Modernised Adana kiln line 4 achieves 165% capacity increase

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The authors describe the equipment used to achieve a significant increase in plant production.

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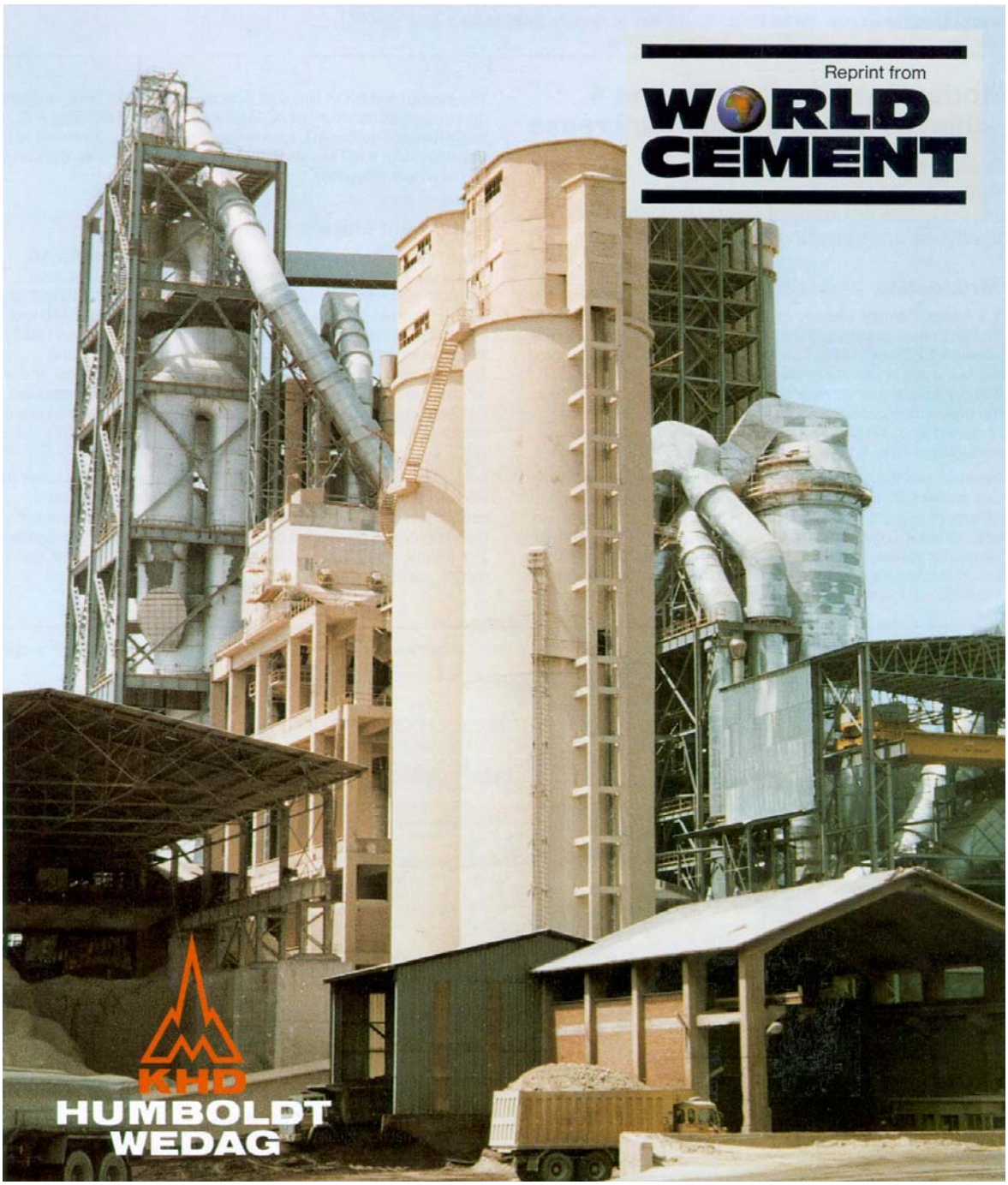

Introduction

The Adana Cement Factory in Turkey operates four clinker production lines supplied by KHD Humboldt Wedag AG, Cologne, between 1957 and 1978. The first three lines utilise rotary kilns and raw meal preheater systems, but line 4 was modified in 1996/97 to a modern precalciner system with secondary firing. The production capacity of the modernised line 4 has been increased from 1700 tpd to 4500 tpd clinker. The total clinker production of the Adana Cement Factory is 7000 tpd clinker.

The main proportions of the clinker and cement production are sold on the domestic market and, to an increasing extent, on the export market. In addition, the Adana Cement Factory has established a quality control system, the aim of which is to keep the quality stable, to increase the average production capacity and to decrease costs. Since 1993, Adana Cement has held an ISO-9002 certificate.

The modernisation of line 4 of Adana Cement has been realised by an open consortium of ASMAS Agir Sanayi Makinalari A.S., Izmir / Turkey, Pfeiffer AG, Kaiserslautern / Germany, Siemens AG / Germany with KHD Humboldt Wedag AG, Cologne as the consortial leader (**Figure 1**).

Raw meal material grinding plant

A new raw mill of type MPS-5600 B designed by Pfeiffer AG, Kaiserslautern was installed. To achieve the higher raw meal capacity required, it was designed for a capacity of 380 tpd (dry basis), whereas the actual operating capacity is about 440 tpd (dry basis). This vertical mill has rollers of 3.15 m dia. and 60 t weight each. It is operated by a 3000 kW main motor and operate with two mill fans. Additionally a static separator and a dynamic separator driven by a hydromotor have been installed. The specific electrical energy consumption of the raw mill plant amounts to 17.5 kW/t raw meal.

The materials are fed to the mill via two weighfeeders of Schenck GmbH. One of these proportioning systems is used for the mixed material prepared in the preblending store with a capacity of 60 000 t. The quality of the material fed to the preblending unit is controlled by a Quarkon Online Analysis System. The other Schenck weighfeeder conveyor is used for the correction material.

The ground material is separated in the mill cyclones and conveyed to the raw mix homogenisation silo by means of airslides and elevators. Samples for controlling the raw meal quality are taken automatically by ROMIX® delivered from KHD Humboldt Wedag AG. The sample is conveyed to the laboratory with a pneumatic transport system which is connected to the ROMIX ®. The analysis of the samples is made with an X-ray analyser in the laboratory.

Homogenisation silo plant

The homogenisation silo type MK-M 2000 was delivered by BMH Claudius Peters AG. It has a storage capacity of 22 000 t, and the blending ratio of the silo is 10 to 1. The bottom of the silo consisting of two sections is covered by open airslides. One section is operated as an outer ring, while the other is placed in the conical mixing chamber centre. The silo has two outlets, one at the bottom of the mixing chamber, the other at a higher level.

Raw meal conveying and proportioning system

Raw material conveying is achieved by 5 belt-type bucket elevators delivered by Aumund Fördertechnik GmbH. The capacity of these elevators is 220 tph each. Two of the elevators are sued for transporting raw meal to the silo, two feed the kiln, and one elevator is designed as a stand by unit for raw mill elevators or kiln elevators.

Dosing system for raw meal and pulverised coal

Two flowmeters of Messrs. Schenck GmbH have been installed as a raw meal dosing system for feeding the preheater tower. The raw meal is fed to the new and the old preheater, i.e. 60% of the raw meal is fed to the new preheater system whereas 40% is fed to the existing preheater. If problems should occur in the old calciner or the new precalcining system, operation can be continued only with the old preheater with reduced capacity.

In the Adana Cement Factory, three coal dosing systems supplied by Schenck have been installed which are operated according to the 'coriolis' principle. One of the systems is used for feeding the main burner of the kiln, whilst one feeds the PYROCLON ® - burner. The third unit feeds the hot gas generator designed by

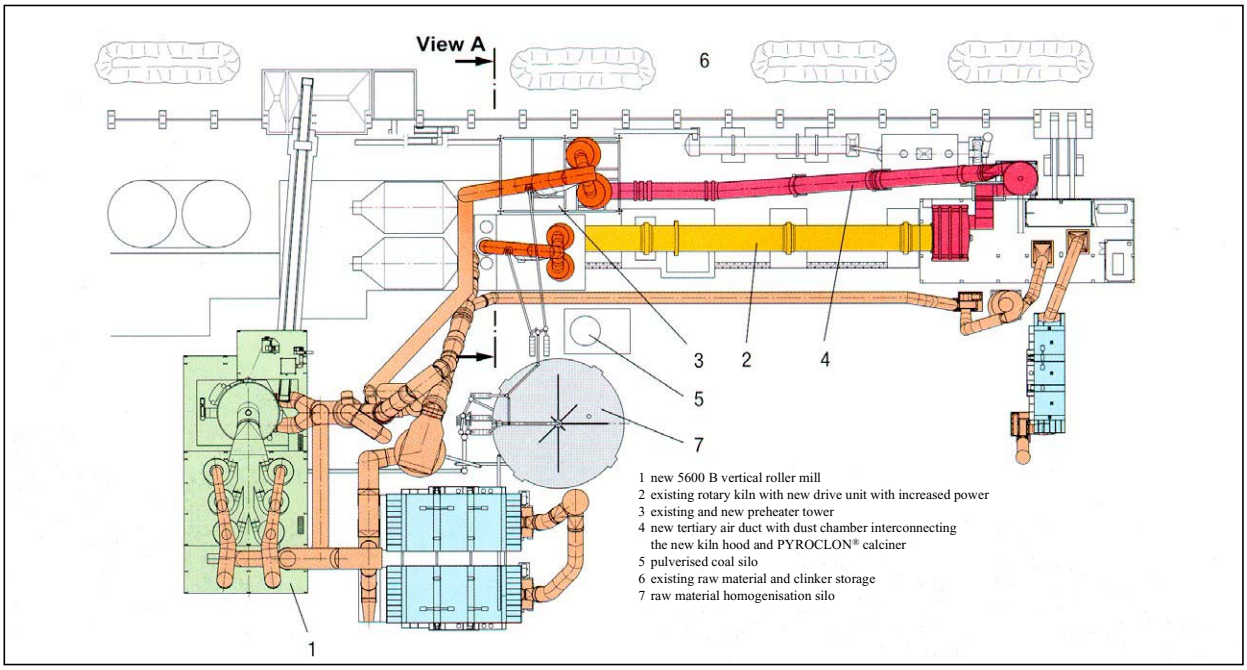

Figure 1: *General layout of production line no. 4 at Adana.*

Pillard GmbH. Line 4 also comprises two new coal dust silos with a capacity of 300 m^3 and 180 m^3.

Kiln plant with new preheater

The capacity increase of the clinker production line has essentially been achieved by both the existing HUMBOLDT WEDAG raw meal preheater and the installation of a second preheater tower with calciner. The latter operates together with the existing strand as PYROCLON®-RP cross-strand system (**Figure 2**).

The P means 'parallel', i.e. there are two gas streams flowing in parallel from the kiln feed end to the system fans. The kiln waste gases flow through the old preheater system. Only the tertiary air is directed to the calciner and then into the new preheater. This arrangement has an essential advantage: the calciner fuel is combusted in clean air and not, as in the case of other systems, in the fuel waste gases. Also, the entire meal volume passes the kiln waste gases as well as the calciner. In this way, the heat contained in the kiln and calciner waste gases is intensely utilised and the particularly low specific heat requirement achieved (**Figure 3**).The rotary kiln, 4.6 m dia. 64.0 m long, is operated with a capacity of 4500 tpd clinker. There are three tyre assemblies and one main drive with a 330 kW DC motor. The kiln has a planetary gear box with two pinion outlets. For achieving safe conveying of a higher clinker throughput rate, the maximum speed of the kiln has been increased to 3.4 rpm. The movement of the kiln along the kiln axis is realised via an automatic HUMBOLDT WEDAG hydraulic thrust roller system HDR 80. Inlet and outlet sealings of the kiln are of spring design. The tertiary air is taken from the kiln hood and transported via a separate duct to the precalciner.

The specific electrical energy consumption of the kiln plant amounts to 21.3 kW/t clinker The specific heat consumption has been measured with 3 094 kJ/kg clinker (739 kcal/kg). All main operation data of the kiln plant is summarised in **table 1**. The clinker cooler type 1044 was installed by BMH Claudius Peters. The following technical modifications have been developed. In the first section, 'mulden' plates are installed. The first grate section is 44 ft long and 10 ft wide, with an inclination of 3°, whereas the second grate is also 44 ft long and 10 ft wide but with no inclination. The total area of both grates is 80.78 m^2, 78.81 m^2 of which are aerated (**Figure 4**).

The grates are driven by hydraulic drive systems with a capacity of 500 kN each. The maximum stroke is 25/min. The mid air is taken from the centre of the cooler and conveyed to the raw mill for raw material drying. The temperature of the mid air is about 350°C. There is also a water injection system which cools down the hot gas in front of the electrostatic precipitator of the cooler, The clinker outlet temperature is 95°C above the environmental temperature. The cooled and crushed clinker is conveyed to the bucket elevator by means of two chain conveyors. These chain conveyors have a capacity of 140 tph. From the bucket elevator, the clinker is conveyed to the enclosed clinker silo with a capacity of 120 000 t. A clinker weighing system is arranged behind the clinker cooler for regular testing of the production capacity of the plant.

Figure 2: *The modernised production line with the new PYROCLON® calciner on the left and existing raw-mix silo plant in front.*

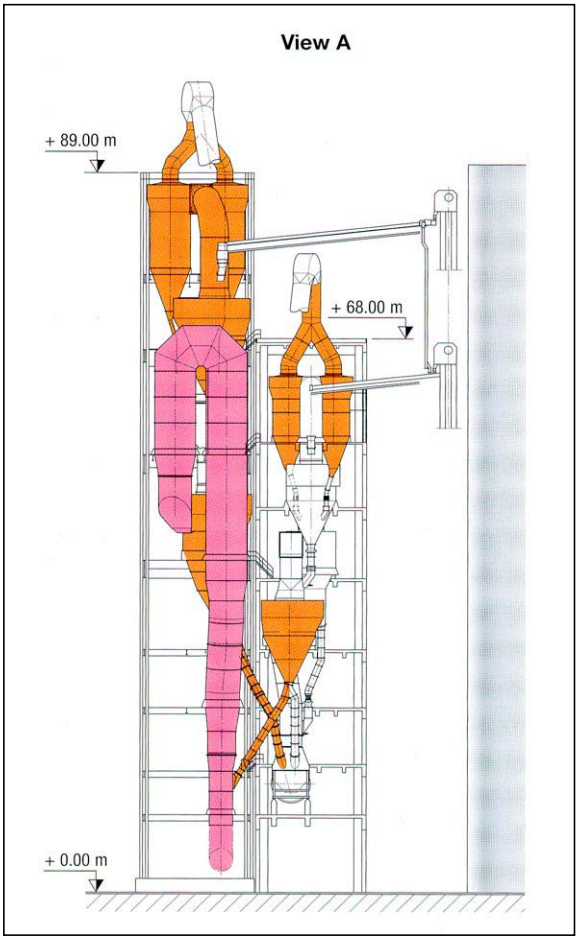

Figure 3*: Layout of the existing preheater system and newly installed preheater with PYROCLON®-calciner.*

	Guaranteed value	Act value
Clinker capacity	4500 t	4500 t
Electrical energy consumption	21.26 kWlt	19.74 kW/t*
Heat energy consumption	739 kcal/t/3095 kJ/kg clinker**	754 kcal/t/3158 kJ/kg clinker
Raw meal capacity	380 tph	413 tph
Electrical energy consumption: raw mill unit	17.47 kW/t	16.20 kW/t
* Without deductions of cable losses and motor efificiencies. ** Tolerance +2%.		

***Table 1**: Main operation data of production line 4*

Electrostatic precipitators

Line 4 of the Adana Cement Factory comprises three KHD Humboldt Wedag AG electrostatic precipitators. Two are used for dedusting the preheater and/or mill gas, while one is used for dedusting the clinker cooler. The maximum admissible dust emission is 30 mg/m^3. The air volume of the dedusting fan is 495 000 m^3/h whereas in the electrostatic precipitator of the cooler, 279 600 m^3/h of waste gases are cleaned.

Electrical equipment and process control

The electrical equipment, drives and process control were installed by Siemens AG, including MV/LV switchgear, UPS, installation equipment.for earthing and lighting and field instrumentation. The drives include the raw mill drive, all fan applications as well as the main kiln drive. The CEMAT process control system helps to guarantee the productivity of Adana's plant operation. It is designed for easy extension and modular expansion and operates on Microsoft's Windows NT 3.51. The various SIMATIC S5 PLC's were linked via SINEC-H1 Ethernet LAN to PC based industrial operator stations using CEMAT VA software.

The following optimal modules are installed:

- CEMAT MIS, the management information system.
- CEMAT KCS, for kiln optimisation, based on fuzzy logic.
- CEMAT EMS, the energy management system.
- CEMAT SCAN, the system for kilnshell temperature monitoring.

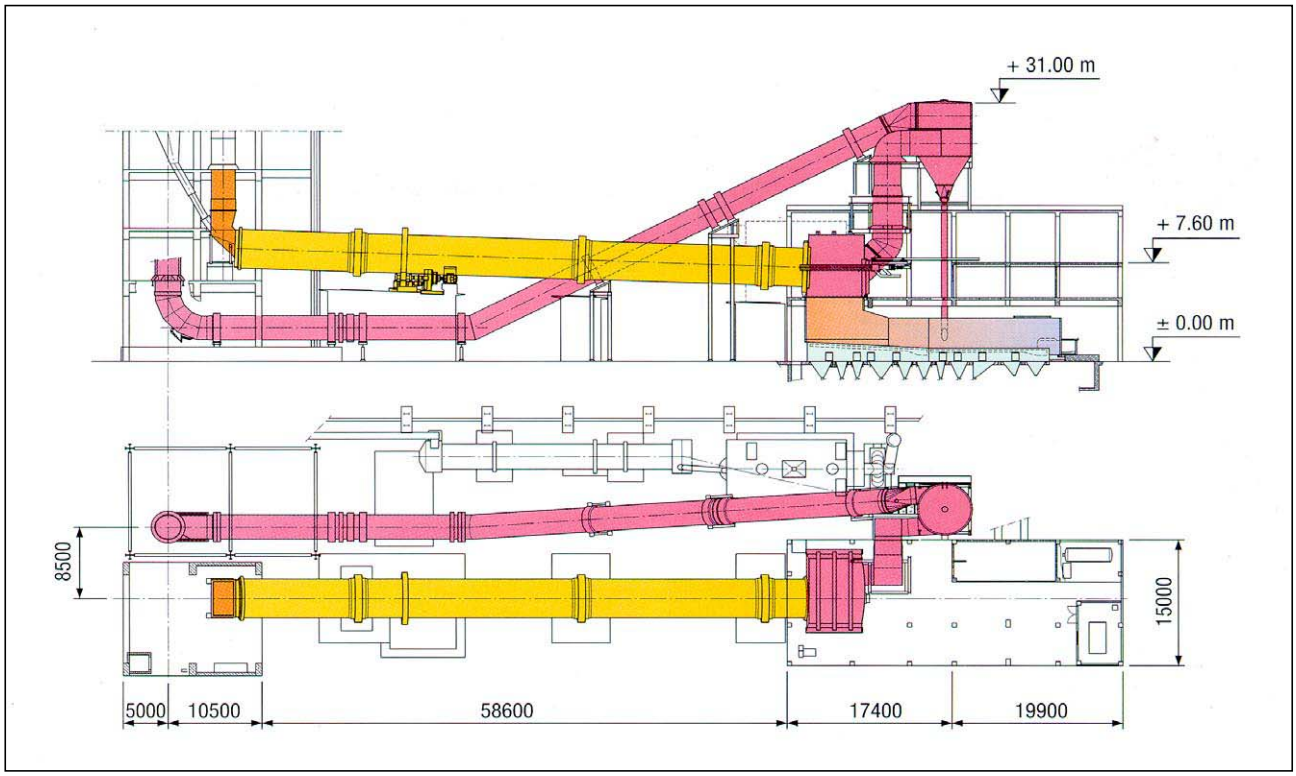

***Figure 4**: Existing rotary kiln with new installed tertiary air duct, dust chamber, extended kiln hood and grate cooler.*

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