



## **PT SEMEN CIBINONG TBK**

### **Kiln refractory lining with better quality chrome-free fire bricks to reduce number of Kiln shut downs**

#### **SUMMARY OF THE OPTION**

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PT Semen Cibinong Tbk is one of the largest cement producers in Indonesia with an annual production capacity of 5,700,000 tons, and supplying to domestic and export markets.

Processing of cement takes place in the kiln reactor, which is lined with refractory/firebrick. The function of refractory lining is to protect the kiln shell from overheating, chemical attacks and abrasion. Data showed that the company carried out kiln refractory patching 3 to 4 times in 2003. Each time the kiln must be shut down and to start up production again a lot of industrial diesel oil (IDO) to heat up the kiln.

To reduce the number of shut downs and thus improve energy efficiency of the kiln, the Team suggested to improve the quality refractory lining. This was done by replacing the brick materials with the higher quality chrome-free brick materials and by introducing an improved procedure for kiln lining. Since this option was implemented, there has been no kiln shut-down caused by brick problems. IDO saving were 253,830 liters per year, resulting in annual savings of Rp 482,277,000 (= US\$ 52,421, whereby US\$ 1 = Rp 9,000). Investment costs included training of staff on the new kiln lining procedure. Operating costs are the higher price for the chrome-free bricks but data are not disclosed. However, the higher costs for bricks are minimum compared to the IDO savings and additional income from increased clinker production. Therefore the payback period is almost immediate. Greenhouse gas emission reductions are 680 tons CO<sub>2</sub> per year.

#### **KEYWORDS**

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Indonesia, Cement, Furnaces & Refractories, Kiln, Refractory Lining, Fire Bricks

#### **OBSERVATIONS**

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Processing of cement takes place in the kiln reactor, which is lined with refractory/firebrick. The function of refractory lining is to protect the kiln shell from overheating, chemical attacks, and mechanical abrasion. It also acts as insulation of the kiln to prevent heat loss.

The brick replacement/patching records at the company (see Table 1) showed that many meters of lining are replaced each year. Based on the data, refractory brick lining repairs are conducted 3-4 times a year at the different kilns and at least once per year in the kiln of NR#4.

The consequences of lining damage and frequent brick replacements are:

- Reduction of thermal efficiency when lining is damaged and therefore loss of energy
- Each time the lining is repaired / replaced the kiln has to be shut down and a lot of diesel oil (IDO) is used during start up of the kiln
- Loss of production time due to kiln shut down and therefore lower production of clinker
- Many hours of maintenance staff required to repair / replace the lining



Possible causes are:

- Poor quality of bricks
- Bad brick installation
- Chemical and mechanical problems in the kiln

**Table 1: Refractory lining repairs and amount of meters of bricks replaced**

| Date<br>(mm/yyyy) | Meters replaced |    |       |
|-------------------|-----------------|----|-------|
|                   | from            | to | total |
| 3/1999            | 8               | 12 | 4     |
| 4/1999            | 1               | 38 | 37    |
| 3/2000            | 1               | 54 | 53    |
| 6/2000            | 1               | 4  | 3     |
| 7/2000            | 34              | 35 | 1     |
| 8/2000            | 1               | 10 | 9     |
| 12/2000           | 1               | 68 | 67    |
| 3/2001            | 3               | 4  | 1     |
| 6/2001            | 1               | 7  | 6     |
| 10/2001           | 68              | 70 | 2     |
| 11/2001           | 1               | 44 | 43    |
|                   | 66              | 83 | 17    |

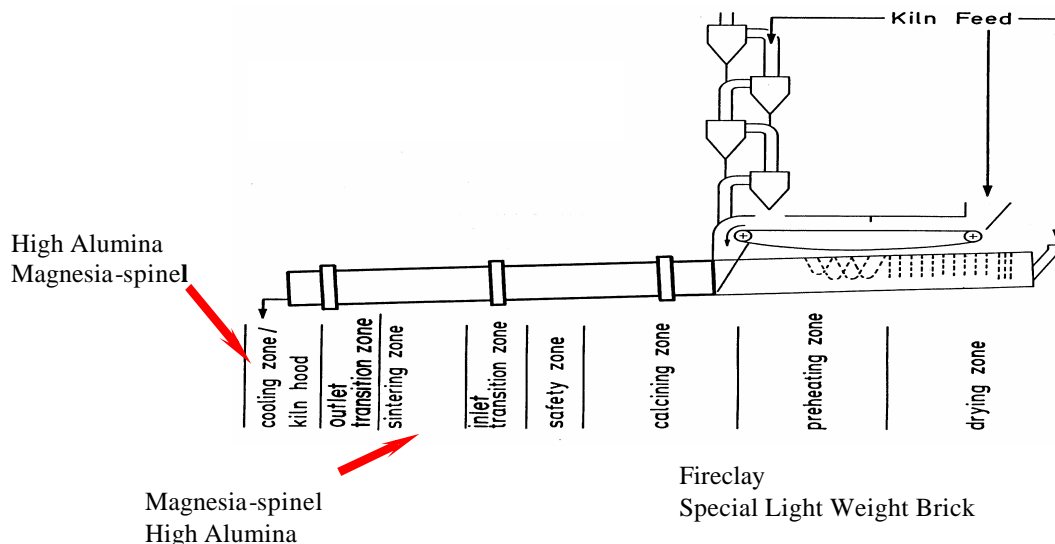
| Date<br>(mm/yyyy) | Meter replaced |    |       |
|-------------------|----------------|----|-------|
|                   | from           | to | total |
| 2/2002            | 5              | 6  | 1     |
| 4/2002            | 26             | 31 | 5     |
| 11/2002           | 1              | 44 | 43    |
|                   | 53             | 67 | 14    |
| 2/2003            | 1              | 3  | 2     |
| 3/2003            | 1              | 2  | 1     |
| 3/2003            | 12             | 22 | 10    |
| 4/2003            | 1              | 3  | 2     |
| 6/2003            | 28             | 31 | 3     |
| 7/2003            | 31             | 42 | 11    |
|                   |                |    |       |
|                   |                |    |       |

## OPTIONS

The Team came up with the following options to improve thermal efficiency by improving the lining quality:

- Replacing the brick material with higher quality bricks, in this case Magnesium-chrome bricks were replaced with Magnesium-spinel bricks
- Improving the quality of the installation of lining, which is a key factor in obtaining a long refractory life. A new procedure for kiln lining was introduced and staff received training from a Holcim expert on refractory lining installation techniques
- Fine-tuning refractory zoning by observing the lining when the kiln is in operation

**Figure 1: Zoning of type fire brick**





An independent refractory consultant reviewed the current plant specification for the type of bricks and castables used at each zone (see figure 1), and also established an approved installation procedure for repairs/patching and for new lining in the kiln. As part of the feasibility analysis, the following information was gathered about the bricks used for lining the kilns:

- Example of different types of bricks used by the company: Spinel, Ankral Ze; Basic, Perilex 80; Hi-Alumina, Kronex 70; Spinel, Almag 85; Basic Ankral S6; Maxial 310-422; Resistal 50z; Spinel, MSN 80. For type of Castable: Gun Cast 1300; Gun Sic 40; Hi Cast – Extra Hi-Cast; Kergun, C-28; Monrox SIC 60; Phlox 1560 SR
- Transition zone refractories are usually exposed to higher thermal loads than the sintering zone. For this reason these are usually lined with Magnesia-spinel bricks (based on synthetic magnesia sinter) because Magnesia-chrome bricks possess inferior thermal and environmental properties
- Brick types used in Sintering Zone Refractories must have high resistance against chemical attack: Magnesia-spinel bricks; Dolomite bricks
- When selecting magnesia-spinel bricks, qualities particularly developed to improve coating adhesion should be chosen (based on natural magnesia sinter)
- Dolomite bricks have the best coating adhesion but must be restricted to zones with permanent coating formation. The price for dolomite bricks is approx. 60% of that of magnesia based bricks

## **RESULTS**

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Since this option has been implemented, there were no kiln shut downs due to brick problems because of the longer life-time of the new types of bricks.

### **Financial benefits**

- Investment: costs to carry out training programmes for staff on the new procedure for kiln lining, but these costs were not quantified
- Annual operating costs: these costs were not disclosed but are considered low because the expenditure of refractory materials per ton of clinker produced is insignificant compared to energy costs. The reduced energy costs each year are many times higher than the additional costs for purchasing higher quality brick materials
- Annual cost savings:
  - IDO reduction: 482,277,000 (= US\$ 52,421, with US\$ 1 = Rp 9,000) (253,830 liters IDO X Rp1,900/liter)
  - Increased clinker production: income from additional 126,752 tons of clinker produced
- Payback period: almost immediate

### **Environmental benefits**

- Annual IDO (industrial fuel oil) savings: 253,830 liters, calculated as follows:
  - Average IDO consumption to heat up the kiln is 63,457.5 litres
  - Each year there are 4 shut downs caused by brick damage
  - IDO savings are 4 X 63,457.5 liters = 253,830 liters/yr (=253.83 kiloliters/yr)
- Annual GHG emission reduction: 680 tons CO<sub>2</sub> (253,830 kiloliters IDO X 2.68 tCO<sub>2</sub>/kiloliter). *Note: the emission factor is taken from the Greenhouse Gas Indicator: [www.uneptie.org/energy/tools/ghgin/](http://www.uneptie.org/energy/tools/ghgin/)*



**Other benefits :**

- Less time required by maintenance staff to repair and replace the brick lining. Time required to repair depends upon the amount of brick damage. It takes four days to shut down the kiln.
- Increased production of clinker for NR#4.
  - Capacity = 7,922 tonne clinker/day
  - Each year there were four shut downs
  - Increased production clinker per year = 4 X 4 days X 7,922 t/d = 126,752 tons
- Improved health situation for employees and communities near the plant area because chrome bricks were replaced with chrome-free bricks.

**FOR MORE INFORMATION**

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