and plant sections including modernization and capacity increase measures, as well as automation and process control equipment. The scope of services includes furthermore feasibility studies, raw material testing, financing concepts, erection and commissioning, personnel training, pre-and after sales services. History of the company goes back to 1856 with the foundation of Maschinenfabrik HUMBOLDT merging 1930 with Motorenfabrik DEUTZ AG. In 1972 forces were joined with WEDAG AG, Bochum establishing KHD Humboldt Wedag AG. The company is a wholly owned subsidiary of FAHR Beteiligungen AG, Cologne.

KHD Humboldt Wedag is a reliable partner to the cement producing industry and the mineral processing industry by supplying most modern plant and equipment, by realising modernization and capacity increase of plants or plant sections and, of course, by providing a competent service as to spare parts and after sales service.

The engineering and service division of KHD Humboldt Wedag carries out the complete spectrum of inspection, reconditioning, maintenance and consulting for all machinery, plant and equipment.

KHD Humboldt Wedag has been delivering key technologies for 140 years, supplying cement and mineral plants with robust and durable machines. These create the basis for regular modernization measures using Humboldt's highly- developed technology.
KHD Humboldt Wedag plants and technology increase production, cut specific power consumption and reduce pollutant emissions.

Main products of KHD Humboldt Wedag are as follows:

Primary and Secondary Crushing:

- Jaw crushers (single and double toggle)
- Cone crushers: CALIBRATOR®
- Hammer crushers (single and double shaft) HES, HDS
- Hammer mills

- Impact crushers PEG, PEF, HARDOPACT®
- Double roll crushers
- Smooth roll crushers: ROLL MILL
- Coarse impact crushers
- HARDOPACT® fine impact crushers
- Impact hammer mills

Grinding Systems and Drivers

- Vibrating mills: PALLA®
- Ball mills
- Rod mills
- Tube mills
- Flash driers
- Rotary driers

Rotary kilns and kiln systems

- Preheater systems
- PYROCLON® calciners
- PYROCLON® LowNox calciners
- Bypass equipment
- Rotary kilns
- PYRORAPID® two-station kilns
- PYROSTEP® grate coolers
- Rotary coolers
- Satellite coolers

Firing systems

- PYRO-JET® rotary kiln burners for coal, gas and other fuels
- Calciner burners
- Pyrocontrol pulverized coal proportioning systems

Laboratory machines for crushing and grinding

Add: No.25A Jianwan Street, International Hotel, 100004,Beijing,China

Tel: 010-65004101 Fax: 010-65008623

http://www.humboldt-wedag.de E-mail:Humboldt@eastnet.com.cn

3-1.3 F.L. Smidth Comany

F.L.Smidth Group is a worldwide engineering company with an annual turnover of DKK 7,217 million in 2002. The organisation employs more than 4,400 competent staff. We supply cement and mineral plants, machinery, services, training programmes and spare parts. 99% of our turnover is generated internationally. F.L. Smidth is part of FLS Industries A/S.

Based on the F.L.Smidth Group's key values ?cooperation, competence and responsibility ?the Group companies aim to be their customers' preferred partner, offering them solutions and products that strengthen their competitiveness. The F.L.Smidth Group was established 120 years ago as a global supplier of cement making equipment.

This forms the basis of the Group's technological key competencies as well as its process control expertise and project management experience. Continued development of competencies is maintained by focused product development and continued employee training.

The F.L.Smidth Group will focus its efforts within the following business areas:

- Supply of services
- Machinery
- Equipment
- Complete production lines
- Plants

To the cement and mineral industries worldwide.

Add for the Beijing Representative Office:

5A Donghubieshu Dongzhimenwan Street, Chaoyang District, Beijing, China

Tel: (010) 64677070 Fax: (010) 64677071

http://www.flsmidth.com E-mail:info@flsmidth.com.cn

3-1.4 A B B Company

ABB is a leader in power and automation technologies that enable utility and industry customers

to improve performance while lowering environmental impact. The ABB Group of companies operates in around 100 countries and employs around 120,000 people.

ABB has streamlined its divisional structure to focus on two core businesses: Power Technologies and Automation Technologies. The Oil, Gas and Petrochemicals division is slated for divestment. ABB Power technologies serves electric, gas and water utilities as well as industrial and commercial customers, with a broad range of products, systems and services for power transmission, distribution and automation.

ABB Automation technologies blends a robust product and service portfolio with end-user expertise and global presence to deliver solutions for control, motion, protection, and plant integration across the full range of process and utility industries.

ABB has announced the introduction of the Industrial IT Extended Automation System 800xA. The new control system delivers the technology and solutions needed to achieve a sustainable competitive advantage by enabling customer's plant to perform smarter and better at a substantial cost savings.

ABB is a leading supplier of Industrial^{IT} solutions, electrical equipment and control systems to the cement manufacturing industry. The excellent results for cement industry clients can be ensured by enhancing ABB's reliable technology with expertise, local support that spans engineering, supply, construction and project management.

From a single critical component to a complete electrification project of automation, drives and power systems, for ABB for cement manufacturing, ABB is your single source of success.

ABB is a leading global supplier of Information Management and Process Optimization Solutions in cement and minerals industries with over 350 industry specific installations, over 1000 users and over 6 million hours on line process optimization experience.

For drives in cement & minerals, as a global leader ABB combines its extensive industry knowledge with its application experience to select the most economical drive solution for the particular, often unique, circumstances of clients to raise throughput, improve reliability, and boost energy efficiency throughout clients operations.

ABB manufactures motors and drive systems worldwide, from sub-kilowatt to the megawatt ratings of the gearless drives for the largest SAG and Ball mill applications.

Dive Packages are engineered to save energy, minimize wear and reduce noise, providing the expertise to specify the optimum package of controls, power electronics, motor and associated equipment to ensure the best match for the specific application.

ABB gearless mill drives minimize capital costs and maximize economies of scale for SAG and ball mill applications achieving unprecedented reliability and energy efficiency.

ABB's plantwide drives engineered services ensure compatibility, integration and reliable operation of kilns, mills, fans, pumps, and conveyor systems with an amazingly short ROI period.

ADDRESS:

ABB Ltd

Affolternstr. 44

P.O. Box 8131

CH-8050 Zurich

Switzerland

Tel: +41 (0)43 317 7111

Fax: +41 (0)43 317 4420

http//:www.abb.com/cement

3-1.5 Haver-Boecker Company

HAVER & BOECKER is a group of companies, which has specialized in innovative solutions for the cement industry and related applications. The company has been founded in 1887 in Westphalia, an industry region in Germany and now spans with two subdivisions around the world. The wire weaving division has five production facilities in Europe, the engineering division consists of four works in Europe and Americas as well as the subsidiaries IBAU HAMBURG, BEHN + BATES and W.S. TYLER.

The Haver Group has more than 1800 employees worldwide and achieves a turnover above £250m. The company has already supplied more than 1000 HAVER packing machines and loading lines for cement, lime, gypsum and mortar. More than 15000 NIAGARA vibrating screens

have been supplied for quarries, aggregate and gravel plants all over the world. IBAU HAMBURG has supplied more than 1000 central cone silos for cement raw material, cement and fly ash.

The HAVER RPTO-PACKER valve bag filling machine has been introduced first in 1960 and since then achieved unprecedented success. Bulk material is efficiently filled and weighed, using 3 to 16 filling spouts on one rotating machine. By combining the ROTO-PACKER with the HAVER RADIMAT automatic bag applicators, which are available as bundle or reel systems, fully automatic operations with filling rates of more than 4000 bags/h are possible. About 2800 HAVER TOTO-PACKERS are operational. As a technology company, HAVER & BOECKER has a leading position in international markets. The sales and design engineers always stay in close cooperation with its customers and equipment users to provide economical, reliable and up- to date solutions. Latest development in the packer sector is the compact packing machine, that simplifies installation and maintenance, thereby integrating drives, that assure minimal machine down time. For the more clean packing process the company has developed the ROTOSEAL ultrasonic filling tube design. More than 50 units have been supplied to the cement and mortar industries since 2000, when the system was introduced to the market.

The engineering works Muenster supplies in conjunction with W.S. Tyler in Canada individual solutions and turnkey plants in screening, cleaning and sorting. NIAGARA and TYCAN are synonymous with advanced and reliable screening machines. HAVER HYDROCLEAN is an economic solution with low water consumption and low wear and tear for heavy soiled raw materials.

In close cooperation with our subsidiary IBAU HAMBURG, the plant engineering division supplies silo storage equipment of single or multi compartment silos with bulk loading facilities and mechanical mixing plants. Furthermore complete cement terminals with ship loaders/ unloaders complete the product programme. IBAU HAMBURG was established in 1975 as an engineering company. Because of its economy and reliability the IBAU CENTRAL CONE SILO had a major impact on the silo designs of modern cement terminals. The complete silo discharge equipment and machinery including mechanical mixers for the production of blended cements, dosing, weighing, packing and reloading equipment can be integrated under the silo cone. The IBAU PUMP for pneumatic transport, a large range of mobile and stationary shipunloaders, and reloading equipment such as the IBAU SIMPLEX loader are examples for other leading IBAU

cement technology.

Major products for the Cement Industry: Complete cement terminals; silo feeding, discharge and bulk loading equipment; manual and fully automatic bagging and loading plants; inline and ROTO-PACKERS; bag applicators; big bag filling stations; automatic dispatch systems; ship unloaders and ship loaders; ash transport and storage systems; NIAGARA vibrating screens; process automation systems.

HAVER & BOECKER and HAMBURG have impressive references around the world. In China they have already supplied some of the most modern cement production plants.

Add: P.O.Box 33 20D –59282 OELDE, Germany

Tel: +492522 –300 Fax: +492522 –30403

http://www.Haverboecker.com

E-mail: haver@haverboecker.com

3-1.6 Gebr. Pfeiffer Company

Gebr. Pfeiffer AG, based in Kaiserslautern , roughly an hour's drive south-west from Frankfurt/M., specialises in the planning, design and manufacture of equipment for the grinding of cement raw material, clinker, granulated blast furnace slag and coal for the cement industry and related industries. The basic product is the famous MPS mill, which is a vertical roller mill with 3 spherical grinding rollers, developed by Gebr. Pfeiffer. Moreover, Gebr. Pfeiffer AG manufactures special machines for the classification and drying of mineral bulk materials and for the preparation of lime and gypsum.

Established in 1864, the company presently employs 250 people with an annual turnover varying between 40-60 million. Besides modern workshop facilities and a foundry of its own, Gebr. Pfeiffer AG maintains a well-equipped pilot plant and laboratory. These facilities serve the R&D activities of Gebr. Pfeiffer AG, and they are the location for tests run with the clients' materials to provide the basis for tailoring the machines and plants to project-specific requirements. To enable these tests, the pilot plant station is equipped with semi-industrial scale versions of all the machines from the company's product range.

Major clients are to be found in the building materials industry as well as the chemical, refractory

and ceramics industry, the majority of Gebr. Pfeiffer's sales being exports. Here, China has evolved as a major market for MPS vertical roller mills over the past years.
Since sales activities started in China in 1983-84, 35 MPS mills, not counting licensed mills, have been ordered by Chinese companies for various applications. Among these figure:

- raw material grinding in cement works
- coal grinding in cement works
- grinding of limestone for flue gas desulfurization plants
- grinding of gypsum
- grinding of clinker in cement works
- grinding of granulated blast furnace slag from steel works

The order for granulated blast furnace slag grinding equipment recently placed with Gebr. Pfeiffer AG by a company based in Chongqing, Sichuan Province, is particularly noteworthy. The MPS 5600 BC mill ordered will be the largest of its kind in the world, boasting a grinding capacity of 170 t/h at a fineness of 4000 Blaine and an installed drive power of 5,300 kW.

Gebr. Pfeiffer AG has a long-standing co-operation with a company with branches in Hongkong and Nanjing, whose service is available to customers at all times. The contact address is:

Hennex Engineering Ltd, Hongkong
Mr Lim Fu Keng
55 Waterloo Rd., Kln, Hongkong
Tel: 00852-27235190
Fax: 00852-27235728

Hennex Engineering Ltd.,Nanjing
Mr James Fu
Rm.1308,Blk.05,Jin Bao Hua Yuan
333 Hong Wu Lu
Nanjing/Jiangsu
Tel: 0086-25-4571891
Fax: 0086-25-4571052
http://www.gpag.com E-mail:mailbox@gpag.com

3-1.7 Schenck Company

The company develops and produces high-tech solutions for weighing, feeding and automation in addition to vibrated conveying and screening.

Worldwide, Schenck Process offers turnkey systems with reliable components, combining process-engineering expertise and field-proven technology.

Schenck Process forms part of **Carl Schenck AG** world-renowned since 1880. In the year 2000, the Schenck group joined the **Dürr group**, a globally operating provider of technologies and services.

Schenck Process is organised into 5 business segments each focussed on specific industries. This ensures: concentration of consulting ability, improved customer support and faster procedures.

Quality and reliability are the cornerstone of Schenck's corporate philosophy. Schenck undertakes strict quality control prior to shipment, installation and commissioning and a proactive after-sales support program.

Heavy Industry business segment **(building material, mining, steel, cement)**
For the steel, cement and mining industries, Schenck Process offers a wide range of reliable systems and sound application expertise.

The company is one of the few providers worldwide accommodating all necessary resources under one roof: bulk solids technology, MechaTronic solutions, application software, and worldwide service. The company's corporate structure enables any challenge to be accomplished as normal practice. The Schenck systems not only determine weights, power and throughputs, but also control single aspects of the production process, process data and communicate with host systems and operators.

In the cement industry, continuously operating weighing and feeding systems efficiently feed pulverised coal into the kilns, and weighfeeders installed downstream of blast furnaces blend the individual ingredients true-to-formula.

Germany

SCHENCK PROCESS GmbH

Landwehrstraße 55

D-64293 Darmstadt

Tel.: (+49) 61 51/32-10 28

Fax: (+49) 61 51/32-11 72

e-Mail: sales.process@schenck.net

http//: www.schenck-process.de

China

Schenck Shanghai Machinery Corp. Ltd.

Process Division

No. 36, Lane 239

Nujiangbei Road, Putuo District

Shanghai 200333

Tel.: (+86) 21/62 65 96 63

Fax: (+86) 21/62 65 53 26

e-Mail: csdbj@public3.bta.net.cn

3-1.8 AUMUND Company

Since foundation of the company in 1922 AUMUND offers products of high technical standard and solutions for a variety of applications wherever conveying and storing of bulk materials is required.

Products of the AUMUND Group are installed in the cement, lime and gypsum industry, in power stations, iron and steel plants, foundries, waste incineration plants, quarries, the mining industry, chemical industry and bulk terminals on all five continents. Throughout more than 80 years of industrial construction, AUMUND has been a trendsetter in conveying technology as a result of research and development and customer driven improvements.

The AUMUND Group with its product companies, AUMUND Foerdertechnik, SCHADE Lagertechnik, LOUISE Foerdertechnik, B&W Mechanical Handling, offers equipment for all applications in the cement industry from raw material reception to dispatch of the finished product: Ship unloading hoppers; Primary and secondary crusher feeding; Raw material handling in the

quarry; Raw material reception and transfer; Stacking, Storing, Blending of raw material and solid fuels; Mill feeding; Raw meal transport; Feeding of pre-blending silos; Feeding of pre-heaters; Coal mill feeding; Reception and transfer of secondary fuels; Clinker transport and storage; Automatic clinker discharge; Filter or ESP dust reclaim and handling; Mill hopper feeding; Cement mill feeding; Cement handling in the packing plant; Truck loading; Ship loading.

The structure of the AUMUND Group with its worldwide organisation, global sales and service network provides the flexibility and technical competence to serve customers worldwide.

Experienced engineers in the head offices and subsidiaries located in Germany, China, Brazil, the USA, India, France, Great Britain, Poland, Italy and Switzerland guarantee performance and quality constantly maintained on a high level.

A further asset of the AUMUND Group is the global service network providing specialist assistance with regular plant visits, qualified hands-on service, spare parts and regular seminars keeping the plants' operating staff updated with all maintenance issues.

All inspection services on site targeting preventive maintenance are organized and carried out by experienced service engineers of the Group's Partner, PREMAS AG, the service pool for all equipment of the AUMUND Group.
Detailis of the AUMUND office in Beijing:

AUMUND (China) Representative Office
Room 909, East Ocean Center, No. 24A
Jian Guo Men Wai Street
Chao Yang District
Beijing 100004
Tel.: +86-10-6515 5813 / 14
Fax: +86-10-6515 5815
E-mail: aumund@public.bta.net.cn

3-1.9 Loseche GmbH

Loesche GmbH founded in 1906 in Berlin, Germany, certified acc. to DIN EN ISO 9001, designs and supplies vertical roller mills and related high efficiency equipment to the worldwide cement, power and iron and steel industries. With almost 100 years of experience Loesche GmbH is a

leader in the advanced process and plant design in the grinding technology sector.

The company's services and products include:

- Engineering for single machines, complete grinding plants and turnkey grinding and cement production plants. Feasibility studies, technical assistance, training.
- Cement raw material grinding plants with 2, 3 and 4 grinding roller mills for a capacity up to 840 tph of cement raw meal and drive motors up to 5,400 kW.

  Grinding plants for cement clinker and blast furnace slag up to 270 tph, each, with fineness between 2,800 and 6,000 cm^2/g.
- Dry grinding plants for coal with 2, 3 and 4 grinding roller mills for a capacity up to 240 tph.

Additionally hot gas producers with an outlet temperature of up to 1,000°C, high efficiency classifiers, mill feeders, dryers and cyclones are supplied.

The Loesche 2+2 mill is a high efficient vertical roller mill for finish grinding of cement clinker and blast furnace slag. Regarding to conventional grinding plants with tube mill, 30 % savings in energy requirements or better are possible.

In 1996 Loesche developed the world´s largest mill type LM 63.4 for a customer in Thailand. The time for development and delivery was only 12 months due to the proven modular design concept of the Loesche mills. The low noise and low vibration level of Loesche mills contributes to a simple plant layout. It makes an outdoor installation possible and increases the plant availability. Civil construction costs are minimized by space saving design.

In China Loesche has a long tradition and more than 50 vertical roller mills have been supplied since 1985 to various clients in the cement, iron and steel and mineral industries. Within the first half of the current year, Loesche signed five contracts with various Chinese customers for the supply of three grinding plants for granulated blast furnace slag and two plants for cement raw material.

For Anning (Yunnan Huayun Industrial Corp.) and Maanshan (Anhui Masteel K. Wah New Building Material Co. Ltd.), Loesche will supply two LM 46.2+2 S, each with a capacity of 90 t/h. A Loesche mill type LM 56.2+2 with 4.300 kW drive capacity will be supplied to Neijiang, Sichuan (Chong Long Co. Ltd. of Sichuan). This plant will have a capacity of 140 t/h at 4.500

Blaine. For this fast track project, Loesche guarantees a delivery time of only six months on FOB-basis.

An LM 56.4 for raw material grinding will be supplied to Luzhu (Zhejiang Jianfeng Dencheng Cement Co. Ltd.). The mill has a capacity of 380 t/h raw meal at a fineness of 15 % R 80 µm. This mill is one of the biggest cement raw material mills installed in China and emphasizes Loesche's leadership in the design and manufacture of the biggest vertical roller mills in the world.

Furthermore Loesche GmbH has been awarded a repeat order for a raw material grinding plant with Jiangxi Wannianquin Cement Co. Ltd. The contract comprises the supply of a Loesche mill type LM 41.4 with a high efficiency classifier type LJKS for a grinding capacity of 186 t/h at a fineness of 12 % R DIN 90 µm.

Add：杜赛尔多夫 Loseche Co., Ltd., German

Tel：0049 211 5353-0　　Fax：0049 211 5353-500

http://www.loesche.com

3-1.10 RHI Company

RHI is a globally operating industrial group with nearly 100 production sites and service offices on six continents. The group's headquarters is based in Vienna, Austria.

RHI employs 7,500 people worldwide; consolidated sales revenues amount to 1.3 billion.
With the Heraklith brand, RHI's Insulating division, is a leading supplier in the European construction sector who focuses its high-quality service range on the requirements of heat insulation, noise insulation and fire protection. Stone wool and wood-wool building boards are the most important products for the markets in Central and Eastern Europe.

With a market share of more than 10%, RHI Refractories is the world market leader. The products of RHI Refractories meet all essential internationally recognized quality standards worldwide. With its 5,800 employees and 26 production facilities in four continents this division generates annual sales revenues exceeding 1,1 billion and produces 1.2 million tons of refractory materials. RHI Refractories offers its customers a wide range of shaped and unshaped refractory products as well as functional products.

The RHI Refractories brand comprises a large number of successful brands established in the market, including Veitscher, Didier, Radex, Refel, Dolomite Franchi, Interstop, which combine tradition from the 19th century with innovative technology and highest quality standards. Today, group-wide R&D activities are concentrated at the Technology Center Leoben, where a total of 150 refractories specialists works to support customers and the sales and marketing departments.

RHI's Cement and Lime Department is a global supplier of specialised refractories and auxiliary materials for the cement and lime industry. The range of products comprises all kinds of basic magnesite bricks, such as magnesia spinel, magnesia chrome and magnesia hercynite / galaxite bricks. Furthermore a wide range of alumina bricks and castables are available for virtually any kind of process and kiln type.

A network of sales offices and service staff guarantees worldwide presence on short term notice whenever required.

Add: Room 2739-2741 Zhonghuan Plaza No. 381 Huanhaizhong Road, Shanghai, China

Tel: 021-6391 5675 Fax: 021-6391 5270

http://www.rhi-gh.com E-mail: Kelly.wang@rhi-ag.com.cn

3-1.11 **Siemens Company**

Siemens Automation and Control area is the world's largest supplier of products, systems, solutions and services for industrial automation and building technology. Using the latest information technology, Siemens Automation and Control Groups cooperate closely to exploit development synergies in the four main fields of automation- manufacturing, process, building and logistics.

Our innovative products, systems and solutions help to build customer value in the industry sector. Siemens creates transparent and intelligent production facilities that enable customers to manufacture high-quality products more quickly, flexibly and economically.

- The Siemens cement line of business, which is part of the Automation and Control Group, has been focussing on this industry sector for more than 35 years. The engineers working in this field have an experience of more than 250 years. The range of services offered covers the complete life cycle of a cement plant. Siemens's experts assist by offering professional management at every stage of a project.

Siemens engineers and supplies complete electrical turnkey package to the cement industry as well as single packages like CEMAT process control, MCC package, MV distribution package or drive systems.

CEMAT is a control system specifically designed for cement plants and is well proven in this harsh environment over many years of service. There are now more than 400 installations world wide, and the number of CEMAT users grows weekly. The latest CEMAT System Version 6 is based on the mainstream process control system of Siemens known as Simatic PCS7. From Version 1.9 to the latest Version 6 there has always been great emphasis on compatibility in communication, operation and visualization as well as all the necessary interlocking, i.e. the basic automation.

This is how it is possible for even the newest CEMAT Version 6 to communicate with earlier CEMAT systems from a previous generation and also to control them, so that 'old' systems can be incorporated into the new Version 6 at no great cost. Siemens has even gone one step further: even quite old CEMAT Versions from the 80's can be converted and upgraded to the latest CEMAT version for very little investment and extremely short plant shut down.

There are many references where Siemens either has supplied and engineered the Cemat automation system or has supplied a electrical turn key package, like for the recent projects Calusco in Italy, for the Chekka project in Libanon, for the Garadagh Cement plant in Azerbaijan and for the Thi Vai Grinding Terminal in Vietnam.

Tel: 010-64731919 Fax: 010-64739213

http://www.ad.siemens.com.cn

3-1.12 Refratechnik Cement GmbH

Refratechnik started out in a partnership with a cement manufacturer in 1950 and has emerged as one of the world's leading suppliers of refractory lining systems for the cement, lime, and steel industry. The company originated from an association between Karl Albert and Norddeutsche Portland cement-fabriken - later Nord cement AG, now Alsen AG. Starting from a small craftsman's establishment in 1950, Refratechnik has now grown into a group of companies being active throughout the world.

Today, independent business divisions with production facilities in Germany, Spain, Italy, and Canada, set up as subsidiaries of the Refratechnik Holding GmbH, enable Refratechnik Cement GmbH to respond efficiently to today's market demands. The company with their headquarters in Goettingen / Germany is developing, designing and converting complete refractory concepts and constructions, thus meeting the requirements of individual customers - reliable and on time.

As part of the group, Refratechnik Cement GmbH operates three production facilities in Germany and Spain, representing the state of the art in the refractory industry. The company's trademarks such as REFRATHERM®, the energy-saving lightweight firebrick, KRONEX®, the high performance bauxite brick, PERILEX® one of the world's best selling low-chrome brick, ALMAG®, FERROMAG® and REFRAMAG®, the environmentally safe high performance magnesia spinel bricks - to mention only a few - mark the development and steady growths of the company. Refratechnik Cement GmbH has a market share of approximately 23% in basic bricks for sintering and transitions zones of cement rotary kilns. As comprehensive systems for lining and operating kilns the company offers the complete installation system REFRA-Rig – a modern efficient lining device for rotary kilns from 3.50 to 6.50 m -, the refractory management system REFRA-Control for optimizing the kiln operation and the electronic thickness meter REFRA-Test for all types of refractory bricks.

As one of the first European refractory producers the company expanded their activities to the Chinese cement industry already in 1985. Almost the full range of Refratechnik's refractory brick grades for rotary kilns were installed in cement works like Ningguo (today Conch Cement Co. Ltd.), Jidong Cement Co. Ltd. and Huaihai (today Jiangsu Julong Cement Group).

Today, 18 years after the first commitment to the Chinese market, Refratechnik Cement GmbH enters a joint venture with Jinlong Refractories in Dashiqiao to launch the production of high quality refractory brick grades for the cement industry. An additional office, established in Dalian, further improves the services to China and the Asia Pasific countries.

Add: 21 Floor Chaongjiang Plaza, No. 123Changjiang Road, Zhongshan District, Dalian, 116001, Liaoning, China :

Tel: 0411-2529803 Fax: 0411-2529670

http://www.refra.com E-mail: rtdalian@refra.com

3-1.13 TESTO Company

The Testo AG was founded in 1957 and has its headquarters in Lenzkirch, Germany. Now the firm has 1200 employees and develops, manufactures, calibrates and distributes portable electronic measuring instruments and probes for measuring temperature, air humidity, flue gas, rpm, pH, redox, conductivity, air velocity, light, sound etc.

About 12% of the turnover is invested in Research&Development, which is clearly above average. Testo owns a full scale laboratory for temperature, humidity, dew point temperature and velocity measurements. The company offers calibration certificates for all physical, chemical and electrical parameters, independent of the equipment manufacturer. Calibrations are carried out in the Testo calibration laboratory and at site. The precision measuring instruments are delivered to all 5 continents via 24 subsidiaries and 50 sales representatives in a number of countries.

For the cement and lime industries Testo is offering a unique portable flue gas analyser, which on the one hand can withstand extreme flue gas conditions such as a high particle load of up to 20 g/m^3, and on the other hand allows accurate measurements. The Testo 360 flue gas analyser is of the same quality as the stationary analysers and is also so easy to use that it can be positioned at any point in the industrial gas. Testo instrument has very good workability and can work in very tough ambient conditions.

The analyser measures the following parameters: O_2, CO, NO_x, SO_2, CO_2, C_xH_y, flue gas moisture, flue gas flow and of course up to 5 temperatures simultaneously. The instrument is equipped as standard with a patented Peltier cooler which dehumidifies the sample gas reliably and with the lowest losses in absorption. A sample gas pump which extracts gas out of a flue gas duct at a negative pressure of 200 hPa/mbar is also integrated. A notebook computer belonging to the instrument is used for operation and to save the readings. The advantages are easy operation using the WINDOWS environment, large saving capacity and user-friendly processing of the measured data. The instrument cover remains closed and therefore also protects the notebook. The IP42 protection class which means that the instrument is not affected by rain and snow is thus attained. Temperatures of up to –25°C can also be compensated by the integrated instrument heater thus enabling long-term measurements to be carried out outdoors.

Electrochemical fuel cells for the parameters O_2, CO, SO_2 and NO/NO_2 are used separately as sensors to meet requirements by worldwide laws and approvals. A miniaturized NDIR sensor is

used for the direct measurement of CO_2. Flue gas moisture measurement is based on the differential oxygen method. The O_2 is measured wet before the cooler and dry after the cooler. The absolute moisture level is then shown in %. The O_2 wet measurement is carried out with a zinc of oxide sensor on account of the moisture and corrosive gases.

An additional feature of the instrument is the dilution system for measuring range expansion which also allows for extreme readings. Ambient air or pure N_2 can be used as the dilution gas. The dilution factors can be selected, e.g. factor 5 (=ratio 4:1) and dilution can be switched off completely to attain the best accuracy at low concentrations in the pure gas. Furthermore, there is an innovative multi-function probe available, which is particularly suitable for industrial gas measurements. This probe combines gas extraction and velocity measurement with the aid of an S bend Pitot tube.

3-1.14 WESER ENGINEERING Company

WESER ENGINEERING was established in 1988 by a group of professional engineers of the former, internationally well-reputed, PHB-Weserhütte. Meanwhile, WESER ENGINEERING is a hundred per cent subsidiary of the Spanish, state-owned company IZAR, which is one of the world leading companies in manufacturing navy and civilian ships, and turbines and is also being the ninth-biggest shipbuilding group in the world, presently represents an annual business volume of several billion US$.

In vertical organization, WESER ENGINEERING and IZAR belong to the Spanish Industrial Participation State Society (SEPI), established in 1914, which ranks among the 20 largest industrial groups in Europe employing around 200,000 people. All capital goods industries, integrated within SEPI, are represented by companies covering different special fields and characteristics, among which WESER ENGINEERING is thus in charge of supplying bulk materials handling plants and machines.

Within this constellation, WESER ENGINEERING, however, is a company located in Bad Oeynhausen, Germany, and registered under German Law with its own worldwide business activities. With the strong backing of IZAR as the mother company and based on solid financial backgrounds, it is the ultimate objective to establish WESER ENGINEERING as a leading company into the international business environment of bulk materials equipment supplies.

In the last 15 years, WESER ENGINEERING built a strong reputation for the design and supply of reliable heavy weight bulk materials handling equipment, such as stackers/reclaimers, bucket wheel reclaimers and drum reclaimers among others. Main activities have been in the cement, coal, ore and other minerals industries. In the cement industry recent orders include a stacker-reclaimer in a limestone blending bed as well as a stacker and two side reclaimers plus two belt conveyors for additives in a cement plant in the U.A.E.

The activities of WESER ENGINEERING include turnkey plants and single machinery in the field of:

- Stockyard and blending systems
- Special materials handling installations
- Coaling plants
- Transshipment installations
- Composing systems

WESER ENGINEERING has active references for the following major equipment:

- Bucket wheel stackers/reclaimers
- Scraper reclaimers
- Barrel reclaimers
- Bridge-type bucket wheel reclaimers
- Stackers
- Plow feeders
- Belt conveyor systems
- Ship loaders and ship unloaders
- Composing systems.

Our service also include technical layout, design, basic and detailed engineering, delivery, erection, commissioning and testing. Among others, the following sectors of industries have our special attention:

- Materials handling in cement, coal, lignite, fertilizer, ore, phosphate, gypsum and general mineral processing industries.
- Coal handling plants and coal stockyards for thermal power plants.

- Port handling plants incl. ship loaders and unloaders.
- Truck, train, barge and ship loading.

Since we gladly take care of all needs of our clients, inspections, reconstruction, refurbishment and modernization of existing machinery are part of our comprehensive service as well.

3-2. The leading cement equipment manufacturers in China and their techniques

3-2.1 CITIC Heavy Machinery Company Ltd (CITIC HMC,Original, Luoyang Mining Machinery Plant)

CITIC Heavy Machinery Company Ltd (CITIC HMC) is a group company and founded on the basis of the former Luoyang Mining Machinery Plant after it enters into China International Trust and Investment Corporation (CITIC).The company is located in Luoyang ,Henan, a city always called"Ancient Capitals of Nine Dynasties". And it is one of 156 important engineering of the "First Five-ear Plan" in China. It has become the largest heavy machinery manufacturing enterprise in China after expanding and reforming during these 40 years. The company possesses the property of 25 bil. yuan with the coverage of 2.16 mil. m^2 .It yields about 30,000t product a year and the output values at 0.8 bil. yuan. Currently 20,000-odd staff and workers are working for CITIC HMC, among whom some 2,500 are technologists and 400-odd senior engineers, 12 experts under authority of Henan provincial government and 9 experts under authority of central government. Luoyang Mining Machinery Engineering Academy, which is subordinate to CITIC HMC, is the state-class enterprise technical center and the designing academy A level. Both subordinate companies, CITIC Heavy Machinery Imp. & Exp. Company and CITIC Project Contracting Company are formed by skillful technical people of great strength. The company is one of the eight large heavy-duty machinery manufacturers in the trade. And it is also the casting, forging and heat-treating center in central southern area and a large processing base of heavy-load gear. CITIC HMC is the enterprise with the right for independent foreign trade appointed by the state. CITIC HMC has exported machines and casting and forging parts to dozens of countries and regions in the world, e.g. America, Australia, southeast Asia, western Europe etc. and imported technology and manufacturing equipment from USA, Japan, Germany, Sweden, Demark, France etc. CITIC HMC operates a tourist company with hotel, restaurant, limousines which are able to provide best services to the guests from home and abroad.

CITIC Heavy Machinery Company LTD. has a long-standing record in making the complete equipment for the cement and activated lime plant and the aluminum refineries. The whole set of equipment for 700-2000t/d cement plant can be provided. The company co-operates with the foreign partners to make the complete set of equipment for the cement plant of 4000t clinker.

Main Product: CITIC Heavy Machinery Company LTD. can supply large complete mechanical equipment for the basic industries, e.g mine, coal mining, metallurgical, chemical, cement, transportation, environment protection, water conservancy and power generation. Meanwhile the project engineering and equipment integration are also undertaken.The products and equipment are distributed worldwide to 17 countries and regions, in Asia, Africa,Europe, America, Australia etc. It covers many of the markets at home and abroad.

Add: No. 206 Jianshe Rd., Luoyang City, 471039, Henan, China

Tel: 0379-4086586 Fax: 0379 4222192

http://www.citichmc.com **E-mail:guojianwei3003@sohu.com**

3-2.2 Tangshan Cement Machine Works

Tangshan Cement Machinery Works, TCMW, is the leading manufacturer of cement machinery in People's Republic of China.

Its main products are rotary kilns, mechanized shaft kilns, various tube mills, gear boxes, roller presses, roller mills, coolers, dryer, separators, dish type nodulizers, mixers, washer mills, crushers. Various wear-resistance materials, such as high-Cr cast steel balls, medium alloy liners, super high- Mn hammers are also supplied by TCMW.

These products produced by TCMW, enjoying a high reputation both at home and abroad, have been exported to the USA, Japan, Germany, Indonesia, Philippine, Pakistan, Thailand, Vietnam, Singapore, S. Korea, Iraq, Namibia and many other countries and regions in the world.

E-mail: tcmwied@public.tsptt.he.cn

3-2.3 Shanghai Jianshe Luqiao Machinery Co., Limited.

The enterprise was founded in 1946. The joint state-private ownership began in 1956. In 1989, the assets was combined with the Road & Bridge Limited Company (Hong Kong) and Shanghai mechanical equipment limited company of road & bridge construction was founded.

In 1998, the company annexed the property of Shanghai Hujiang machinery plant in the lease form.

Shanghai mechanical equipment limited company of road & bridge construction:

Registered capital: 10 million US dollars

Classification of the enterprise: joint venture (capital from Hong Kong)

Shanghai Hujiang machinery plant:

Registered capital: 1124.6 thousand yuan

Classification of the enterprise: state enterprise

The developed , manufactured and sold products:

The main machine and the complete sets of equipment can be put to use in such aspects as mine, metallurgy, building materials, traffic, energy, city public utilities, environmental protection engineering and light textile industry etc.

Quality system recognition:

Passed the recognition of examine and verification center of Shanghai quality system in Feb. 1999.

Shanbao brand crusher

Evaluated as the state quality silver medal, top quality prize, the high quality product of the Ministry of Mechanical Industry and the high quality product of Shanghai before 1994, it has also been appraised the famous product of Shanghai and mechanical industry of China and the satisfactory product for the nationwide customers since 1994.

Hammer Crusher

The Single –Stage Hammer Crusher are suitable used to crushing ordinary fragile ores of the compressive strength no more than 200Mpa, such as limestone, gypsum, coal, marl, sand-shale etc. This series product features of high crushing ratio, even product graininess, simple construction, reliable operation, easily maintenance, economical running cost etc., so are widely used in cement industry.

PE-1 Series Impact Crusher

This crusher have features of greater reducing ratio, Created product with cubical shape, be

suitable for crushing material with edge length up to 100~500mm, compression strength up to 350 Mpa.

Production and management:

Actively studying and importing the domestic and foreign advanced standard and technology, the company has made strenuous efforts to develop new products . The company is also determined as the " double intensive enterprise" of technology and knowledge by the foreign trade committee and foreign capital committee of Shanghai. The amount of sale is up to 750 million yuan in 2000. Thus, the company has been occupied in the rank of 500 biggest foreign enterprises in China and 500 biggest sals of industry enterprises in Shanghai. Consequently, the company has been the production and export base of kibbler in China and has been appraised the "double excellent" trinity joint venture for its foreign exchange and profit earnings by China and Shanghai foreign tradesman investment enterprise association in successive 8 years.

Address: No.480 Banshongyuan Road, Shanghai

P.C.: 200011

Tel: 021 - 63139054

Fax: 021 - 63133936

http://jslq.chinasec.com

E-mail: webmaster@shanbao-china.com

3-2.4 Shengyang Cement Machinery Co., Ltd.

Shenyang Cement Machinery Co., Ltd is a large-sized limited company in China's building materials industry, based on Shenyang Cement Machinery Factory as a main body and specializing mainly in the design and manufacture of cement machinery, and is a comprehensive economic entity integrating the design and development of cement equipment, import and export of electro-mechanical equipment, equipment set complement, installation and commissioning of equipment and handling and transportation as a whole. It can supply cement enterprises at home and abroad advanced, excellent, high-efficient technological equipment set for 200t/d, 1000t/d, 2000t/d and 4000t/d cement clinker production lines. Shenyang Cement Machinery Factory has more than half a century development history and has a capacity of manufacturing the main equipment for new dry process cement production lines with a capacity of and under 4000t/d. It is a state-level A class enterprise.

Shenyang Cement Machinery Co., Ltd is a large-sized backbone enterprise in China's building materials industry, the products of which represent the most advanced technique in China's building materials industry, enjoying a good reputation at home and abroad. The enterprise was awarded one of the "key enterprises of Machine-building Industry for Building Materials" approved by the State Machinery Commission of China in 1987. It is approved as a "State-owned large-sized A Class Enterprise" by State Commission of Economy and Trade of China in 1993 and one of "The Ten Most Powerful Enterprises of Building Materials Machinery Industry in China" in 2000. The company is the leading enterprise of China's Cement machinery industry, having a most powerful cement machinery complement capacity.

The company is located in the High-and New-Tec Development Zone of Shenyang City, occupying an area of 0.23 mil. sq.m and having 200 pieces (sets) advanced heavy-duty, CNC processing equipment and is capable to provide equipment set complement, installation and commissioning for the 4000t/d cement clinker production lines.

The major products of the company are the complete set of cement machinery, and it has a capacity and qualification of designing, manufacturing, erecting and commissioning of the first and the second category of compressed containers. The company stands at a international leading position in new generation aerated beam-type grate cooler and the products of the type have already installed in hundreds of new dry process cement production lines at home and abroad replacing imported ones. The large-sized main machines, such as cement kilns, ball mills, crushers, etc, produced by the company have also high technical content and quality advantages. The products of the company not only equips the Chinese cement enterprises but also exported to Australia, Japan, USA, Brazil and the countries and regions in Southeast Asia, enjoying trust of broad circle of customers at home and abroad. The company has passed in the first group ISO9001 Quality System Attestation in building materials industry of China in 1997.

In the past years the company has trained a contingent of technical personnel with rich experience and has advanced cement machinery manufacturing technique and processing technology and has formed an independently creative design and development institution using modern information technology.

In the sixty years' development process, the company has achieved dozens of "the first" in the

domestic building materials industry.

It produced the first grate cooler in the country in 1965;

It introduced firstly the grate cooler technology of 1980's international advanced standard from Fuller Co. of USA;

It independently and initially designed, developed and manufactured the first in the country 3000t/d grade cooler in 1993 and exported it to Philippine;

It successfully manufactured the first in the country 4000t/d grate cooler in 1995;

It successfully produced the first in the country 2200t/d aerated beam-type grate cooler in 1998.

3-2.5 Chaoyang Heavy Machinery Co., Ltd. (CHM)

Chaoyang Heavy Machinery Co., Ltd. (former Chaoyang Heavy Machinery Factory) is one of 500 largest enterprises of machinery industry in China and a large-sized backbone enterprise of Chinese building materials machinery industry. It accupies the first place in equipment strength, product sales volume, foreign currency earning capability and economic benefits in the Chinese building materials industry. It is a certificated enterprise passed ISO9001 Quality System attestation and enjoys independent import and export right. It has been successively awarded the honored titles and prizes, such as National First-class Measurement Qualified Unit", "National Quality Control Prize", "National Energy-saving silver Prize", "The first Place among the 100 Best Industrial Enterprises for Environmental Protection in China", "AAA Grade Unit of the Best Prestigious Chinese Enterprises and the Best Image Chinese Enterprises", etc.

The enterprise is situated in the ancient city of Chaoyang in the west Liaoning Province, China and was founded in 1959. It develops and produces "Chaozhong" Brand machinery for building materials production with an annual production capacity of more than 40,000 t, with being about 1 eighth of market demand for the building materials machinery at home in China. The enterprise occupies an area of 80617 m^2. The fixed assets are 0.113 bil. yuan. It employs 1100 people, of which 165 engineers and technicians and 61 of them have high-degree technical titles. It has more than 1500 pieces (sets) of equipment, of which more than 200 are large-sized, precise and rare ones. The production technology is advanced and the testing means are sophisticated. The ISO 9001 Quality Standard is fully implemented in the production. The CHM is fully capable in providing large- and medium-sized complete set of equipment with a daily capacity of 300 t to 4000 t from engineering development, production, testing, quality guarantee system, hoisting and delivering to after-sales service.

Since the mid 1980's, CHM has successively introduced from Japan, Germany, USA and other developed countries and developed the engineering and manufacturing technique for the key equipment for the 2000t/d, 1000t/d and 800t/d cement clinker production lines of precalcing kilns, double-spout stationary and six-spout rotary cement packing machines, high-efficient bucket elevator, bag dust collector series, vertical mills, plate-chain bucket elevator and so on, which are up to international advanced level of 1990's.

The main products of the enterprise are 789 specifications in 181 assortments, 29 series and 9 categories of complete sets of cement plants with an annual capacities between 0.88 and 1.20 mil.t. The production capacity of those products is 40000 t. In the recent years CHM has developed 215 specifications new products at its own selection, obtaining 12 national patents, winning 10 technical achievement prizes at ministerial or provincial level, among which 7 are the firstly developed in China.

Address: 22 Third section, Huanghe Road, Chaoyang City, Liaoning Province
P.C.:122000
Tel: (86-421) 2814979
Fax: ((86-421) 2813151

3-2.6 Wuxi Jianyi Instrument & Machinery Co., Ltd.

Situated at the lakeside of scenic spot of Taihu lake, Wuxi Jianyi Instrument & Machinery Co.,Ltd., founded in 1958, is one of the key and large scale enterprises under former the State Administration of Building Material Industry specialized in manufacturing apparatus for physical test of building materials, machinery for building materials and new decoration materials. With its long history, complete set of products, high technology content and workmanship, the company enjoys the high reputation and has been authorized the right of operating I/E business. Its products sell well both at home and abroad.

The company, covering an area of 1C2,000 sq. m, is equipped with fine working facilities and equipment, complete measuring and inspection means and powerful backing of technical personnel. It has 1000 staff members and workers including 200 engineers and technicians. Under the company there are foundry, metal working, cold work and welding, heat treatment and

assembly plants, a product developing and research center and a Sino-Holland joint venture enterprise WuxiProfil Metal Ceiling Co., Ltd.

The company has established a quality system for the whole process of raw material and auxiliary parts procurement, production, assembling, inspection, packing and servicing and has been granted the Quality System Certificate in conformity with ISO9001:2000 standard. The company's products meet the requirements of national GB standards and JC standards for building materials industry. Part of its products conforms to relevant stipulations of ASTM of the USA.

Adhering to the principles of quality first and clients first, we are ready to design and manufacture the products with the requirements of our clients and supply the best after –sale service.

Address: No.8 Fangqianchunyangdong Road, Wuxi City, Jiangshu Province
Tel: 0510-8275668
Fax: 0510-8275118
E-mail: wxjianyi@public1.wx.js.cn

3-2.7 Zhuzhou Cement Machinery Factory

Zhuzhou Cement Machinery Factory is a key enterprise under the State Administration for Building Materials Industry of China. It has more than 40 years' production history, possessing a strong technical power and good product development capability and complete testing means. It is capable to supply the complete set of equipment and all-round technical service for the 0.3 mil. t/a rotary kiln and shaft kiln cement production lines. It is also able to provide part of equipment for 0.6 mil. t/a rotary kiln cement production lines.

The company can provide complete set of cement manufacturing equipment and accessories for the 1000t/d rotary kiln cement plant and shaft kiln cement plant. The major products of the company are ball mills, rotary kilns, mechanical shaft kilns, the equipment for drying, pelleatizing and cooling and the main equipment complementary machines for elevating, handling, feeding and dust-collecting. It supplies constantly the accessories. The most of main equipment produced by the company are the superior quality products of Hunan Province.

3-2.8 Pingdingshan Electrostatic Precipitator Factory (PEPF)

Established in 1972, Construction Corporation for Pingdingshan Electrostatic Precipitator Factory (CBMCC PEPF) under China National Building Material Industry is one of the leading enterprises subordinated to the China Noumetallic Minerals Industry Group Corporation. Now the factory is one of the largest and earliest enterprises in China engaged in research, development, manufacturing and installation of environmental protection equipment. During more than 20 years, the factory has produced and supplied more than 2000 Eps, bag filters and cement industry conditioning towers of different sizes and specifications to such industrial sectors both at home and abroad, as building material industry, metallurgical industry, electric power industry and chemical industry, and has got unanimous praise from all clients and successively won many honorable titles, such as National Second-class Enterprise, one of China's 100 Top Enterprises for Environment Protection, China's Advanced Enterprise for Science and Technology of Environmental Protection, Enterprise of Henan Province of Advanced and New Technology, Civilized Unit of Henan Province and so on. PEPF is entitled to operate import and export business by itself. In 1996, PEPF got the ISO9002 Quality System Certification of China, France, USA, Germany, Netherlands, Australia and New Zealand.

EP lies in Pingdingshan, the "Famous City in the Central Plain of China". The occupied area of PEPF is 155 thousand square meters. PEPF has fixed assets of 35 million yuan, 6 main workshop (Riverting & Welding shop, Metal Processing shop, Casting shop, Forging shop, Rolling shop) and 7 specialized parts production lines. PEPF has more than 200 sets of advanced different equipment, such as rolling machines for electrode plates, CO_2 automatic housing welder, numerical control plasma cutter and so on. It has an ability to manufacture dedusting equipment in amount of 20 thousand tons per annum. In 1984, 1987, and 1996, PEPF successively imported the designing, manufacturing, installation and commissioning technology of the BS780 EP of Lurgi GmbH, Germany, the Baf Filter of Fuller Inc, of USA and BS930 E of Lurgi GmbH, Germany. The factory has done a lot of digesting, assimilation and improvement works of the imported technology, so as to upgrade all the technical and economic targets of the factory's leading products – "aflyng" EP and Bag FILTER –up to the advanced world level, and to make the products sell well both at home and abroad such as in USA, Germany, Australia, Philippines, Pakistan, Malaysia, Iran, Brunei, Vietnam, Rwanda and others.

Add: 35 West Nanhuan Rd., Pingdingshan, 467001 Henan, China

Tel: 0375-4944054 Fax: 0375-4945874

3-2.9 China National Building Material Equipment Corporation (CBMEC)

Established in 1981, China National Building Material Equipment Corporation (CBMEC) is now subordinated to China National Non-metallic Minerals Industry Corporation (Group) (www.cnmc.com). Through the development and innovation in more than 20 years, CBMEC has become into a leading company in the field of building material equipment of China as a supplier of complete set of equipment and machinery, contractor of turn-key project at home and abroad, chartered tender agency for national technical renovation project and construction project, agency of foreign partners, trader of materials and products and importer of advanced foreign technique and equipment, etc.

With "major business with multiple operation as her development strategy, and with excellent service for the building material industry of China and other developing countries in Asia, Africa and Latin America as her mission, CBMEC provides domestic and foreign customers with fine quality, low energy consumption and high efficiency complete specialized equipment and machinery and auxiliary facilities, repairing and spare parts, and other building materials and products. Periodical, "China Cement", published and distributed by CBMEC, is a state-level professional technical monthly in the Cement Industry of China. China Building Material Machinery Association (CBMMA) and the Technical Standardization Committee of China Building Material Machinery (SCCBMM), standing in CBMEC, execute the managerial functions including reasonable adjustment and control on the building material industrial structure, working-out technical and quality standard in the field of building material equipment and machinery.

CBMEC owns her own research and design institute of cement industry, research and design institute of automatic control and manufacturing factories. Since 1984, CBMEC has organized local manufacturers importing from abroad and developing more than 40 advanced technique and equipment with the world advanced level of late 1980's and early 1990's, And all these help the production technologies and equipment of cement and flat glass reach the world advanced level. Up to now, CBMEC has successfully provided more than 40 domestic cement plants with over 50 complete sets of cement production lines, 20 of which have a capacity of from 2000t to 4000t clinker per day, and provided about 10 glass plants with complete sets of float glass production lines. Based on the advanced technique, fine quality equipment and rich experiences on engineering construction, CBMEC exported many cement production lines with a capacity of from 400t to 2000t clinker per day to about 10 countries including Malaysia, Pakistan, Myanmar and

Bangladesh, etc..

At present, CBMEC has powerful abilities of providing complete set of cement equipment and machinery with a capacity of 350t, 700t, 1000t, 2000t, 4000t clinker per day, complete set of float glass equipment and machinery with a melting capacity of 300t, 400t and 500t per day. complete set of equipment and machinery for producing refractory, ceramic and mining or processing machinery producing marble, granite, terrazzo slabs. In order to further adopt the developing requirements of market economy, CBMEC pays a close attention to multiple operations, and has expanded its businesses to all the fields related to equipment manufacturing or building material products, including providing of repairing and spare parts, development and production of special cement and wall materials, distribution of building material, platinum-rhodium alloy, nonferrous metals, timber, pig iron and copper. In addition, CBMEC becomes the sole agencies of some famous world companies including Johnson Window Films Inc. and PEWAG, etc..

With providing domestic and foreign customers with satisfactory services as her tenet, CBMEC strengthens and expands foreign economic and technical co-operation based on the faith of "Quality First, Service First and Reputation first" for the mutual benefit and common development, CBMEC warmly welcomes all clients and partners to cooperate in building material industry and other related fields. CBMEC has the following certificates of qualification:

The First Class Certificate ff General Contractor For Supplying Complete Plant Of Mechanical & Electrical Equipment authorized by the State Administration of Building Materials Industry and Ministry of Machinery and Electric Industry of P.R.C.

The First Class Certificate of Tender Agency For Equipment In Construction Project authorized by the National Planning Council and the State Administration of Technical Supervision;

Certificate of First Class Chartered Tender Agency For National Technical Renovation Project authorized by State Economic and Trade Commission of People's Republic of China (SETC);

Certificate of Approval for Export Credit for undertaking turnkey projects and export of complete set of equipment authorized by Ministry of Foreign Trade and Economic Cooperation P.R.C. and People's Bank of China;

Certificate of Approval for Enterprises with Foreign Trade Rights in the People's Republic of China issued by Ministry of Foreign Trade and Economic Cooperation, P.R.C.

Add: No.12 Floor, Canjiakou Plaza, No.21 Sanlihe Rd., 100037,Beijing, China

Tel: (010) 88372171 Fax: (010) 68311354

http://www.cbmec.com E-mail:cbmec@public3,bta.net.cn

3-2.10 Shannxi Yanhe Cement Machinery Factory

Shannxi Yanhe Cement Machinery Factory is an appointed specialized factory for producing cement machinery and equipment and wear-resistant castings in national building materials industry. It is also considerably large and well equipped cement machinery and equipment manufacturing enterprise in Northwest China, responsible for supplying cement machinery and equipment and wear-resistant castings to large- and medium-sized cement producing enterprises. It is listed as a state level large enterprise, having an authorized independent import and export right.

The factory was initially founded in 1966, having a over 30 years experience in producing cement machinery and equipment. Its products are in 200 specifications, 16 categories, main ones of which are rotary kilns, mechanical shaft kilns, ball mills, dryers, coolers, crushers, electric fans, dust collectors, high-quality wear-resistant castings and other industrial and mining accessories. It is capable to provide complete sets of 0.6 mil. t/a cement production lines and can also supply key and non-standard equipment for chemical, metallurgical and building materials industries.

The factory has a strong technical contingent, excellent technological equipment and advanced testing means with over 800 pieces (sets) of main production equipment including automatic high-pressure caseless vertical separately modeling lines from DISA Co. of Denmark, VRH-CO2 technological modeling lines from Japan and other large-sized specialized equipment from Sweden and other countries. The casting and processing capacity is strong.

Registered fund: 38.25 mil. yuan

Address: Fangnan Road, Textile city, Xian City, Shannxi Province

P.C.: 710038

Tel: (86-29)3523423

Fax: (86-29)3524911

3-2.11 Ningguo City Wear-resistant Materials General Factory of Anhui Province

Ningguo City Wear-resistant Materials General Factory of Anhui Province has a more than thirty years' history of professional production and sale of "Fengxing" brand wear-resistant materials. Its products include various kinds of balls, wear-resistant and heat-resistant cast steel segments, as well as abrasive aides for cement and mining industries. It passed ISO 9002 Quality System Attestation and International Standardization Attestation in July 1998 and ISO 9001 (2000 version) conversion Attestation in March 2001. The "Fengxing" brand trade mark was approved as "Chinese Famous Trade Mark by State Bureau of Industry and Commerce" in 1999.

The "Fengxing" brand wear-resistant materials are widely applied in powder preparation and superfine grinding for the cement and building materials industry, metallic or mining industry, power generation with coal slurry, chemical engineering, ceramic coating, light industry and paper-making, magnetic materials manufacturing and so on. There are at present more than 100 varieties and specifications of products in 7 series. The products are well sold to more than 2000 enterprises in 31 provinces, municipalities and autonomous regions in the country and exported to Japan, Korea, USA, Australia and different countries in Southeast Asia and Africa.

Ningguo City Wear-resistant Materials General Factory of Anhui Province is a State-level Large-scale Enterprise, State Second-class Enterprise, one of the 50 Most Powerful Industrial Enterprises of Anhui Province. It has formed a production capacity of producing 0.1 mil.t/a of cast ball and cast sticks and 20,000 t/a of cast steel segments. The scale of the factory stands in the lead of the same trade in Asia.

3-2.12 Luoyang Refractory (Group) Co., LTD,

Luoyang Refractory (Group) Co., LTD., established in 1958 during the state "First Five-year Plan" period, is the largest refractory commercial enterprise at present, and only one of 520 state key enterprises dealing with refractory in China. It has 8 production branches, 3 auxiliary shops, one technology center, one limited company and one joint-venture company. There are 5758 employees including 507 managerial personnel, 1018 technicians. The corporation occupies an area of 1,114,900 square meters.

The corporation is equipped with 3,910 production devices, including 9 tunnel kilns, such as 98.4m, 59.4m ultra-high temperature tunnel kilns, 202.5m tunnel kilns which is the longest in

China, two $30m^3$ one $20m^3$ full-auto shuttle kilns imported from Germany, 750t compound-friction press imported from Japan, 1,250t automatic hydraulic press imported from Germany, 2,500t full-auto hydraulic press imported from Italy,1,000t hydraulic automatic press made in China, computer-assistance design systems for moulds, computer-control batching systems and advanced testing systems for both physical and chemical properties, and necessary installations for packing and special railway line.

Various refractories (acid, basic and neutral)are now produced in a large scale according to the requirements of the strict quality guarantee system of ISO-9002. The main products are silica, magnesia, high-alumina, magnesia-chrome, middle-and high-grade sintered product and alumina-carbon, alumina-magnesia-carbon, alumina-zirconia-carbon products for continuous casting, sinalon composites, electrofused magnesia-chrome, alumina-silica-zirconia products, insulating products, unburned products, ceramic kiln furnitures and necessary monolithic refractories. The corporation has a production capacity of 160,000t and 600,000 ceramic rollers. The products have been sold all over China, 20% of the products have been exported to more than 20 countries and regions, such as Japan, USA, Brazil, Italy, South Africa countries and Southeast Asia.

Add: Xiyuan Rd., Luoyiang City, 471039, Henan, China

Tel: (0379) 4226148 4208809 4209546

Fax: (0379) 4210864

http://www.lyrg.com E-mail: lnyxgs@sina.com

Part 4 Main design institutes, industrial associations, and other supporting institutions focusing on their services in cement industry in China

4 – 1 Brief introduction of main research institutes in cement industry in China

4 – 1.1 Tianjin Cement Industry Design and Research Institute (TCDRI)

Tianjin Cement Industry Design and Research Institute (TCDRI) is one of the prospecting and designing institutes under the management of Central Enterprises Operating Committee (former under SABMI). As one of the earliest founded design institutes in China, TCDRI now became a first-class design institute with the strongest design capability in building materials industry in China since it was set up in 1953. Through years of development and expanding, TCDRI now has turned into a large comprehensive designing enterprise incorporated scientific research, engineering design, construction supervision, turnkey contract construction, consultative engineering technical service and machinery & electrical equipment manufacture. In 1992, TCDRI was granted "the Direct Business Right with Foreigners" by the Ministry of Economy and Trade, and in 2000 TCDRI was granted "Self-run Import Enterprise" by Tianjin Foreign Economic Relations and Trade Committee. In 1995, TCDRI was entitled by the Development and Research Center of the State Council as "the first institute for design and research on new dry process cement production line in China", and was enlisted in the book "Honor Records of the Most in China" (1949~1995). In 1993 TCDRI was honored as one of "the Hundred Strongest Institutes" (the sole design institute gained this title in building materials industry) and afterwards, was successively chosen as one of "the Hundred Strongest Prospecting and Designing Institutes in Overall Strength in China ". In 1996, TCDRI was the first one passing the conformity of quality system certification ISO9000.

China Cement Development Center (CCDC) under the TCDRI created by Chinese government and UNIDO is a sole international institution in Asian and Pacific region. From the founding of CCDC in 1983, entrusted by UNIDO, TCDRI successfully organized and sponsored three international mini-cement meetings and trained more than 100 cement professional staffs for

Asian and pacific region. TCDRI played an important role in training professionals, providing technical assistance and international technical exchange in Asian and Pacific region.

At the present, TCDRI has obtained several qualifications on engineering and consultation including non-metallic minerals, construction engineering, environmental pollution protection and control. The certificates which TCDRI commanded involve "Export Licence of Engineering Design", "Grade A Certificate on Cement and Waste-heat Generation Engineering Design", "Grade A Certificate on Turnkey Contract Construction", "Grade A Certificate on Engineering Consultation" and "Special Qualification on Intelligent System of Construction Engineering" as well as the "Conformity of Quality System Certification ISO 9000".

The major business and services include: Cement engineering design, cement raw materials quarry engineering design, new process / technology and new materials development and application, raw materials testing and evaluation, pressure vessels design, environmental impact assessment and prevention, turnkey contract construction, construction supervision and operation management, construction costs and consultation service, equipment manufacture and complete installation supply, cement technical information and consultation service etc.

There are about 800 staffs and 300 other employees in TCDRI. Among 800 staffs, 700 are professionals in different sectors including 2 design masters, 2 experts at national level and 4 experts at provincial and ministerial level, 220 professors and senior engineers, 300 engineers and 160 assistant engineers.

In order to respond to meet market competition, TCDRI has established several sections of multiple economic structure comprising 24 divisions, 2 wholly-owned subsidiaries, 11 holding subsidiaries and 1 collectively-owned company.

There are varieties of advanced facilities for scientific research in TCDRI. 16 labs including laboratory test center, cold and hot model pilot plants, machinery and electric plants, cement technical training center and computer center etc. In TCDRI it is possible to carry out simulating test, research experiments, semi-industrial scale tests and auto-control development for cement manufacturing, industrial wastes utilization, raw materials grindability and burnability testing, as

well as training programs for technicians. The results of these activities provide reliable technical guarantee for first-rate engineering design and scientific research in China's cement industry.

The completion of the state "Torch Plan" project - new energy conservation cement installation manufacture base is a beneficial practice for industrial development of TCDRI technical achievements, this plant has a stronger ability on equipment manufacturing and sales and has become a new economic growth point of TCDRI.

As one of the demonstration units of CAD, various intelligent computer soft-wares are widely-applied in scientific research and engineering design in TCDRI, now, the level for applying computer-integrated circuit makes progressing, computer network and shared engineering database, as well as office automation realized. This makes TCDRI being in a leading position among design institutes in China.

Over 50 years, TCDRI has accomplished more than 400 cement plants and other engineering designs, over 200 projects of turnkey contract construction, construction supervision and engineering consultation, has developed and designed more than 6000 sets cement equipment and fulfilled scientific research on 140 subjects. With these achievements, TCDRI has made great contributions to the products adjustment and technical progress in China building materials industry and created notable social and economic returns both for state and clients.

Add: Beichen District, 300400, Tianjin, China

Tel: 022-26391311 Fax: 022-26390071

http://www.tcdri.com.cn E-mail: TCDRI@public.tpt.tj.cn

4-1.2 China Building Materials Academy (CBMA)

CBMA, founded in the early 1950s, is the largest comprehensive research and development organization in China in the fields of building materials and advanced inorganic non-metallic materials. Since 1999, CBMA has become one of the high-tech enterprises under the central government.

CBMA's R&D covers cement and concrete, ceramics, refractory, glass fiber, housing materials, engineering design, test technology, quality supervision, environment engineering and technology information etc. Over the past 50 years, CBMA has completed about 2300 research projects. The contributions made by CBMA to the Chinese building materials and advanced material industries are well demonstrated by more than 430 government awards, including 100 national prizes. CBMA has close academic and trade relations with organizations of more than 50 countries and regions all over the world. Its technologies and products are widely acknowledged both at home and abroad, and have been exported to more than 30 countries and regions.

Add: No. 1 Guanzhuang Dongli, Chaoyiang District, 100024, Beijing,China

Tel: 010-65761787 Fax: 010-65762976

http://www.cbma.com.cn E-mail:cbma@public.bta.net.cn

4-1.3 Nanjing Cement Design and Research Institute

Nanjing Cement Design and Research Institute (NCDRI) was founded in 1953 and is one of the earliest design and research institutes of its kind in China. In the past 50 years or so, NCDRI has been developed into a distinguished and strong class A design and research institute in China's building materials industry.

NCDRI has incorporated the process, mechanical and control technologies in the development of a large variety of cement production lines, process control systems and special cement manufacturing equipment of national or world advanced level. It is capable to undertake the engineering project of technical services and technical transformation of 1000-8000tpd plus NSP/SP kiln, pre-heater kiln, cogeneration kiln, wet process kiln, anthracite burning kiln and cement production with wastes and low-grade raw materials for cement plants. Since its establishment, NCDRI has accomplished design of more than 200 cement production lines of various scales for clients both at home and abroad and has been awarded over 60 prizes of national and provincial levels. It was awarded with certificate of ISO-9001 in 1997.

NCDRI's major business scope is: engineering design for cement plant and quarry; Turn-key project contract for building material engineering, power engineering and environmental engineering; development, manufacture and sales of specialized equipment for cement plants and transfer of related technology, technical services and supply of complete set of equipment;

construction supervision for ordinary civil and industrial construction and installation projects of Grade Ⅰ, Ⅱ and Ⅲ of building materials industry, engineering survey, consultation, design and supervision for overseas funded projects at home and abroad; export of equipment, materials and spare parts; export of labor and technical services in the building materials industry etc.

Add: No. 209 Hanzhong Rd, Nanjing, 210029, Jiangsu, China

Tel: 025-6611333 Fax: 025-6611234

http://www.NCDRI.COM E-mail:NCDRI@JLONLINE.COM

4-1.4 Chengdu Design & Research Institute of Building Materials Industry (CDI)

Initially founded in 1953, Chengdu Design & Research Institute of Building Materials Industry (hereafter referred to as CDI) is one of the prestigious design and research institutes among China's building materials industry and also the first one being granted the premier design certificate regarding cement plant and non-metallic quarry. Entitled to deal with direct foreign trade, domestic and international engineering design, engineering general contracting, and premier design qualification of civil engineering, and taking research, design, engineering consulting, technical service, general contracting and engineering supervision of building materials and non-metallic quarry works and promotion of new technology as the major businesses, CDI through 50-year hard working has developed into one of the top design and research institutes in China. In June 1998, CDI passed the ISO 9001 qualify system qualification.

Since its foundation 50 years ago, CDI has undertaken design, consulting, supervision, and general contracting of hundreds of cement plants at home and abroad, non-metallic quarries and civil buildings, and fulfilled dozens of new technology development and raw materials researches as well, among which about 50 designs and new technologies have been respectively awarded national, ministerial, provincial excellent design or technology improvement awards. Scores of new dry process cement production lines with capacity ranged from 600t/d to 4000t/d designed by the CDI have finished construction and reached their expected output, gaining substantial economic and social benefits. Moreover, in recent years CDI has finished successively 5 large projects by general contracting both at home and overseas: 1.5 million limestone quarry of Lafarge-Dujiangyan Cement Co., Ltd., quarry and plant of 3000t/d clinker production line of Shandong Yantai Dongyuan Cement Co., technology upgrading of 2000t/d clinker production line of Gansu Wushan Cement Plant, 3000t/d clinker production line of Iran Fars Nov Group, and 2000t/d clinker production line in Xinjiang, that makes CDI among domestic design institutes of building materials industry the first one in undertaking independently the large-scale general

contracting projects.

Concerning deploitation of international operation, besides technical communication and contact with companies in Iraq, Laos, Sri Lanka, Bangladesh, Thailand and Burma, CDI has offered engineering design and technical service to cement plants and non-metallic quarries in various countries such as Pakistan, Vietnam, Iran and Albania, and established technical cooperation with many renowned companies from Germany, United States of America, Canada, Denmark, Japan and etc., which lays a solid foundation for a broader reach of CDI's operation all over the world.

Add: No. 331 Xinhong Rd, Chengdu City, 610051, Sichuan, China

Tel: 028-4333584 Fax: 028-4333545

http://www.cdi-china.com.cn E-mail:ybgs@cdi-china.com.cn

4-1.5 Hefei Design & Research Institute of Building Materials Industry

Hefei Cement Research and Design Institute (HCRDI)used to be a key research institution and a state Class-A qualification holder under the State Administration of Building Materials Industry. Its predecessor is The Research Institute of Ministry of Building Materials Industry and Beijing Cement Design Institute. After the system reform in 1997, it has been integrated into China New Building Materials (Group) Company. The institute takes up 25 hectares of land. It owns 895000 square meters of covered area. It has more than 680 employees, with about 500 technical staff, of whom there are more than 200 senior technical professionals and more than 200 are middle level technical professionals.

HCRDI has 12 departments (centers and companies): Design Department, Powder Engineering Company, Jinshan Industrial Company of Science and Technology. Environment Protection Engineering Company, Equipment and Metal Materials Engineering Company, New Building Materials Company, Machinery and Motor Engineering Company and Information Center and etc. It is mainly engaged in the design, technical service, construction supervision, complete set of equipment supply, construction project contracting and environment evaluation related to cement production lines of all types of kilns. Supply of new process, new equipment, new materials, new technology and new products is supported by running enterprises that produce high-tech products.

Since its establishment, the institute has undertaken 300 research projects including 16 scientific projects of the state government, 50 such projects of the state ministry. The total investment of these projects amounts to 16,000,000 yuan. 180 research projects have been evaluated and

accepted. 78 of them have reached up to world's or national advanced level, and found wide application both at home and abroad. There are quite a few technological achievements that have been listed in the state scientific achievements promotion plan. It has made great contributions to the technological progress of cement industry. Today, HCRDI has formed a competitive advantage in such technical fields as thermal process, powder engineering, production automation, environment protection, metal materials, optimized exploitation of cement materials and comprehensive utilization of resources. It has brought up large numbers of experts in various specialized areas.

In the field of design, during the eighth five-year plan period, the institute further developed pre-calciner kiln with capacities ranging from 1000 – 6000 tons clinker per day. It has been applied in the design of cement plants of various scales achieving good results. Up till now, the institute has designed more than 100 cement production lines of various types with capacities ranging from 1000 to 6000 tons. In addition, many projects of various production capacities have been awarded the titles of excellent design.

In the field of scientific and technological industries, the manufacturing entities of the institute are growing steadily. The institute's manufactured products are based on either imported or self-developed technology. Product quality is increasingly improving, gaining good reputation both at home and abroad. The manufacturing facilities of the institute are able to supply equipment for the cement production lines with capacities ranging from 1000 to 5000 tons per day. The institute has established an industrial park where Zhongya Cement Machinery Works, Feixi Energy Saving Equipment Works, Environment Protection Equipment Works, Wear and Heat Resistant Materials Works, Building Materials Machinery Works, Zhongya Steel Structure Factory are located. The total output value of these entities has amounted to 600, 000, 0000 yuan.

Add: No. 60 Wangjiang Rd, Hefei City, 230051, Anhui, China

Tel: 0551-3439196 Fax: 0551-3424995

4-1.6 Institute of Technical Information for Building Materials Industry (ITIBMI)

ITIBMIC was established in 1958. Through more than 40 years construction and development, the institute has become the scientific, technological, economic and trade information research, consultation services and documentation center for building materials industry on China. ITIBMIC has accomplished about 1000 reports on special subjects and more than 100 research projects of soft science. Meanwhile, having a function of building materials documentation

resources center of China, ITIBMI has a collection of more than 180.000 special books in Chinese and foreign languages, about 500 domestic and foreign special periodicals subscribed and the databases on building materials literatures in Chinese language, Chinese building materials patents and scientific & technological achievements of Chinese building materials industry established.

ITIBMIC undertakes fundamental research projects assigned by the Ministry of Science &Technology and edits and publishs more than 10 periodicals, including "Cement" which has the largest circulation in Chinese building materials industry, "Building Materials Industry Information" and so on. A line within the Institute and a web site of China Building Materials Industry Information Network on Internet have been set up. ITIBMC is capable to offer all kinds of web services for the domestic and foreign clients on web site.

Add: No.2 Guanzhuang Dongli, Chaoyang District, 100024,Beijing, China

Tel: 010-51164601 Fax: 010-6575-61207

http://chinabmi.com E-mail:cys@sohu.com

4-2 Industrial associations and other administrative institutions in China

4-2.1 China Building Material Industry Association (CBMIA)

China Building Material Industry Association (CBMIA) is a nation wide, non-profitable and self disciplined social organization that is voluntarily formed by the building material industrial enterprises, social organizations and individual members and serves as a bridge between the government and enterprises, offering them services in the meantime. Its major tasks are as follows:

(1) Conduct studies on key and important topics related to the building material industry as a whole and its development, submit economic and legal suggestions to the central government.

(2) Voice out the interests of its members and enterprises, coordinate relations among its members, organize and formulate the industrial regulations, coordinate disputes on products' prices, normalize the enterprises behaviors, establish the industrial discipline mechanism and protect the legal rights and interests of enterprises.

(3) Provide timely and accurate information and various services on technology, management

consultant and talent development, promote contacts with foreign colleagues, develop international economic and technical cooperation, participate in coordination of economic disputes, and assist its member enterprises to develop international market.

(4) Authorized or entrusted by the central government or departments concerned to participate in working out the industrial planning, making of revising national standards and industrial standards and other industrial management.

(5) Exercise supervision over the trade associations, i.e. to guide them in activities according to their constitutions, oversee their disciplines, observe legal regulations and the state policies; provide the final approval of reformation, adjustment and development suggestions and their structural alterations etc. of its subordinated associations; be responsible for the personnel management, party construction and ideological and political work. Assist the government to check in –discipline behaviors.

Add: No. 11 Sanlihe Rd., Haidian District, 100831, Beijing, China

Tel: 010-68311144-2215 68314360 Fax: 01068332658

http://www.bm.cei.gov.cn E-mail: msc@cbminfo.com, msc@bm.cei.gov.cn

4-2.2 China Cement Association

China Cement Association (CCA), established in February 5, 1987 is a mass social organization of cement enterprises and other institutions related to cement industry under the principle of voluntary participation.

Ever since its establishment, the CCA possesses a great attraction to the entire industry. The organization and various businesses have been rapidly developed and strengthened. Up to date, there are 3200 members among which 900 are direct members and 50 collective members of provincial and municipal sub-associations and trade committees etc. that forms the nation wide network of cement industry, which possesses highly extensiveness, representation and authority.

Add: No. 11 Sanlihe Rd., Haidian District, 100831, Beijing, China

Tel: 010-68332654 Fax: 010-68332654

http://www.cncement.com.cn E-mail:zjx@c-bm.com, Zgsn@sina100.com

4-2-3 Chinese Ceramic Society

The Chinese Ceramic Society is voluntarily formed by the silicate non-organic non-metallic materials Science and technology after registration according to law. It is a social organization of learned and public characters having independent legal representative and is a component part of the Chinese Society of Science and Technology. The aim of the society is to unite the broad mass of workers of ceramic science and technology for the promotion of prosperity and development of science and technology, the facilitation of popularization and spreading of Science and technology, the promotion of growth and upgrade of scientific and technical talents and the promotion of the integration of science and technology with economy.

The former body of Chinese Ceramic Society is the Chinese Ceramics Society. It was initially established in 1945 and its name was changed to Chinese Kiln Engineering Society in January 1951 and ceased action for some reasons in October the same year. In December 1956, the Preparation Commission of Chinese Ceramic Society was formed. In November 1959 the First National Congress was held in Shanghai, and it is decided on the congress that the name of the society was Chinese Ceramic Society.

The members of the society include personal members, senior members, organization members and foreign members. The member of personal members is 33.000 at present and that of organization members is 40. There are 18 professional branch societies and 3 working commissions. There are 124 local societies at present. The administrative body of the society consists of 5 departments (sections).

The main tasks of the society are to carry out academic and science and technological exchanges between domestic and foreign learners and implement international science and technological co-operation among peoples, to edit and publish scientific and technical books and magazines, to undertake continuous education and popularization work of science and technology; to undertake consultation for decision-making, technical consultation and technical service; to carry out citation and reward for outstanding persons and works, to organize scientific and technical exhibitions and demonstrations at home or abroad.

4-2.4 Beijing Building Materials Association (BBMA)

Beijing Building Materials Association (BBMA) is a mass organization consisting of building materials trade associations in Beijing area, units of production, management, scientific research and design and information etc. BBMA is the building materials industrial organization

administered by Beijing Municipality, sponsored by Beijing Jinyu Group, a non-profit legal organization approved and registered by Beijing Social Organization Register Administration Office.

4-3 Main design institutes, industrial associations, and other supporting institutions focusing on their services in cement industry in the three provinces of Zhejiang, Hubei and Shandong.

(1) Administrative Office for Building Materials, Metallargical and Coal Industries under the Commission of Economy and Trade of Zhejiang Province

The main functions of the office are as follows:

1. To organize the implementation of the policies of building materials industry, to study on the technico-economic policies for promotion of the development of building materials industry in Zhejiang Province, to supervise and check the conditions in implementation of industrial policies

2. To study on and formulate the relevant development programme of the building materials industry and to put forward the directions, key points and national distribution of development of the building materials industry for the whole province to push on the readjustment of structure of the building materials industry of the province.

3. To grasp properly the analysis of economic operational condition and the information release of the building materials industry of the province, to strengthen the macroscopic coordination within the industry.

4. To study on the key problems in the development of building materials industry and put forward advices and suggestions.

5. To instruct the system reform of the building materials industry of the province.

6. To carry forward the development and popularization of new building materials and their manufactured products.

7. To make comments of preliminary examination and approval on capital construction of enterprises and technical transformation projects. To take the responsibility of management in the process of implementation the projects. To assist the administration upon relevant industrial (garden) zone.

8. To make examination and appraisal on the key projects of technical innovation of enterprises and to assist the administration upon the projects in the process of implementation.

9. To instruct and contact with the building materials association and other intermediary organizations.

Add: No. 79 Tiyuchang Rd., Hangzhou City, 10007, Zhijiang, China

Tel: 0571-88826775 Fax: 0571-88083409

(2) The Management Office for Building Materials Industry of Hubei Province

The main functions of the office are as follows:

1. To undertake the relevant items and works assigned by the former State Administration for Building Materials Industry, provincial government and provincial commission of economy and trade.

2. To undertake administration upon the building materials industry of the whole province. To carry out the guide lines, policies, laws, rules and regulations for the development of building materials industry. To carry out the investigation and study on the key problems in the reform and development of building materials industry of the whole province. To keep breast of and analyze the production and management trends of the industry, to put forward the suggestions timely to provincial government and relevant departments. To take responsibility for the statistics of the industry to provide information and consulting service. To co-ordinate the internal relationship within the industry of the province to keep the order for fair competition. To give impetus to development and popularization of the application of new building materials and manufactured products. To be responsible for the reform and innovation of walling building materials and for the popularization of bulk cement to promote the comprehensive utilization of building materials resources. To instruct the state-owned enterprises of building materials industry to conduct reform, to overcome the difficulties, to increase efficiency while reducing the personnel and to carry out reemployment engineering.

3. To be in charge of administration upon and service to the outgoing retired cadres. To instruct the works for the trade union and industrial associations.

Add: No.45 Wuchang Zhongnanyi Rd.,Wuhan City, 430071, Hubei, China

Tel: 027-87815471 Fax: 027-87831047

(3) Hubei Building Materials Industry Research & Design Institute (HBMIRDI):

Hubei Building Materials Industry Research & Design Institute (HBMIRDI), located in Hubei, P.R.China, is a state-owned provincial technical institution focusing on R&D and engineering design for building materials industry, and a state-authorized center for building materials' quality inspection & supervision.

There are six specific departments under HBMIRDI covering cement engineering, civil engineering, new architecture engineering, new materials research & industrial design, chemical building materials research and a laboratory for building materials quality inspection.

HBMIRDI is the largest share-holder of Hubei Times Engineering Supervision Corporation, Inc. (HBTES). Hubei Building Materials Quality Inspection Centre (HBMQIC) is also affiliated to HBMIRDI. HBMIRDI has been granted First-Class Design Certificate for Cement Industry, First-Class Design Certificate for Engineering Advisory, First-Class Supervision Certificate for Industrial and Civil Construction Projects, Second-Class Design Certificate for Civil Engineering, Second-Class Certificate for Turn-Key Project Contracting. HBMIRDI is capable of rendering all technical services covering product research & development, manufacturing, engineering design, construction project supervision and product testing in building materials industry.

Presently, HBMIRDI has the staffs of 164. Among them 148 are technicians with 4 professor-level senior engineers, 62 senior engineers and 53 engineer. Seven of the senior engineers are ranked outstanding specialists, enjoying honor status jointly awarded by the State Council and provincial authorities. HBMIRDI has been rendered technical services to more than 500 clients since founded 20 years ago.

Up to now, HBMIRDI has designed more than 120 cement production lines covering all kinds of

process including precalcining, preheating (vertical tube or cyclone), waste heat power generating, wet process rotary kiln production line and shaft kiln production line. HBMIRDI has also designed 60 non-cement building materials projects covering glass, ceramics, stone, new walling materials production line. Among 108 civil engineering design projects accomplished by HBMIRDI 30 are of large or medium scale. Since its foundation, HBMIRDI has won Excellent Design Reward of Hubei province for 7 times, Yellow Crane Design Reward of Wuhan City for 2 times.

HBMIRDI has also been a leading designer at provincial level in applying precalcining technology in cement production. As early as 1980s, it undertook engineering designs of Puqi Cement Plant's 700 t/d precalciner cement production line and Tianzhen Cement Plant's 750 t/d precalcining cement line. In 2004, HBMIRDI undertakes engineering designs of three 1000 t/d precalcining cement lines. The clients are Dangyang Changbanpuo Building Materials Corp. Inc. in Hubei province, Taihe Cement Corp. Inc. in Jiangxi province and Jiangxia Cement Corp. Inc. in Wuhan.

HBMIRDI has been active in international technical co-operations in cement engineering. It has accomplished engineering design for three foreign cement production projects. Among them are Power Cement Plant in Kingdom of Nepal, Sino-Vietnam Cement Corp. Inc in Vietnam and a cement factory under the Military Holding cement corp. Inc. in Burma.

In recent accomplished civil engineering design project, HBMIRDI has applied a new technology referred as High Efficient Pre-stressed Overlapping Structure in its design of Jinhui Apartment, Green Hill Plaza and Dawning Soft-ware Base's R&D Building . As a result, the application has not only fulfilled the aim of saving investment and increasing efficiency but also shortening construction period. The average construction cost has been cut down as much as by 50/m^2 yuan and construction period shortened by 25%.

In the field of R&D, HBMIRDI has gained more than 20 scientific achievements and developed 15 new products, with 2 granted State Invention Patents and 11 won Hubei Science & Technology Progress Prize. Among new products developed, EC type highly-purified super-fine silicon powder has won State Key New Product Certificate of 2002 while EC type dry mortar mixture won State Key New Product Certificate of 2003.

In construction project supervision, HBTES has accomplished more than 50 large and medium sized new type dry process cement projects or civil engineering projects, such as Huaxin 2500t/d

Cement Project, Gezhouba 2500t/d Project, Tree-Lion 5000t/d Project of Zhejiang , Red River of Huayun. Hanzhong Project of Shannxi, Elephant King of Burma, etc.

HBMQIC is responsible for quality supervision / inspection in provincial building materials industry. With state authorization, HBMQIC can inspect and test 108 kinds of products in 10 categories covering all building materials in the province.

Main Business Scopes of HBMIRDI are as follows:

1. Cement Project Design
2. Civil Engineering Design
3. New Building Materials Project Design
4. Technical Service
5. B.M Products Quality Inspection
6. Construction Project Supervision
7. Turnkey Project Contracting
8. New products developing in cement industry
9. Equipment & Spare parts Supply

Chief Director: Mr. Hui-xiang Luo
Address: No.234 Yaojialing, Wuchang, Wuhan, Hubei
Fax: 0086-27-87301384
Tel.:0086-27-87823910
Post Code: 430071
E-mail: hbjcsjyl@public.wh..hb.cn

(4) The Administrative Office for Building Materials Industry of Shandong Province

The main functions of the office are as follows:

1. To study on and put forward the development strategy, plan and relevant policies and measures for the building materials industry of the whole province according to the national development strategy, plan and relevant industrial policies for building materials industry to facilitate the structural readjustment of the industry and to rationalize the distribution of the industry.

2. To organize the implementation of industrial laws, rules and regulations as well as technical norms and standards, to study on and formulate relevant industrial management measures and to co-ordinate the internal relationship within the industry so as to facilitate the readjustment of products mix and to keep the order for fair competition.
3. To keep breast of and analyse the production trends in building materials industry, to collect, analyse the production trends in building materials industry, to collect, analyse and issue the technico-economic and market information of the industry and to provide information and consulting service. To promote the comprehensive utilization of building materials resources, to give impetus to reform of new building materials and structural readjustment of building materials. To push on the establishment of modern enterprise system to push the state-owned building materials enterprises to make up deficits and increase efficiency and to implement the reemployment engineering.

Address: 360 Jingsi Road, Jinan City, P. C. : 250001
Tel: (86-531) 7938621, 7181303

Part 5 An Investigation on China Cement Industry 's Advanced Energy Saving and Emission Reducing Technology as well as Some Cases on Respective Enterprises

5-1 Recommendation of advanced energy saving and emission reducing technology for China cement industry

5-1.1 Present situation and development direction of new dry process for cement manufacture

5-1.1.1 The present situation of new dry process for cement manufacture

China cement industry has achieved remarkable success in new dry process for cement manufacture, attaining top quality and high output of the product, moreover, the investment in the capital construction has been greatly reduced, and the investment per ton cement has been controlled within about 300-400 yuan. In the meanwhile cement production enterprises, scientific research and design institutes, and equipment building factories carried out continuous optimization and improvement of the technology of the whole production process and the complete sets of equipment, so that the reliability and advancement of the production lines have greatly been improved, among which the typical ones are homogenization technique of raw materials, precalcinator and precalcining process, grinding and milling technique, automatic control technique and environmental protection technique, etc.

5-1.1.1.1 Homogenization technique of raw materials

The crux for guarantee of the cement quality made by new dry process is the application of the homogenization technique for raw materials. The equipment that is widely used in recent years are:

(1) CQMS is used in mine design. The exploitation scheme drawn up according to this system guarantees the consistency of the main ingredients in the extracted ore, and also created a prerequisite for the most effective use of ore of low grade.

(2) Set up a pre-homogenizing storage yard providing a good homogenization effect to raw materials and fuel. There is a condition for supplying the equipment to meet the requirements of pre-homogenizing storage yard of various scales at home at present (The diameter of the round storage yard can be up to 110 m, the span of the rectangular one can be up to 50 m. They can meet the requirements of the production lines of 2000-10000 t/d).

(3) Accurate proportioning devices for lump and powdered materials. Applying the devices and

quality control system, regulating the feeding proportion of various raw materials in time so as to guarantee the quality of raw meal and cement coning out of mill.

(4) Raw meal homogenization silo with high homogenizing effect, low power consumption and high discharge rate (H value is up to more than 8. Power consumption is about 0.25 kWh/t, discharge rate is more than 98%). By using it the quality of raw meal fed to kiln is ensured.

5-1.1.1.2 Energy-saving technology and technological equipment of precalciner kiln

(1) 5-stages cyclone preheater system with high efficiency and low pressure loss, having a system pressure loss 4800 Pa, has been developed through systematic testing and research. At present single series of preheaters of 2000 t/d, 2500 t/d and double series of preheaters of 2500 t/d, 3200 t/d, 5000 t/d, have already been put into production. At the same time, the improvement of the preheater inner tube wind lock valve, refractories etc. ensures the reliability of the clinker calcining system and reduction of heat consumption.

(2) A practical and reliable calcining technique and equipment suitable for fuel characteristics have been developed through research and industrial experiment of burning characteristics and burning mechanism under the working condition of the kiln for all kinds of coals (including anthracite, low heat value coal, high-sulphur coal), so a possibility of comprehensive utilization of resources and reduction of operation cost has been created. At present this technique has already been spread.

(3) In order to meet the requirements of establishment of production lines of different scales, a series of rotary kilns have been developed and designed, including the rotary kiln with two bearings and three bearings, in which the biggest scale of three bearings kiln is $\phi 4.8\ m \times 74m$, which can meet the requirements of the production line of 5000 t/d-6000 t/d capacity.

(4) TC-series air beam grate cooler of third generation has been developed and spread. This technique has made clinker cooling air requirement lower to 1.6-1.8 m^3/kg clinker. Heat recovery rate is raised to more than 74%, and the reliability of this equipment ensures that the running rate of burning system reached above 90%.

(5) A series of burners applicable to all kinds of fuels (including anthracite) has been developed. The primary air volume has reduced to below 60%. This device has many advantages, such as high applicability to fuels, flexibility in regulation. Application of them benefits kiln skin protection, prolongation of service life of the lining.

5-1.1.1.3 Energy- saving grinding and milling technology and equipment

(1) Mining technology and equipment single-stage crushing technology of the raw materials possesses a lot of advantages, such as high reduction ratio, being not easy to blockage by the

materials, being convenient to maintenance, low power consumption, simple technological process flow. Through many year's effect, at present various types of single crusher for lime stone with a output of 80 t/h to 1800 t/h have been developed and put into operation.

The maximal output of the toothed roller crusher applicable for various materials has already come up to 350-400 t/d. The crushing technology and equipment for high abrasive and hard to crush materials have also been well developed, and can meet the requirement of engineering construction.

(2) Drying and grinding system for raw materials

According to grindability, abrasiveness and the different requirements of drying of the raw materials, the tube mill system and roller mill system have been developed respectively.

① Steel ball mill system with high-efficiency built-up separator

Tube mill system has a good flexibility for grindability and abrasiveness of the raw materials and a reliable running. Newly-developed TLS built–up high-efficiency separator, having a high separation efficiency, good flexibility in product fineness regulation, high structure compactness and other advantages, is able to raise the output, lower power consumption of the whole system, simplifying the process flow and reducing the investment in capital construction.

Newly developed tube mill is equipped with double sliding track bearing and advanced peripheral driving device. Its specification could meet the requirements of production lines of 3000 t/d and 5000 t/d.

② Roller Mill system

In prerequisite of proper raw materials, as compared with tube mill roller mill has simple process flow, power saving and high ability for drying and other advantages.

In recent years with the development of materials industry and machinery processing industry, the scientific and research and design institutes and machine-building factories have developed a new–generation Chinese-built roller mill roller (roller structure improved, speed of revolution of the mill disk is accelerated, advanced and reliable hydraulic device is employed, roller pressure is enhanced, high-efficiency separator is allocated in the line, external circulation is used) on the basis of digestion and absorbing of international advanced technique, so the reliability of the mill and the service life of damageable parts can be ensured (under normal conditions of the raw materials, the service life of the roller sleeve and lining plate amounts to more than 1 and a half years), and the effectiveness of power saving has further been increased.

At present there exists condition to provide a series of roller mills for preparation of raw meal and coal powder to meet the requirements of cement production line of below 5000 t/d (part of key parts used in raw materials mill for 5000 t/d line needs to be imported).

(3) Cement grinding system

① Tube mill closed-circuit system

The cement grinding system consisting of high-efficiency cage type separator, high-efficiency bag-type dust collector and tube mill set is recognized as one of the best examples of remolding the traditional process flow with high-technology. The system is equipped according to requirement of manufacturing ISO standard cement product double sliding track bearing and advanced peripheral driving device are used for the tube mill; the separating efficiency of the third generation high-efficiency cage type separator is more than 80%. High-efficiency bag-type dust collector ensures that the dust content in the purified gas is less than 50 mg/m^3, while the dust content in the gas at in-let is 800 g/m^3. The system attains high output and low consumption. The capacity of the system which has already been put into operation at present is 40-100 t/d (according to P42.5).

② High pressure grinding roll system

High pressure grinding roll is a main equipment in the course of pre-grinding and half-final grinding, and it's technical reliability and power saving superiority are recognized and accepted by numerous customers. As compared with tube mill system, it's power consumption for grinding can be reduced by 25%.

In recent years the technical problems, such as vibration of machine body, heavy abrasion of roller surfaces and short service life, in coordination of automatic control system, ineffectiveness of regulating mechanism of hydraulic system, etc. for Chinese-built high pressure grinding have been solved, and the machines have been serialized.

It's the biggest specification can meet the requirements of complete- set-formation for half-final grinding system of 150 t/d.

5-1.1.1.4 Automatic control technique

There are nearly 1000 motors and valves, hundreds of mechanical equipments, a thousand switching points and hundreds of analogue measure points, and dozens of regulating circuits in the whole cement production line of new dry process. So a good automatic control is necessary in order to guarantee the steady running and top product quality.

In recent ten odd years internationally advanced computer control technique, communication technique and graphic display technique have extensively been used in China. Discrete control and concentrated management system (DCS) has also been employed. The information system for factory production management (PMIS) has been developed and put into operation. So the target of reliability, safety and practicality of the system has been attained.

5-1.1.1.5 Environmental protection technique

New type dry process for manufacturing cement has nearly no contamination and is an environment friendly industrial practice, so in recent years close attention has been paid to it by public. As the main pollutants (dust, waste water, and waste gases) emerging from traditional cement production have been disposed systematically. Dust discharge is far inferior to the permissible limit of the state standard; no discharge of waste water has been achieved. The discharge of harmful gas (NOx) has also effectively been controlled. At present, in China, a set of new dust collection technologies and high-efficiency dust collecting equipment and sound insulation or absorbing equipment have been developed. Recently the dust emission concentration (standard state) of the NSP production line can be brought under control of <50 mg/m^3. Besides, a new type low NO_x calcining system has been developed, its NO_x emission in the waste gas can be reduced. The environmental protection technique of the large NSP production line lately established has already reached a quite high level, it can make the air fresh, environment healthful and the factory like a real garden.

5-1.1.1.6 Simple electric power generation technique with low-temperature exhaust-heat

More and more close attention to the sufficient utilization of exhaust-heat of the NSP production line has been paid by cement workers. In the light of international electric power generation technique of cement industry, in cooperation with technicians of other trade, a breakthrough in simple electric power generation technique by exhaust-heat without additional combustion furnace has been made, and it has met with success in application to clinker production line of 2000 t/d. The features of this technique are less investment of the system, short recovery period of investment, and good economic benefit. As far as NSP kiln of 2000 t/d is concerned, if additional 20mil.-30 mil. yuan invested about 20 kWh/t clinker electric power can be recovered, and the steady operation of the cement production line is not disturbed basically.

5-1.1.1.7 Waste slag utilization technique in cement production

Since reform and opening up, the economy has been developing steadily and rapidly. More and more waste slags have been formed with the fast development of metallurgical industry, electric power industry etc. In fact, however, a lot of waste slags is a precious resources of building

materials. With deepening of cognition for environmental protection and heightening of utilization technique of waste slag, good results in comprehensive utilization of fly ash and slag in domestic cement production have been achieved. In the fifties of the twentieth century slag as a bended component was used in the cement production. Since entry into the nineties, people have seen that addition of superfine slag in concrete can make the latter meet various requirements of the properties, so the equipment and system for preparation of superfine slag have been introduced. Thus it has become a new product with a high additional value, which can replace a lot of cement, saving resources and energy, as a result, a remarkable economical and social benefits are obtained. Besides utilization of industrial wastes as raw materials and fuel to a maximal degree, there is a great prospect of use of industrial and daily life garbage in cement production by new dry process. A set of corresponding industrial experiments has already achieved some essential advancements.

5-1.1.2 Development direction of China's new dry-process cement production technology

As a result of nearly half a century's is efforts and equipment level of China's new dry process cement production has approached the international advanced level, but as far as the whole level is concerned there is still a larger gap. According to the cement output in 2001 published by State Bureau of Statistics, the cement output produced by new advanced dry process only accounts for 14% of the total output (in developed countries, it is more than 90%), and the technical levels of these new dry process production lines are uneven, their average scale is only 0.46 mil. t/a. Therefore, the technical development has to be strengthened. To strive to increase ratio that the cement output produced by new dry process makes up. At the same time to work hard to make the technical and economic targets of the production lines of 5000 t/d and less reach the international advanced level at that time up to 2005, and to complete the development and construction of production line of 10000 t/d, making every effort to reach the international level of the end of the twentieth century in the environmental protection and ecological construction.

At present China's cement industry is still situated in initial stage of development towards ecological and environmental materials industry and sustainable development. Development of China's cement industry has to take aim at international most advanced science and technology, pay close attention to carrying out authentication work according to international ISO Quality System, International ISO 14000 Environmental Management system (OSHMS) in the course of execution of management institution of modern enterprises. By way of technical innovation and strengthening environmental management, to further optimize and improve production technique and equipment of new dry process, so as to further improve all technical and economical indexes and to reach the international advanced level as soon as possible. The main technical and

economical indexes that should be reached before 2010 are listed in table 37.

Table 37 The technical and economical indexes the China's new dry process production line should reach in 2010

Items	Unit	International advanced levels	Internal existing levels		Levels that should be reached in 2010	
			Ordinary	Advanced	< 4000t/d	>4000t/d
Production output ratio produced by new dry process	%	> 85	< 15		> 50	
Average scale of clinker-production line	10 thousand t/a	60 – 150	46.3		>60	
Strength of clinker	MPa	> 62.5	55~62.5		62.5~72.5	
Heat consumption of clinker	KJ/kg	2900~3010	3550	3032	3032	2926
Running rate of kiln	%	>90	80	>90	90	95 左右
Total power consumption of cement	KWh/t		115	100	< 100	<90
Dust emission concentrator	mg/Nm^3	30~50	<150	<100	30~50	
Emission concentrator SO_2	mg/Nm^3	50~200			200	50
Emission concentrator NO_x	mg/Nm^3	200~500	1000	500	<700	<500
Chinese-built equipment	%		>80	>70	>95	>90
Average rate of bulk cement	%	70~90	19	>70	>50	

In the middle of the 20th century, before the perfection of the new dry process for cement production line, lots of developed countries put the cement industry in list of "sun-set industry", ceased to develop it at home because of its high consumption of resources and energy and severe pollution to the environment. But since the late nineties of 20 century, the USA, Germany, even Switzerland that manages environment very strictly, etc. have again one after another constructed cement production lines and carried out environmental protection and information technology transformation and upgrading of existing cement production lines by means of optimal advanced and applicable technique (BAT) of environmental protection type and Internet network technique.

For example, 3 production lines of 5000 t/d have been built in Germany since 1996 and production lines of 6000 t/d and 5400 t/d were newly built in the USA and Switzerland in 2000 respectively utilizing multistage burning decomposition furnace. BAT technique and network technique platform, and using combustalbe waste materials to replace premium fuel. The theory and practice have proved that the cement industry can fully grow into a ecological and environmental protective material industry in the new century.

In order to bring the above-mentioned goal to be achieved, process technique, informationization construction, development and innovation of key equipment, enterprise management and training of personnel have to be strengthened, and optimization of the designs should be carried out continually. Therefore the main subjects are:

(1)To enhance the research of homogenization technique of raw materials, to further enlarge the application of low-grade raw materials and industrial wastes to further intensify homogenization measure and means from extraction to before their grinding to reduce the investment in homogenization and storage of raw meals after grinding.

(2) To heighten further the technical performance of the preheating and pre-calcining system, to develop the key calcining equipment, such as high-performance rotary kiln (new-structure wheel band with grooved teeth, friction driving etc.) and new generation clinker, cooler to extend further fuel varieties and substitutive fuels to enhance the research of application of poor coal of low thermal value, industrial wastes, for example waste tyres, waste plastics.

(3) To enhance the strength in development and popularizing the application of raw mix roll mill system and high pressure grinding roll and roll mill system used for pre-grinding and final grinding of cement, so that the comprehensive power consumption can be reduced to below 90 kWh/t (according to PO42.5).

(4) To research and develop control software for optimization of technological equipment process on the basis of development of DCS and other special software, and to continually enlarge the application of information technique in enterprise management to popularize the modern management technique like enterprise resources plan (ERP) and customers relationship (CRM).

(5) To further do a better job of individualization design to make every effort to meet the needs of the market demand to a great degree with the least investment, the least consumption of resources, and the lowest production cost.

(6) To research and develop high-efficiency de-dusting equipment, and technique and equipment for reduction of emission concentration of NO_x, SO_2, etc., so as to achieve Zero emission of

pollutants.

(7) In view of current situation of not high labour productivity, development and application of technical equipment should to be enhanced, for example storage and transportation of materials, cement product package, issuing and transportation of bagged cement and bulk cement, etc..

(8) To further research optimization of technological process of production to meet the requirement of all kinds of functional cement products, and to reduce the production running cost to a great degree.

(9) To strengthen research and application of functional materials, so as to enhance the equipment performances, for example high-performance abrasion-resistant metal materials. ceramic, refractory and thermal insulating materials.

(10) To carry out research of ecological engineering design, make every effort to be in harmony with environment under presuppositions of corresponding capital investment.

(11) To further reduce investment in new dry process cement production line on the basis of perfection and enhancement of technology and equipment by way of continuous optimization of engineering design, construction and management.

(12) To strengthen research of standards for cement production related products, environmental protection, substitutive fuel, new equipment, instruments, management, etc.

5-1.2 Energy saving production technology for shaft kiln cement production

5-1.2.1 Prehomogenization technology of raw materials and fuel

prehomogenization of raw materials and fuel is a basic technological requirement for the production of cement with shaft kiln. Lots of factors, such as the quality of raw materials and fuel, technology, equipment and operation and management level, all have influence on the cement quality. If no homogenization of raw materials and fuel is carried out, raw mix can not be in exact proportion. The investment for newly constructed prehomogenization storage yard is quite large. In the first trial production the existing raw materials storage house can be used and to control the storage house charge and discharge and collocation by plan, a certain homogenization effect can be achieved.

The homogenization techniques mostly used are: rectangular prehomogenization storage yard, round prehomogenization storage yard, prehomogenization storage house of long strip form, round

prehomogenization storage house, collocation of multi-store-houses, etc.

5-1.2.2 Homoginization techniques of raw mix and cement

Homogenization and testing have to catch up, they must be carried out before energy saving transformation as much as possible. It is difficult to get the batch to meet the design ingredient requirement without homogenization of raw mix. And it is also difficult to get a consistent quality cement without homogenization of cement , if the grade of cement is not very well controlled, the economical benefit will be influenced.

Homogenization of raw mix can reduce the fluctuation of all ingredients, so as to ensure the quality of raw mix entered the kiln and stabilize and enhance the quality of clinker. There are two kinds of homogenization of raw mix. They are pneumatic homogenization and mechanical homogenization. As for common pneumatic homogenization there are intermittent homogenization storage house and continuous storage house. As to mechanical homogenization there are multi-storage house collocation and mechanical rearrangement of storage-house. The homogenization effect of intermittent homogenization storage house system is the best, continuous homogenization storage house system comes the second. The mechanical homogenization store-house system gives a poor homogenization result. The homogenization effect of multi-storage house collocation is the worse. It can hardly meet the requirement of raw mix quality.

Homogenizing cement is also an indispensable, important technological link. The standard deviation of the 28 day's compression strength of the cement should not be more than 1.65 MPa. This has not only ensured the stability of the cement strength, but also ensured that the other quality targets approach stability.

5-1.2.3 Improvement and selection technique of feed proportioning scheme of raw mix

Selection of feed proportioning scheme of raw mix is a basic technological requirement for cement production. It is related to top quality, high output and energy saving of cement. It does not need much efforts, but has great influence. As much attention as possible should be paid to it before reform of energy saving equipment, and produce an effect to get twice the result with half the effort.

In early stage feed proportioning of the clinker of the shaft kiln KH=-0.85-0.90, SM=1.9-2.2, IM=1.2-1.4. Since the eighties by way of long-term effort of the scientific and technological workers of cement industry, the homogeneity of raw mix ingredients for shaft kiln has began to improve quite a lot, and at the same time, by means of many techniques the whole black raw mix,

complex mineralizer balling-up by pre-additions of cement the KH value of clinker of the shaft kiln has been raised step by step, and reached 0.90-0.94, and the strength of clinker has also increased gradually. In recent years, a number of cement factories using shaft kiln with good condition have further improved the homogeneity of raw mix, employed some new techniques like calcining of small raw mix ball, thermal insulation of burning zone of shaft kiln, KH value of the clinker has further been raised to about 0.92-0.97, SM to about 2.3, the strength of the clinker has attained the same level as that of the clinker produced with rotary kiln of new dry process.

In cement production, cement factory should determine its feed proportioning scheme both suitable for its own factory's circumstances and advanced, in accordance with the features of the raw materials and fuel, and technological and operational levels. At present the following three kinds of feed proportioning schemes have mostly been employed:

(1) High saturation ratio and high aluminium scheme:

KH=0.92-0.96, SM=2.0-2.2, IM=1.6-1.9;

(2) High silicon and low iron scheme:

KH==0.90-0.94, SM=2.2-2.4, IM=1.3-1.5;

(3) High saturation ratio and low silicon scheme:

KH==0.9r-0.98, SM=16-1.8, IM=1.3-1.5;

Gradual enhancement of KH value of the clinker of shaft kiln with improvement of the production conditions is a main trend.

5-1.2.4 Feed proportioning in accordance with rate value and heat distribution technique of block raw mix

Feed proportioning in accordance with rate value and heat distribution technique of block raw mix is a basic technological requirement in cement production. What the quality of clinker is directly influences output, goodness and heat consumption amount of clinker. Rate value for production can determine burnable property of raw mix and the quality of clinker. Therefore, only direct control of rate value of raw mix out of mill and carrying out feed proportioning in accordance with rate value can in all-round way enhance the percentage of qualified raw mix out of mill, stabilize the raw mix ingredient and ensure the quality of clinker calcined in shaft kiln.

Application of heat distribution technique of black raw mix can measure thermal value quickly and exactly. Thus, an automatic end-to-end joint with control system of adjustment rate value of raw mix happens, and intelligent joint adjustment of rate value of raw mix with thermal value realizes, and calcining technology of shaft kiln is further stabilized.

5-1.2.5 Pre-grinding technique

Pre-grinding technique can make mill save energy and increase output by means of reduction of particle size of materials fed into mill. This technique is very important for enhancement of output of raw mix mill and meeting the needs of supply of raw mix after energy saving and output increase of shaft kiln. It should be used as a complementary technique for energy saving.

5-1.2.6 Technique of application of grinding aid

Application technique of grinding aid has a certain effect for increase of cement mill output and meeting the needs of shaft kiln after energy saving and output increase for heightening of efficiency of cement mill. The essential way is still to improve the grindability of the clinker.

5-1.2.7 Energy saving technique in drying

Drying of raw materials and fuel is an important link in cement production, and it can ensure that the moisture index of the materials meet the requirement in the production process. At the moment the drying technology and equipment for the most shaft kiln cement enterprises are mot perfect.

5-1.2.8 New mill application technique

High pressure grinding roll and compressive size reduction technique, vertical mill technique, high fineness and high output screen mill technique, high-efficiency separator technique etc. are some practical and advanced technologies and equipment used in cement factories. They can raise the grinding efficiency, save energy and increase output in varying degrees.

5-1.2.9 High-efficiency separator application technique

It can raise the efficiency of grinding system, attain results of energy saving and output increase.

5-1.2.10 Pre-watering nodulization and small nodule firing technology

The strength of dry nodules homogeneity of particle sizes of nodules, porosity inside the nodules and resistance to impact loading of nodules prepared by pre-watering nodulization technology are better than those prepared by traditional process. It has a greater promotional effect on quality, output and energy saving of shaft kiln cement.

Quick firing technology has improved the calcining condition in the shaft kiln, and also enhanced essentially the burning quality of the clinker (the 28 days' compression strength is increased by 5 MPa-10Mpa) and production capacity of shaft kiln (output is increased by 15%-20%), and it can reduce heat consumption of 418 kJ/kg clinker-627 kJ/kg clinker as well.

5-1.2.11 Dust disposing technique in shaft kiln enterprise

Dust disposing techniques of shaft kiln has also been proven. It can be selected and used according to the condition. So the control over dust emission in the cement enterprise with shaft kiln can come up to norm.

5-1.2.12 Quality control and management technique in the production process

Production control is a key to ensure that cement factories carry out normal production, stabilize and heighten the cement quality. The control of the quality of raw materials, raw mix and clinker and the fineness and homogeneity of cement are all the focal points in quality control work of cement factory.

5-1.2.13 Automatic control technique of the production process of shaft kiln enterprises

If automatic system really plays its proper role in shaft kiln production, it has to carry out process control of every link and every working procedure from the entry of raw materials and fuel to the leave of end products, including supply chain management, mine management, etc., so as to realize stable production.

5-1.2.14 Chemical instrument analysis and physical testing technique

In order that shaft kiln enterprise stabilizes cement quality, realizes energy saving and reduces consumption, instrument analysis technique and devices are an indispensable test and measurement means.

5-1.2.15 Frequency converting and speed regulating technique for energy saving

This technique can make enterprise reduce cost and increase benefit.

5-1.2.16 Comprehensive utilization technique of resources

If there are lime stone of low calcium, marl, industrial wastes like coal gangue, tailings or country rocks of other metal minerals etc., cement factory can utilize wastes as raw materials to replace clay, and attain more than 10% technical and economical results in both output increase and coal saving. Cement factory itself has also changed into an environmental protection type industry and heightened its sustainable developing ability and social position by means of employment of wastes. In case of lack of investment funds, this technique can be selected at first. It needs no much cost, but it can change the existing situation of the shaft kiln factory.

5-1.2.17 Energy saving type lining mating technique

Any technical advancement of kiln has close relationship with refractories. As for cement rotary kiln and shaft kiln refractories with different characteristics should be selected in accordance with

the requirements of the specific technological positions. There is a set of basic problems of such as too large sectional temperature difference, inhomogeneous sectioned temperature distribution in cement shaft kiln, etc. They can be solved to a certain degree by way of mating employment of lining.

Technical results and economical analysis

This technique has many advantages, such as a remarkable comprehensive economic benefit, little investment, instant effect, and great practicality. It has been used in many comprehensive energy saving projects of mechanical shaft kiln with success. Dozens of mechanical shaft kilns of different specification employed this technique and all achieved good results. It can fully affirm that the energy saving type lining possesses the following functions according to the practical reports of relative factories and thermodynamical determination:

(1) Reduce heat consumption of clinker, and have remarkable energy saving;(2) lower the surface temperature of kiln body, have no need for external insulation work; (3) increase the per hour output of mechanical shaft kilns; (4) enhance quality of clinker; (5) possess a stable and reliable structure, a long-term insulation effect, and a long service life.

The difference in the investment between energy saving type lining and ordinary lining, is very little but the benefit of the former is very notable. If the reduction of heat consumption of clinker is 150 kcal/kg, a mechanical shaft kiln of $\phi 3 \times 10$m (output 12 t/d) can save 1851 tons of standard coals annually, corresponding to 2356 tons of substantial coals (calorific power 5500 kcal/kg)worth 0.353 mil. yuan (the price of coal 150 yuan/t); a cement factory that manufactures 0.2 mil.t of clinker per year can annually save 4294t of standard coal valued at 0.818 mil. yuan. In addition, if the kiln can increase 1 ton of clinker every hour, it can produce 7200 t clinker more annually and 8470 tons of ground ordinary Portland cement more which are valued at 1.69 mil. yuan.

Applied living examples:

(1) the product quality of a certain factory in the South China has come up to a higher level before the employment of energy saving type lining. Its heat consumption of clinker was also lower, about 930-950 kcal/kg clinker, and was among the best in Jiangsu Province. In order to further save coal on the basis of low consumption of coal, the kiln has employed energy saving type lining mating technique in the times of major overhaul, so the heat consumption of clinker has lowered to 800-820 kcal/kg, the kiln per hour output has been increase by about 1 ton reaching for $\phi 2.95 \times 10$m kiln 12.5-13.5 t/h, $\phi 3 \times 11$m 14-14.5 t/h. The energy saving type lining has created a completely new calcining condition for the mechanical shaft kiln, and unexpected good results

has achieved.

(2) A certain factory in the North China manufactures cement with whiting as raw material of limestone. The burnable property of its raw mix is good, the quality of the clinker is fine, and its cement found a good market. The heat consumption of the clinker produced with its $\phi 3 \times 10$m mechanical shaft kiln was 900-920 kcal/kg, has been listed in the nation-wide advanced ranks. After the employment of energy saving type lining, the heat consumption of the clinker has further been reduced to about 800 kcal/kg, even 770 kcal/kg at minimum. The output of the kiln has also gradually been enhanced. The good quality clinker has been calcined under the condition of so low disposition of coal, the 3 days' bending strength was 6.5 MPa, compressive strength 41.6 MPa, the 28 day's bending strength 8.5 MPa, compressive strength 62 MPa. Under the condition of reduction of coal consumption, the calcining condition of the shaft kiln has been improved, so it has played a active role in promotion of advancement of cement manufacture technique with mechanical shaft kiln.

5-2 A survey of cases of example enterprises

5-2-1 The technologies and their exemplary production lines for energy conservation and reduction of pollutant discharge in the cement production with new dry process kilns

The precalcining process kiln production lines featuring large scale, high output and low heat consumption have obtained fast popularization and application in China and a great standard for energy conservation of the cement industry. From the environment protection point of view, with less discharge of dust, less specific energy consumption for the cement clinker and less emission of waste gases and SO_2, the application of precalcining process kiln (ie. So-called in China the new dry process kiln) has lessened the impact on the environment by a big margin, in comparison with the other cement production technologies.

The technology of new dry process kiln production lines with a daily capacity of 2500 t is proven regardless of production scale, or production output, energy consumption and discharge of wastes to the atmosphere. Carrying out technical innovation for energy saving and discharge reduction to the enterprises with small scale production, high resources and energy consumption and heavy environment pollution, which commonly exist in the Chinese cement industry, has a real exemplary role. The process technology is a recommended technology for the replacement of shaft

kiln cement production in accordance with state policy of "to construct the large-scaled productions and transform the small ones".

The new dry process kiln production line with a capacity of 2500 t/d is advanced in technology and can undertake scaled production. It is capable of producing any varieties of high-grade clinker of Portland cement and processing low-alkali Portland cement and moderate heat Portland cement to meet the requirement of various engineering and the market demand, using the local raw materials and energy resources. It can raise the comprehensive utilization rate of limestone resources and produce high-grade Portland cement with limited limestone resources to further increase the strength, durability of concrete to lasted the service life of engineering construction. The automatic control level of the technology is improved remarkably. In the production using new dry process kiln line with a capacity of 2500 t/d only 225 workers are needed and a total process control is realized.

The measures for energy saving in the 2500 t/d production line with new dry process kiln are as follows:

(1) To employ the milling and drying system as the main system for the raw meal grinding, which has advantages of simplicity of process flowsheet, low construction cost, large drying capacity, low power requirement and benefiting the energy saving, comparing with the traditional ball mill or tube mill systems; (2) To apply 5-stage cyclone preheater and low-moderate heat calcining can increase production output, reduce heat consumption. The heat consumption for firing is 3011 kJ/kg clinker, which reached the domestic advanced standard; (3) The new aerated beam type grate cooler is applied for cooling of clinker, decreasing the unit cooling air volume and power requirement. It raises the temperature of secondary air entered the kiln and the temperature of tertiary air entered the calcining furnace. The heat recovery reaches higher than 72% so the firing condition in the kilns is improved, the firing result is raised, the heat consumption for firing is decreased, at the same time the cooling with the water-spray is replaced by air cooling, reducing the consumption of fresh water and saving the water resources; (4) The coal firing is accurately controlled. An advanced and reliable measuring and controlling equipment are applied in the coal feeding system of rotary kiln and precalcing furnace, which can automatically regulate the coal feeding in accordance with the technological requirement to guarantee the homogeneous coal feeding and timely and accurate readjustment; (5) The surface heat loss of the equipment and pipe-line is reduced; (6) A water circulation system is applied for the cooling of production

equipment. The utilization rate of indirect circulation water reaches 95%, so the water consumption is saved and the waste water discharge, at the same time, is reduced; (7) The energy-saving electro-mechanic equipment such as electric motors, fans, are used and high-efficient, low power consumption electric controlling equipment are employed, such as transformers, contactors and lamps, etc.

As the above mentioned measures were taken, the unit energy consumption indexes for the clinker production line of the same capacity are as shown in tab.39.

Tab. 39 The unit energy consumption for the 2500 t/d clinker production line

Normal coal consumption for firing	kg/t	127
Comprehensive power consumption for clinker	kWh/t	60
Power consumption for clinker firing	kJ/t	3050

It can be seen from the table, that the comprehensive power consumption for clinker is only 60 kWh/t. The result of energy-saving is good.

The measures for the reduction of pollution discharge from the 2500 t/d production line with new dry process kiln are as follows: (1) The application of the cement production technology with precalcining kiln instead of mechanic shaft kiln technology not only improved the production efficiency and heat efficiency, but also remarkably reduced the unit product pollutant discharge in comparison with other technologies; (2) Under the technology the drying and milling of the raw meal were carried out simultaneously in the raw meal mill. The kiln waste gases introduced were used as the drying gases. After drying the gases returned to kiln back-end and entered into electric dust collectors. This not only reduced the energy consumption by reduction of a set of production and dust collecting equipment, but also greatly reduced the discharge of pollutants; (3) To use the coal with sulfur content less than 1%. The use of clean fuel reduced the discharge of waste gases, especially the discharge of SO_2; (4) To reduce the dust emission points in the production as much as possible by the technological design. As the measures were taken, the unit product dust discharge from the production line of major technological process was 0.45 kg (the most advanced one was 0.087 kg); SO_2 – 0.13kg (the major advanced one was 0.07 kg); NO_x – 1.82 kg (the most advanced one was 1.15 kg); (5) The GHG emitted from the cement works is mainly CO_2. According to the principle of present cement production, to reduce the heat consumption and improve the quality of cement clinker are the effective means to reduce direct emission of GHG. Simultaneously, to spread the use of high-strength concrete technology to reduce the usage of

cement in the engineering construction can also decrease the emission of CO_2 by a big margin.

To sum up, the 2500 t/d cement clinker production line can undertake the clean production, and furthermore, it can absorb and consume a lot of solid wastes and fly ash from power plants. The comprehensive utilization level of resources is high.

Technology for utilization of merely low-temperature waste heat in cement industry

The cement industry is a traditional industrial sector of high energy consumption, and even at present there is still a large amount of waste heat of low-temperature of below 350℃, which cannot be completely utilized by the most advanced domestic cement production technology. The amount of waste heat accounts for about 30% of the total heat used in the total system. Consequently, to recover the low-temperature waste heat produced in the cement production process for the heat supply or the electricity generation has a very practical significance for the energy conservation and environmental protection and complies with the strategic guidelines of sustainable development.

Technology for the low-temperature waste heat power station

The waste heat power station is constructed using merely the low-temperature waste heat from the cement kilns without disposition of any combustion equipment. Consequently, there are no any discharge points for fume gases, dust and waste residues needed to be disposed, so that the better energy conservation and environmental protection results achieved.

As the temperature of the waste heat from the kiln hood and kiln end is relatively low, the electricity generation using merely the low-temperature waste heat applies stricter requirements to the equipment and system technology. The research and development of electricity generation technology and equipment using low-temperature waste heat from cement kilns in the foreign countries have started from the 1960's, and either the thermal system or equipment both have entered into the practical application stage in the middle of 1970's.

In 1997, the Tianjin Cement Industry Design and Research Institute with the domestic turbine building units, with the former as the major force, jointly at the first time had started research and development of special equipment for electricity generation with low-temperature waste heat

applicable to the cement factories, namely the mixed pressure steam type turbogenerator, formulating a completely domestic technical approach and implemental scheme for electricity generation using merely the low-temperature waste heat from the hood and the end of the cement kiln.

In May 2002, the Tianjin Cement Industry Design and Research Institute in cooperation with Shanghai Wanan Enterprise Corporation has carried out a technical renovation for the merely low-temperature waste heat electricity generation to the four-stage cyclone preheater kiln with a daily production capacity of 1350t produced by the corporation. The engineering project was formally commenced in September 2002 and was completed and put into production in May 2003. The installed capacity of the power station using waste heat is 2.5MW, the real average electricity generating capacity is 1800KW. The station is equipped fully with the domestic equipment and technology. After about 1 year's production operation it is shown, that the main equipment and whole system have been running smoothly and normally, and every techno-economic index Achieved the designated target.

Now the electricity generating system using the merely low-temperature waste heat complemented to the 4000t/d precalciner kiln in the Ningguo Cement Factory of the Conch Group, the electricity generating system using merely low-temperature waste heat complemented to the 3600t/d precalciner kiln of Liuzhou Cement Factory and the electricity generating system using low-temperature waste heat complemented to the 1350t/d precalciner kiln of the Shanghai Jinshan Cement Factory are serving the exemplary engineering projects.

The major techno-economic indexes of the electricity generating station using low-temperature waste heat

As influenced and restricted by the many factors, such as the differences in kiln types, technological processes, raw mix compositions, moisture contents of raw materials and fuels for cement production, geographic locations of cement factories and so on, it is difficult to provide the exact techno-economic indexes of installed capacities, investments and so on of the electricity generating station using low-temperature waste heat complemented to every type of cement kilns. For the reference, the relatively important specific techno-economic indexes and parameters are shown in the following table:

Item		Domestic technique and equipment	Foreign Technique and equipment
Main Process equipment	Waste heat boiler at the kiln head	A set (Vertical type, natural circulation)	A set (Vertical type, natural circulation)
	Waste heat boiler at the kiln end	A set (Vertical type, natural circulation)	A set (horizotital type, forced circulation)
	Turbine	Steam added turbine 1 set	Mixed pressure steam intake turbine 1 set
	Generator	Air cooled generator 1 set	Air cooled generator 1 set
	Sewage treatment equipment	A set	A set
	Circutating cooling equipment	A set	A set
	DCS control equipment	A set	A set
Per ton clinker generated energy		24 ~ 32kWh	28 ~ 36kWh
Propoction of electricity for self use (%)		<9	<9
Yearly running time (h)		7500	7500
Cost of power supply (yuan/kWh)		About 0.10	About 0.2
Per KW investment (yuan)		About 6000	About 16000
Fixed number of labor forces (person)		16	16

According to the technological process and the waste gases parameters of the China-developed cement production line with precalciner kiln , the electricity generating technology using merely low-temperature waste heat developed by the Tianjin Cement Industry Design and Research Institute and applying the China-made equipment has a electricity generating capacity of 24 to 32kWh at present. Calculating in accordance with the current electricity price on the market of 0.50 yuan/kWh, deducting the cost of electricity supplied by the waste heat electricity generating station of about 0.10 yuan/kWh, the per ton clinker cost can be lowered by about 10 to 13 yuan. It can be seen from here that, the implementation of electricity generating engineering project using merely low-temperature waste heat can also effectively reduce the cement production cost of the

enterprises and enhance the market competitiveness of products of the enterprises, bringing about good benefits to the enterprises.

In general, in the electricity generating engineering using merely low-temperature waste heat with full application of the waste heat of waste gases generated in the cement production as the sole heat source there is no any original energy fired in the whole thermal system and in the same time with recovery of large amount of waste heat from the waste gases which exerts heat pollution to the environment the constructed waste heat electricity generating engineering projects do not pollute environment at any extent. It plays an active role in reduction of emission of carbon dioxide, lowering the green gas effects and protection of ecological environment.

5-2-1.1 A brief introduction to Beijing Liulihe Cement Factory

The factory is a first class large-scale cement enterprise in the building materials industry of the country with an annual production capacity of 1.5 mil. t.

Liulihe Cement Factory has a strong contingent of technical personnel and is capable to undertake batch production of 525R and 425 ordinary Portland cement and 525 and 425 slag Portland cement. "Great Wall" brand cement has won several times the titles of "the Beijing Famous Brand" in the first and second round of public quality appraisal. A 100% qualified cement rate and qualified cement grate of the factory have been kept for 20 successive years. In November 1996 the Liulihe Cement Factory firstly in the Beijing Cement Industrial Sector passed ISO 9003 Quality System Attestation". It was enlisted in the Hohour Roll of "China Ten-thousand Li traveling Quality Inspection". The engineering project of 2000 t/d cement clinker production lines of precalcing process was the first one among 14 key old enterprises to be saved in the country to pass the state examination and approval. The factory's 525R ordinary Portland Cement has been widely welcome by the customers after its entrance into the market and put an end for the Beijing City the history of incapacity for batch production of high-grade cement. It took the lead in passing the state products attestation among the cement enterprises in Beijing. Its 525R cement won the title of "Beijing Ten Best New Products".

Main products:

(1) Ordinary technical indexes:

Main technical indexes:

3d compression strength is not less than 32.0 MPa, 28d compression strength is not less than 56.0 MPa. The final setting time does not exceed 6.5h. The other technical indexes meet the current national cement standards.

(2) Ordinary 425R Portland cement

Main technical indexes:

3d compression strength is not less than 26.0 MPa, 28d compression strength is not less than 46.0 MPa. The final setting time does not exceed 6.5h. The other technical indexes meet the current national cement standards.

(3) 425, 525 slag Portland cement

Main technical indexes:

3d compression strength is not less than 22.0 MPa, 28d compression strength is not less than 46.0 MPa. The final setting time does not exceed 8.0h. The other technical indexes meet the current GB1344-92 national cement standards.

(1) The main equipment applied in the 2500 t/d production line at Liulihe Cement Factory

(2) Raw meal grinding system:

LM 4140 Roll mill of Laixie Co. is applied. The designed output is 200 t/h and it can reach up to 400 t/h. The machine reduces the power consumption of unit product for raw meal grinding.

(3) Coal grinding system:

The domestic vertical mill is applied for grinding anthracite to increase the use of poor-quality coal in the cement production with rotary kiln and to reduce the cost of cement production.

(4) Firing system:

Aiming at the firing characteristics of anthracite used at the Liulihe Cement Factory, the TCIDRI developed a precalcining system with a set of single series 5-stage preheater on the kiln back-end and preburning furnace. The precalcining furnace has multi-channel burner. The specification of rotary kiln is $\phi 4 \times 60$m. The Pilard coal burner pipes are employed at the kiln head. A grate cooler of third generation developed by TCIDRI is used at the firing kiln head to reduce the unit air volume for cooling and the power consumption. The heat recovery reached over 72%, and the firing condition and result of the kiln were improved, the heat consumption for firing was reduced.

The output of the kiln has kept basically at 2500-2700 t/d. The heat consumption for firing was 3011 kJ/kg, which is the domestic advanced level. The comprehensive power consumption for clinker was 60 kWh/t and the normal coal consumption for firing was 127 kg/t.

At the back end of kiln the bag filters are used for dust collection. The designed dust emission at the outlets is 50 mg/m^3 and less. The real index at the factory was less than 30 mg/m^3.

5-1-2.2 Shanghai Wanan Enterprise Corporation

To generate electricity using merely low-temperature waste heat from the kiln hood and end, the corporation implemented technical innovation to a f 3.5×88m four-stage cyclone preheater kiln(SP kiln) with a daily production capacity of 1050t (actually it is 1350t) in 2002. The engineering project was designed by the Tianjin Cement Industry Design and Research Institute and was accomplished and put into production in May 2003. The installed capacity of the electricity generating station using waste heat was 3.5MW and the designated average electricity generating capacity was 1800kW. In the project the wholly domestic equipment and technology were employed. After about half of a year's operation, the main equipment and the whole system have been running smoothly and normally and all techno-economic indexes reached the designed targets.

1. The constitution of thermal system

The main equipment set of the system consists of two waste heat boilers(a AQC waste heat boiler at the kiln hood and a SP waste heat boiler at the kiln end) and a set of turbogenerator steam replenishing and condensing type. The installed capacity was 2.5Mw. The designated average electricity generating capacity was 18ookW.

The source of kiln end waste heat was SP(kiln end preheater):waste gases flow 95000Nm3/h, temperature 390℃(actually 360℃);

The source of kiln hood waste heat was AQC(cooler): waste gases flow 40000 Nm3/h, temperature 350℃.

2. Techno-economic analysis

The total investment in the waste heat electricity generating engineering project was 15 million yuan. The designated electricity generating capacity was 1800kW. The present actual electricity generating capacity is more than 1800kW. Calculating by 7000 hours for electricity generation annually, the annual generated energy is 1260×104kWh. Deducting 10%(actually 8%) for self use in the waste heat electricity generating station, 1134×104kWh of external purchased electricity can be reduced.. The operating cost of the waste heat electricity generating station is about 0.06yuan/kWh. Calculating by externally purchased electricity average price of 0.48yuan/kWh

(the taxes here are excluded), the electricity fees of 4.76 million yuan can be saved annually for the enterprise. In the practice of operation an additional part of electricity fees can still be saved through readjustment of power factor of the electricity system and reduction of loss of existing power supply and distributing system in operation of the waste heat electricity generating station. Calculating in this way, the total investment in the project can be recovered in a period of about 3 years.

3. is the first production line reaching the designated target in the country. The real generated energy of per ton of clinker reaches 33 to 35 kWh/t. The proportion of generated energy fo Conclusion

The electricity generating system with merely low-temperature waste heat r the station own use is less than8%, reaching up to the international advanced standard (there is no secondary circulation of AQC waste gases). The whole system is operating reliably and the operation is easy and flexible. The total staff of the station needed is 15 with 2 operating personnel in a shift. The investment cost in the station is low since it employs wholly domestic equipment and technology. The technology of utilization of merely low-temperature waste heat is extremely worthwhile to popularize and has excellent application perspectives.

5-2.3 Zhejiang Shenhe Cement Co. Ltd.

The predecessor of Zhejiang Shenhe Cement Co. Ltd. is Heshan Cement Factory of Tongxiang City, which was established in 1975 and was one of the earliest enterprises of cement industry in the city. It was originally located at Heshan Ji Township as a township subordinated enterprise. Up to the beginning of 1990's it was a small enterprise with indigenous kilns for production of cement. The technology was backward, the equipment set was incomplete, and the production output was small, quality of products was unstable. The enterprise has had loss in a long period of time and been on verge of closure. In 1991, the new leadership of the enterprise was established. Facing the situation, the enterprise leadership decided to move the enterprise and to undergo technological transformation through repeated analysis and proof. A considerably advanced at that time overall computer controlled mechanical shaft kiln production line with a capacity of 0.1 mil. t/a was newly set up with an investment of over 20 mil. yuan. It thoroughly changed the situation of the factory. Nevertheless, the enterprise hasn't stopped at that and invested further 40 mil. yuan to expand the second mechanical shaft kiln production line to develop itself to a certainly large scale. After structure reformation in 1999. the enterprise has got new energy and has developed even fast. With the implementation of the strategy of "To control the total output, to readjust structure", the

elimination of backward shaft kiln technology and development of advanced new dry process cement production technology had become the development tendency of cement industry in China. The decision-making group of the enterprise, applying the historical opportunity of entrance into the new century, invested 100 mil. yuan in 2000 to build a first class 1000 t/d new dry process cement production line so as to make the enterprise's publicity, standard of product quality and market competitiveness improved remarkably, and it has laid a solid foundation for the trans-century development of the enterprises. In 2002, with the successful convening of 16th Congress of CPC, an upsurge of building a well-off society in an all-round way and speeding up the socialist modernization construction has been sprung up. The decision-making group of the company, firmly grasping the opportunity, after only one year since the 1000 t/d new dry process cement production line has brought into operation, made an important decision to build a 2500 t/d cement clinker production line, which is being under construction at present. After completion of this project a 2 mil. t production scale will be formed in the company, so that the company will become the largest in scale and the highest in the product quality cement production base in the Jiaxing City and stand at the forefront of cement industry in Zhejiang Province. The products of the company are mainly sold to Hangzhou, Jiaxing, Shanghai and other areas.

The evolution of the company is as follows: In 1975 the Heshan Cement Factory was set up. It was a township enterprise subordinated to Heshan Township, Tongxiang City. In 1991, the factory was incorporated with Shanghai Wusong Cement Factory and renewed as Jiaxing City Shenghe Incorporated Cement Factory. In 1995, to meet the requirement of further development, it shifted to Jiaxing City Shenghe Building Materials Group Co. Ltd. In 1999. in accordance with relevant regulation the company was transformed into Tongxiang City Suihe Cement Co. Ltd. All shareholders are natural persons. In 2002, approved by the Zhijiang Provincial People's Government, the company transformed into Zhejiang Shenhe Cement Co. Ltd. with the registered capital of 45.89 mil. yuan.

(1) The condition of assets

The company, adhering to the development strategy of enterprise of "Don't stop at small renovation, take a step forward every 3 years and take a steps forward every 3 years and take 3 steps forward every 10 years", make the scale of the enterprise expanded continuously and economic results improved year by year. The total assets at present are 220 mil. yuan. 167.39 mil. yuan's production value and over 40 mil. yuan's profit and taxes were achieved in 2002.

(2) Registered trade-mark

The registered trade-mark of the products of the company is "Suihe".

(3) The conditions of personnel

The total personnel of the company at present is 530, of which administrative personnel 42, accounting for 7.9% of the total personnel, the number of technicians with college education is 20, accounting for 3.5% of the total personnel.

The company has won successively the honourable titles such as "The ten best cement production enterprises in Zhejiang Province", "The pacesetter enterprises on the quality control", "The best economic beneficial enterprise and AAA qualified enterprise", "The civilized unit of Jiaxing City", "The 100 most powerful industrial enterprises", "The advanced enterprise on environmental protection", "The pacesetter enterprise on site management and control", "The industrial over-scale enterprise of Tongxiang City". "Suihe" brand cement products run out by the company were firstly in the cement industry in the Zhijiang Province passed double assessment for product quality and quality system and won the titles of "Test-free product of Cement Quality Testing Centre under the Ministry of Agriculture", "The famous trade-mark of Jiaxing City", "The famous brand product of Jiaxing City, and the company is one of the zhejiang cement enterprises winning the entrance license into shanghai.

5-2-2 The shaft-kiln cement producing enterprises using exemplary technologies for energy conservation and waste discharge reduction.

5-2-2.1 Mishan Cement Co. Ltd.

Feicheng, Shandong Proivnce applies heat-regulating technology for the cement raw meal- the new type carolitic capacity meter to raise the output to reduce the energy consumption and to save the national coal resources.

The carolitic capacity measuring method shows the comprehensive heat value of the raw and fuel materials, benefiting the raw meal batching and stabilizing the raw meal quality and improving the firing quality of cement clinker. They all are playing an active role in the energy conservation, raw materials reduction and production increase.

The comparison of results between the carolitic capacity measuring method and the Loss method

(The industrial analysis method) is shown in the following table 40.

Method	Target Value Regulation	KH value qualification rate %	The heat consumption for clinker	Quality of clinker			Output by produced shaft kiln t/d
				f-CaO	Loss	28d compressi on strength MPa	
Loss method 1998 – 2000	29	67.5	4096.4	78.3	72.4	50.7	9.8
Carolitic capacity measuring method 2000 – 2002	7	88.7	3678.4	89.6	90.2	58.4	12.73

5-2-2.2 Lianzhuo Cement Factory, Guangdong Province

The effects applied the Comprehensive Utilization Technique of Resources by the Lianzhou Cement Factory. The Lianzhou Cement Factory originally used high-grade limestone (53% of CaO) + Coarse quartz sand contain minated clay + water-washed iron ore (Fe_2CO_3) + fluorite + gypsum + coal in firing of cement with the firing heat consumption in a range of 5014.0 kJ/kg to 5852 kJ/kg. Then they used 33%~34% CaO, marl with a calcing point of 822.5℃ in stead of part of high-grade limestone, copper tailing (added amount is 3%~5%) high content of iron sulfide from neighbouring Liannan County instead of clay and mineralizer in firing. As a result, the monthly average heat consumption was reduced to a minimum of 2428.4 kJ/kg clinker (581 kcal ≈83 kg/t normal coal) and the coal consumption was reduced by more than a half. The clinker quality has been the stable and its strength has been improved. The output has been increased from 2.0 t/d formerly to more than 14.0 t/d for the Ø3×10 m shaft kiln.

5-2-2.3 Changjiang Cement Factory, Zhejiang City, Jangsu Province

The effects applied the Energy Saving Type Lining Mating Technique by Changjiang Cement Factory. The quality of products of shaft kiln in Changjiang Cement Factory has already reached a high level before the application of energy saving kiln lining, and the heat consumption for clinker was rather low either in a range between 930 kcal/kg and 950 kcal/kg. To further conserving of coal on the basis of low coal consumption, the factory applied energy-saving lining complementary technology in the overall maintenance of the kiln. Afterwards, the heat consumption for the clinker has decreased to 800 kcal/kg~820 kcal/kg, and the output has been raised to about 1 t/h and 12.5 t/h~13.5 t/h for the Ø2.95×10 m shaft kilns, 14t/h~14.5 t/h for the Ø3×10 m shaft kilns. The energy-saving kiln lining created a brand new firing condition for the

mechanical shaft kiln, achieving a good technical result.

5-2-3 Example for comprehensive energy-saving and reduction emission technology

5-2-3.1 Hejiashan Cement Co., Ltd, Jiangshan City, Zhejiang Province

Hejiashan Cement Co., Ltd. Of Jiangshan City was initially a township collective enterprise and was originally founded in 1976. At that time the annual cement production capacity was only 7000t. After the reform and opening-up, the township enterprises have met a new prosperous spring. The company, grasping firmly the opportunity for development, has been undertaking constantly the technical renovation and expansion, and in 1998 it merged the former Sanfeng Cement Factory so as to raise the annual cement production capacity of the enterprise up to 0.7 mil.t. In 1998, the enterprise carried out the reform of property right system, transforming the enterprise from collective ownership into the private one. And the vitality of the enterprise was further activated. In accordance with the industrial policy of cement industry, the company targeted at cement production with new dry process kiln as the development orientation. In 2001, it build a 1000t/d cement clinker production line with new dry process rotary kiln, and in 2003, another 2500 t/d cement clinker production line with new dry process rotary kiln was built in the company. At present, the company has employees 1037, fixed assets of 0.3582 bil. Yuan with an annual cement production capacity of 2.3 mil. t. In 2003, it run out 1.1217 mil. t of cement, realizing a sales income of 0.22806 bil. Yuan and creating a profit of 60.36 mil. yuan, sustaining an operational achievement of winning profit year by year since the enterprise was established.

The company has attached great importance to the technical progress. It has a technical contingent of 128 people, accounted for 12.34% of total employees. In respect of technological equipment, it introduced Ibau homogenizing equipment from Germany, Simens computer on-site controlling station, Pfister rotor weigher, domestic vertical mills, 5-stage cyclone preheater with on-line precalciner and cement grinding system equipped with roller presses and separators, which have been employed in the cement production lines with new dry process rotary kilns. The computer controlling systems, separators, pre-watering granulating technology, frequency variable speed regulators and the other energy-saving equipment have been widely applied in the production lines with mechanical shaft kilns. The company was selected as one of the "National Advanced Enterprises for Energy Conservation and Reduction of Materials Consumption and Efficiency

Improvement", the "outstanding Enterprise in Technical Progress of Zhejing Province", the "Advanced Enterprise for Energy Conservation of Zhejiang Province". The company has an outstanding credit in quality of products, financial affairs and environmental control.. In the aspect of quality of products, as early as in 1995, the company has passed firstly in Zhejiang cement industry quality system attestation of ISO9001 standard and products quality attestation. The leading product of the company---"Jiangshan Tiger" brand cement series was successively granted "provincial Excellent Product" in 1998, "The famous Brand Product of Local Industries of Zhejiang Province" in 1996, "The famous Brand Product of China International Agricultural Fair" in 1999, "The Famous Brand Product of the Zhejiang Province" in 2001, "The National Product Exempt from Examination" in 2002. In 1999, the trade mark of cement of "Jiangshan Tiger" Brand won the provincial famous trade mark. The company was selected "the Advanced Unit for Quality Control among All-China Village and Township Enterprise" by the Ministry of Agriculture of China in 2000, "Famous Brand Creating Key Enterprise among All-China Village and Township Enterprises" by the Ministry of Agriculture of China in 2001. From 1991 to 2002, the company has selected in the 12 successive years "the AAA Class Creditable and Trusty Enterprise" by the China Agricultural Bank. In the aspect of environmental protection, the company one after another has invested over 80 mil. yuan in dust disposal and control. The company passed the examination and check of "One Control and Double Attainments of Standards" in 1999, the examination and acceptance of attainment of standard of environment protection for the 1000t/d cement clinker production line with new dry process rotary kiln by the Environmental Protection Bureau of Zhejiang Province in 2002. The company was selected as an "Advanced Enterprise in Dust Prevention and Collection in Cement Industry" by the Labor Department of Zhejiang Province" in 1998 and in the same year it was selected as an "Advanced Enterprise of 'Six Ones Engineering' of Environmental Protection" by the Environmental Protection Bureau of Jushou City. The 2500 t/d cement clinker production line with new dry process kiln, the construction of which was just completed, has already been equipped with environmental protection facilities according to the requirement of department of environmental protection which were put into operation simultaneously with the operation of production equipment. The company also on successively the honorable titles of "The Key Enterprise of Five First-Batches" of the Zhejiang Province", "The Model Trusty and Creditable Enterprise of the Zhejiang Province", "The Contract-abiding and Credit-stressing Unit of AAA Class" and "Provincial Advanced Enterprise for Comprehensive Utilization of Resources" and so on.

To make enterprise scale even larger and stronger and to upgrade the competitiveness of the

enterprise, the company has started construction of the cogeneration project of 12000 kW generator unit using the kiln back end waste gases from rotary kiln of new dry process. As the next step, it will build a 5000 t/d cement production line with new dry process kiln and other projects, striving to achieve 7.00 mil.t of annual cement output and 2 bil. yuan of sales income in 2010.

The cement enterprise is a large energy consuming unit. To do well the energy conservation work has an important significance in lowering the production cost of cement enterprise, reducing emission of GHG and alleviating tension condition of energy supply. A good economic benefits achieved by the company are inseparable from consistent energy conservation. The company achieved good result in energy conservation in 2003. The comprehensive power consumption of cement production was 79.28 kWh/t, of which 73.71 kWh/t was for mechanic shaft kilns and 85.87 kWh/t for rotary kilns of new dry process. The normal coal consumption of per ton cement clinker was 117.70 kg/t, of which 116.37 kg/t for mechanic shaft kilns and 119.43 kg/t for rotary kilns of new dry process. 1560t of normal coal and 4.70mil. kWh of electricity were saved in the whole year in comparison with the previous year. Thus, in the recent years the company has been selected successively "The All-China Advanced Enterprise in Energy Saving Consumption Reduction and Efficiency Improvement" by the State Commission of Economy and Trade of China", "The Provincial Outstanding Enterprise of Technical Progress", "The Provincial Advanced Enterprise of Energy Saving in the 'Ninth Five-year Plan' Period", "The Provincial Advanced Enterprise in Comprehensive Utilization of Natural Resources" by the Commission of Economy and Trade of Zhejiang Province, "The All-China Village and Township Enterprise with the Best Economic Benefits". Looking back on the works done for the energy conservation an GHG emission reduction by the company in recent years, we can see that the company has mainly done the following two aspects of works and achieved positive results:

A. Carrying out technical renovation for energy conservation, employing energetically new technologies.

1. Carrying out technical renovation with building of cement production lines with new dry process rotary kilns.

New dry process of cement production having the advantages of low-energy consumption, less pollution and high quality of products, has become the main stream of development in cement industry of China in recent years. According to policies of cement industry of "To build

large-scale cement plant, to reform the small and to eliminate the backward one", the company, on the base of demolishing of 2 cement production lines with ø2.2m mechanic shaft kilns, invested 0.105 bil. yuan to build a 1000 t/d cement clinker production line with new dry process rotary kiln in 2001 and invested additionally 0.156 bil. yuan to build a 1500 t/d cement clinker production line with new dry process rotary kiln in the last year.

The production lines with new dry process rotary kilns, built in the company have taken full consideration of energy saving requirement. In the process design, the 5-stage cyclone preheater with off-time precalcining furnace and the high-efficient grate cooler with controlled flow technology of third generation were applied to both lines. For the raw meal grinding, air-swept mill with separator was employed in the first line and roller-press and separator were used for the cement grinding in the both lines. Furthermore, the frequency variable speed regulators, energy-saving electric motors, energy-saving electric fans as well as new types fire-proof, thermo-insulating materials have been widely utilized. The application of a large number of energy-saving equipment has made the enterprise to reach the advanced standard of energy consumption indexes. In the last year, for the 1000 t/d cement production line with new dry process rotary kiln, the comprehensive power consumption for cement was 85.87 kWh/t and the normal coal consumption was 119.43 kg/t clinker, both of which were lower than the designated indexes. According to the design scheme, the indexes of energy consumption for the 2000 t/d production line with new dry process rotary kiln will be even more advanced – the comprehensive power consumption for cement will be only 90 kWh/t clinker and the normal coal consumption will be 107 kg/t clinker.

2. A technical renovation for comprehensive energy saving has been implemented in production lines with mechanic shaft kilns by installation of frequency variable speed regulators. The project of "study on technology for comprehensive energy conservation with application of frequency variable speed regulators "put forward by the company was a project in "Spark Program" registered in provincial commission of science and technology in 1997. The project included 9 items of technical renovation. They were: (1) To use frequency variable speed regulating technique for the ventilator in the production line with mechanic shaft kiln; (2) To use high-efficient deparator and to use frequency variable speed regulating technique in main axis; (3) To use computer controlling technique in frequency variable speed regulating balance of grinding mill; (4) To apply screening technique in limestone and clinker crushing; (5) To apply computer controlling technique to pre-watering granulating in production line with mechanic shaft kiln; (6)

To equip the main electric motor of grinding mill with static phase advancer; (7) To employ computer automatic controlling technique in cement package metering; (8) To apply mill noise controlling technique; (9) To carry out renovation of grinding mill with small diameter.

The total investment for the whole project was 9.5 mil. yuan. This project was examined and appraised by "Spark Program" commission organized by the provincial commission of science and technology in 1998 and was granted Spark Prize of First-Grade of Juzhou City and Spark Prize of Second Grade of Zhejiang Province in 1999. After the project completed, the comprehensive power consumption for cement in the company was lowered by 6.5 kWh/t and nearly 3.00 mil. kWh of electricity were saved every year; the normal coal consumption was lowered by 4 kg/t clinker and 1500 t of normal coal were saved every year. The conservation of energy and coal has brought a reduction of production costs in a sum of about 5.0 mil. yuan to the enterprise every year, at the same time the cement output and the quality of cement were raised remarkably.

3. To carry out the testing and metering of energy balance in the company. To clarify the condition of energy consumption of energy-consuming equipment in the company and to spread out the technical renovation for energy conservation accordingly, the testing and metering of energy balance were undertaken twicely by the Center for Energy Conservation of Zhejiang Province and the Center of Technical Service for Energy Conservation of Jushou City by invitation of the company. Through the testing and metering of energy balance the energy consumption condition of main energy-consuming equipment in the company has been further clarified, providing a basis for technical renovation of energy conservation and normalized operation in the company. For instance, in the testing and metering the low-energy utilization rate of mechanic shaft kiln has been found, the company employed two-layed insulation to the kiln and changed firing mode in the shaft kiln from the shallow invisible flame operation to invisible flame operation, reducing the heat loss, improving the heat efficiency. By calculating more than 2000t of normal coal can be saved every year.

B. To deepen the energy management, to make sure the energy conservation in the practice.

1. To set up special institution for energy control, to perfect the laws and regulations on the energy management. To do well the energy conservation, the company set up a leading group for energy conservation with the general manager as the head of the group and the vice general manager for

production as the deputy head of the group. The member of the group are the number 1 of a set of related departments, such as production department, chemical laboratory and every production workshop. The leading group for energy conservation holds a meeting every month to summarize the experience obtained in energy conservation and to analyse the existing problems in energy conservation and to discuss and decide the measures to solve the problems. The company also set up an energy management section with 5 special administrators. The responsibilities of the energy management section are implementing energy related policies, laws, regulations; formulating and amending the company's energy management regulations and norms; organizing the testing amd metering of energy balance; formulating the energy consuming morms and practicing awards and punishment; organizing the energy conservation measures to be implemented; establishing and perfecting energy consumption statistics accounts and reports. There are at present 17 energy management regulations in the company. The formulation of these regulation makes every department and every worker clear of responsibilities and requirements in respect of energy management and strengthens the energy conservation and materials reduction through their implementation.

2. to widely carry out propaganda and training of energy conservation, enhancing the consciousness and skill for energy conservation of employees. The energy conservation is a long-term strategical principle for the economic development of our country and is also an important link in raising economic benefits of the enterprises. To make the energy conservation the conscious action of employees, the company, applying the opportunity of event of national "Energy Conservation Week" in recent years, has organized "Energy Conservation Month" event every year. In the "Energy Conservation Month" event the company has deeply and widely propagated the energy conservation guide-lines, policies, laws, regulations of the government and the importance of energy conservation work, and has popularize the knowledge of energy conservation among employees using blackboard newspaper, slogan bands, leaflets, pamphlets, as well as meetings and other means of propagada. In respect of laws and regulation knowledge training, the company has done the followings: (1) It organized 4 backbone cadres headed by the general manager to participate in the training course of "Energy Conservation Law" and "The Measures for Implementing of 'Energy Conservation Law' in Zhejiang Province", sponsored by the provincial commission of economy and trade. Though the training course these cadres have well understood and mastered the essentials of "Energy Conservation Law" and its implementation measures, and they would serve as the teachers for the training courses within the company; (2) Organizing a 3 days training course on Energy Conservation Law and the Measures

for Implementing of Energy Conservation Law in Zhejiang Province" for the leading cadres, medium-level cadres and administrative workers of energy management department. The course was directed by the general manager himself and was held in the vocational school of the company; (3) Compiling a set of propagation and learning materials of laws, regulations and related measures for energy conservation and distributing them to every employee to make them aware of knowledge on energy conservation and means for implementation. To achieve the anticipated results of the courses, the company organized examines and competition on energy conservation knowledge within the company in the period of "Energy Conservation Month" and carried out a test and check of energy conservation results of every workshop and team of workers. The advanced collectives and persons were awarded to encourage whole staff of employees to pay more attention to energy conservation.

At the same time with popularization of energy conservation knowledge, the company has successively organized by stages and in turns the operational skill training for the workers of grinding mills, separators, computer operators and kiln operators. Through the training the workers of different energy-consuming equipment have further understood and mastered the skills and means for raising the output and quality of products and reduction of coal and power consumption for clinker firing, that has guaranteed to put the energy conservation work into the practice.

4. To enhance the works on the energy metering and statistics

The energy metering is the basis for energy consuming norm management. To guarantee the accuracy of the energy metering, the company formulated a set of regulations on metering management and vigorously worked on supply, checking and application of metering equipment and apparatus, that made the completeness and qualification rate in periodical test and examination of energy metering equipment reach up to 100% and those of second-grade and third-grade metering equipment reach up to over 98% and 95% respectively. In respect of energy statistics, the company established original records of energy consumption by shifts, groups and main equipment according to the requirement of energy management department of government and the concrete situation of energy management of the company, and made statistic analysis, establish accounts and submitting energy management reports for every main equipment, workshop and the whole company in time.

(1) To strictly implement norm management and awards and punishment for energy conservation. To encourage the enthusiasm of employees in energy conservation the company has made the energy consumption norms as the main assessing index of the economic responsibility system. The results of implementing of energy consumption norm of every workshop and persons of every level and every category have been checked and assessed every month. It has been achieved that the saving on energy was awarded and overconsuming of energy was punished. For the types of work in production, which have a important influence on the condition of energy consumption, such as grinding mill operators, computer controlling operators, kiln operators and separator operators, a high award and heavy punishment system has been used. The energy-saving prize was as high as over 200 yuan for every person every month who did well in energy saving with low energy consumption index, and a fine of 100 yuan has been imposed on every person every month who did bad work in energy saving with high energy consumption. Furthermore, a high prize has been granted to persons who made an outstanding contribution in energy saving. For example, a technician named Xue Shou-fu, who exerted himself wholeheartedly to work and found out the relationship among load, per hour output and energy consumption of the grinding mill through intensive study and raised the per hour output of grinding mill, reduced the power consumption by a big margin by adjusting the grading of grinding media and controlling of particle sized of mill feed material. He was granted 30,000 yuan as a energy-saving prize.

The Hejiashan Cement Co., Ltd. has done a set of work in energy conservation and GHG emission reduction and has achieved a certain result. Nevertheless, the company is aware, that the cement enterprise features high energy consumption, only by deeply and consistently carrying out the energy saving and production cost reduction can make the company gain the initiative, obtain the survival and development in the intense market competition. The company will continuously make great efforts, constantly explore and do the work on energy conservation and material consumption reduction even better and deeper.

5-2-3.2 Zhonglida Group

Zhonglida Group is a diversely developing enterprises group with a stress on the cement production, checked and approved by the State Administration of Industry and Commerce of China. Its existing capital at present is more than 800 mil. yuan, of which 500 mil.t are the capital of cement and like enterprises. The annual production scale of cement in the Group is 1.5 mil.t of P.O. 32.5 and P.O. 42.5 cement. In 2003, the output of cement was 1.393 mil. t, and the sales

income was 330 mil. yuan. The taxes and profits realized were 60.39 mil. yuan. The Group has earned taxes and profits, exceeded 10 mil. yuan, in successive 9 years. It has been elected one of "The Industrial Enterprises with the Best Economic Benefits in the Zheing Province", "The Model Truthful and Prestigious Enterprises in the Zhejiang Province", "Provincial Three-star Enterprises", "Provincial Energy-saving Advanced Enterprises" and so on. It is a backbone enterprise in Zhejiang cement industry and the key distinguished and strongest enterprise in Huzhou City.

The Zhonglida Group is subordinated by ten enterprises, of which the Zhejiang Zhongkaiyuan Cement Co., Ltd., the Zhejiang Zhongshengyuan Cement Stock Co., Ltd. and the Zhejiang Deqing Zhongxinyuan Cement Co., Ltd., are the cement enterprises. The main cement production lines are one 2500 t/d new dry process cement clinker production line (will be completed in April 2004), one 1200 t/d new dry process cement clinker production line, one 800 t/d new dry process cement clinker production line, two sets of ϕ3×10 m mechanical shaft kilns, two sets of ϕ3×11 m mechanical shaft kilns. The cement output of rotary kilns accounts for more than 10% of the total output.

The enterprises have paid great attention to the strengthening of management, energy conservation and consumption reduction. In years, the Group all along has consistently kept on the internal development, no matter how the market has changed. It, keeping eyes on the market, making the effort one the site, has constantly strengthened the internal management, trained to benefit its own ability and formed a set of Zhonglida its own management mode with the core of "following the ten tracks". The energy conservation and consumption reduction are the main content of strengthened management of the Group. In the management for energy conservation and consumption reduction the Group put emphasis on doing the following three works:

1. Metering by grades, checking and examining by levels

The cement production is a large energy consumer. According to production costs, the energy consumption accounts for about 40% of the cement production costs. To reinforce the energy management, on the basis of perfection of laws and regulations and improvement of organizations, the Group has put the stress on the metering of coal on the acceptance at the entrance into the factory and at various links within the factory. And delivery of coal to any users has been strictly conformed to the norm of energy conservation and consumption reduction so that the energy consumption at every link has been always under control.

Firstly, to check strictly the metering of raw coal on its acceptance at the entrance into the factory. No matter it had been metered and tested before, its weight and water content are reweighed and retested. The results are connected with the working achievement of the responsible persons. Failures are tracked to the end troublemakers. There are strict regulations for awards and punishments. Since strict regulations and their implementation the quality and quantity of coal have been guaranteed.

Secondary, the power consumption has been measured by levels. The overconsuming has been punished and power saving has been awarded. For the every link a power consuming norm has been set in accordance with the average consumption level of the last year. The stress has been put on following the track of main equipment with heavy power consumption. To check the workshops and departments by levels. To make the statistics every day, and to live up to the awards and punishment on the same month. The power consumption for the crushing of the limestone, raw meal grinding, mechanical shaft kilns, clinker mills and other main equipment in 2003 was all lowered than the norms set for the last year and at the beginning of the year. The accumulated power conservation of the whole year was 9.50 mil. kWh, and the power consumption of per ton cement was less than 75 kWh, that made the contribution to the lowering of production costs and improving the economic benefits of the enterprise.

2. Saving energy and reducing consumption relying on technical innovation

In the recent years the Group has developed faster with constant expansion of cement production scale. However, in the technical transformation, no matter it was primary or small one, the stress of it has been always put on the energy conservation and reduction of materials consumption.

On the disposition of equipment, a priority has been given to selection of advanced energy-saving equipment. The main ones of them were:

(1) SS9 energy-saving type transformers, which is the state-recommended energy-saving equipment. The capacity of the transformer of the Group is 12000 kWA.

(2) For the electric motors with a capacity of above 55 kW, the Group employs various ways of depressing switch-on. For the wire-winding type of electric motors the liquid speed-regulating

switch on was applied. For the squirrel-cage motor the imported soft switch up was applied. By this way the loss in the line and the impact on the electrified wire netting were greatly decreased.

(3) For adjustable equipment, such as electric fans, etc. the frequency convertors for control were applied, which numbered more than 40 for motors with the capacities over 55 kW only, and even more for the motors with the capacities less than 55 kW. The results of energy conservation are remarkable, and the energy conservation rate reached over 30%.

(4) All electric motors with the capacities over 7.5 kW in the Group were equipped with reactive on-site compensators, and furthermore, in cooperation with the plant and electric transformer station's centralized compensation the power factor of the whole Group reached over 0.95. Various kinds of losses in line were lowered down to the minimum. All these created not only better economic benefits to the Group, but also more wealth to the state electric wire netting.

The Group has been constantly optimizing the production technology to saving energy and to reduce the consumption of materials:

(1) For the newly built three cement production lines with new dry process kilns in the recent years, the energy saving technology was employed. The heat from the kiln back-end was used for raw meal drying, that reduced the links for raw materials drying and raised the output of medium grinding, the result of energy conservation is remarkable.

(2) The water for the cooling of the equipment in the newly built production lines is supplied by circulating water pumps. The utilization rate of circulation water is over 90%. A lot of electricity and water resources are conserved.

(3) To increase the unit output of grinding machine a technical transformation of raw meal grinding machine for mechanical shaft kiln was undertaken. A closed crush-screen system was introduced so that the particle size of feed materials was diminished and uniformity of materials fed into the mill was controlled, as a results the unit output of the mill was increased and the power consumption was decreased remarkably.

3. To upgrade the consciousness of energy saving, to start from every bit detailed things and to put an end to waste.

The most essential in the management of energy conservation and material reduction of the enterprise is the management over the employees. On the basis of strengthening of the education of the employees, the Group emphasized on establishment of three systems: The first is the restricting system by laws and regulations. To make the energy conservation and materials reduction works systematized and normalized. To normalize and restrict behavior in the work by the laws and regulations. Secondary, to implement encouraging system in the distribution. To make the energy conservation and materials reduction works quantitated and detailized. To give full play to economic levers. To award ones who make contribution to energy conservation and reduction of materials and to punish the violation of the laws and regulations on the energy conservation and reduction of materials consumption. Thirdly, to carry out a idealogical encouraging system. To encourage every one to participate in energy saving management over oneself. The consciousness of energy conservation of the employees of the Group was greatly upgraded through the implementation of these series of measures. To constantly enhance the management, the Group has carried out "Looking for Problems" event twice a year to seek the problems in energy and materials consumption and to put forward the improvement and prevention measures. With the deepening of the management the energy conservation and reduction of material consumption activities have been sustainedly developing.

Appendix 2:

Part 6 Survey reports on cement industry in Zhejiang, Hubei and Shandong Province

A. A survey report on cement industry in Zhejiang province

A-1 The current situation and furture forecast of cement industry in Zhejiang province

A-1.1 The current situation of cement industry in Zhejiang Province

A-1.1.1 General condition and output of cement enterprises in Zhejiang Province

Zhejiang is a large cement producing province in China. Since reform and opening up, the cement industry in Zhejiang Province has developed with high speed. The average increase rate of cement output has been over 15%. At present, there are more than 360 cement enterprises in Zhejiang Province, of which 266 are over scale cement enterprises (i.e. state-run cement enterprises and enterprises of other ownerships with an annual output value of 5mil. yuan and over), and private enterprises and enterprises of other economic types account for 97% of the total. The number of direct employees is about 0.1 mil.. The total cement output of the province in 1999 was 37.95 mil. t, ranking sixth in the country. Nevertheless, generally speaking, the technological standard of cement industry in Zhejiang Province is low, and technological equipment there is backward. By the end of 2002, existing cement production capacity of new dry process was 13mil. t, accounting for 24.8% of the total ones. Up to now, among about 500 different cement kilns in the province there are altogether 29 new dry process production lines being constructed and coming into operation, among which one was with a capacity of 5000 t/d, 12 of 2500 t/d capacity, 16 of 1000-1500 t/d capacity (3 wet milling dry firing production lines excluded), 4 production lines of 4000-5000 t/d capacity are being under construction. By the end of 2003, the proportion of cement production lines of new dry process will reach about 40%. The cement outputs in Zhejiang Province between 1990 and 2002 are shown in table 1.

Tab. 1 The cement outputs of Zhejiang Province between 1990 and 2002 ($\times 10^4$ t)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Output	1340	1622	1966	2226	2698	3265	3547	3430	3434	3795	4257	4763	5793

The cement output in Zhejiang Province in 2002 was 57.93 mil. t, increasing by 18%, comparing with that in 2001. The total output there ranked fourth in the country, accounting for 8%. Among all output, that by new dry process was 8.15 mil. t. The cement output by new dry process, covering that from cement grinding plants, was 11.15 mil. t, accounting for 19.2%of whole provincial cement output.

A-1.1.2 The major economic indexes of cement industry in 2002

In 2002, products sales income was 1.37 bil. yuan, which were 102.32% of production values, increasing by 16.8%, over the previous year, accounting for 60% of the national total. Total profit was 0.88 bil. yuan, increasing by 27.5% over previous year, accounting for 19% of the national total. The gross profit ranked first among different provinces of the whole country, which over-passed firstly Shandong Province, outputs and profits of which have ranked first in whole industry in previous years, creating a new pattern of fifth largest outputs and first largest profits. The sales rate of cement was 98%, 4% higher over whole country's average level. The amount of bulk cement was 24.39 mil. t, increasing by 33% over previous year. The bulk cement rate was 42.7%, 18.4% higher over whole country's average level. The total number of employees was over 0.1 mil., accounting for 6.7% of that in whole country's cement industry. But the cement output of the province accounted for only 7.8% of the national total. The fact illustrates that the personnel labor productivity was higher over whole country's average level by 1.1%. Tab. 2 shows the major economic indexes achieved by the cement industry of Zhejiang Province in 2002.

From tab. 2 it can be seen, that the average production scale, labor productivity, management level and product prices, etc. of cement industry of Zhejiang Province are higher over national average level by a big margin, especially it achieved the highest contribution rate in the country by the number of deficit incurred enterprises and gross profits.

The statistics of clinker and cement production capacities of kilns of different types in Zhejiang Province in 2002 is shown in tab. 3.

Tab. 2 Major economic indexes achieved by cement industry of Zhejiang Province in 2002

Main economic indexes	Zhejiang	Proportion of national total,%
Output (Mt)	57.93	8.15
Number of enterprises (enterprises)	2.49	5.38
Deficit incurred enterprises (enterprises)	0.47	3.21
Total industrial output value (bil.yuan)	13.66	8.84
Industrial added value (bil.yuan)	3.56	7.37
Sales value (bil.yuan)	13.39	8.88
Sales income (bil.yuan)	13.70	9.51
Gross profits (bil.yuan)	0.88	18.92
Gross taxes (bil.yuan)	1.05	9.90
Volume of bulk cement (Mt)	24.39	14.26

Tab. 3 Clinker and cement production capacities of kilns of different types in Zhejiang Province

Cement production lines (kiln types)	Clinker capacity (t/d. kiln)	Actual in 2002		
		Production lines (line)	Clinker capacity (Mil.t/a)	Cement capacity (Mil. t/a)
New dry process total		30	11.58	15.40
New dry process	<700	1	0.18	0.20
New dry process	1000	21	6.30	8.40
New dry process	2000	6	4.50	6.00
Wet milling dry firing	<2000	2	0.60	0.80
Preheater kiln total		12	1.40	1.90
Cyclone preheater	<600	4	0.30	0.40
Cyclone preheater	≥600	5	0.90	1.20
Shaft preheater		3	0.20	0.30
Dry hollow kiln total		17	1.67	2.20
Dry hollow kiln	<500	7	0.17	0.20
Dry hollow kiln	≥500	10	1.50	2.00
Of which: without cogeneration		6		
Wet process kiln total		22	1.30	1.70
Wet process kiln	<500	6	0.55	0.70
Wet process kiln	≥500	5	0.75	1.00
Shaft kiln total		415	30.78	41.00
Improved Shaft kiln		60	5.22	7.00
Mechanical Shaft kiln		355	25.56	34.00
Ordinary Shaft kiln				
Overall Total		496	46.73	62.20

A-1.1.3 Major techno-economic indexes approached advanced standard at home and abroad

The most new dry process cement production lines in Zhejiang Province are at trial production stage. The major techno-economic indexes of these lines approached the advanced standard at home and abroad (see tab. 4).

Since in operation of new dry process production lines advanced de-dusting equipment and hermetically-sealed installations are applied, fuel consumption is lowered, the total discharge volumes of dust and toxic and harmful gases are greatly reduced, and clean production standard is gradually heightened. At present, one of cement enterprises has taken the lead in passing ISO 14000 international attestation. Some of finished projects of 1000 t/d and 2000 t/d capacities production lines have passed provincial environmental protection examination and acceptance. The detailed indexes comparison is shown in tab.5.

Tab. 4 Comparison of techno-economic indexes of different technologies

Items	Advanced level of new dry process	New dry process in Zhejiang Province	Wet process	Wet milling and dry firing	Mechanical Shaft kiln
Normal coal consumption (kg/t)	100 ~ 110	110 ~ 120	207 ~ 220	129 ~ 136	130 ~ 140
Comprehensive power consumption (kWh/t)	85 ~ 90	95 ~ 100	85 ~ 100	90 ~ 100	70 ~ 90
Labor productivity (t/a. labor)	10000 ~ 15000	4000 ~ 6000	600 ~ 800	1500 ~ 2000	400 ~ 500

Tab. 5 Comparison of pollutant emission indexes

Items	Podwer (flue) dust t mg/Nm^3	SO_2 (mg/m^3)	Fluorides (mg/m^3)
Mechanical shaft kiln	≥150	400 ~ 600	37
New dry process kiln	≤50(advanced 10 ~ 30)	12 ~ 22	5

A-2 Measures for restructuring of structure of cement industry in Zhejiang Province and existing problems

A-2.1 Measures for restructuring of structure of cement industry

(1) To eliminate backward production technologies, to raise the concentration of enterprises

In 1998, there were 408 cement enterprises in the province. The average scale of production was 90000t. Of 734 cement production kilns the number of shaft kilns reached 674, which accounted for 91.8%. Whereas the rotary kilns made up 17% of the whole provincial total output, which was lower by 3% the national average level. Among shaft kilns one third belonged to the category, which was subjected to be eliminated by the formal decree stipulated in state industrial policies. and most of rotary kilns were the backward ones with high consumption, low efficiency and small scales. Up to 2000, there were only 6 precalcination production lines all over the province which represent the advanced cement production technology, and there was no single production line of new dry process with a capacity over 2000 t/d. The cement output by now dry process rotary kilns amounted only to 2% of the total cement output, which was far behind the national average level of 10%. The backward technological equipment and low standard product structure of cement industry in Zhejiang Province formed a strong contrast with the leading position of Zhejiang Province in national economic development.

Since 1998, according to the state industrial policy for the cement industry of "To readjust the structure and to control the total output", the government of Zhejiang Province facilitated the shaft kiln demolishing and output reducing work, centering on "to control the total output and to eliminate the backward production capacities", disassembled mechanical kilns with kiln diameter less than 2.2m, through applying the law, administrative and economic means. Through more than 3 years' backwardness eliminating work, by the end of 2001, 230 mechanical shaft kilns have been demolished all over the province, reducing backward production capacities by more than 10 mil. t. 23 mil. yuan of subsidiary funds for demolishing shaft kilns were put into the work by the provincial finance. The number of cement enterprises of the province has reduced from over 400 to 295. The total cement output reached 42.36 mil. t. The average scale of cement enterprises has raised to 0.146 mil. t. The concentration rate of the industry upgraded by 50%. Under the condition of "cement supply falling short of demand" in 2002, 19 mechanical shaft kilns closed up successively. The number of cement producing enterprises has been further reduced to 276. The total cement output amounted to 57.93 mil. t. The average scale of cement enterprises reached 0.21 mil. t. The concentration rate of enterprises has been raised again by 50%. Starting from 2001, the government of Hangzhou City has renovated the shaft kiln enterprises surrounding the city, and closed and stopped 20 shaft kiln enterprises, demolishing 42 mechanical shaft kiln production lines, reducing 3.5 mil. t production capacities, disposing 1.12 bil. yuan enterprises' assets and displaced 9500 employees.

(2) To speed up the development of new dry process cement, satisfying the market demand

In less than 4 years since 2000, a great change has appeared in Zhejiang cement industry. The modern new dry process kilns sprang up like bamboo shoots after a spring rain. The small shaft kiln enterprises one after another have been setting up new dry process cement production lines. According to incomplete statistics, in a period from the second half of 2000 up to the end of 2000, over 10 bil. yuan have been invested in construction of new dry process kilns with daily cement clinker production capacities of 2000 t and over.

More than 60 projects have been applied and approved to set up. By the end of 2002, 20 production lines have been constructed and put into production. The total annual production capacities of them are 13 mil. t. The production capacity of new dry process cement has reached over 20% of the provincial total capacity, which firstly surpassed the national average level.

The embryonic forms of four advanced cement production bases, Quzhou cement clinker base, Jiande cement clinker base, Fuyang cement clinker base and zhuji and Changxing cement clinker bases, have begun to take shape.

Private capitals have catalyzed the great changes in the Zhejiang's cement industry which not only have made the new dry process cement production develop rapidly in the province, but also made the Zhejing's cement industry march by a large pace westwards and northwards, forming an industrial layout of all-round development with their footmarks scattered over 26 provinces (municipalities, autonomous regions) all over the country. The province has made investment with an amount of over 5 bil. yuan in different locations throughout the country. There are more than 180 cement production enterprises invested in different forms by Zhejiang Province which scatter in Anhui, Jiangxi, Hunan, Beijing, Liaoning, Shaanxi and other provinces (municipalities and autonomous regions). Not a few of them are focusing on large-sized new dry process cement production.

In Beijing, a 2500 t/d new dry process production line, invested by Zhejiang Lima Group, has built and been put into production. In Shaanxi Province, a 2500 t/d production line, invested by Zhejiang Shengwei Building Materials, has been put into operation, and another 5000 t/d production line is being paid close attention to for registering. Zhejiang Jinyuan Cement has invested two 2500 t/d production lines in Hubei Province, construction of which will start soon. In Tongling of Anhui, Zhejiang Zhuji Enterprise has two 5000 t/d and one 10000 t/d production base projects. In Anqing, several large-sized cement production projects, planned to be invested by Zhejiang Province, are under negotiation, which is moving forward smoothly. In Guangde,

Zhejiang ""Shanshi", Zhejiang Zhonglide, Zhejiang Dongxing, etc. have settled. Entering into 21 century, vigouous Zhejiang private entrepreneurs, having seen rare opportunities of investment in new dry process cement industry, are concentrating their capitals on construction of new dry process cement production.

In April 2002, in Lanxi, Jinhua, shaft kilns concentrated area, Zhejiang Hongshi Cement Co. invested a 2000 t/d clinker new dry process cement production line, which has been put into production putting an end to cement industry history in Zhejiang of lack of large-sized new dry process cement production. And it is a right enterprise invested by several original private shaft-kiln enterprises combined in joint stock form. Simultaneously, industrial capitals within and out of the cement industry have invested one by another in this field, Among them not a few are famous, such as Black Cat group, Furen Group, Shangfeng Package, etc.

Zhejiang's state-run cement enterprises also have come into new dry process cement business with vigorous strides, employing market operating mechanisms and absorbing boldly private capitals. "Shanshi" is the largest state-run cement production enterprise. On entrance into the new century, the wet process cement production prevailed in the company. A big stride has been brewing for two years. In May, 2002 in Changxing, "Shanshi" own location, the first 2500 t /d new dry process cement production line went into operation. In Donglu county, far from "Shanshi" head-quarters, two 2500 t clinker/d production lines went into operation. Not far afterwards, a new dry process kiln of larger scale laid foundation in Jiande. In Jiangxi, the company intends to invest in two 5000 t clinker/d capacity new dry process cement production lines.

According to incomplete statistics, the sum of capitals invested in new dry process cement construction accounts for over 90% total investment in all provincial cement projects, so that a quantitative and qualitative stride has been made in Zhejiang cement industry in less than 4 years. Experts forecast, that the resources of limestone is concentrated in four districts of Zhejiang Province, Changxing, Jiande, Fuyang(including Donglu), Changshan(including Jiangshan) and Lanxi(including Jinhua), where cement clinker production capacities reach separately between 7 mil. t and 12 mil. t. According to the basic conditions and market potential capacities, besides rational construction of several cement grinding plants, the annual cement production capacities in these districts will reach between 100 mil.t and 15 mil.t. Thus, the modern cement production bases in Zhejiang Province will be formed.

The occurrence of present situation of Zhejiang's cement industry, in one side, is a result of good

investment benefits and in other side, is because of energetic guidance of macro-readjustment policies of the government, whereas in the last 10 years of the twentieth century, Zhejiang's cement industrial circles have paid more attention to shaft kiln development, So the development of new dry process cement production lagged behind the whole country. However, after entry into 21 century, within less than 4 years, the production scale and standard of new dry process cement production have put the province in the ranks of advanced ones. Among all the investment benefits are the most essential. At the beginning, for construction of a 2000 t/d clinker/d production line of new dry process, a total investment of 0.7-0.8 bil. yuan were needed, which reached more than 1 bil. yuan for the investment in a larger project. The construction period lasted 2 to 3 years. The enterprises had very heavy pressure for debt repayment. Whereas construction of shaft kilns required far less investment than that for new dry process kilns. Furthermore, the repayment in case of shaft kilns was faster. In the recent two years, the rate of domestic production of equipment of new dry process cement production lines has reached over 90%, so the investment in new dry process cement production line construction has decreased by a big margin, and the period of construction has shortened. At the same time, a new round of rapid development occurred, the cement market demand has been much heated, a new rush on construction of new dry process cement production lines by private capital investment has been rising. The enthusiasm of Zhejiang private enterprises in investment in new dry process cement production is also a natural result under the market economy condition.

Under the guidance and powerful macro-readjustment of industrial policies of the government, in a period of 3 years starting from 1999, the Zhejiang Province firstly in the country eliminated backward "small cement ". The provincial government collected 23 mil. yuan special funds for demolishing shaft kilns and reducing cement output by shaft kilns, and local governments have allocated a lot of complementary funds as well. In the 3 years over 230 small mechanical shaft kilns have been dismantled, and over 10 mil. t backward shaft kiln cement production capacities have been eliminated, evacuating large market space for development of new dry process cement production.

In 2000, the Economic an Trade Commission of Zhejiang Province issued the first industrial guidance policy –"The Guidance Suggestions on Structure readjustment and Development of Cement Industry in Zhejiang Province", which further clarified policies and measures on encouraging and supporting the construction of new dry process cement production, restricting new construction and expanding shaft kiln cement production, eliminating equipment and

technology for backward small-sized cement production. It made the problems of "what to eliminate", "what to restrict", "what to support" very clear and perfectly guided the direction of investment of enterprises. The first 2500 t/d clinker new dry process cement production line started to construct not long after this. Then a rush of construction of modern new dry process cement production lines rapidly rose throughout the province. With the fast development of the construction of new dry process cement production lines, the governmental departments concerned, losing no time, issued a series of policies and measures, striving to eliminate small-sized cement enterprises by market operating mechanisms to form a proper market order benefiting the development of new dry process cement production.

Since 2001, the total investment in cement projects, which have been completed or approved to be constructed, is 11.719 bil. yuan, of which, 4.337 bil. yuan are bank loans accounting for 37.05 of total investment, 6.387 bil. yuan are enterprises' individual funds or stock cooperative funds, accounting for 54.55, foreign (including funds from Hong Kong and Taiwan) funds 0.994 bil. yuan, accounting for 8.5%. From there it can be seen, that the sources of Zhejiang cement projects investment are mainly private ones.

By the end of 2001, accumulated number of new dry process production lines, passed examination and approval was over 30, of which 8 were constructed and put into production in that year. In 2002, another 20 odd new lines were approved and 12 of them were put into operation in that year. By the end of 2002, the production capacity of newly constructed new dry process production lines was 13 mil.t, accounting for 22.4% of the provincial total. Up to now there are 29 new dry process production lines in operation, of which one of 5000 t/d, 12 of 2500 t/d, 16 of 1000-1500 t/d (three wet-milling dry firing process production lines are excluded). There are 4 cement production lines with daily capacities of 4000-5000 t/d being in construction. By the end of 2003, the proportion of capacities of new dry process production lines in Zhejiang Province will reach about 40%. It is estimated, that by the end of 2005, the proportion of capacities of new dry process production lines of whole province will be over 60%. It is needed to indicate, in particular, that since implementation of structure readjustment of cement industry in 1998, except for construction of new dry process production lines, no cement production lines of other kiln types have been newly constructed in Zhejiang Province.

In Zhejiang Province, the private economy is very vigorous, becoming the strongest driving force in economy development, making the cement industry in the province from shaft kiln leading

industry to new dry process leading one.

A-2.2 Main Problems Existed in Zhejiang's Cement Industry

(1) The scale structure of enterprises is irrational.

The structural contradiction in Zhejiang's cement industry hasn't been essentially resolved. The production capacities of mechanical shaft kilns are still great. The environmental pollution problems caused by mechanical shaft kiln cement production technology haven't been fundamentally solved. According to statistics, the average scale of existing cement enterprises in zhejiang Province is 0.154 mil. t. Among all cement enterprises in the province the number of large- and medium-sized enterprises is 46, accounting for 16%, whereas there is only one large-sized cement enterprise with an annual output of about 2.40 mil. t. At present, there are 415 mechanical shaft kilns in the enterprises which passed examination of production licences in Zhejiang Province. Their total production capacity is 45 mil. t. By the end of "Tenth Five-year Plan", calculating on basis of annual cement demand of 77 mil.t in the Zhejiang Province, to achieve 60% of new dry process cement production in the province, a production capacity of mechanical shaft kilns of over 15.0 mil. t should be eliminated, and annual cement production capacity of new dry process production lines should reach 47.0 mil. t. So, it is a must to further speed up the elimination of mechanical shaft kilns and construction of new dry process production lines.

(2) The technological structure of enterprises is irrational

There are some 500 cement kilns of different types throughout the province at present, of which the number of shaft kilns accounts for about 90%, ordinary rotary kilns 8.5%, new dry process kilns 1.5%. In the recent years, though different improvements have been undergone for the mechanical shaft kilns, achieving a lot of results, due to restriction of technology, no breakthroughs were made as regards to quality consistency of cement products, dust disposition, labor productivity, etc. The replacement of shaft kiln technology by new dry process is the trend of times. In respect of ordinary rotary kilns, the majority of them is wet process kilns and hollow cogenerative, the technological level of which is equavalent with that in 1930's with high energy consumption and is inferior clearly to new dry process kilns. The cement output by new dry process occupies only 4% of total output of the province, which is below the national average level of 10%.

By the end of 2002, the number of operating new dry process cement production lines is 30, of which there is only 8 production lines with a capacity of 2000 t/d and the remainders are those of 1000 t/d and below. The production scale of single line is strongly incoodinative with the economic environment of Zhejiang Province. The industrial administrative department of Zhejiang Province has already paid much attention to the situation.
Thus, the organization structure and industrial concentration of cement enterprises are remained to be further improved.

(3) The situation of limestone resources is not optimistic

The proven limestone reserve in Zhejiang Province is about 1.8 bil. t, of which mineable reserve is 1.2 bil. t, which can only meet 25 to 30 years needs for an annual cement production of 50 mil. t. Additionally, most of limestone mines are irregular with heavy waste of resources. As a result, the effectively applicable resources are much less. Though there are additional unproven reserves, due to environmental protection, ecological equilibrium and tourism needs etc., a considerable part of the unproven reserves is unusable.

(4) The environmental pollution is heavy

Though in recent years a certain achievement has been made in disposition of dust contamination in cement enterprises, the environment pollution of mechanical shaft kilns is still heavy. Especially, mechanical shaft kiln enterprises around the cities not only bring about much pollution to the cities and their surrounding ecological environment, but also affect the natural landscape. Besides dust contamination, the shaft kiln cement enterprises also emit carbon dioxide and noise.

To dispose dust emitted by the mechanical shaft kilns is a heavy duty, and the elimination of mechanical shaft kilns, step by step is the key point in permanently harnessing of the heavy pollution.

A-3 The current situation and development trend of cement market in Zhejiang Province

A-3.1 The current situation of cement market in Zhejiang Province and its economic operating situation

The cement market in Zhejiang Province is very vigorous. Since 2003, cement industry in Zhejiang Province is thriving in both production and marketing. The cement price is going up on the relatively stable basis. All total indexes are all-time high. From January to June, the accumulated cement output of whole province is 33.10 mil. t, up by 29.5 % over the same period of last year. Realized product sales income is 7.6 bil. yuan, up by 25.6% over the same period of last year. Realized total profit is 0.354 bil. yuan, up by 57% over the same period of last year. From the situation in the first half of 2003 it is seen, that the total production increased in pace with the economic benefits. A new high was created on the high base of 2002. Since the beginning of 2003, the cement price has been going up month by mouth. The selling price per ton of ordinary bagged 32.5 cement for the whole province was raised by between 10 and 30 yuan differently, comparing with the beginning of the year. A "supply falls short of demand" situation of cement occurred, which was very rare in the recent years. The fulfilled production, sales income and price are shown in tab. 6. Fig.1 shows production and operation situation in cement industry in the first half of 2003.

Tab. 6 Fulfilled situation of production, sales and price of cement industry in the first half of 2003

	January	February	March	April	May	June
Output Mil. t	4.45	3.27	550	6.48	6.51	6.60
Sale income Mil. yuan	985.67	809.34	1315.18	1446.19	1459.46	1560.10
Profit Mil. yuan	8.01	6.55	46.05	68.38	95.02	129.77
Price of P.O32.5 yuan/t	193.69	185.66	187.67	190.11	194.92	203.51

In this round of investment upsurge in cement industry Zhejiang Province is glaring. From the second half of 2000 to the end of 2002, over 10 bil. yuan in the whole province were invested in construction of 2000 t/d clinker new dry process kilns. Over 60 new dry process production lines have been approved to construct in the province. In just 2 odd years, Zhejiang Province achieved the target of five-year's program.

It's known, that over 90 shaft kiln cement production lines are located around Hengzhou City, a beautiful tourism city, The total annual output of these enterprises is accounting for 80% of total cement output of the city. In recent 2 years, the municipal government closed or ceased a set of shaft kiln production lines with high energy consumption and high pollution every year. But this is a heavy burden for the government, especially the cement price is so high in this year, to close or cease these shaft kilns is very difficult. So, this should be done by means of market economy.

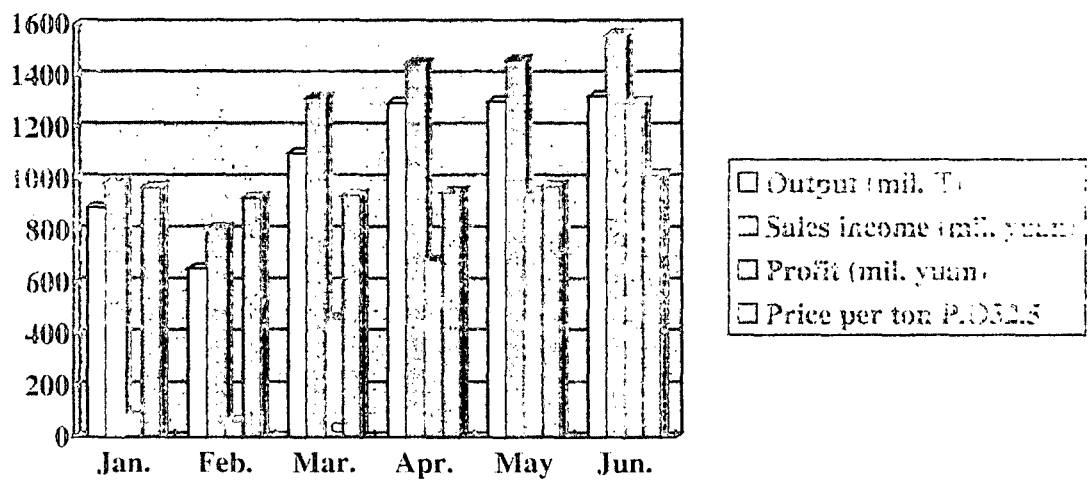

Fig. 1 Diagram of production and operation situation in cement industry in first half of 2003

As a matter of fact, Zhejiang cement industry has started to carry out "go out" strategy to avoid concentrated development of cement industry in a single area. Up to now, Zhejiang cement capitals have scattered over 26 provinces (municipalities or autonomous regions), investing in over 180 cement enterprises.

The government of Zhejiang Province continues to speed up the structure readjustment of cement industry on the one side, and avoids repeated construction of small-sized and low-benefit cement projects through heightening threshold of the industry on the other side. So, the Economic and Trade Commission of Zhejiang Province and governmental departments decided in last year no

longer to examine and approve the construction of production lines with a capacity below 2000 t/d. A few days ago, adjusting the "Tenth Five-year Plan" of Provincial Cement Industry, the Economic and Trade Commission of Zhejiang Province raised the threshold of capacity of cement project for investment to over 4000 t/a, restricting construction of projects below this scale.

At present, the general economic operating situation of cement industry is "supply falls short of demand". The existing outstanding problems are mainly as follows:

(1) Electricity supply falls short and is unable to give full play to production capacity of cement production lines.

(2) With the gradual stabilization of cement market demand, the problems with elimination of mechanical shaft kilns will break out.

A-3.2 Analysis and forecast of cement market demands in Zhejiang Province

The population in Zhejiang Province is 46.47 mil. By the end of 2002, the per capital cement accumulated consumption is 10.16t (1983-2002). The per capita annual cement consumption in Yangtze River Delta area is 0.91 t. From development trend it is seen, that the top point of cement consumption in Zhejiang Province should occur around 2010. Since the beginning of implementation of "Tenth Five-year Plan", with the rapid development of national economy, the rapid increase of fixed assets investment and thriving real estate, etc. have drawn up steady increase of cement demand. The cement output of Zhejiang Province has kept constantly at a rapid growth trend. It increased by 12% in 2001 over the previous year, and by 18% in 2002. In a period from January to June 2003, it increased by 29% over the same period of previous year. At present, supply of cement still falls short of demand. According to forecast by the cement supply and demand trend, the cement output of Zhejiang Province in 2003 will break through 70 mil. t. That in 2005 will over 80 mil. t. The production capacity of new dry process production lines in Zhejiang Province was 13 mil. t, accounting for 22.4% of total provincial cement production capacity. The production capacity of new dry process production lines will reach 23-25 mil. t by the end of 2003, accounting for about 35%. That will be 45 ~ 50 mil. t by the end of 2005. According to "the Guidance Suggestions on the Cement Industry Development in the last 3 years of "Tenth Five-year Plan" period, the proportion of production capacity of new dry process cement production lines will reach over 60% up to 2005. It is striven to attain over 90% by the end of the Eleventh Five-year Plan period, and thus the structure readjusting task of cement production

in Zhejiang Province will be basically accomplished. The increase of cement demand will be satisfied through the development of new dry process cement production. The development targets of cement industry in Zhejiang Province in 2005 are shown in tab. 7.

Tab. 7 Development Targets of Cement Industry in Zhejiang Province in 2005

Total output (Mil. t)	New dry process		Rate of bulk cement (%)	Reduction of Production capacity of shaft kilns (Mil t)	Average scale of enterprises (Mil. t)	Environmental protection		Technical targets of new dry process		
	Output (Mil.t)	Proportion (%)				Up to standard rate %	Pollutant reduction (1000t/a)	Heat consumption of clinker (kgcoal/t)	Comprehensive power consumption (KWh/t)	Laborproductivity (tcement/labor.a)
77.00	47.00	60	54	15.00	0.35	100	0.20	110	90	4000

From the cement production development trend at present it is seen, that the proportion of new dry process cement in Zhejiang Province in 2005 will attain 61.4%, surpassing the restructuring targets. The production capacity in Zhejiang Province will reach 84 mil. t of which that of new dry process will over 41 mil. t. The total cement output and output of new dry process cement both present upward trend and outputs of kilns of other type will go down (see tab. 8).

Tab.8 Proportion of clinker or cement produced by various kilns in 2002 and 2005 respectively

Kiln type	Proportion of clinker in 2002 (%)	Proportion of clinker in 2005 (%)	Proportion of cement in 2002 (%)	Proportion of cement in 2005 (%)
New dry process	24.8	61.4	24.8	59.9
Preheater kiln	3	1.7	3	1.8
Dry hollow kiln	3.6	2	3.5	2
Wet process kiln	2.8	16	2.7	1.7
Shaft kiln	77	33.3	65.9	34.6

A-4 Guidelines, Targets and Main Policies and Measures on the Structure Readjustment and Development of Cement Industry in Zhejiang Province

A-4.1 Guidelines and Development Targets

Guidelines: Taking the market as a guide, speeding up the development of advanced technology, enhancing the strength of elimination of backward technologies, making more effort on optimization of structure of cement industry to change Zhejiang Province from a large cement producing province into a powerful cement producing province.

Development targets: To upgrade the proportion of output of new dry process cement in Zhejiang Province from 4.5% of the total provincial output by the end of "Ninth Five-Year Plan" period, eliminating 5 mil. t of backward production capacity.

4.2 Main Policies and Measures for Development of Cement Industry in Zhejiang Province

4.2.1 To accelerate the elimination of mechanical shaft kilns and structure readjustment, using combination of policy guidance and operation mechanisms of market economy

In recent years the cement market demands have increased rapidly, The increment of cement production capacities of newly constructed new dry process production lines had been absorbed by increase of market demands. The shaft kiln cement production has still had good economic benefits. This enhances the hardness for elimination of mechanical shaft kilns. To ensure the structure readjusting targets of cement industry in Zhejiang Province to be realized, multiple measures of policy guidance and operating mechanisms of market economy should be taken.

(1) Making full use of policies of comprehensive utilization of resources, applying regulating role of taxes, using inclinable taxing policy in favor of new dry process cement production enterprises, strictly implementing "Suggestions on attestation work on comprehensive utilization of resources in cement enterprises of our province" (Zhejiangmaoxhiyau [2003]No. 39), to restrict for the mechanical shaft kiln enterprises the enjoyable rights stipulated by policies.

"Suggestion" requires that" Implementation Measures for Attestation of Enterprises (projects) of Comprehensive Utilization of Resources of Zhejiang Province" (Zhejiangmao Zhiyuan[2001]No.2703) should be continuously carried out. To strictly normalize the work of attestation of resource comprehensively utilizing enterprises. To enhance examination over application forms submitted by the enterprises applying for attestation, and to calculate and attest individually in accordance with production technologies. Starting from 1st January, 2003, the mechanical shaft kiln cement production enterprises with an annual cement production of 0.15 mil.

t and less, the production line (or enterprise) of mechanical shaft kiln with a diameter of kiln of 2.6 m and less, mechanical shaft kiln production lines promised to be eliminated on application for construction of new dry process cement production lines or cement grinding plants, the cement production lines required to be eliminated within a definite time by the orders of people's governments at central, provincial or municipal, county (city, district) levels, cement production enterprises been punished due to environmental protection accidents, production safety accidents will be not allowed principally to apply for attestation within 2 years.

To encourage the enterprises to develop bulk cement, it is required to the attestation applying enterprises, that the rate of bulk cement for the rotary kiln production kilns should principally reach 50% or over, and 70% or over 2 years later, that for the mechanical shaft kiln production lines should be 40% or over.

"Suggestions" requires, in order to earnestly enhance the supervision and control over the rate of comprehensive utilization of natural resources and environmental protection and safety works of the enterprises applying for attestation, to firmly promote clean production, the enterprises, applying for attestation for a title of "enterprises of comprehensive utilization of natural resources", should be certificated to be up-to standard in pollutants emission by administrative departments for environmental protection before application.

(2) To further implement" circular on strengthening the control of cement application in construction engineering in our province" (ZhejiangmaoJianyemai[2002]No. 1273), to enhance the supervision and checking strength over restriction and application of mechanical shaft kiln cement in key engineering, concrete mixing plants, cement manufactured products enterprises, transportation and water conservancy engineering projects, multistory building construction, etc., to speed up the pace of elimination of mechanical shaft kiln cement by means of market operation.

(3) To strictly implement state environmental protection policies, to manage by laws, to enhance the environmental protection examination and measurement strength. To firmly close an cease the enterprises which are unable to attain up to pollutant emission norms and mechanical shaft kiln enterprises which are located in environment sensitive or tourism areas.

(4)To strictly implement state industrial policies in the examination process of issuing cement production licenses, In order to ensure smooth implementation of provincial cement development

plan and rational distribution of cement enterprises, the newly applying cement projects should be examined and approved by the provincial or central governments in accordance with limits of authority. All newly built new dry process cement production lines should apply for examination of cement production licenses after 3 to 6 months' operation.

(5) To collect funds through multiple channels, to promote the development of cement industry. To develop new dry process cement production lines, especially large-sized lines, a large amount of funds are needed. Therefore, it is a necessity to collect funds through multiple channels. Firstly, to energetically strive to make the 2000 t/d and over capacity new dry process cement production lines projects to be included into state debt or state technological transformation plan, to win over state special loans and financial interest deducted funds. Secondly, to absorb energetically foreign funds for investment in construction of large-sized cement enterprises. To encourage large enterprise and large groups out of cement industry to invest in development of cement industry. Thirdly, to encourage and absorb private funds to construct new dry process cement production enterprises through normalized operation. Fourthly, to encourage and support large-sized backbone cement enterprises to participate in distribution of share certificates or to be listed to collect funds for development.

(6) To prohibit the construction of production lines of backward technology. To prohibit new construction or expansion of different types of shaft kiln production lines. To prohibit development of mechanical shaft kilns through enlarging diameter of kiln or expansion production in the name of technical renovation. To prohibit new construction and expansion of wet process kilns, Lepol kilns and hollow kilns. To eliminate all shaft kiln cement production lines with a diameter of kiln of 2.2m and less. To eliminate wet process kilns and dry process hollow kiln cement production lines with a diameter of kilns of 2.5m and below (except those for production of special cement).

(7) To carry out talent strategy, to bring up a contingent of worker staffs which can meet the requirements of modern cement industry.

(8) To enhance the guidance and restriction role of industrial and technical policies in development of cement industry. The industrial and technical policies are the important means in macroscopic regulation and control of the government. Administrative departments of the cement industry at provincial level, besides firm implementation of national industrial policies, should

formulate implementation measures and detailed rules and regulations in accordance with concrete situation of the province and understand the results of implementation of various policies, making them effective in practice. To issue directory suggestions for adjustment in time according to different characteristics of various stages of development of cement industry.

4.2.2 To implement strictly, the national industrial policies and correctly guide the construction of cement projects

Though remarkable results have been achieved in structure readjustment of cement industry in Zhejiang Province, the guide for cement production and construction should still be strengthened, since the member of mechanical shaft kilns is still large and for the sake of prevention of new round of repeated construction of cement production lines. To implement strictly national industrial policies, promoting large and prohibiting small lines construction. Before approval of construction of projects of new dry process cement production lines, the enterprises or the local governments should eliminate mechanical shaft kiln cement production lines as required. To put an emphasis on encouraging and supporting of development of 4000 t clinker /d and over capacity new dry process cement production lines, to restrict the development of 2000 t clinker /d capacity and less capacities clinker production lines. Starting from 2003, the construction projects of 1000 t/d and less capacities production lines won't be approved resolutely. The projects which were approved and the construction of which hasn't been started, should be stopped. It's predicted, that 12 production lines will be put into operation, of which four are 1200 t/d production lines, the rest are 2500 t/d or 5000 t/d lines. The lines, which will be put into operation in 2004 and 2005, are all 2500 t/d and 5000 t/d production lines.

4.2.3 To strengthen management and control over limestone resources, to construct limestone supply bases.

The limestone resources in Zhejiang Province are mainly distributed in North-western areas of the province. In accordance with the situation of limestone resources in Zhejiang Province and geological exploration and development and utilization program of limestone resources of Ministry of Land and Resources, implementing the principle of "develop in protection, protect in development", to give a priority to supplying resources to large and extra-large cement enterprises. In the planned areas for cement clinker bases to encourage and support the geological exploration work by the enterprises, to construct large-scale mines, to form limestone supply bases. To

consolidate and punish in accordance with law a set of small-sized mines which extract resources recklessly, wasting resources and damaging the eco-environment.

B. A Survey Report on Cement Industry in Hubei Province

B-1 The present situation and future forecast of cement industry in Hubei Province

B-1.1 The Present Situation of Cement Industry in Hubei Province

B-1.1.1 General Situation and Outputs of the Cement Enterprises in Hubei Province

In 2002, the cement production capacity in Hubei Province was about 34 million tons, of which, 12 million tons, 22 million tons and approx. 10 million tons were produced by rotary kilns, shaft kilns and new dry processes respectively, which had occupied 35%, 65% and 29% in the total separately. The cement output was 29.49 million tons in 2000, increased by 11.3% than last year, which was the 8th in China, of which, 9.6 million tons, 19.89 million tons and 7.3 million tons were from rotary kilns, shaft kilns and new dry process respectively, which had occupied 32.6%, 67.4% and 24.75% separately. Nine cities and prefectures had a cement production over 1 million tons, among which, Huangshi City and Jingmen City had achieved cement productions of 8.183 million tons and 5.16 million tons respectively.

In 2002, there were 196 cement enterprises in Hubei, including 4 rotary kiln enterprises, 10 rotary-shaft kilns combined enterprises, 169 shaft kiln enterprises and 13 grinding plants; the number of the shaft kiln enterprises occupied 86.2 percent in the total cement enterprises.

Tab. 1 Cement Productions in Hubei Province, 1995- 2003 (Jan. – Sept.)

Year	1995	1996	1997	1998	1999	2000	2001	2002	(Jan. – Sept.) 2003
Production (mil. ton)	1838	1786	2093	2270	2210	2461	2616	2949	2425

Among the 196 cement enterprises, 43 enterprises, 22% of the total enterprises, had an annual production higher than the national average scale (0.15 million tons); the total production of these enterprises was 18.79 million tons, which was 63.7% of the total provincial production, in which, 29 enterprises have a production between 0.15 and 0.30 million tons, 15% of the total enterprise number, and the total production of these enterprises is 5.81 million tons, 19.7% of the total production in Hubei; 12 enterprises have a production between 0.30 and 1.00 million tons, 6% of the total enterprise number, and the total production of these enterprises is 5.67 million tons, 19.2% of the total production in Hubei; and 2 enterprises have achieved a production over 100 million tons, 1% of the total enterprise number. The total production of these enterprises is 5.81 million tons, 19.7% of the total production in Hubei. These two enterprises are Huaxin Cement Co. Ltd. and Gezhouba Cement Co. Ltd. These two enterprises belong to rotary kiln enterprise and have a total production of 8.24 million tons inside Hubei Province, 27.9% of the total production in Hubei. The basic state of Hubei cement industry in 2002 is shown in Tab. 2 and 3.

Tab. 2 Basic status for cement industry in Hubei, 2002

Enterprise divided by kiln type	Enterprise number	Production capability (million tons)	Production (million yuan)
Rotary kiln	14	12.00	9.60
Shaft kiln	172	22.00	19.89

Tab. 3 Basic status for cement industry in Hubei, 2002

Divided by production scale	Enterprise number	Production capability (million tons)	Production (million tons)	Production value (million tons)
Large enterprise	2	8.00	8.24	152.84
Mid-enterprise	25	8.00	6.97	125.95
Small-enterprise	169	18.00	14.45	268.21

The major cement production cities in Hubei Provinces are Huangshi, Jingmen, Wuhan and Yichang. These 4 cities have a production of 19.43 million tons, 65.9% of the total production in Hubei; in which, the production in Huangshi has occupied 27.7% of the total production in the whole province. In the 4 cities, Huangshi and Jingmen possess two large-scale cement enterprises whose principle parts are of new dry-process kilns; while Wuhan and Yichang possess many shaft kiln enterprises in large-scale and huge medium sized grinding plants.

The total cement produced in Hubei is 24.25 million tons from January to September, 2003. Since the last quarter of the year is a good marketing season, it is predicted that the annual production could reach 33 million tons.

B-1.1.2 Main Economic indicators accomplished in 2002 for cement industry in Hubei

Province

Cement production continued to increase rapidly in 10% in 2002; the product marketing rose smoothly and the link-up level between production and sale was further improved. Since the fixed capital investment in Hubei province has increased greatly in 2002, the realty business was invested actively and there were many important infrastructure projects for traffic, energy source and irrigation works, which have promoted the market demand of building materials. The marketing of the building materials and the linking level between production and sale rose steadily. The scaled building material enterprises have accomplished 16.984 billion yuan marketing product value in 2002, 12.55% higher comparing with the value achieved last year. The product sales rate has reached 96.58%, higher than the level obtained last year, in which, the production and sales ratio for cement industry was up to 98.48%, 0.64 percent growth comparing with the same period last year and 0.88 percent higher than the same trades inside China.

The economic operation quality has improved in some way in 2002; hence, the industrial economic performance increased continuously and the integrated economic effectiveness has risen visibly. In 2002, the state-owned building material enterprises and building material enterprises of other ownerships with a production value of and over 5 mil. yuan in Hubei realized a sales revenue for 15.018 billion yuan, 11.49% higher than last year; the total profit and tax turnover for 1.203 billion yuan, 9.96% higher than last year, in which, 0.461 billion yuan of profit, 14.5% higher than last year. The cement industry has gained a profit rise above 20%, a net earning of 146.064million yuan, 41.8% higher than last year, which has occupied 31% of the total amount of profits gained by the total building material industry in Hubei Province.

Primal problems existed during the economic operation of building material industry in Hubei, in 2002:

(1) Industrial restructuring could not fit the demand of the economic development in Hubei. The gap between Hubei and other advanced coastal provinces and cities were enlarged.

(2) The prices of the dominant building materials products were on the low side. In the recent years, the cement prices in Hubei have declined increasingly due to influences of various factors. The mixed average ex-factory price last year was 203.2 yuan per ton, 5.4 yuan lower than last year. In Yidu, Songci, Zhongxiang and Jingmen where shaft kilns are concentrated, the cement price was 30-40 lower than that in Wuhan region. The pick up of the economic effects in cement industry was mainly achieved by increasing outputs greatly last year. The statistic data indicated that the average profit for cement in Hubei last year was 4.95 yuan/ton, while the average profit in whole country was 6.5 yuan/ton, 30% higher than the profit

achieved in Hubei.

(3)The building material market was still in a poor operational order with incessant price wars. A few small enterprises prohibited by national explicit orders were put back on production to impact the market with their sham products in the time when market demand rose. Some individual leasing out enterprises undertook dealer contests for seizing markets. This cutthroat competition was so serious that most of the enterprises did not achieve any profits with higher outputs.

B-1.1.3 Cement Market and Economic Operation Situations in Hubei in 2003

The state will insist on the policy to enlarge the domestic demands over a long period of time, hold on positive financial policies and moderate monetary policies, vigorously support medium and small-sized enterprises and nongovernmental businesses with various measures and continuously rectify the industry to achieve better performances. The total fixed assets investment in Hubei is designed to rise 9%. The gross investment will exceed 180.0 billion yuan, in which, investment for 30 important construction projects is more than 30 billion yuan; for realty is 20.0 billion yuan. It is predicted that the total cement demand in Hubei would exceed 32 million tons. The building material industry in Hubei is still kept in a good progress. The industrial advance shows an excellent tendency. The cement industry also shows an excellent situation for increasing output, enlarging sales, higher profits and accelerating development. The main characteristics are as follows:

(1) **Production is rising rapidly and output is increasing obviously.**

From January to July, the over scaled cement enterprises have produced cement 17.09 million tons, the highest in the corresponding periods, which is 16.3% higher than that of the same period last year with a 0.9% rise higher that of the national cement output. Gross industrial output value achieved in total (invariable price): 3.553 billion yuan, industrial value-added: 1.033 billion yuan, 21.8% and 15.9% higher those achieved last year separately. Seeing by month, the outputs in March and April are both higher than 2.70 million tons, while the outputs in May and June are both higher than 3 million tons – high outputs that have never emerged in the same period of the past. Seeing by regions, 11 among the 13 cities, prefectures and municipalities directly under the Provincial Government have a rise in cement production, of which, six cities, prefectures and municipalities directly under the Provincial Government including Wuhan, Huangshi, Xiangfan, Ezhou, Suizhou and Enshi have a rise higher than the average provincial level.

(2) **Market demand tends rising, cement sales are in good progress.**

Cement distribution is the best in the recent years. This is a common feeling in cement industry.

From January to July, gross sales value achieved by cement industry in Hubei is 4.008billion yuan, 16% higher than that achieved in the same period last year; produciton and sale rate: 96.88%, which is the maximum in the recent years and also 0.11% higher that of the national average rate. Analyzing by period of time, with an exception of February to April when the market fluctuated for Spring Festival and the obviously increased overcast and rainy weathers, the sales have been in good situation in the other months. Analyzing by regions, cement demands in Wuhan and its surrounding areas rise visibly this year. Many enterprises are out of stock. Cement sales are in a better situation in Xiangfan, Shiyan, Jingmen and Yichange than the past years due to the construction of many key engineering projects.

(3) **Operational quality and economical performances improved.**

Although the prices for raw and fuel materials are rising leading to higher costs, the economic operational quality and profits in cement industry are improved obviously after the enterprises enhanced reform and inner management to improve their link level between production and sale. From January to July, a gross revenue from goods sold accomplished by the cement industry in Hubei is 3.452 billion yuan, 8.88% higher than that achieved in the last year; gross profit and tax turnover is 0.26 billion yuan, in which, profits are 30.51 million yuan, 21.5% and 100% higher respectively than those achieved last year. The rate of profit based on the cost and expenses of production, the ratio of profits and taxes on industrial funds, the current asset turnover ratio and the labor productivity of the entire body of industrial workers have risen by 0.39%, 0.69%, 0.12% and 22% respectively comparing with the same period last year.

The overall economic operation and development situation for cement industry in Hubei are in better state in 2003, however, some conspicuous problems and difficulties still exist in the progress.

Firstly, some principal indicators have a lower rise than those of the average level for the cement industry in China. In the view of outputs, the cement advance in coastal provinces and cities were faster, especially in Shandong, Zhejiang and Jiangsu where cement advances swiftly in amplitude above 20%. In the view of profits, the national accumulated earnings from January to July was 2.535 billion yuan, 1.25 times rise than that of the same period last year, which was 25% higher than that achieved by Hubei Province; the national average cement profit per ton was 5.78 yuan, while that for Hubei Province was 1.78 yuan, which was more than 2 times of Hubei's figure. From January to July, up to 45% of the cement enterprises in Hubei have deficits. The total deficit of the deficit bearing enterprises is 60.77 million yuan, 87% of the total deficit of the building material industries in Hubei Province.

Secondly, Cement costs rises with the increasing of raw materials and fuel prices and shipment costs. From January to July, the average cost for per ton cement has risen by 8.3% in Hubei; however, the rise for cement sales is 7.4% lower than that for output rise in Hubei and 8.5% lower than that of the national cement sales income. January – July in 2003, the average price for cement is 200.4 yuan per ton in Hubei, which is 1.4 yuan lower than that of the national average price indicating that the cement price in Hubei is in low side. Even in this year when the market demand turns right, some enterprises dare not raise the price with costs increased in fear of losing the original markets.

Thirdly, with so many small-scaled enterprises, the situation that the enterprise in Hubei are in smaller sizes still exists. Analyzing the output stat. data for the scaled cement enterprises from June to July, only Huanxin and Gezhouba have a monthly output higher than 0.10 million tons, 15 enterprises have a monthly output with 0.05-0.10 million tons, while 58 enterprises, 30% of the total enterprises, have an output over 5000 tons. The enterprise scales are in small side with a low production centralization degree. This is not only a key factor to make parts of the cement industrial indicators in Hubei lower than the national average level, but has seriously restricted the rapid and proper progress for cement industry in Hubei Province as well.

In view of analysis for cement market situations in Hubei, it is predicted that the cement demand will increase steadily in the second part of 2003. The cement price will float 20 yuan upwards on the basis of the current prices. The cement enterprises should catch the market chance and undertake cement marketing properly for the next half year.

B-2 Structural readjustment measures and the existing problems for cement industry in Hubei Province

B-2.1 Structural readjustment measures for cement industry in Hubei Province

After 1995, Huxin Cement Co. Ltd. and Gezhouba Cement Plant built a 2000-ton-daily-capacity line and a 4000-ton-daily-capacity line successively under the requirement put forward by the former State Administration for Building Materials Industry to reduce the investment in the precalciner kilns. The big decrease of the cement investment and the excellent production results of the precalciner kiln attracted the attention from the cement industry for the construction of precalciner kilns.

In 1997, in accordance with the national industrial policy and the suggestion from the building material administrative department in Hubei Province, Hubei provincial government, in the name of its general office, issued a document for adjusting the structure of cement industry. It provided

that precalciner kilns with a daily capacity above 200 tons should be developed positively; it is encouraged to apply the preheater kilns with 600-1000 tons daily capacities to renovate the mechanical shaft kilns and wet-process kilns; appropriate shaft kiln enterprises should be selected to be changed into the grinding plants for rotary kiln clinker. The mechanical shaft kilns are strictly forbidden to be built or extended. The ordinary shaft kilns and the mechanical shaft kilns with 2-2.2 meter diameters will be closed in batches. Hubei provincial government and its general office had issued documents thrice in 1999 to rectify the mechanical shaft kilns focusing on closing the ordinary shaft kilns and the mechanical shaft kilns with 2-2.2 meter diameters

Since 1999, the building material administrative department in Hubei Province has implemented the new cement standards in the whole province under the suggestions on implementing the new cement standards provided by the former State Administration for Building Materials Industry. Through trainings, demonstrations, inspections and exchanging the certificates for the laboratories of cement enterprises, cement products produced by over 190 cement enterprises in Hubei (including 169 mechanical shaft kiln enterprises) have achieved the requirements of national grade of 32.5Mpa (equivalent to former grade 425) or higher grade, that has changed the situation that 65 - 70% of cement are "low- grade 325" cement in Hubei Province.

To keep good gross balance between supply and demand according to the market demand and undertake coordination and service properly for economic operations. A emphasis on keeping a gross balance between supply and demand should be put for cement industry. Guide the enterprises to organize their productions according to the market demands. Lay stress on structural readjustment, variety and quality optimizations but quantity increase. Insist on enhancing the coordination and service works in industrial economic operations.

To prompt industrial restructuring and speed up the optimizing and updating of industrial structure. Develop the new dry process cement vigorously and keep on optimizing the cement industrial structure. The general thinking for cement industry restructuring is to build large scaled cement clinker production bases in the areas with abundant limestone resources, build large-medium sized cement grinding plants in the areas with large cement market capacities and develop bulk cement and concrete mixing stations in the big and medium cities to form one serial development mold of continuous line with clinker bases, cement grinding plants and concrete mixing stations. Keep on supporting the development of large scaled cement groups. While paying close attention to achieving up to designated production and techno-economic targets for Yidu cement project, Huxin Group will firmly grasp the construction of Huaxin and Yangxing projects and strive to finish the construction within 2003; meanwhile, the Group pays much attention to the

initial works of Huaxin Xiangfan cement project and Yidu 2nd line project to strive to commence construction in 2004. Support and assist Wuhan Yadong cement Ltd. for Yangluo new dry-process cement project and try to start building as soon as possible. Direct and support the shaft kiln concentrated area to develop the new dry-process cement. Put more attention on the administration of cement grinding plants and guide them to improve their operation quality and performance.

Enhance the strength of attracting merchants and capitals and promoting investments earnestly. In 2003,the party committee and the provincial government in Hubei request that all industrial offices should shift their work stresses on merchant and capital attraction to promote investment. Each building material administrative department and enterprises are required to analyze the situations seriously and find out the gaps with the similar enterprises of same trade to set up their new development objectives.

To exploit building materials markets continuously and further improve the production-sale level. Put stress on exploiting the domestic market in Hubei to improve the provincial market share. The key points of exploitation in the inner market are the principal provincial infrastructure constructions, urban residential building engineering construction, construction of water conservancy works and the decoration and finishing of the town residential houses. Guide the cement enterprises in different types to exploit the relevant markets as well as the markets outside Hubei. Export sales for the special type cements in Hubei are great. It is requested to guide the enterprises to take the competitive advantages to further exploit the markets outside Hubei.

To enhance the industrial administrations and improve the total industrial quality earnestly in accordance with the industrial rules. Works in 4 aspects should be implemented carefully: firstly, following the three industrial regulations, such as quality control regulation for cement enterprises,etc. issued by the State Economic and Trade Commission, further improve the practical quality for cement by sticking on the construction of cement enterprise quality control system, the standard management and contrast testing works in the laboratories of cement plants. In 2003, it is planed to make an overall inspection on the laboratories in the cement enterprises in Hubei for exchanging certificate of conformity and grades.

Stick to promote the applications of bulk cements. The No. 237 Order issued by Hubei government for bulk cement must be followed. To emphasize the infrastructure construction for the bulk cement in principal backbone enterprises and large-medium cities and to form a complete set of facilities for the production, transportation, storage and application of bulk cement so that the bulk rate for large-medium sized enterprises and cities could reach 40% and 30% respectively; the bulk cement rate for key projects could be above 50%, and the entire provincial bulk cement

rate could reach 24%.

B-2.2 Influences of the industrial policies and the industrial administrative measures

Since 1978, the economy in Hubei has been going on a rapid development track. Rapid increase of investment has led to the deficiency of cement. At the beginning of 1980s, Hubei Province emphasized to develop Huaxin-type wet-process rotary kilns and the mechanical shaft kilns with an annual production capacity of 88000 tons. Some small kilns with an annual production of 44000 tons or even smaller were also put into production for urgent demand of cement.

Beginning from 1985, following the requests from the State Administration for Building Materials Industry, Hubei Province had begun to build the precalciner kilns with a daily clinker production of 700 tons while promoting and expanding the shaft kiln energy saving technique. At the beginning of 1990s, two precalciner kilns with a daily production of 2000 tons were built in Huaxin Cement Co. Ltd. and Gezhouba Cement Plant separately.

In 2000, following the quality control regulations on cement enterprises issued by the State Economic and Trade Committee, the building administrative department in Hubei Province undertook training and implementation works for the "regulation" all over the province to guide the enterprises to tamp the management foundation starting from quality management. Seeing from the data of the economic operation, the profit of cement enterprises in Hubei rose steadily although the average cement price dropped and the prices for raw and fuel materials as well as the transportation price increased.

Starting from 2002, the building material administrative department in Hubei has speeded up the construction process for new dry process cement production. At present, 10 new dry process cement production lines have been built in Hubei Province, with a total production capacity of 8 million tons. 2 new dry process cement production lines with a total annual production capacity of 4 million tons are in construction. It is predicted that 7 projects could be started to construct in 2004, in which 3 lines with a total annual production capacity of 8.5 million tons are reconstructed from the mechanical shaft kiln enterprises. While speeding up the development of the new dry process kilns, part of the mechanical shaft kilns is being reconstructed into grinding plants. 13 grinding plants with an annual production capacity above 0.3 million tons have been built. The total production capacity of them is about 8 million tons.

B-3 Present situation of the cement market in Hubei Province and its trend of development

B-3.1 Present situation of the cement market in Hubei Province and its economic operation condition

As a heavy industrial province with abundant limestone resources, Hubei Province has convenient land and water traffic facilities so that it can either be an important cement import or export province. According to the statistics undertaken by Hubei statistics department in 1994, the total cement output in Hubei in 1994 was 15.08 million tons, cement imported from other provinces: 4.84 million tons, cement exported to other provinces was 1.23 million tons. After balancing out, the net import from other provinces was 3.61 million tons. 90% of the imported cement were high-quality cement better than No. 425. on the other hand, the cement production structure in Hubei Province was irrational with approx. 70% low-quality cement of No. 325.

Since 1995, the cement product structure in Hubei has changed greatly, the production capacity for high-quality cement has increased visibly. In one hand, 6 new dry-process production lines were installed in the enterprises of Huxin, Gezhouba and etc.; On the other hand, part of the shaft kiln enterprises have improved their production capacity for high-quality cement through technical innovations.

In 2002, over 90% of the total cement production in Hubei belonged to Class 32.5 MPa (equivalent to No. 425). According to the sample analysis on selective enterprises and regions, the cement production in Hubei was 29.49 million tons in 2002, approx. 1.40 million tons were exported to the other provinces. With the notable exception of some two-way interflow around the provincial boundary, hardly any high-quality cement was imported into Hubei.

In 2003, the demand in Shanghai and other coastal areas has risen, the cement amount exported from Hubei has increased evidently. From January to August in 2003, the large-scaled enterprises such as Huaxin and Gezhouba have provided 1.80 million tons cement to other provinces. It is predicted that the cement output in 2003 will be 33.00 million tons. 2.50 million tons will be exported to the other provinces. The high-quality cement produced in the other provinces can hardly enter into Hubei.

The cement demand in Hubei Province tends to rise rapidly. With the upgrade of the economic development level in Hubei, the cement consumption per capita is also rising correspondingly. Since the annual practical consumptions are not available, in analysis the annual output are considered as the annual consumption.(See Tab. 3).

In Hubei Province in 1952, GDP was 2.452 billion yuan, per capita GDP was 89.09 yuan; annual cement output was 0.250million tons, per capita cement production was 9.09 kg;

In 1980, GDP was 19.938 billion yuan, per capita GDP was 425.62 yuan; annual cement output was 4.2777 million tons, per capita cement production was 91.32 kg;

In 1990, GDP was 82.438 billion yuan, per capita GDP was 1515.60yuan; annual cement output was 9.807 million tons, per capita cement production was 181.46kg;

In 2000, GDP was 427.632 billion yuan, per capita GDP was 7175.03 yuan; annual cement output was 24.6092 million tons, per capita cement production was 412.91 kg;

In 2002, GDP was 497.563 billion yuan, per capita GDP was 8309.66 yuan; annual cement output was 29.49 million tons, per capita cement production was 492.50 kg.

The above-quoted data indicate that Hubei cement output has increased from 0.25 million tons to 29.49 million tons within 50 years with an annual growth rate of 10%.

Tab. 4 Economic growth vs. cement consumption in Hubei

Year	GPD (10^8 yuan)	Cement demand (10^4 tons)	Population (10^4 person)	Per capita consumption (kg/a*person)	Per capita accumulated consumption (kg/person)
1952	24.51	25.00	2751.20	9.09	21.33
1957		53.89	3062.41	17.60	93.28
1965		85.93	3504.54	24.52	239.52
1970		126.32	4026.83	31.37	318.86
1980	199.38	427.78	4684.45	91.32	801.54
1990	824.38	987.00	5439.29	181.46	2069.95
1991	913.38	1122.80	5446.83	206.14	2273.72
1992	1088.39	1263.16	5513.65	229.10	2474.77
1993	1424.38	1363.73	5590.46	243.94	2684.71
1994	1878.65	1522.32	5718.81	266.20	2890.65
1995	2391.42	1838.25	5772.07	291.80	3182.45
1996	2970.20	1824.52	5825.13	313.22	3466.67
1997	3450.24	2093.50	5872.60	356.49	3795.14
1998	3704.21	2269.92	5907.23	384.26	4175.15
1999	3857.99	2209.70	5938.03	372.13	4507.72
2000	4276.32	2460.92	5960.00	412.91	4904.01
2001	4662.28	2603.72	5974.56	435.80	5327.86
2002	4975.63	2949.00	5987.76	492.50	5808.61

Tab. 5 Economic growth rate vs. cement consumption in Hubei

Year	Economic growth rate (%)	Cement demand (10^4 tons)	Population (10^4 person)	Per capita consumption (kg/a.*person)	Per capita accumulated consumption (kg/person)
1952	13.80	25.00	2751.20	9.09	21.33
1957	7.4	53.89	3062.41	17.60	93.28
1965	18.10	85.93	3504.54	24.52	239.52
1970	26.90	126.32	4026.83	31.37	318.86
1980	6.4	427.78	4684.45	91.32	801.54
1990	5.00	987.00	5439.29	181.46	2069.95
1991	6.60	1122.80	5446.83	206.14	2273.72
1992	14.10	1263.16	5513.65	229.10	2474.77
1993	14.30	1363.73	5590.46	243.94	2684.71
1994	15.20	1522.32	5718.81	266.20	2890.65
1995	14.60	1838.25	5772.07	291.80	3182.45
1996	13.20	1824.52	5825.13	313.22	3466.67
1997	13.00	2093.50	5872.60	356.49	3795.14
1998	10.30	2269.92	5907.23	384.26	4175.15
1999	8.30	2209.70	5938.03	372.13	4507.72
2000	9.30	2460.92	5960.00	412.91	4904.01
2001	9.10	2603.72	5974.56	435.80	5327.86
2002	9.10	2949.00	5987.76	492.50	5808.61

Tab. 6 Economic growth rate vs. cement growth rate

Year	GDP		Cement Output		coefficient of elasticity
	Growth multiple	Average annual increase rate	Growth multiple	Average annual increase rate	
1952	1.00		1.00		
1980	7.13	7.78	16.11	10.67	0.73
1990	32.63	9.69	38.48	10.15	0.95
1995	96.57	11.24	72.53	10.51	1.07
2000	173.47	11.35	97.43	10.03	1.13
2002	202.00	11.21	116.96	10.01	1.12

Note: 1952 is used as the base year for calculation.

B-3.2 Analysis and Forecast on Cement Market Demand in Hubei Province

By 2005 in Hubei Province, GPD will be 640 billion yuan, population: 60.25 million, per capita GNP: 10600 yuan; annual cement production: 40 million tons, per capita consumption: 660kg.

By 2010 in Hubei Province, GPD will be 950 billion yuan, population: 60.80 million, per capita GNP: 10600 yuan; annual cement production: 50 million tons, per capita consumption: 820kg.

C. A Survey Report for Cement Industry in Shandong Province

C-1 The present situation and future forecast of cement industry in Shandong Province

C-1.1 The Present situation of Cement Industry in Shandong Province

Shandong province is a main cement-supplying province. The rapid growth in Shandong's cement industry began during a ten-year's period from the beginning of the 'Seventh Five Year Plan' period till the end of the 'Eighth Five Year Plan'period. The number of cement enterprises in Shandong had grown from 320 enterprises in 1985 to 560 enterprises till 1995. Shandong's total number of cement enterprises, production volume, the increase speed, the export, and the bulk cement sales volume all rank top-one in the country. Additionally, the cement varieties have progressed from the single product type to no less than ten specialized cements including road construction, decoration, oil well, quick hardening, swelling, dam and sulfate resistant cements.

Ever since 1999, through the implementation and the execution of State Council's document **[Guobanfa [1999] No. 49]**, Shandong province has clamped down, closed and eliminated 310 small cement production lines, thereby erased 8.6 million tons of underdeveloped production capacity. Till year 2002, there were approximately 460 cement enterprises in Shandong province with a production capacity of around 73 million tons. Among which, there are 312 cement enterprises in Shandong province, each generating more than 5 million yuan in annual sales revenue; there are 65 enterprises in the province with a production capacity of 300000 tons each; there are 18 enterprises in the province with a production capacity of 600000 tons each. The province has nine new dry process rotary kiln production lines with a daily production capacity of 1000 tons, and total annual production capacity of nine million tons; the province has eight wet process rotary kilns, representing an annual production capacity of two million tons. Shandong province sells more than 20 million tons of cement to the other provinces each year. In year 2001, the province finished a cement production volume of 69.31 million tons, occupying 11.16% of the total cement production of the nation (621 million tons). Among total output, the production volume of new dry process rotary kiln was 7.84 million tons, representing 11.31% of the total provincial output; bulk cement sales volume was 15.31 million tons, representing a bulk sales rate of 22%; and the cement export was 2.25 million tons.

With the approach of the new century, the cement industry in Shandong sustained a relatively high growth speed and a decent development trend. The total cement production for year 2002 reached 82.387 million tons (please refer to Shandong Statistics Communiqué, 2002). During the first two years of the 'Tenth Five-year Plan' period, the total cement supply had exceeded 16.91 million tons (in which the net growth for year 2002 was 13.077 million tons). These two years marked the greatest growth volume and growth speed of Shandong's cement supply since the 'Ninth Five Year Plan' period. How do we interpret the rapid growth in cement production in the recent two years; how large the market will be in future for Shandong's cement industry; what are the influences from the relevant elements on the cement trend for the province; and how is the prospect for the development of cement industry; these are all the questions that entails further research and analysis.

The rapid development of cement industry in Shandong province started during the ten-year period that began from the 'Seventh Five Year Plan' period to the end of the 'Eighth Five Year Plan' period. The number of production enterprises had risen from 320 to 560 enterprises. The production volume progressed from 11.2185 million tons to 51.194 million tons, indicating an annual growth speed of 17.27% that ranked top-one in the nation. The range of cement products progressed from a few types to more than ten product varieties. The quality of the product was improved eminently. The No. 425 cement (the old standard) takes approximately 80% of total cement supply. Another batch of big and middle-size enterprises that employ the new dry process cement production were constructed and put into production. The Sishui Dayu single-line cement production capacity (clinker) reaches 7200 tons per day, which ranks top-one in China; Lunan Cement Factory has a capacity of 2000 tons per day, where the production line made in China has primarily reached the designed techno-economic production targets.

During the 'Ninth Five Year Plan' period, due to the influence from the Asian Economic Crisis and the domestic macro-economic policy, cement in Shandong province experienced a low growth period. Since year 1999, through the implementation of State Council's [Guobanfa [1999] No. 49] document and the previous State Economic and Trade Commission's [Guojingmao Jiancai [1999] No. 715] document, Shandong province implemented the industrial structure adjustment, control of total output and the elimination of the underdeveloped production capacities at the same time. Until year 2000, the province has clamped down, closed and eliminated 310 small cement production lines, representing a capacity of 10.48 million tons. At present, the province has

cement production enterprises approximately 460 entities, total production capacity of 86 million tons. Among which, there are 312 overscaled cement enterprises, 65 enterprises in the province are with an annual production capacity of 300000 tons each, 18 enterprises in the province are with an annual production capacity of 600000 tons each. The province has twenty new dry process cement production lines with the total production capacity of 11 million tons. The province has eight wet process rotary kiln, representing two million tons of production capacity. In year 2002, the province completed a cement production of 82.387 million tons, representing 11.69% of national output (705 million tons); the cement industry generated a tax income of 1.94 billion yuan, representing 11.5% of the national tax income from the industry. The idle production capacity has also decreased from 20 million tons in during the beginning of the 'Ninth Five Year Plan' period to 5 million tons, ended the era of low growth-speed situation and started the trend for recovery growth. The average production scale for the enterprises has advanced from 100000 tons to 210000 tons. The production from new dry process cement takes a ratio of 11.85% to the total production. The structural adjustment in cement industry has been primarily successful. The cement supply volume in Shandong province has satisfied the need for the rapid and continuous economic growth for the province and the economic constructions on grand scale. Please refer to Table 1, Chart 1 and Chart 2 for the annual production volume and annual growth rate for Shandong's cement production.

During the first half of year 2003, Shandong province produced 44.48 million tons of cement, increased by 23.6% over the same period last year. This year's projected output is 100 million tons, mainly relying on production from shaft kilns. The cement from shaft kilns takes 90% of total production. Despite the facts, the Shaft kilns in Zaozhuang, Zibo are all under full-load production. Trucks are lined up for the cements. Lunan Cement Factory changed the situation of 40 ~ 50% for provincial export, its provincial export in this year is no more than 10%. The reason for the extravagant demand for shaft kilns cements is because of the shortage of new dry process cement.

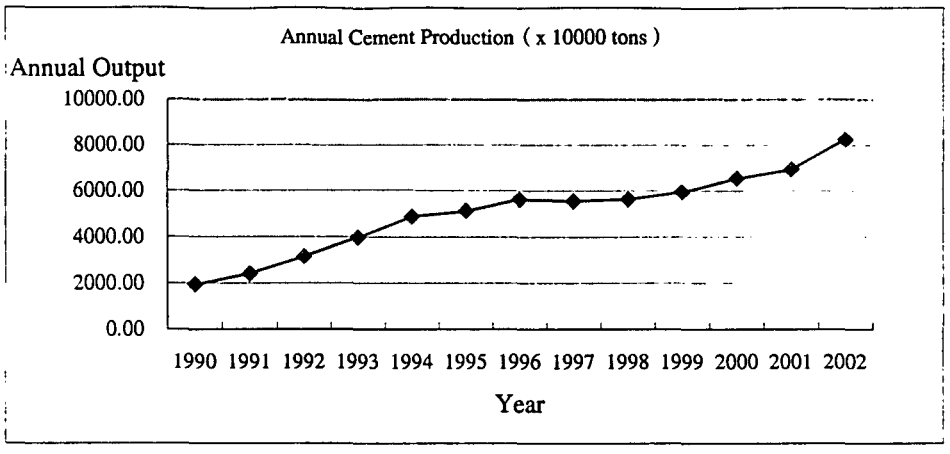

Chart 1 Annual Cement Output in Shandong Province since 1990

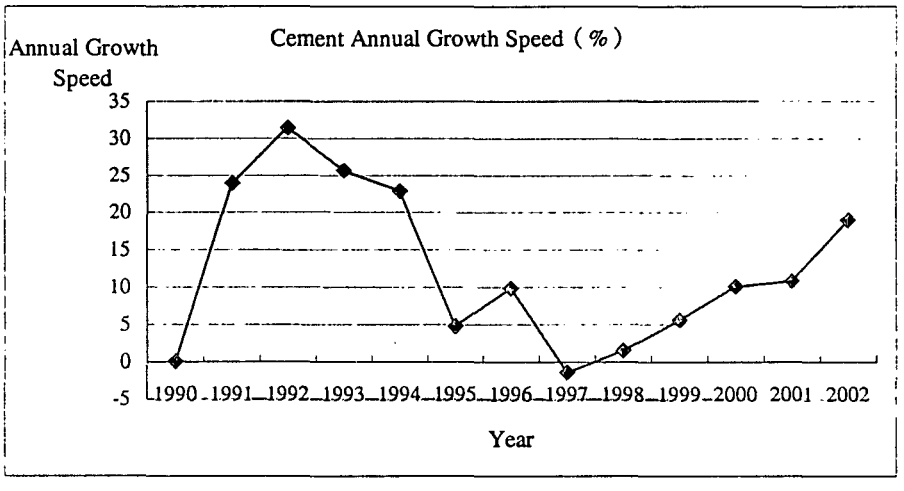

Chart 2 Cement Annual Growth Speed in Shandong Province since 1990

Table 1 The Cement Output in Cities in Shandong Province (x 10000 tons)

Year & Volume / Cities	99	2000	2001	2002
	6209.48	6570.41	6931	8247
Jinan City	474.47	485.12	572	866
Qingdao City	205.36	137.51	149	140
Zibo City	799	856.18	935	1098
Zaozhuang City	1361.11	1519.43	1648	1911

Dongying City	38	32.65	13	15
Yantai City	672.79	889.54	801	961
Weifang City	281.79	321.36	354	388
Jining City	393.15	435.72	472	553
Tai'an City	320	324.8	317	371
Weihai City	102.08	114.66	110	131
Rizhao City	324.6	154.07	190	236
Laiwu City	105.39	122.85	137	141
Linxun City	876	883.92	914	1046
Dezhou City	107.5	127.7	141	162
Liaocheng City	31.28	38.5	43	54
Binzhou Area	99.4	111.78	125	161
Heze Area	17.56	14.62	10	13

Table 2 Export Status of Shandong's Cement

	Qty of Export Goods			Value of Exported Merchandise (x 10000 USD)	
	Qty	This Year	Total	This Year	Total
	Unit	Total	Growth Rate(%)	Total	Growth Rate (%)
2001	Ton	2253184	4.7	6358.4	3.3

C-1.2 The New Feature for the Development of Cement Industry in Shandong province

(1) Total cement output and efficiency has kept a relatively high growth

Due to the continued rapid development of economy in Shandong Province, and due to the influence from the fixed-asset-investment pull and the high growth in real estate industry and construction industry, cement output in Shandong Province has been keeping on a relatively high growth trend. The growth rate for year 2001 reached 10.84%; the growth rate for year 2002 reached 18.99%. The net volume growth of provincial cement output during the two years reached 16.92 million tons. While the output volume is experiencing a rapid growth, the economic efficiency in cement industry has also experienced substantial improvement. It generated a tax income of 1.549 billon yuan in year 2001 and 1.94 billion yuan in year 2002, implying an annual growth speed of 25.24%.

(2) Increased Development for new dry process cement.

Shandong province has started the construction of new dry process cement production lines since early 70's in the last century. After more than thirty years' development, and until year 2001, it has formed a production capacity (clinker) of 9.87 million tons of new dry process cement per year, which approximates annual cement production capacity (converted into ordinary Portland cement) of 11 million tons. This represents 15.88% of total capacity. In year 2002, there were eleven new dry process cement production lines under construction in the province, the cement clinker production capacity was 8.643 million tons per year, almost reaching a thirty years' accumulated production capacity of new dry process cement (approximates 87.54%). The ratio of new dry process cement will reach 24.5% after the projects are put into production, realizing a leap in the development for new dry process cement. Thirteen new dry process cement production lines will be under construction in year 2003, adding a production capacity (clinker) of 13.95 million tons per year. After these new dry process cement production lines are put into production, the new dry process cement production capacity in Shandong province will reach 32.16 million tons per year, representing a ratio of 36.98% to the total volume. Such an accomplishment will exceed the target of 25% ratio for new dry process cement recommended for the 'Tenth Five Year' schedule, and will also be achieved ahead of the schedule.

The new dry process cement production line status (including planned sites for year 2003) in Shandong province is as per Table 3.

Table 3. The new dry process cement production line status (including planned Projects for year 2003) in Shandong province

Single-Line Production Capacity	Existing Capacity (Clinker t/d)		Capacity under Construction (Clinker t/d)		Capacity from Planned Constructions (Clinker t/d)	
	Number (lines)	Total capacity	Number (lines)	Total capacity	Number (lines)	Total capacity
< 800t/d	5	2800	1	300		
1000 ~ 1500t/d	9	10300				
2000 ~ 2500t/d	4	9600	7	17500	7	17500
3000t/d	1	3000	2	6000		
4000t/d					1	4000
5000t/d			1	5000	5	25000
> 7000t/d	1	7200				
Subtotal	20	32900	11	28800	13	46500
Annual capacity (x10000 tons)	20	987	11	864	13	1395

(3) The new dry process cement production technology has been maturing, the size is progressing towards bigger scale.

With the advancement and maturation of domestic new dry process cement technology, equipment quality and the degree of localization, (the localization of technology and equipment for the new dry process production line with a capacity of 5000 t clinker / d of has reached no less than 90%), the scale for the constructing and the planned new dry process cement single-line production lines are approaching rationalized and towards even larger. We can find out from Table 1, that the clinker production capacities of single newly constructed and planned new dry process production lines are as follows: 14 lines of 2500 t/d, two lines of 3000 t/d, one line of 5000 t/d and six lines of 5000 t/d. The grand equipment facilities and the more rational scale have improved the automation level and the labor productivity for cement production enterprises, improved the environment, reduced the resources consumption and increased the economic return for the enterprises. It realized the goal of low investment and high localization for the new dry process cement project construction. It has also mightily established the model effect for the huge group of shaft kilns cement enterprises to switch to new dry process cement production technology.

(4) **The co-existence of structural adjustment and the enterprise restructure. Fast expanding scale.**

By the end of the 'Ninth Five Year Plan' period, the production capacity (about 15.12 million tons) of the top-ten cement enterprises in Shandong's cement industry weighs no more than 14% of the entire industry, in which the weight of new dry process cement is 9%. After the development during the first two years in the 'Tenth Five Year Plan' period, the production capacity of every enterprise is constantly expanding. Shanshui Group's production capacity has exceeded 5 million tons in year 2002 (it will reach 20 million tons in future years.). The degree of concentration for the top ten enterprises has exceeded 24%. It has occupied 70% of the entire provincial new dry process cement production capacity. While the enterprises are expanding their own production capacity, a group of big enterprises, using the capital, technology, brand, market sales network and the resource advantage, reorganizes the cement production industry through the power of market. For example, Shanshui Group, focusing the construction of three major clinker bases, operating eight cement markets, broadens the strategic conception for cement industry and marches eastwards and expands westwards and reaches the south and north along Jiaoji line to reorganize Changqing Cement Factory, Weifang Cement Factory, Changle Cement Factory, building the

2500-t/d capacities new dry process cement production lines, building 5000-t/d capacity new dry process cement production lines in Zibo and Jiangyin. The Group's cement clinker production capacity will reach 9.7 million per year. They reorganized Qingdao Liuting Cement Factoryconstructed cement grinding plants of 2 million tons per year in Qingdao, Liaocheng, Dongying, Dezhou and other places, becoming the biggest cement enterprise in Shandong Province by one leap and finding its place in the three-A circle among the cement enterprises in our country. The other important cement enterprises in Shandong province have started to aim at the adjacent markets, and to build cement clinker base in resourceful places, or to build cement grinding plants in places near the markets, and to acquire middle and small enterprises to enlarge the market share. Such an enterprise expansion has exerted important function of direction and support to improve the competitiveness, controlling power of Shandong Province to speed up the structural adjustment of the cement industry.

C-2 Structural Adjustment of Cement Industry Structure in Shandong Province and its Measures

C-2.1 Structural Adjustment of Cement Industry in Shandong Province

The structural adjustment of cement industry in Shandong is directed by the power of market demand, motivated by scientific advance and technological innovation and focusing on quality improvement, energy conservation and environmental protection. It seeks the active development for the new dry process cement production technology, definite elimination of underdeveloped production technology and equipment, supporting of the giant enterprise groups and for the enhancement of technological level, management skills, integrated quality and the strength of the enterprises.

By the end of the 'Tenth Five Year Plan'period, the total cement production should be controlled within 70 million tons, the proportion of the new dry process cement should reach 40%. The proportion of the specific and special cement should reach 8%. 20 ~ 30 million tons of underdeveloped production capacities should be eliminated and reduced. To implant and develop 4 ~ 5 leading cement enterprises with production capacity of more than 5 million tons. The proportion of cement output from the giant enterprises (Groups) with capacity of at least one million tons should be over 50%. To realize a labor productivity of 1500 tons per person per year for the whole province..

The emphasis of industrial adjustment of cement industry:

Taking new dry process cement kilns as the basic means, to centering on construction of new dry process kiln clinker production bases in the areas with abundant resources and construction of cement grinding plants scatteredly in areas lacking of resources but with market potential. To implement the strategy of expansion through leading enterprises, taking Jiaoji line as the horizontal axis to extend towards south and north, and to open up export channel across ocean, to restructure the cement market.

C-2.2 Problems in Development of Cement Industry in Shandong Province

Although the trend has been favoring the cement industry in Shandong Province in the recent two years, with the constant prosperous market, the simultaneous growth in output and efficiency, the accelerated development of new dry process cement and the optimization of cement industry structure to certain extent, the problems confronting the development of cement industry in Shandong still requires some close attention.

(1) The problem of eminent unreasonable industrial structure

Although the development of new dry process cement has been relatively fast in the recent two years, its weight in the total cement output is still not adequate however. Eighty five percent of the total cement output is still from the underdeveloped shaft kilns, wet process kiln, and the small dry process kiln. Among the 705 million tons of cement output in the country in year 2002, large and mid-sized enterprises produced 331 million tons, representing 47% of the total output and their average scale was 470000 tons. Yet the average scale of cement enterprises in Shandong is small, which computes as 220000 tons, far from the economic scale for cement production (MES = one million tons) requirement. From the market share of enterprises with annual output volume of more than one million tons (i.e. MES enterprises), D value is 24.86% (the ratio of output from MES enterprises to the total output). In meanwhile, the Herfindabl Index that reflects the degree of production concentration is 0.56. This implies a low industrial economic of scales efficiency and an unreasonable industrial structure of cement production enterprises in Shandong. Either the market share allocation or the distribution of production capacities shall all be improved through the intensified structural adjustment efforts.

(2) Surplus of underdeveloped production capacity, low growth potential for part of enterprises

Due to the restraints inherited from historical reasons and the external conditions, the shaft kilns production line is widely dispersed in Shandong province. They have made contribution to the national economy. But with the development of the economy and the upgrade of the industrial structure, the problem of low-level overlapping construction of small cement factories has been vastly eminent. The first problem is that it brings low investment efficiency, small enterprise production scale has no effect of scale economics. It limited the advancement of enterprise competitiveness. The enterprise of non-economic scale is disadvantageous in cost reduction, quality and labor productivity improvement. With the limited financing, low technology and the lack of market stability, the enterprises are short of the strength to participate in competition, especially the international competition. The second problem is that it worsens the industrial structure conflict, creating the excessive competition within the industry. Small enterprise scale and the low market entry barrier result in low production concentration, high market competition and low price (the cement price of Shandong Province has been lower than the cement price of other provinces for 20 ~ 40 yuan/ton for many years.). Therefore, it is very difficult to achieve the status of high quality and premium price. Such a small-scale and dispersed mode of production is disadvantageous to the healthy development of the industry and even may delay the progress of modern industrialization. The third problem it brings about is that it is difficult for the macro-control by the state. In the industry, due to the lack of giant enterprises as the pillars, there is a massive number of small enterprises directly. The macro-policy for the industry cannot take effect promptly and effectively. Another current problem is that the underdeveloped production technology is growing on the one side while being eliminated on the other side. The number of newly constructed shaft kiln cement production lines in last year was at dust ten.

(3) The sustainable development problem is still the biggest challenge for cement industry

The huge consumption in resource and energy and the environmental damage and pollution by cement industry has been restricting the development of cement industry. According to the primary assessment, the annual resource consumption by the cement industry in Shandong Province reaches as much as 150 million tons, the annual coal consumption is approximately 16.5 million tons, which represents 16% of the coal output in Shandong Province. The annual dust emission volume from cement industry in our province reaches 1.1 million tons; the annual emission of CO_2 approximates 50 million tons; plus the emission of waste air such as SO_2 and

NO_x, have all caused serious environmental pollution. For most of the enterprises using shaft kilns technology, it is very difficult to comply with the requirement of clean production due to the limitations from production technology and financial constraints. On top of that, how to reuse the industrial wastage thoroughly and comprehensively, and how to improve the development of recycling economy for the cement industry are the important project for the cement industry in Shandong Province.

C-2.3 The policy measures for the development of cement industry in Shandong Province

(1) Implementing national industrial policy, to close and eliminate small cement enterprises. According to the requirement of government document **[Guobanfa [1999] No. 49]** document issue and the [6th, the 14th and the 16th order] from State Economic and Trade Commission and **[Guojingmao Dianli [1999] No. 1289]** document for the cement production lines that are eligible for elimination and closing down, the power supply should be stopped. According to **[Jiancai Shengchanfa [1998] No. 256]** document; their production licenses should be collected back. According to **[Jiancai Xingguanfa [2000] No. 24]** document; their business license should be cancelled and suspended. According to **[Gongyinban [1999] No. 147]** document; the banks will only collect the balances and not lend the funds to such enterprises. To strength the monitoring and inspection to the closed enterprises and will dismantle the shaft kilns production facilities and the equipment shall not be transferred for other use. To research and analyze the plan for eliminating the enterprises of shaft kilns with diameter of 2.5 m and less and single-line of 100000 tons production capacity and to make it implemented. To clamp down and close down the shaft kilns enterprises near cities, tourism areas and main traffic paths, no matter of their size during the 'Tenth Five Year Plan' period.

(2) According to the requirement of government **[Guojingmao Touzi [2002] No. 235]** document, to prohibit the new construction, expansion and moving of any cement projects that are not new dry process cement (dry process rotary kiln) by any local government, government departments or enterprises. No entities in Shandong province shall approve, no bank shall lend, and related entities shall not process the work-resumption applications from these enterprises. The government and departments at different levels shall observe their duty and strictly control the project establishment, land usage, investment, credit and loans, business license, production license and the power supply. The principles and the officers of the relevant entities and

departments are held ultimately responsible for any breaches of the above regulations.

(3)Take the opportunity of the production licenses renewal by the cement production enterprises, any enterprises who fail the standard requirements for production facilities, product quality, inspection measure, enterprise management and environmental standards will be stopped production license by the quality monitoring department. For the enterprises that were ordered to be eliminated by the state, the production license renewal will be undertaken only after the production line was dismantled. The commerce administration department will suspend their business license according to law. Any distribution or construction companies shall not purchase or sell the products from or to the cement enterprises that do not have the production license.

(4) To broaden the financial channel, financing the development fund for new dry process cement. To improve the investment environment, explore and to invite the transnational companies to develop cement productions through mode of FDI, joint venture and cooperation. Actively attract the privately owned enterprises to invest in the new dry process cement production line.

(5) To strengthen the market monitoring, clear the industrial entrance barrier that separates and blocks the market, to produce the market environment of 'premium quality and premium price' and 'good quality in good use'. The important projects and the commercial concretes in Jinan, Qingdao, Dezhou, Weihai, Yantai, Dongying, Rizhao and Jining will have the preferred acquisition for the cement products from new dry process cement kilns.

(6)To nurture and to support the development of big enterprises (Groups). While supporting and implanting Shanshui Group, Jinghua Group, Lineng Group and Lunan Cement Co., Ltd, these four leading enterprises, to establish Zhangdian Cement Corporation (Zibo), Liuyuan Cement Group (Zaozhuang), Luye Cement Factory (Zibo), Qiyin Cement Group (Zibo), Huachen Group (Zibo), Wanli Group (Linxun), Jintawang Group (Jining), Lubi Group (Laiwu), Weiyang Group (Yantai), Luzhou Group (Rizhao). These ten big enterprises (groups) that are based mainly on new dry process cement kiln production lines and have annual output scale of more than one million tons.

C-3 The Present Situaiton and Development Trend of Cement Market in Shandong Province

C-3.1 The present situation and the economic operation status of cement market

in Shandong Province

C-3.2 The demand analysis and forecast for the cement market in Shandong province

As a traditional industry, the cement industry has experienced 180 years' development. It has very limited development space in the developed countries. Yet in our country, the total demand for cement product is still on the gradual growth trend. This is especially true after the goal set by Sixteenth CPC to thoroughly construct the healthy society and to achieve the target of doubling the GDP till year 2020. The national economy will still undergo a constant growth for the next twenty years and the fixed asset investment scale will be increasing. All these factors present the pulling effect for the development of cement industry. Additionally, the structural adjustment for the cement industry is a long-term process. Therefore, from the point of national aggregate, the development prospect for cement industry is optimistic. From the development trend of Shandong Province, as one of the fastest growing, reform and opening provinces in eastern coastal areas, the economy here has been on a fast track of development. The average GDP growth rate in the previous thirty years was 12.4%, the annual growth rate in fixed assets investment was about 14%, the rate of investment has been stably above 30%. In the new century, Shandong's economy presents the accelerating development trend. GDP in year 2002 reached 1055.2 billion yuan, growth rate of 11.6%, fixed asset investment 351.2 billion yuan, growth rate of 25.1%. The fixed asset investment, the international trade and the demand encouragement have become the three constant drivers for the provincial development and have pulled the need for the development of cement industry in Shandong. These resulted in 18.9% super growth speed in cement industry in 2002, the new wave of structural adjustment is looming.

C-3.2.1 The Cement Demand Estimation

According to the projects from the relevant departments, the cement demand in our country in year 2010 is 760 ~ 840 million tons. When computing according to the total demand volume, from year 2003 till year 2010, the cement demand in our country will remain an annual growth of 20 million tons, the annual cement demand growth speed is about 3%.

The future demand for cement in our country is shown in tab. 4.

Table 4 The Cement Demand Prediction for Our Country (x 100 million tons)

Demand	2005	2010	2020	2030
Production	2.02	2.80	3.40	4.00
Infrastructure construction	2.62	3.60	4.60	5.00
Countryside	1.46	2.10	3.00	3.20
Total	6.1 ± 0.2	8.5 ± 0.3	11.0 ± 0.5	12.2 ± 1.0

The cement consumption in Shandong has been growing steadily with the economic development. The growth rate was 3.24% during the 'Ninth Five Year' period, the growth rate was 4.37% during the first two years of the 'Ten Five Year' period with the annual consumption volume growth of about 2.59 million tons and a steady growth trend is showing. According to the development plan for Shandong for the next ten to fifteen years, GDP will reach 2.0 trillion yuan in year 2010 and 4.0 trillion yuan in year 2020 with annual growth rate of more than 9%. Judging by the correlative analysis of GDP with fixed asset investment and the level of urbanization to reach 50% in year 2010 and 70% in year 2020, it can be determined that the growth rate of fixed asset investment in Shandong Province in the future will be more than 12%. Therefore, the cement consumption will be pulled at a steady growth rate of 2 ~ 3% each year. The predicted average annual consumption increase before 2010 will be between 2.4 and 3.2 million tons.

The predicted cement consumption in Shandong Province is shown in tab. 5.

Table 5. Predicted Cement Consumption in Shandong Province ($\times 10^4$ t)

Demand Volume	2005	2010	2015
Production	2511	2846	3172
Infrastructure construction	3274	3668	4290
Countryside	1825	2137	2802
Total	7160 ± 200	8651 ± 300	10264 ± 500

C-3.2.2 The Preliminary Analysis of the Total Cement Output Increase Potential

During the first two years of the 'Tenth Five Year Plan' period, the total cement volume growth speed, especially that for year 2002, has exceeded the expectation. The fast growth of cement volume is mainly because of the growth in the fixed asset investment, the expansion in the urban construction scale and the rapid growth in real estate investment. In year 2001, the total social fixed asset investment in Shandong was 277.844 billion yuan, increased by 9.3%. In which, the renewal and renovation investment was 51.767 billion yuan, increased by 29.9%; real estate investment was 29.163 billion yuan, increased by 30.6%; infrastructure construction investment was 84.892 billion yuan, increased by 9.7%. In year 2002, the total social fixed asset investment in Shandong was 351.201 billion yuan, increased by 25.1%. In which, the renewal and renovation investment was 63.76 billion yuan, increased by 22.2%; real estate investment was 39.05 billion yuan, increased by 31.3%; infrastructure construction investment was 109.14 billion yuan, increased by 27.3%. From a view of the mid and long-term development trend of Shandong's economy, it is difficult to maintain such a high growth speed in fixed asset investment. Experts estimate that the appropriate speed is approximately 11 ~ 15%. Additionally, the growth in real estate investment in the province has been exceeding 30% for several consecutive years, which demonstrates the symptom of over-investment, over-pricing of houses, increased idle house spaces. After the real estate market reorganization, economic-bubble reduction and the growth rate reduction, the future real estate market investment rate may be reduced to below 20%, and maintains a moderate and stable growth pattern.

In the trend of the steady growth pattern for GDP and fixed asset investment, we shall also notice that the pulling effect for the demand of cement product by the economic growth and the fixed asset investment increase has been reducing. From the statistics of 10000 yuan GDP vs. the cement consumption, during the 'Eighth Five Year Plan' period, per 10000 yuan GDP's cement consumption was 1.296 tons, and 0.822 ton during the 'Ninth Five Year Plan' period. During the ten-year period, between 1990 and 2000, per 10000 yuan GDP's cement consumption has reduced from 1.28 tons to 0.77 ton, the general trend in the future is on the decline.

The per 10000 yuan GDP's cement consumption trend in Shandong is shown in Chart 3.

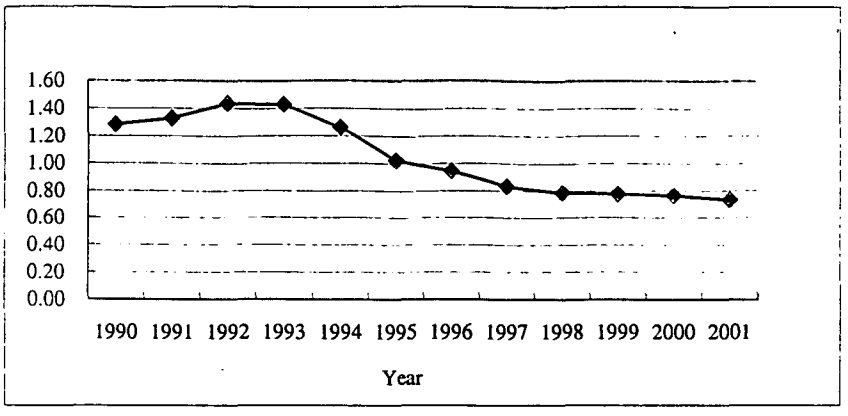

Chart 3. Trend for Per 10000 yuan GDP's Cement Consumption in Shandong

From the analysis of cement consumption in the context of social fixed asset investment, during the 'Eighth Five Year Plan' period, the average per 10000 yuan fixed asset investment's cement consumption was 4.694 tons, and 2.934 tons during the 'Ninth Five Year Plan' period. This indicates that the pulling effect of fixed asset investment is going down year by year with the technological advance and the adjustment of investment direction.

Per 10000 yuan social fixed asset investment's cement consumption in Shandong is shown in chart 4.

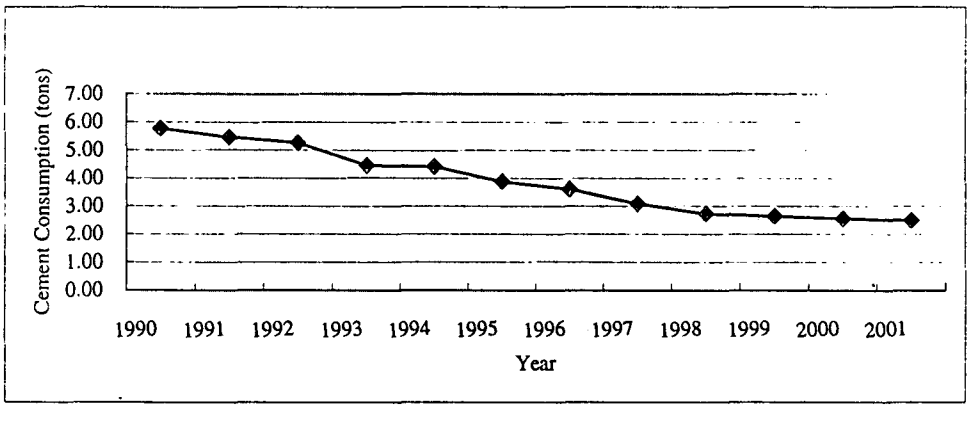

Chart 4. Per 10000 yuan Total Social Fixed Asset Investment's Cement Consumption (ton) in Shandong

From the analysis of demand elasticity, the elasticity of cement demand vs. GDP and fixed asset investment in Shandong Province is decreasing since the 'Ninth Five Year' period (See Table 6). Cement demand elasticity vs. GDP was 0.58 in year 2001.and 0.64 vs. fixed asset investment in year 2001. These prove that the development speed of cement industry won't play forerunning role in the future, judging the relationship between development speed and economic growth or fixed assets investment in these years.

Table 6. Cement Demand Elasticity from 1996 to 2001

Year	GDP elasticity of demand	Fixed Asset Investment elasticity of demand
1996	0.514	0.549
1997	0.118	0.091
1998	0.205	0.107
1999	0.801	0.615
2000	1.12	0.718
2001	0.581	0.639
Average	0.56	0.45

According to the common features of cement consumption in developed countries, when the economy has progressed into certain phase, and when the per capita consumption has reached a certain degree, the cement consumption saturated. According to the analysis of cement consumption volume in the developed countries such as the U.S.A, Germany, France and Japan, when the average accumulated per-capita consumption reaches 12 ~ 14 tons, per-capita annual cement consumption reaches 700 kilograms, the cement consumption attains saturation and enters into a stable consumption period. When the average accumulated per-capita consumption reaches 20 ~ 22 tons, per-capital annual cement consumption reaches 800 ~ 1000 kilograms, the cement consumption will tend to decline, the total volume of consumption and the per-capita annual consumption volume starts to slide gradually.

The average per-capita cement consumption volume was 518 kilograms in Shandong in year 2001, the average accumulated per-capita consumption reached 6.5 tons, the cement consumption demand has not reached its saturation point and therefore the demand will still grow. It's estimated that from 2011 till 2014, the domestic average accumulated per-capita consumption will reach a range of 12 ~ 14 tons, the average per-capita consumption will be in a range of 630 ~ 660 kilograms. The annual demand for cement will be 860 to 900 million tons. By then, the cement consumption might reach saturation; An abrupt in total consumption growth will occur. Judging from the average per-capita cement consumption in Shandong (Chart 5), the average per-capita cement consumption is 659 kilograms in year 2001 (the average consumption in Guangdong and

Shanghai was 800 ~ 1000 kilograms). The accumulated consumption reached 8.1 tons. So there still existed potential for growth. It is estimated that up to year 2005, the average per-capita annual consumption will reach 699 kilograms, accumulated consumption will reach 11 tons. They will be 736 kilograms and 15 tons respectively by 2010. That is to say, according to the experience of developed countries, after year 2010, the consumption for cement in Shandong will tend to saturate, and the consumption will enter into a stable period. Till around year 2015, the accumulated consumption volume will be 18 tons, the consumption level might start to decline.

The development trend of the average per-cap cement consumption and the accumulated cement consumption are synchronous with the trend of the modernization construction in Shandong Province. From a view of the target of economic modernization construction and the development phases in Shandong province, a preliminary modernization will be attained around year 2010, and a level of medium developed countries will be attained in year 2020. The average annual GDP growth rate will be about 9%. Hence we preliminarily conclude that the cement consumption will stabilize around year 2010. It is still anticipated that there exists a growth space before then.

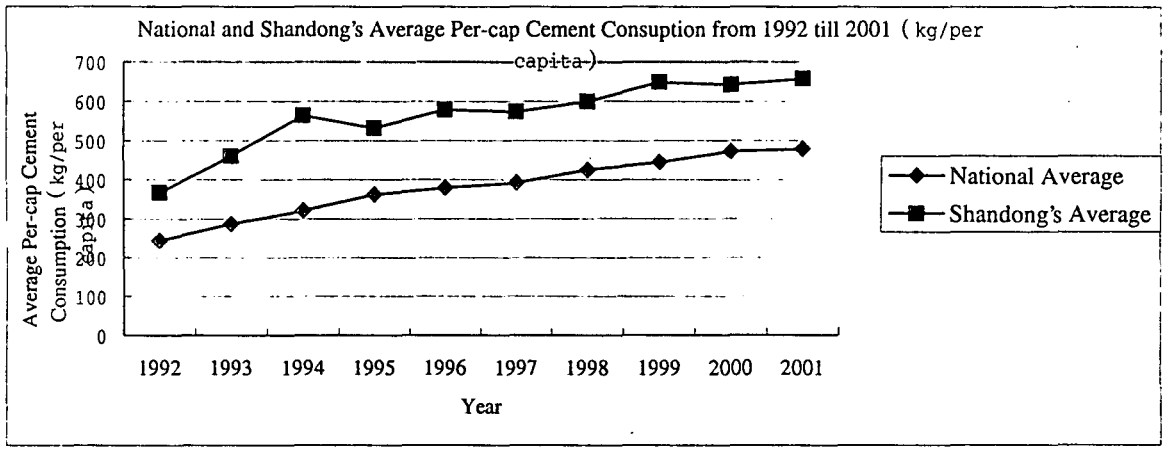

Chart 5, Shandong's average per-cap consumption level

C-3.2.3 The development of cement shall be based on structural readjustment, to energetically develop new dry process cement

At present, under the circumstances that the cement production capacity in Shandong has exceeded the market demand, the elimination of the underdeveloped capacities is the largest development space for the growth of the cement in Shandong province. If we can eliminate 5 million tons of underdeveloped production capacities from now on each year, and to replace them with the new dry process cement, we can complete the reform of 50 million tons of

underdeveloped cement in about ten years, allowing the new dry process cement in Shandong province to dominate. Additionally, if we satisfy all the new social demand volume with new dry process cement, the cement industry in Shandong province will step up on a new industrialization path with high technology content, high economic efficiency, low resource waste, low environmental pollution and the best utilization of the human resource. Therefore, the goal of sustainable development will be realized. In the implementation process, a priority should be given to large enterprises and company groups with more than one million tons output to develop new dry process cement. The starting point of the development scale (single-line production capacity) shall be at a level over 3000 t/d.

As a conclusion from the above discussions and analysis, the cement industry has a relatively decent prospect in Shandong Province at present. This is especially true for the new dry process cement that represents the direction of technology advancement. It has a relatively broader development potential. The industrial technology improvement will bring about the change of cement consumption structure, thereby encouraging the transfer of the industrial structure from volume expansion and dispersed industrial structure towards quality and efficiency type one, and to transfer the driving force for cement consumption from the type relying on mainly the fixed-asset-investment to the joint forces of consumption structure guidance and the fixed-asset-investment pulling one. The first ten years of the new century will be the critical period for the grand development of new dry process cement in Shandong Province. Seizing the opportunity, grasping firmly the main guide line of structural adjustment, increasing the effort to develop and attract the social and international investment, the target of 80% ratio for the new dry process cement by year 2015 should be achieved, through the effort of the entire industry, thereby strengthening the cement industry in Shandong Province, to make a even greater contribution to the development of national economy.