PT SEMEN CIBINONG TBK

False Air Leak Survey & Repair, Installation of Mechanical Seal on Kiln

SUMMARY OF THE OPTION

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.

A false air / vacuum leak survey was undertaken at the production line NR#4 in Narogong Bogor. This confirmed significant volumes of ambient air ingresses, for example through ducting and the feeding chute of the Raw Mill and manholes, chute ports, inspection windows, and nose ring of the kiln and preheater. False air causes an increase in coal consumption (false air is heated from ambient to operational temperatures) and electricity consumption (increased loads of motor fans in calciners).

The Team recommended two options to reduce energy loss from false air / vacuum leaks: the installation of a mechanical seal between the kiln and the nose ring, and a false air leak survey and repair of identified leaks.

These two options have been implemented and investment costs were not high. However, the exact investment costs could not be quantified because the mechanical seal was designed and produced in-house and the leak survey and repair was conducted by regular staff with the assistance of BPPT (organization implementing GERIAP project in Indonesia). Potential coal savings are 12,210 tons per year, based on a mass balance was made before the implementation of these options. This results in 30,674 tons CO_2 emission reductions and financial savings of US$ 339,167. As the investment costs were not high, the payback period was estimated at a few months only.

KEYWORDS

Indonesia, Cement, Furnaces & Refractories, Kiln, False Air, Vacuum Leaks

OBSERVATIONS

False air is also known as a vacuum leak because outside air enters a system, for example a kiln, under negative pressure. A vacuum leak survey was conducted in production line NR#4. False air or vacuum leaks were observed and measured at:

- Main ductwork of the Raw Mill: fittings, flanges, welded joints
- Raw Mill's feeding chute, where readings ranged from 1 m/sec up to 50 m/sec
- Between the kiln and nose ring, where an 8-10 cm gap causes false air to enter at a speed of 5 m/sec
- Inspection port at the burner plate of the kiln, where protective mica glass has been removed and false air is entering at 5.5 m/sec
- Other areas at the kiln and pre-heater, including man holes, check holes, down pipe, flap gate, inspection windows and roof

False air results in energy losses because it causes:

- Increased coal consumption, as coal is used for heating false air from ambient the ambient environment to operational temperatures
- Increasing electricity consumption since the loads of motor fans in the Separate Line Calciner (SLC) and the In Line Calciner (ILC) are higher than under normal conditions (see Figure 1).

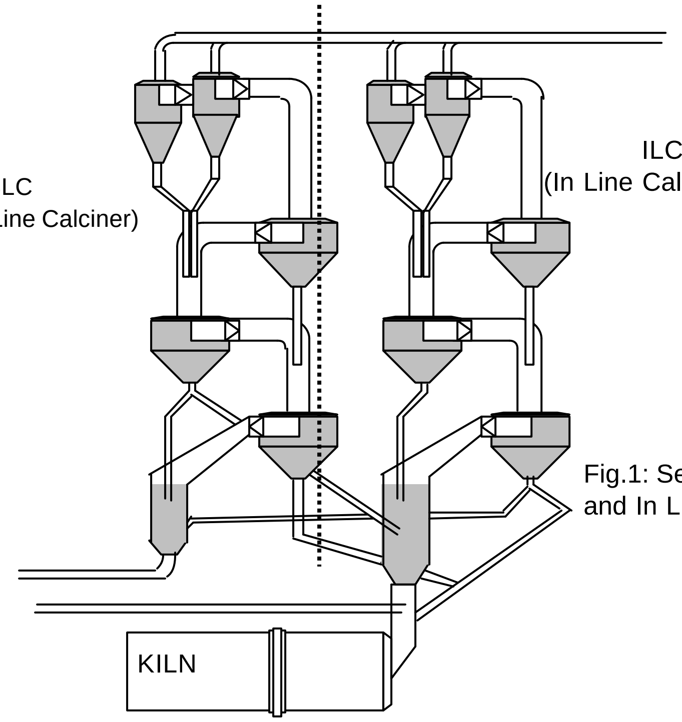

Figure 1: One of the areas with vacuum leaks

OPTIONS

The Team recommended two options to reduce energy loss from false air / vacuum leaks: the installation of a mechanical seal and a false air leak survey and repair.

A **mechanical seal** was designed, manufactured in-house and retrofitted between the kiln and the nose ring in 2004 to seal off the largest area where false air ingresses into the kiln (see figure 2 and 3). This was considered a better option than repairing the opening because movements and friction between the kiln and nose ring will very soon cause new cracks to appear and therefore false air to enter the kiln again. The advantage of a mechanical seal is namely that has a built-in flexibility to move when the kiln and nose ring move.

A detailed **false air leak survey** was conducted in 2004 and 2005. An electronic leak detector was used to speed up the survey. The Plant Engineer noted the leak points down for repair. Some leaks could be repaired immediately but most leaks could only be repaired during a plant shut down. Many leaks that were identified during the 2005 leak survey can therefore only be repaired during the next plant shut down.

Figure 2. Nose ring (mechanical seal) in Kiln

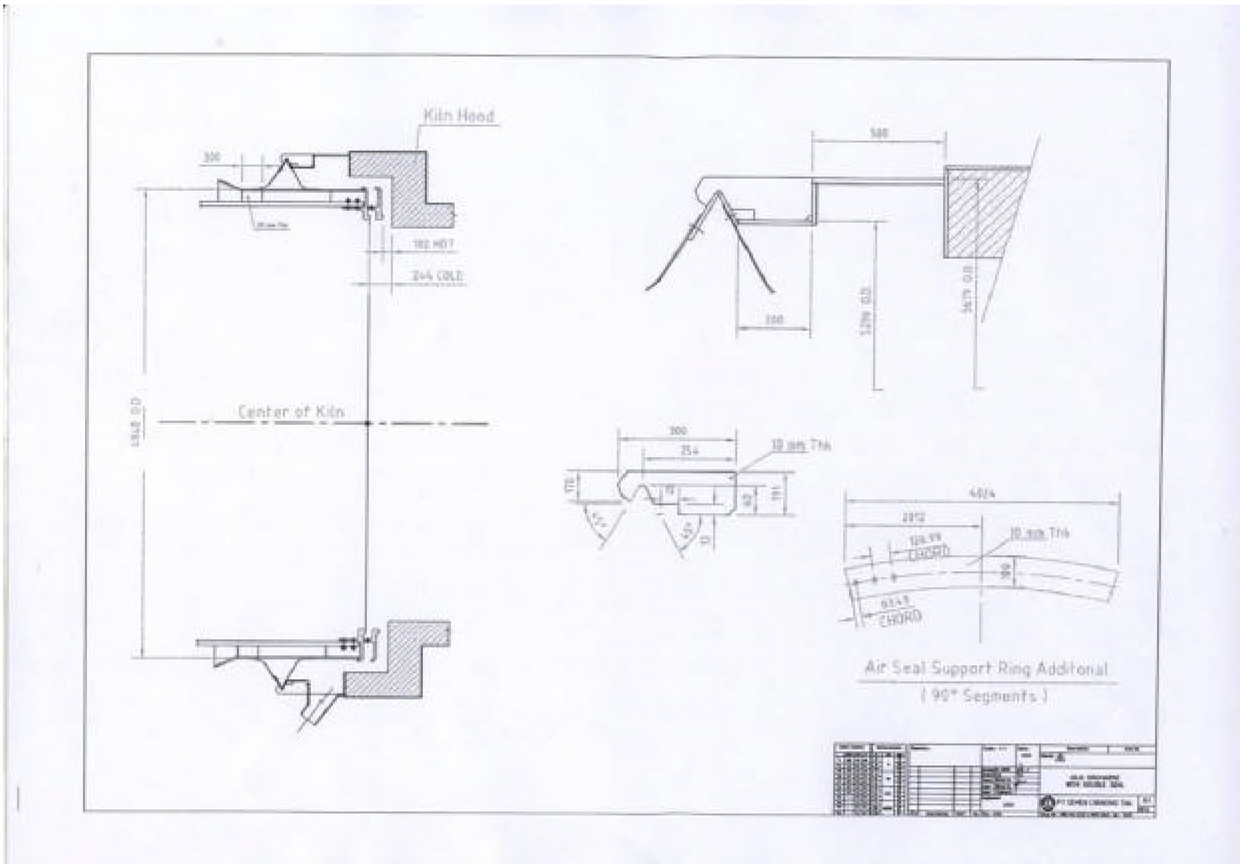

Figure 3. Drawing mechanical seal nose ring

RESULTS

The financial and environmental benefits of the implementation of these two options can be measured by comparing a mass balance before implementation (i.e. indicating the coal and electricity losses and thus the potential savings) with a mass balance after implementation (i.e. indicating the actual coal and electricity savings).

The mass balance before implementation of options was established. This was done as follows:

- Theoretical exhaust gas per ton clinker produced: 1.45 Nm^3/kg clinker, calculated as follows:
Based on stoichiometric, 1 kg Clinker production:
    - Total Exhaust Gas (Theoretical): 1,196.30 liter (STP)
    - O_2 Excess in Exhaust Gas 4%: 49.84 liter (STP)
    - Excess air (combustion): 249.19 liter (STP)
    - Total Exhaust Gas: 1,445.29 liter (STP) or 1.45 Nm^3/kg Clinker

- Actual exhaust per ton clinker produced (before option implementation): 1.59 Nm3/kg clinker, calculated as follows and using data gathered from the Central Control Room (CCR) in February 2005:
    - Measured gas flow rate at Separate Line Calciner (SLC): 261,260 Nm^3/h
    - Measured gas flow rate at Inline Calciner (ILC): 264,520 Nm^3/h
    - Clinker Production in the kiln: 7,922 ton/day or 330,083 kg/h
    - Sp Kiln Gas = (SLC+ILC)/ Clinker production
      = (261,260 + 264,520) Nm3/h / 330,083 kg clinker/h
      = 1.59 Nm3/kg clinker

- False air ingression: 46,211.62 Nm3/h, calculated as follows:
    - False air = actual SP Kiln gas – stoichiometric
      = (1.59 – 1.45) Nm3/kg clinker
      = 0.14 Nm3/kg clinker
      = 46,211.62 Nm3/h

- Increased coal consumption: 12,210 tons/year, calculated as follows:
    - Two formulas are used:
      $Q = m_{air}\ cp_{air}\ dt$
      $Q = m_{coal}\ Hv$
      Whereby:
      - Average Temperature : 614 ^{0}C
      - Ambient Temperature : 35 ^{O}C
      - Caloric value of Coal : 6,000 kCal/kg
      - cp_{air} at 614 ^{O}C : 0.38 kCal/Nm3/^{O}C
      - Coal price : Rp 250,000/tones
    - From two equations above:
      - $m_{air}\ cp_{air}\ dt = m_{coal}\ Hv$
      - 46,211.62 Nm3/h * 0.38 kCal/Nm3/^{O}C * (614-35) ^{O}C = m_{coal} 6,000 kCal/kg
      - m_{coal} = 12,210 tons/year
      - This coal cost Rp 3,052,500,000/year (=US$, 339,166.67; 1 US$ = Rp. 9,000),

As the second mass balance can only be completed in 2006 after the next plant shut down when all identified leaks are repaired, the potential financial and environmental benefits below are based on the calculated energy losses.

Financial benefits (potential)

- Investment: purchasing equipments for the mechanical seal and installation cost, but data were not available at time of writing of this case study
- Annual operating costs: none
- Annual cost savings: Rp 3,052,500,000 (= US$ 339,167 @ 1US$ = Rp 9,000)

Environmental benefits (potential)

- Annual coal savings: 12,210 tons/year

- Annual electricity savings: data were not yet available at time of writing of this case study
- Annual GHG emission reduction: 30,674 tons CO_2 (= 12,210 tons coal x 2.51 tons CO2/ ton coal) *Note: the emission factor is taken from the Greenhouse Gas Indicator: www.uneptie.org/energy/tools/ghgin/*

FOR MORE INFORMATION

GERIAP National Focal Point for Indonesia
Dr. Ir. Tusy A. Adibroto MSc; or Ms. Widiatmini Sih Winanti
BPPT - Jl. MH Thamrin 8
BPPT II building 20th floor
Jakarta, Indonesia
Tel: + 62 21 316 9758/68
Fax: + 62 21 316 9760
E-mail: tusyaa@ceo.bppt.go.id, widiatmini@yahoo.com

GERIAP Company in Indonesia
Lilik Rendra
Enviroment Superintendent
PT. Semen Cibinong, Bogor, Indonesia
Tel: +62 (21) 8231260
E-mail: lilik.rendra@semen-cibinong.com