# JIANGXI YADONG CEMENT CORPORATION LTD

## COMPANY DESCRIPTION

Jiangxi Yadong Cement Corporation is a joint-venture producing Portland cement and clinker near the Yangtse River at Ruichang City, Jiangxi Province, with 550 staff. The installed capacity is two production lines of 4200T/D each, which were established in July 2000 and March 2003. Annual production is 3 million tons of clinker and 4 million tons of cement, but capacity will be expanded to reach 15 million tons of clinker and 20 million tons of cement products per year by 2010. The company's products are mostly consumed in the East and Southeast of China as building materials. The company management was keen to participate in the GERIAP project because they wanted to learn to cut production costs through energy efficiency and to avoid negative environmental impact. They also wanted to acquaint themselves with China's CDM (Clean Development Mechanism) project management policies and measures and seek the possibility to apply for participation in a CDM project.

## PROCESS DESCRIPTION

The production process involves the following steps:

- ***Acquisition of raw materials:*** Limestone is mined in quarries through pneumatic drilling and subsequently, blasting with explosives and then is fed to primary and secondary crushers to reduce the size to around 25 mm. Crushed limestone is transported to the plant on a belt conveyor through a vertical shaft and horizontal tunnels, and stored in the partially closed-type stockyard via stacker conveyors. Other raw materials, including sandstone, clay, pyrite and gypsum, are mined in quarries 10 km always from the plant and are then transported by trucks and stored in closed storehouses. Slag and coal ash powder is transported via waterway or railway. Coal is purchased directly from suppliers and transported via waterway and stored in the closed bunker.
- ***Preparation of the raw materials:*** Raw materials (limestone, sandstone, clay and pyrite) are fed to the raw mill via weighing feeders in required proportion to be ground into fine powder. Meanwhile, the raw coal is pulverized in a Loesche pressure mill and coal particles are collected through a cyclone dust collector and an electrostatic precipitator. The required size is 80 % of 90µm and less than 2% of 212µm.
- ***Pyroprocessing of the raw materials into clinker:*** The raw meal/material mix enters the preheaters, which are vertically arranged in series, and get heated while moving downwards by hot exhaust gases from the rotary kiln that move upwards. The raw meal moves to the preheater vessels to the base of the preheater tower, where up to 95 % of the raw meal turns into Calcium Oxide and Silica, Aluminum Oxide, Ferric Oxide. Finally, the raw meal enters the kiln at the top, and continuously and slowly moves towards the bottom by rotation of the kiln. During the process, the raw meal is transformed into Portland cement clinker. Meanwhile, the pulverized coal is sprayed into the bottom end of the kiln and moved upwards in the opposite direction to the raw meal. There is also a substantial amount of coal introduced in the precalciner vessel as the combustion fuels.
- ***Grinding the clinker to Portland cement:*** The clinker is mixed with gypsum and other constituents (slag, coal ash powder, phosphogypsum, high magnesium lime, etc.) and ground via a rolling press. These materials are then sent through the tube mill which performs the finishing-grind. The grinding process occurs in a closed system with an air separator that divides the cement particles according to size. The cement with desired fineness is collected in the bag filter and taken to cement silos through a screw conveyor.

## METHODOLOGY APPLICATION

The draft ***Company Energy Efficiency Methodology*** was used as a basis for the plant assessment to identify and implement options to reduce energy and other materials and wastes. Some of the interesting experiences are:

- ***Task 1c – Pre-assessment to collect general information***

The company initiated a Cleaner Production audit of the plant that lasted from September 2003 until August 2004 and overlapped with the GERIAP project. This audit generated 21 no/low cost projects and 10 medium/high cost options, and all options except one medium/high cost option were implemented. As a result the specific coal consumption was reduced by 1kg / ton clinker and the specific power consumption was reduced by 1 kWh / ton cement. The GERIAP project "piggy-backed" on this project by involving the Japanese consulting firm (Kawasaki Heavy Industries) who carried out the audit in the identification and evaluation of energy efficiency options and by using the plant's CP team formed for this audit as the Team for the GERIAP project also.

<u>Lesson learnt: During the pre-assessment find out what other projects are being carried out at the company to avoid duplicating work and to make maximum use of the strengths of other projects for the energy assessment.</u>

- ***Task 2d – Quantify inputs and outputs and costs to establish a baseline***

The Team could make use of the company's on-line monitoring system to collect baseline data. This system covers production, consumption and financial information but also management, process and other information. This allows the company to pro-actively manage production and operation cost at company and department level. The plant manager and each department has a terminal display unit that can be accesses by most production staff to continuously enter and read production parameters such as temperature, pressure, flow rate, materials and energy consumption, and wastes and emissions. This has as an advantage that any irregularities are immediately noticed and reported to the plant manager. Because the system stores the monitored data, daily and monthly reports can be produced automatically, which facilitates the communication between different departments and to top management. However, it was noted that some on-line measurements are not very accurate, for example, the flue gas analysis at the inlet chamber of the kiln, and the Team took additional measurements to get more accurate data. On-line measurements of coal consumption were found less accurate than the daily measurements by staff on the work floor so the Team used the latter data.

<u>Lesson learnt: A good information system will save the Team a lot of time to collect baseline data. However, it is important to check the quality of on-line measurements against real measurements to ensure that the data collected is accurate.</u>

- ***Task 3b – Identify options***

Power generation using waste heat was a main area for energy savings and to identify options for this, the Team, assisted by a Japanese consulting firm, used the experiences of some national pilot projects on power generation with low temperature waste heat in cement companies as a reference.

<u>Lesson learnt: It is worthwhile to find out about the experiences from other Cleaner Production and energy efficiency projects that have been carried out at other companies when identifying possible options.</u>

- ***Task 4a – Technical, economic and environmental evaluation of options***

The evaluation of an option to generate power from waste heat required more than just an internal feasibility analysis. The proposal for the project had to be submitted to local authorities for examination and approval before implementation. The company also has to negotiate with local electric utilities on how to supply excess power from this project to the utilities network and how much money the company would receive per unit of electricity. The project has received

Government approval and an agreement with the utilities companies was reached in 2004 and will be implemented by November 2005.

- ***Step 6 – Continuous improvement***

Top management commitment to environment and energy efficiency is high and energy is a fixed item on the agenda of weekly management meetings. An interesting aspect of energy management at the company is the consideration of environmental and energy performance for material and equipment procurement. For example, every batch of purchased coal must be tested and obtain approval from the Quality Control Unit before the Storage and Warehouse Unit accepts it. Another example is fans and motors, which must meet minimum energy efficiency standards with a 2 years warranty and the Procurement Division must get approval from the Electricity and Instrument Unit before procurement.
Lesson learnt: The inclusion of energy efficiency criteria in procurement procedures is important to ensure continuous improvements in energy efficiency.

## OPTIONS

- The focus areas selected for the project were (1) clinker cooler; (2) kiln off gas after preheater; (3) dissipated heat loss from the kiln shell.
- One option was implemented as part of the GERIAP project, requiring an investment of US$ 24 million, resulting in savings of US$ 4 million per year and an 8 year payback period. Once the power generation from waste heat option goes into operation, the (1) energy reductions will be 34695 tons of coal standard per year; (2) GHG reductions will be 85,599 tons of $CO_2$ per year.
- Just prior to the GERIAP project, the company performed a Cleaner Production Self-audit in compliance with " Guidelines for Cleaner Production Self Audit in Medium and Small Sized Cement Plant" co-ordinated by the China National Cleaner Production Center and IVAM Environmental Research Institute of the University of Amsterdam from October 2003 to April 2004. During the audit, 31 options were identified, including 21 none or low cost housekeeping options and 10 medium/high cost options, of which, all the none/low cost options and 9 medium/high cost options passed the feasibility analysis and have already been implemented. These implemented projects focused not only on cleaner production but also energy efficiency. The company saved 130 MWh of power consumption, 50 tons of coal burning and 20 KL of oil each year.
- A Table with a summary of options, including the option from GERIAP and selected options from the previous Cleaner Production Audit, is shown below.

**Table 1: EXAMPLES OF OPTIONS IMPLEMENTED AND INVESTIGATED**

| FOCUS AREA/ OPTION | CP TECHNIQUE | FINANCIAL FEASIBILITY | ENVIRONMENTAL BENEFITS | COMMENTS |
|---|---|---|---|---|
| Surplus hot air from clinker cooler; and, kiln off gas after preheater/ Power generation from waste heat from clinker cooler and preheater *(see case study)* | Onsite reuse / recovery | ▪ Investment: US$ 24 million<br>▪ Cost savings: US$ 4 Million/yr<br>▪ Payback period: 8 years | ▪ Electricity savings: 110,880 MWh<br>▪ Coal savings: 34,695 tons<br>▪ GHG emission reduction: 85,599 t/yr<br>▪ Other emission reductions:<br>- 491 tons of | ▪ Identified by the GERIAP team; still under construction |

| FOCUS AREA/ OPTION | CP TECHNIQUE | FINANCIAL FEASIBILITY | ENVIRONMENTAL BENEFITS | COMMENTS |
|---|---|---|---|---|
| | | | $SO_2$/yr<br>- 218 t soot and dust/yr | |
| Cement mill segment/<br>Use of coal ash powder instead of steel slag as clinker substitute in cement *(see case study)* | Input material substitution | ▪ Investment: US$ 110,000<br>▪ Cost savings: US$ 380,000 /yr<br>▪ Payback period: 4 months | ▪ Energy savings: not determined<br>▪ GHG emission reduction: not determined<br>▪ Reduced coal ash powder waste and disposal | ▪ Identified by the company in a previous Cleaner Production Audit program |
| Belt feeder for separator at #2 raw mill/<br>Replacing belt feeder with gravity chute | Production process/ equipment modification | ▪ Investment: US$ 2,418<br>▪ Cost savings: US$ 9,915/yr<br>▪ Payback period: 3 months | ▪ Energy: savings: 130 MWh<br>▪ GHG emission reduction: 100 t/yr<br>▪ Other emission reduction: 580kg $SO_2$ and 250kg soot and dust per year | ▪ Identified by the company in a previous Cleaner Production Audit program |
| Belt conveyor below the Deagglomerator at #2 raw mill/<br>Elevating the bottom of the belt conveyor to reduce overflow of raw meal | Production process/equipment modification | ▪ Investment: US$ 2,418<br>▪ Cost savings: US$ 1,209/yr<br>▪ Payback period: 2 yrs | ▪ Energy savings: not determined<br>▪ GHG emission reduction: not determined<br>▪ Reduced raw meal waste | ▪ Identified by the company in a previous Cleaner Production Audit program<br>▪ Reduced labour time for cleaning |
| Industrial and canteen waste/<br>Reuse of combustible waste as kiln fuel, selling the recoverable waste, and blending the non-recoverable waste into raw meal or clinker | Good housekeeping | ▪ Investment: US$ 24,184<br>▪ Cost savings: US$ 4,837/yr<br>▪ Payback period: 6 yrs | ▪ Coal savings: 50 t/yr<br>▪ GHG emission reduction: 123 t/yr<br>▪ Other environmental benefits: no garbage dumping to environment, saving garbage disposal cost, this is the best cost saving. | ▪ Identified by the company in a previous Cleaner Production Audit program |
| Used lubricant and waste oil/<br>Waste oil recovery (about 60% reused as chain lubricant for simple machines and 40% blend with raw meal as fuel) | Good housekeeping | ▪ Investment: very small<br>▪ Cost savings: US$ 13,301/yr<br>▪ Payback period: immediate | ▪ Oil savings: 20 kL/yr<br>▪ GHG emission reduction: not determined<br>▪ Reduced pollution from oil | ▪ Identified by the company in a previous Cleaner Production Audit program |

## FOR MORE INFORMATION

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