A TEC

World Leader in Cement Pyroprocess Technology

Chlorine Bypass

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Please note:
In the following article A TEC GmbH could also be mentioned as A TEC Advances Process Technologies GmbH, PMT; PMT-Zyklontechnik GmbH, Zyklontechnik GmbH
(= company name before 1st June 2005).

World Cement, January 2006

CHLORINE BYPASS

Luca Danuvola, Production Manager Ternate plant, Holcim Italia S.p.A., and Wolfgang Freimann, Senior Process Engineer, A TEC Advanced Process Technologies GmbH, describe the efforts of Holcim's Ternate plant to reduce dependence on fossil fuels.

General information

Holcim (Italia) was founded in 1928 as Cementeria di Merone S.p.A. In the 1980s and 1990s the company grew by acquisitions of cement, ready-mix and aggregates businesses. In 1996 it became part of the Holderbank Group and in 2002 changed its name to Holcim (Italia).

Holcim (Italia) operates two full-cycle plants, one located in Merone (CO) and one in Comabbio-Ternate (VA), and one grinding station in Morano Po (AL).

Total cement production amounts to approximately 3 million t, of which about 30% is produced at the Ternate plant.

The Ternate production system consists of:

- A Vertical roller mill RM5126 (5.1 m plate, 2.6 m rollers).
- A Prepol - 1993 kiln.
  - Grate cooler: 3 m x 23 m with fixed grate inlet.
  - Rotary kiln: 4.2 m x 56 m.
  - Inline calciner with tertiary air duct.
  - Dopol 4280 preheater.
  - Conditioning tower and electrostatic precipitator.
- Five cement mills.

Introduction

The objective of the Ternate plant was to increase use of alternative fuels to significantly reduce fossil fuel consumption.

The continuous increase of alternative fuel

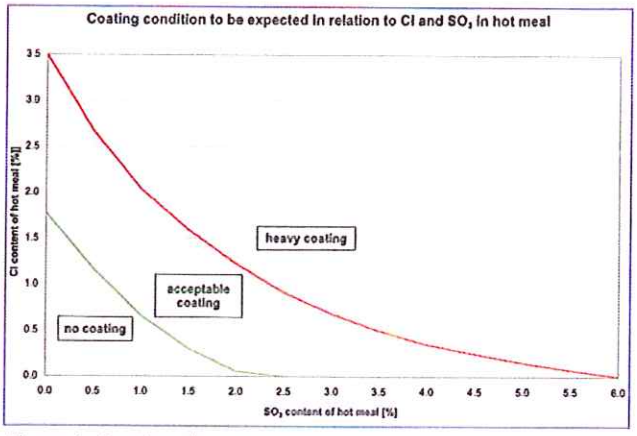

Figure 1. Coating diagram.

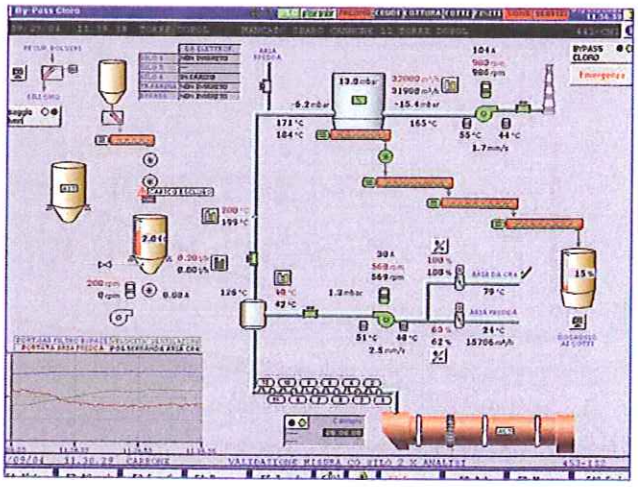

Figure 2. Flow sheet from control room gas handling.

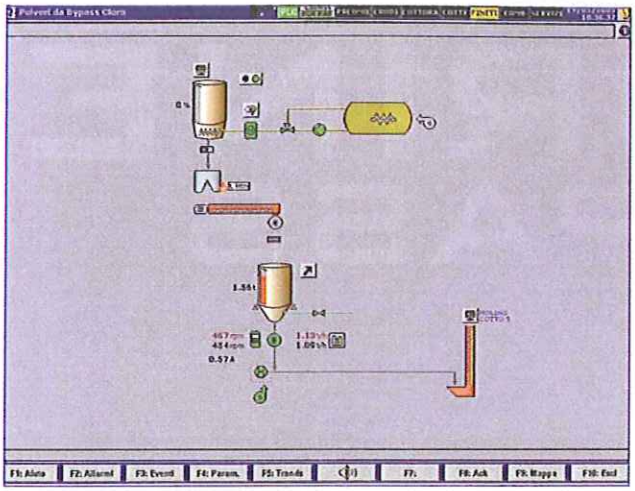

Figure 3. Flow sheet from control room dust handling.

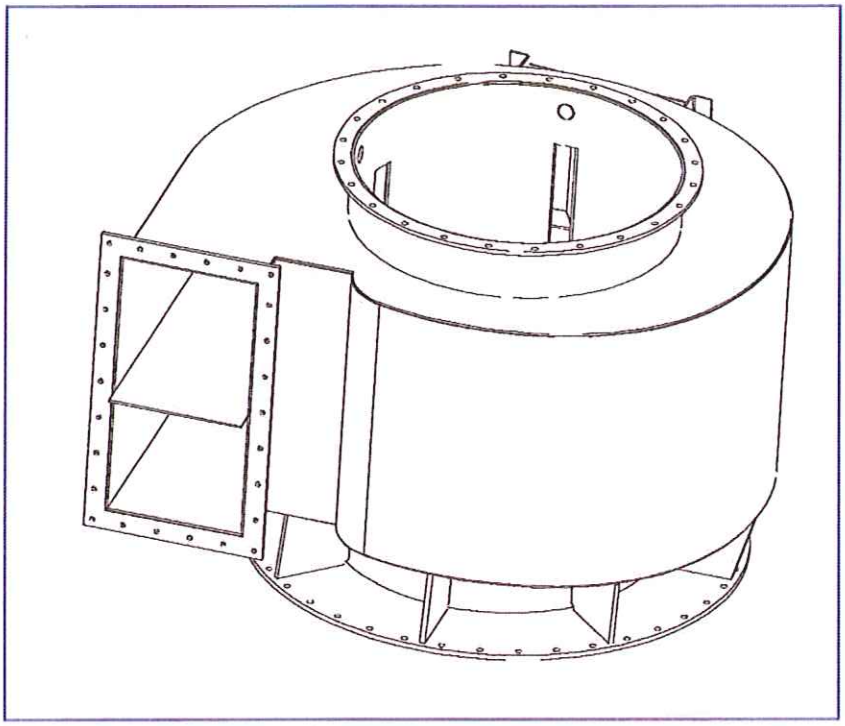

Figure 4. Sketch of quenching chamber.

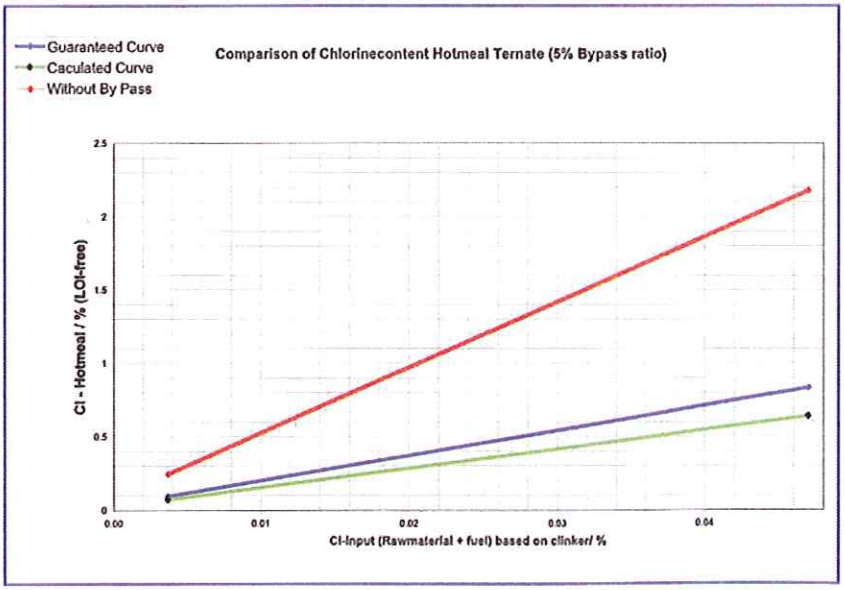

Figure 5. Guarantee graph.

consumption in recent years has led to a considerable increase of chlorine input into the kiln system. Consequences of this increased chlorine concentration include stickiness of the hot meal, heavy coating of the lower preheater section (bottom cyclones, bottom meal pipes and kiln inlet chamber) and reduced lining life time.

To avoid these problems, A TEC GmbH developed the chlorine bypass system, REDUCHLOR®, which reduces the circulation of volatile components. The Ternate plant placed the order for a turnkey bypass solution consisting of the following main parts:

- Take off chamber.
- Quenching chamber.
- Quenching fan.
- Baghouse filter.
- Filter fan.
- Dust dosing device into take off.
- Screw conveyors for bypass dust.
- Bypass dust silo.
- Bypass dust dosing system.
- Piping system.
- Structural works.
- Instrumentation.

INSTALLATION

Due to the very high volatility of chlorine, a 5% bypass ratio of kiln inlet gases was chosen.

The total kiln inlet gas flow is approximately 64 000 Nm³/h (1100 °C, -3 mbar). Therefore the amount of gas extracted by the bypass is approximately 3200 Nm³/h. A peculiarity of the Ternate request was the limitation of total additional exhaust gases to the stack to a maximum of 10%. With these preconditions, A TEC GmbH proposed to use a mixture of 16 500 Nm³/h fresh air (external environment condition) and 11 000 Nm³/h raw mill exhaust gases (approximately 90 °C) to cool down the kiln gases to 200 °C (bagfilter).

The temperature of the gas mix is controlled by control flaps. The gas mixture is pressed by the quenching fan via a pipe into the quenching chamber.

The real amount of cooling gas is controlled by the temperature at the filter inlet through the frequency controlled motor of the fan. In the metallic quenching chamber, take off and quenching, gas volumes are mixed in a turbulent way avoiding hot spots. The total gas flow (design 39 200 Nm³/h, 200 °C) is adjusted by the filter fan driven by a frequency controlled motor. In the bagfilter the dust with a high concentration of salt is finally collected.

The filtered gas is transported via a piping system to the existing stack.

In case of insufficient cooling to protect the filter bags a fresh air flap in front of the filter is installed and opens if the filter inlet temperature reaches the defined limit.

Due to problematic pneumatic transport of bypass dust with high chlorine content, a dust handling facility from the main filter with a dosing capacity of up to 2 tph is installed in order to dilute, if necessary, bypass dust during the cooling down. Screw conveyors and a rotary gate are installed below the filter to transport the dust into a 100 m² silo. The flat bottom silo is equipped with a planetary rotating screw for material extraction. Bypass dust is dosed to the cement mills.

Erection

During the maintenance period in January and February 2004 the connecting flanges to the kiln inlet chamber, the raw mill outlet duct and the stack, as well as the dividing chute of the electrostatic precipitator dust transport, including blind flanges, were installed. In Spring and early Summer the other equipment, such as filter, fans, flaps, screw conveyors, rotary gates, rotary piston blowers, silo, dosing bins and quenching chamber piping were installed during normal production. The electrical works were finished by the end of July 2004.

Commissioning

After a few days of safety checks and small adaptations the bypass plant was working normally and was handed over to the client.

Figure 6 (left) Dust dosing system, and Figure 7 (right) Bypass REDUCHLOR®.

Table 1. Gas mix calculation

Description	Kiln gas	Cooling air	Mill gas	Mixed gas
Gas quantity [Nm³/h]	3200	16 500	11 000	30 700
Gas quantity [Nm³/s]	0.889	4.583	3.056	8.530
Gas portion	0.10	0.54	0.36	1.00
Temperature [°C]	1100	30	90	199
Gas density [kg/Nm³]	1.37	1.28	1.32	1.30
Gas analysis				
CO_2 [%]	18.50	0	12.00	6.23
H_2O [%]	5.00	2.50	10.00	5.45
N_2 [%]	74.00	77.00	62.00	71.31
O_2 [%]	2.00	20.50	16.00	16.96
SO_2 [%]	0.50	0	0	0.05
Sum heat capacity [%]	100	100	100	100
CO_2 [kJ/Nm³k]	2.253	1.659	1.716	1.811
H_2O [kJ/Nm³k]	1.742	1.493	1.498	1.516
N_2 [kJ/Nm³k]	1.411	1.303	1.304	1.309
O_2 [kJ/Nm³k]	1.491	1.313	1.318	1.336
SO_2 [kJ/Nm³k]	2.318	1.744	1.811	1.907
C_p (gas) [kJ/Nm³k]	1.589	1.309	1.375	1.356
Dust load [g/Nm³]	250.00	0	80.00	54.72
C_p (dust) [kJ.kg k]	1.014	0.774	0.788	0.812
Enthalpy [kJ/Nm³]	2027.380	39.283	129.417	278.81
Take off volume approximately: 5% of kiln inlet gases (design). *Cooling with mill gas and fresh air.*				

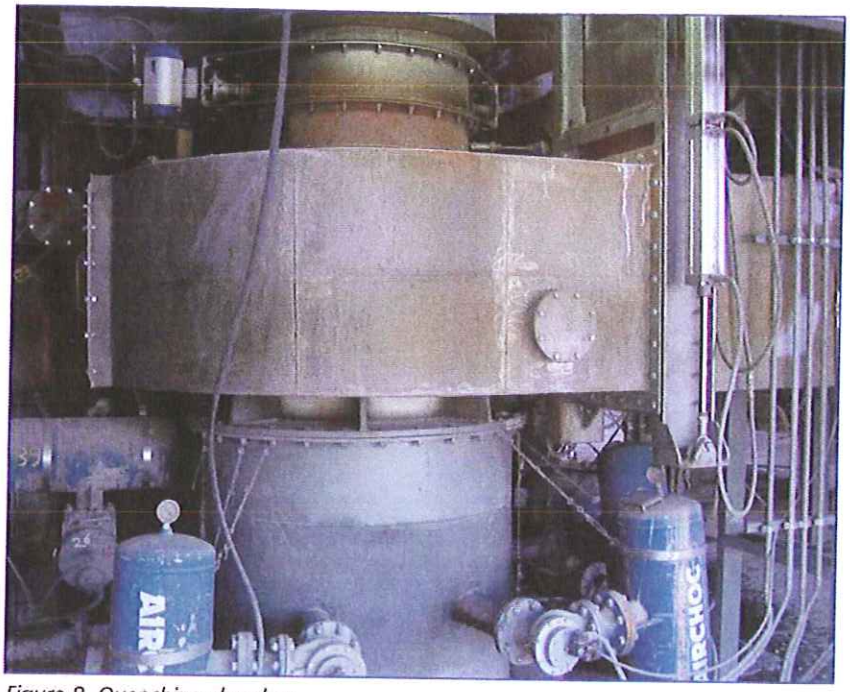

Figure 8. Quenching chamber.

Results

To handle variations in chlorine input (fuels and raw materials) and to be able to check the chlorine content of hot meal, the company guarantees a performance of the bypass system as stated in Figure 5.

During the evaluation of the chlorine input compared to the chlorine content in hot meal the real values were in the area of 'calculated value' and therefore within guaranteed performance.

Conclusion

The project was successfully implemented and fulfilled the objectives of the client. The technical concept is simple and easy to handle without maintenance activities. According to Holcim's requests, all fans have been designed with 15% overcapacity and therefore the maximum bypass ratio is approximately 6%. No significant increase of dust, sulfur oxides, carbon monoxide, hydrochloric acid or nitrogen oxides emissions have been measured since the start up of the bypass.

With the new installation, Ternate kiln has reached a thermal substitution rate of fossil energy above 30%, reducing chlorine content in hot meal by approximately 50%. Without bypass, thermal substitution rate with the same alternative fuel mix was limited to approximately 18%. ◆