LIME MASTER LIMITED

COMPANY DESCRIPTION

Lime Master Co Ltd is located in Saraburi, Thailand. The company was established in 1999 with an annual production capacity of 54,750 tons of lime and expanded its capacity to 99,000 tons per year in 2004. The company has 51 employees who work in three 8-hours work shifts. The production process is ISO 9001 certified and its products are in demand due to their consistent high quality. In addition, the company uses the state-of-the-art production equipment and is considered one of the most efficient lime producers in the region.

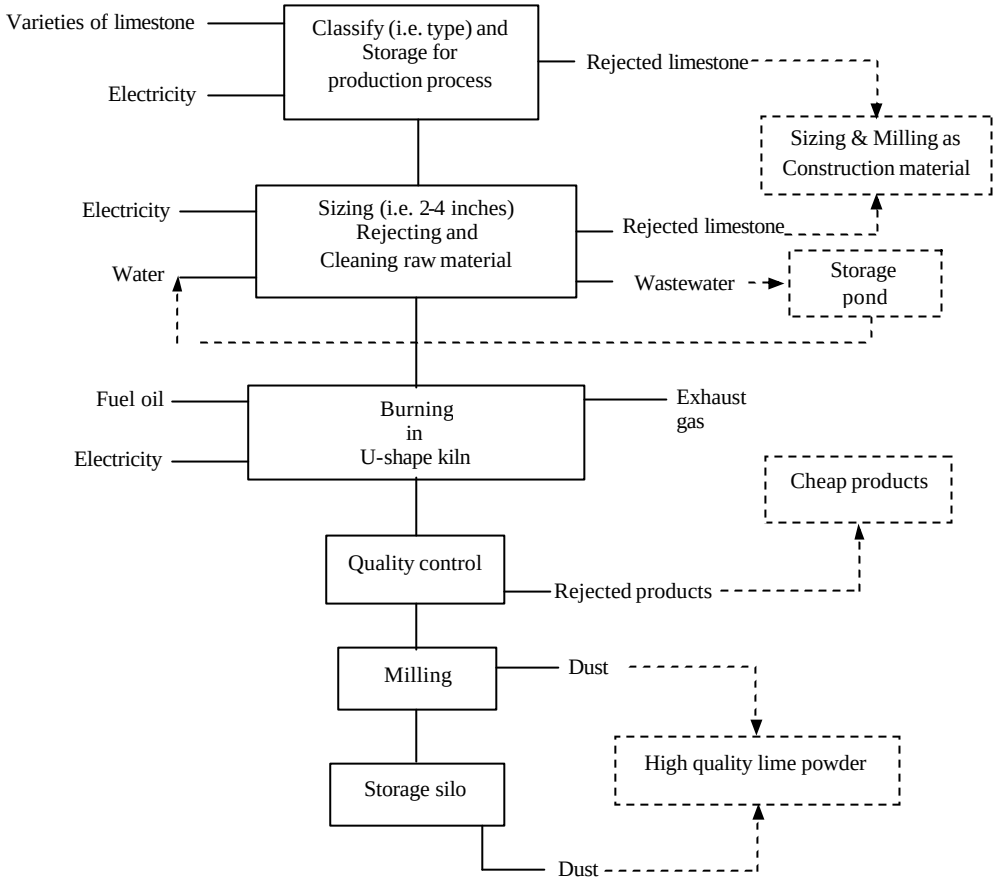
Lime Master participated in the GERIAP project to increase its production and energy efficiency through the application of the cleaner production methodology, which is more effective and environmental friendly than end-of-pipe solutions to waste and energy losses. A dedicated Team was established to cooperate with TISTR, the organization that conducted the GERIAP project in Thailand. The Team had complete support and encouragement from top management for developing plans to identify and implement energy efficiency options.

PROCESS DESCRIPTION

Figure 1 illustrates the production of lime, which includes the following steps:

- ***Classify and storage*:** As sources of high quality limestone are scarce, the classification of limestone is required to select only the best quality available material. Selected limestone is stockpiled until it is fed into the production process to produce lime.
- ***Sizing, rejecting and cleaning:*** Limestone is conveyed from stockpiles to the vibrating screen via a conveyor that is driven by an electric motor. Limestone smaller than 2 inches will fall through the screen onto a bypass conveyor and is carried away to separate stockpiles. As a result, only limestone of 2-4 inches is going to the kiln. Water jet nozzles are installed over the vibrating-screen to clean the limestone during the sizing step.
- ***Burning in U-shape kilns*:** Cleaned limestone is loaded into two shafts of the vertical kiln by an electric conveyor and buckets. The two shafts operate alternately. First, limestone is burnt in the first shaft at > 1000°C using 8 oil-fired burners installed vertically between the two shafts. The burning process takes 10-13 minutes depending on the limestone feeding rate. Flue gas from the burning process moves down the first shaft moves and then up the second shaft to preheat the limestone stacked at the top of the second shaft. Once the burning process in the first shaft is completed, lime parts are unloaded at the bottom of the kiln while new limestone is loaded at the top of the first shaft. Then the preheated limestone is burnt in the second shaft.
- ***Quality control***: Chunks of lime from the kiln are passed over a conveyor for a manual quality control process. Rejected products are separated and stockpiled for sale. The remainder is conveyed to the milling process or storage silos, depending on the type of product requested by customers.
- ***Milling process*:** Chunks of lime are processed in the milling process to produce lime powder.
- ***Storage silos:*** Lime powder and lime chunks are stored in separate silos for sale to customers.

Figure 1. Diagram of Lime Master production process



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 2a – Staff meeting and training***

A 1-week technical training course was delivered by TISTR, the facilitating agency for the GERIAP project in Thailand. This company decided to sent the Deputy Production Manager, the Chief of Production Process and the Chief of Quality Control to this course so that the entire production process was covered. This made it possible to easily extend the energy assessments to other focus areas after the methodology was applied once. In addition, top management is adopting the bottom-up energy and environmental management policy to the company production process.

Lesson learnt: When the company selects which staff should follow training it is important to not only to consider the selected focus areas, but also what areas may need to be covered in future assessments.

- ***Task 2c – Walkthrough of focus areas***

Prior to the walkthrough of the plant, several non-technical workers were trained on how to recognize inefficient use of energy and materials. They joined the Team, the external Thai facilitators and an external consultant in the walkthrough of the plant and managed to point out

several inefficiencies that staff working in the plant every day had got used to, such as dripping or left open water taps, leaking steam valves, and compressed air leaks.
Lesson learnt: Non-technical staff who do not work in the plant on a daily basis are able to identify obvious losses of materials and energy because they look at the processes with fresh eyes, and therefore they should join the walkthrough of the focus areas.

- ***Task 5a – Implement options and monitor results***

Several of the recommended options that required behavioral changes of staff would first be tested to see if the option would work in practice and achieve the desired results. Only if the tests were positive the change would be incorporated in operating procedures and instructions to make sure that the new practices would also continue when staff would rotate. By doing this it was ensured that new procedures would be successful and continue to be followed in the future.
Lesson learnt: Testing options that require behavioral changes before including them in operating procedures ensures the procedure will be effective. Incorporating behavioral changes in procedures ensures that the changes will also be adopted by new employees.

- ***Task 5b – Evaluation meeting with top management***

Top management informed the external facilitators at the end of the project that they were most pleased and surprised by the success of the installation of a bag filter to collect lime powder dust. This option was approved because dust is considered a major problem by local authorities and residents, although financially the option would not save the company money. However, when the bag filter was put into operation it was found that the lime powder could be recovered and sold as product. This provided the company with unexpected savings of almost US$ 35,000 and the bag filter was paid back in 18 months!
Lesson learnt: Sometimes options that seem to be financially unfeasible can provide unexpected savings. It is therefore useful to think about all direct and indirect benefits that a proposed option might bring.

OPTIONS

- Focus areas selected included (1) the conveyor system, (2) raw material and product recovery/recycle and (3) fuel switching.
- A total of six options were identified and investigated, of which two options were fully implemented, three options were partially implemented and one option was rejected following the advice of consultants hired through UNEP.
- Total investment, annual cost savings, payback period
- Total energy savings were # kWh/yr, # liters oil/yr
- Total greenhouse gas (GHG) emission reductions were # ton CO2/yr

Table 1. EXAMPLES OF OPTIONS IMPLEMENTED

FOCUS AREA / OPTION	CP TECHNIQUE	FINANCIAL FEASIBILITY	ENVIRONMENTAL BENEFITS	COMMENTS
Conveyor system /Installation of magnetic timers to turn off conveyors during no-load periods *(see case study)*	Production process/ equipment modification	▪ Investment: US$ 50 ▪ Cost savings: US$ 2,385 ▪ Payback period: 8 days	▪ Electricity savings: 52,998 kWh/yr ▪ GHG emission reductions: 33 tons CO_2/yr	▪ The option was implemented
Raw materials and products/ Installation of bag filters to recover	Production process/ equipment modification	▪ Investment: US$ 48,364/yr ▪ Operating costs: US$	▪ Electricity increase: 109,176 kWh/yr ▪ Fuel oil savings: 66,312 l/yr	▪ The option was implemented.

lime powder from storage silos and reduce dust emissions *(see case study)*		6,227 ▪ Cost savings: US$ 56,411/yr ▪ Payback period: one year	▪ Material savings: 730 ton lime/yr ▪ GHG emission reduction: 176.4 tons CO_2/yr	
Raw materials and products / Recovery and reuse of washing water at vibrating screen through installation of concrete ponds and gutters *(see case study)*	Good housekeeping	▪ Investment: US$ 4,250 ▪ Cost savings: US$ 2,340 ▪ Payback period: 2.3 yrs	▪ Electricity savings: 11,170 kWh/yr ▪ Water savings: 14,700 m^3/yr ▪ GHG emission reductions: 7 ton CO_2 /yr	▪ Partially implemented, construction of water reservoir and gutters to be completed ▪ Estimated potential benefits only
Raw materials and products / Recover low quality raw materials to sell as construction materials *(see case study)*	Offsite reuse / recovery	▪ Investment: none ▪ Cost savings: US$ 12,500 ▪ Payback period: immediate	▪ Reused rejected materials : 10,000 ton/yr	▪ The option was partially implemented ▪ Estimated potential benefits only
Raw materials and products/ Recover rejected limestone products to sell as low quality materials *(see case study)*	Offsite reuse / recovery	▪ Investment: none ▪ Cost savings: US$ 125,000 ▪ Payback period: immediate	▪ Reused rejected products : 5,000 tons/yr	▪ The option is partially implemented ▪ Estimated potential benefits only

FOR MORE INFORMATION

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