Modifications at Matera

Mariano Miggiano, Italcementi, Italy, with Sebastian Maibaum of IKN, Germany, outline the work undertaken to convert the Matera plant to the dry process.

The Matera cement plant, built at the beginning of the 1970s, was successfully converted from the semi-dry Lepol grate preheater to a modern 5-stage suspension preheater with precalciner and separate combustion chamber. Since the existing rotary kiln remained and underwent only minor modifications, it became the anchor point of the new equipment arrangement. In the original plant layout, external heat sources were needed for the clay drier and raw milling. Today, the process heat from the pyro line is utilised in a modern vertical raw mill and the clay drier could be eliminated completely.

Best practice is implemented with the new plant configuration. The selected setup yields energy savings of 180 – 200 kcal/kg of clinker through the omission of primary energy in the raw milling section, the application of a modern precalciner system and the removal of the Lepol grate preheater with its water intensive nodulisation process.

Clinker production could be raised from 1650 tpd to 2200 tpd with a maximum production level of 2400 tpd.

Table 1. Emission reductions and comparison of main performance indicators		
Values	**Previous**	**Current**
Clinker production (tpd)	1625	2200
Clinker production capacity (tpa)	520 000	704 000
Heat consumption (kcal/kg clinker)	945	780
Electricity consumption (kWh/t clinker)	88	68
Reductions in environmental emissions: 72% dust 98.9% sulfur dioxide 42.8% nitrogen oxides 67.1% of the sum of SO_2 and NO_x dusts 10% CO_2		

Equipment sourcing and integration engineering

IKN from Germany, together with its fully integrated pyro division from Prerov in the Czech Republic, took the largest share of responsibility for this plant conversion through supply and engineering work.

The supply portion for the pyro line included the new 5-stage preheater with a separate combustion chamber, followed by a calciner channel, a new Pendulum Clinker Cooler and new kiln drive. Additional supply from IKN focused on the environment in the form of advanced NO_x control using stage combustion, SNCR technology, one large fabric filter for kiln and raw mill, and another for the cooler excess air. In addition, the IKN scope included equipment for raw meal storage and kiln feeding. IKN's responsibility included detailed engineering of process ducts, material and dust transport, steel structures, and the integration of the raw mill into the new plant. The raw mill circuit followed the two fan system and was delivered under a separate contract between Italcementi and Gebr. Pfeiffer SE.

Preheater

The preheater from IKN is a state-of-the-art preheater of type LUCY 5ST 2/560.700 SCC. In line with the raw mill's drying requirements the preheater can be operated in 4 and 5 stage mode. Since the tower height was restricted to 90 m, the configuration had to be of compact design. It was placed inside a concrete tower with coloured cladding to limit the visual impact of this tall structure. The raw meal storage is integrated into one of the tower's columns.

Through the improved pyro process, a sustainable reduction of emissions and optimisation of the fuel mix could be achieved. Maximising petcoke usage was a primary goal, together with the application of a high percentage of coarse alternative fuels in the separate combustion chamber.

The process improvements were achieved through the coupling of state-of-the-art equipment to a modern day dry process circuit. The upgrade included the following sections:

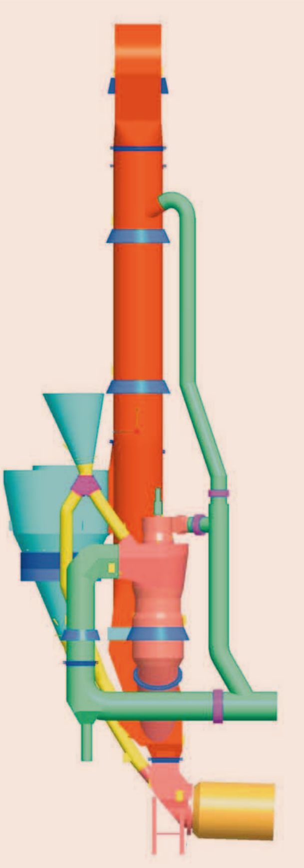
- The existing ball mill was deactivated and replaced by a new vertical roller mill (VRM) from Gebr. Pfeiffer SE.
- A new preheater with precalciner from IKN was built over the Lepol grate preheater.
- The new precalciner is designed for staged combustion as a primary NO_x emission control measure.
- The separate combustion chamber is designed for the application of petcoke/coal, natural gas or the firing of coarse alternative fuels, e.g. shredded tyres.
- Final NO_x control is achieved through an SNCR system, which was part of IKN's scope of supply.
- A new IKN Pendulum Cooler completely replaced the original clinker cooler.
- A new enlarged kiln hood from IKN with connection flange for the new tertiary air duct was installed in place of the original kiln hood. The kiln's outlet shell was replaced with a new shell together with the outlet seal from IKN.
- The tip of the Pillard kiln burner was modified in adaptation to the new capacity.
- The girth gear and pinion, together with some of the kiln's tyres, were replaced.
- A higher rated gearbox with a larger transmission ratio for increased kiln speed was part of IKN's scope of supply.
- The existing kiln shell was shortened at the inlet by cutting off 10 m and installing a new 6 m long section together with a new inlet seal.
- A new fabric filter for the pyro line and raw mill was integrated into the new mill circuit, which follows the two fan system. IKN supplied the filter and process fans.
- A new fabric filter for the clinker cooler improved dust emissions considerably compared to the gravel bed filter unit. Filter and dust transport were part of IKN's scope of supply.
- IKN installed new raw meal storage, dosing and transport equipment.
- The plant's coal mill circuit was enhanced by a new dynamic separator from LVT to meet the new targets for fineness and throughput for coal and petcoke firing.

Additional modifications in other plant sections were introduced to make technological and environmental improvements throughout the entire production line. The following modifications contribute to the operation:

The Matera plant.

Calciner

The separate combustion chamber SSC is designed to ignite fuels in pure hot air. In combination with the calcining channel KKN, it is considered the best available technique for the combustion of fuels with a low amount of volatiles and coarse alternative fuels. The SCC fits into the tower below the second lowest cyclone stage and receives meal from this cyclone. Fuel particles are ignited in the SCC and burn out completely in the KKN. The temperature in the SCC is controlled by meal splitting between SCC and KKN. Petcoke, coal and natural gas (start-up) are burned through a dedicated calciner burner located centrally in the SCC. Coarser secondary fuels, e.g. shredded tyres, are fed gravimetrically. The KKN allows staged combustion for NO_x reduction as a primary measure. As a secondary measure, nozzles for the injection of ammonia water are installed along the upstream part of the KKN.



Calciner.

- Installation of a new online analyser system for the uncrushed raw material. It was installed upstream of the raw mill and fully integrated into the new raw mix control strategy.
- Installation of a new covered stacker reclaimer system from Bedeschi for wet clay. The reclaimer feeds directly into a new crusher with counter-rotating rollers. The crusher is installed upstream of the belt conveyor feeding the raw mill.

The site

Construction of the new line commenced on 15 May 2008 and continued without interruption until 23 March 2010, when the line entered into production.

During all of the project's phases, particular attention was placed on the safety of the workers, even at the expense of the speed of implementation.

Overall finish of the work not related to production, restyling and town planning interventions continued until September of the same year. Local labour was employed, totalling 900 000 working hours with a maximum site presence of about 480 external staff.

In addition to these external resources, some 120 000 hours were provided by

Italcementi group staff for planning and project management, supervising the site work and commissioning of the new line.

The total weight of machinery assembled, including the steelwork, was about 7000 t, of which approximately 2000 t involved working at height. About 13 000 m^3 of concrete was laid through the various section of the construction site. The preheater tower is executed as a concrete tower, which consumed an extra 3400 m^3 of self-compacting concrete.

The improved automation and control system transfers some 8300 signals, requiring the laying of some 330 km of cables from the field to the control room for plant process management.

The construction work was carried out in three main stages:

- Stage 1: construction of a new clay plant including a new store, a raw materials reception system and the conveyors for the connection with the new raw mill.
- Stage 2: construction of equipment related to the raw milling and new pyroprocess, which could be built while the kiln line was still in full production. The main units were the concrete tower, with the cyclone preheater and calciner equipment, the raw mill with its external material circulation, kiln/raw mill filter, kiln feed storage and dosing, together with material transport systems, tertiary air and process ducts.
- Stage 3: shutdown and dismantling of the original plant, completion of the new equipment, cold commissioning and start up of the new system.

There was a significant overlap between stages 1 and 2, together with intensive preparation and preassembly to reduce the shutdown period of stage 3.

Stage 1

This took place between May 2008 and September 2009, and included the commissioning of individual components of the plant, such as the powering up of the dedicated electrical cabins and management of the plant control system from the central room.

The new store was prepared to receive and automatically manage clay on 19 July 2009.

Construction did not present particular problems – with the exception of interferences with existing structures, since available working areas were limited in space and placed inside the running cement plant.

Stage 2

Apart from some preparatory and excavation work, the main activities of this stage started in October 2008 and continued without interruption up to 11 December 2009.

The challenges faced were not only caused by maintaining a running plant in operation, but also due to managing the presence of several companies of different origins, working simultaneously in small overlapping corridors.

Installing equipment at different height levels required the extensive use of cranes. Due to the space restrictions, installation procedures and lifting sequences

SNCR

The reduction agent is ammonia water with a concentration of ≤ 25% NH_3. The vertical stainless steel tank is designed for pump filling directly from the delivery truck. The gas displaced during filling is returned to the truck via a dedicated gas return pipe connecting tank and truck. The tank itself is installed inside a suitably sized, sloped tank pit with gutter and pump sump. Delivery trucks park in front of the tank pit on a sealed asphalt area, which is a recessed and inclined basin. It connects to a collection reservoir via drains. The reservoir is open to atmosphere and carries the pumping units for truck unloading and reduction agent processing. The process unit, with its blending module and eight injection modules, was shop tested and installed inside a fully air conditioned container within the preheater tower. The blending module produces the quantities of reduction agent-water mixture of the concentration and volume required by individual operating conditions.

Table 2. Equipment suppliers

Abate Meccanica	ABB
Aerzen Italia	Arcemi Impianti
Atlas Copco Italia	B&F
Bedeschi	Boffetti Impianti
Boldrocchi	CAR.MET.
Cardascia	Cefisa Centrales Edificaciones
Cemit SRL	COM.CAVI SpA Multimedia
Consorzio Unistara	CTM
Edilbreda	F.LLI Maragno
FKV	FLSmidth
FMI Solza	FMI SUD
Gambarotta Gschwendt	Gebr. Pfeiffer SE
General Smontaggi	Guerricchio
Gruppo Eil	Hasler Suisse SARL
Impresa Stagno	IKN-Ingenieurburo Kuhlerbau Neustad
ITECA SOCADEI	L.V. Technology PCL
Longhi	Mariani
Montek	Motridal
ONT SpA Officine Nastri Trasport	Pype Lyne
Ruffa Costruzioni	R.G. Impianti
SA.VE.	Schenck Process GmbH
Sodern	SI.STE.MA Costruzioni
Toloni Sergio	Travaini Carpenterie
Trivelterre	VEM Sachsenwerk GmbH
Vienna A. Forgiatura	

Cooler

To cater for the new production level, the original cooler was replaced with a Pendulum Cooler with Roll Crusher. The Pendulum Cooler is a single grate driven by one hydraulic cylinder. Uniform clinker bed aeration is ensured by Coanda nozzles, which purge the fines out of the clinker bed up to the surface with the right air flow and improved heat transfer between clinker and cooling air. The resulting clinker bed is characterised by low resistance to the passage of cooling air. The large kiln hood is sized for 5 m/s to reduce dust return to the kiln and calciner. Tertiary air is taken from the kiln hood to have identical temperature as the secondary and tertiary air at all times.

Table 3. Safety statistics	
Contractor hours	926 512
LTI	1
First aid	0
Near miss	0
Work days lost	9
Frequency index	1
Gravity index	0.01

Table 4. Target milestones	
Kiln fired up	22 March 2010
Start of clinker production	30 March 2010
First white cement bag produced	19 May 2010
First tyre burning	14 June 2010
Test for CO_2 contribution completed	21 July 2010
New additive hopper in production	18 April 2011

were extensively studied by the companies involved, focusing on positioning of preassembled equipment, lifting gear and optimisation of any lifting sequences. The Italcementi site team continuously coordinated these activities to ensure safe working conditions at all times, prioritising the progress of individual lots with regard to the overall schedule, as well as minimising costly waiting time.

A 500 t crane truck, a 400 t crane truck and an additional 300 t crane truck were continuously present on site. A 120 m tall tower crane with 60/2.5 t capacity was dedicated to the slip form construction of the concrete tower and later on to the lifting of the mechanical equipment installed in and around the concrete preheater tower.

Site progress greatly benefited from a high degree of component preassembly. This took place in dedicated zones outside the construction area. It was carried out in parallel to civil works, allowing the best utilisation of the available manpower.

Stage 3

This stage started on 11 December 2009 when the existing plant was shut down and dismantling could begin. Just 101 calendar days later, on 23 March 2010, the kiln burner was reignited. During the shutdown period, large sections of the original plant were dismantled to make the installation of the remaining equipment possible. The tie in with the existing plant had to take place in several areas, including the following sections:

- Structural and mechanical completion of the two lowest floor levels within the concrete preheater tower.
- Installation of conditioning tower and kiln ID fan right beyond the preheater tower.
- Modification to the existing kiln.
- Complete assembly of the new Pendulum Cooler in place of the existing one with some modification to the surrounding burner building.
- Installation of the fabric filter and air-to-air heat exchanger for the cooler exhaust in place of the gravel bed filter.
- Installation of refractory from the bottom part of the preheater, the entire kiln and cooler.
- Placement of the preassembled and fully refractory lined kiln hood.
- Completion of the electrical power supply and powering up.
- Connecting the control system cables and checking of all the signals.
- Cold commissioning of the new plant and subsequent start-up.

The site activities during the final stage were carried out on average by 480 people, working in total about 300 000 h. The activities were realised on a continuous three shifts per day pattern, seven days a week, with the sole exception of the Christmas and New Year holidays.

The ambitious shutdown period was achieved by maximum emphasis on the following:

- Dismantling and demolition in large parts.
- Prefabrication and pre-assembly of large components.

In the light of the realised goals, the implemented concept of maximum preassembly proved to be the winning formula. Thanks to the methodical planning, the challenge of using large hoisting appliances almost continuously and often in parallel was well managed. A good example was the lifting of the kilnhood complete with refractory – total weight approximately 160 t.

The safety statistcs confirms the effort put into the thorough planning by Italcementi's site team.

New plant: production record

The new plant's startup was on 22 March 2010. The operating parameters were met shortly afterwards. The main performance indicators (previous vs. new) are shown in Table 1.

The overall target milestones for the new plant operation (Table 4) were met within the year of startup. A reduction of emissions was achieved.

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