Why so much of the world's limestone is burnt in Maerz kilns.

For over 60 years we have been passionately devoted to the technology of limestone calcination. A technology, which we have continuously enhanced. With the result that today a large portion of the burnt lime produced worldwide comes from our customers. For their success we always go the extra mile. And we will continue to do so. www.maerz.com
Astra Mining Company Ltd., Saudi Arabia

ASTRA Mining company, located in Riyadh in the Kingdom of Saudi Arabia, signed a contract with Maerz for the supply of design, engineering, key equipment and technical assistance during erection and commissioning for a Maerz R1P type Parallel Flow Regenerative Lime Kiln.

The kiln will be operated using light diesel oil and will produce 300 tons of lime per day with a limestone grading of 30 to 60 mm. Additionally, Maerz was also chosen by ASTRA Mining Company to supply both engineering and equipment for a complete lime hydrating plant.

The new plant will be built on a green field site in Al-Kharj, close to the city of Riyadh. Both the kiln and the hydration plant are planned to start operation in early 2016.

Matanat A, a company located in Baku, and Maerz signed a contract for the supply of engineering, license, know how, equipment and technical assistance during erection and commissioning of a high performance H3-1 Maerz single shaft HPS kiln for a green field lime and hydrating plant.

The kiln will be operated using natural gas, producing 150 tons of lime per day with a limestone grading of 40 to 80 mm. The plant is planned to become operative towards the end of 2016.

Cal & Cemento Sur S.A., Peru

Cal & Cemento Sur S.A., located in Arequipa, signed a contract with Maerz for the supply of design, engineering, key equipment and technical assistance during erection and commissioning of a liquified petroleum gas (LPG) firing system add-on to their kiln#2 of the recently installed 3 Maerz petcoke dust fired PFR kilns of type R3S located in Juliaca close to Lake Titicaca.
The additional firing system will provide CXal & Cimento Sur with the choice of operating their kiln no. 2 using either LP gas, petcoke dust or a mixture of these two fuels. The new firing system will be operational in the first half of 2015.

**DAESUNG MINING DEVELOPMENT INC., KOREA**

DAESUNG MINING DEVELOPMENT INC., located close to the city of Yeongwol, signed a contract for the supply of engineering, license, know-how, material & equipment and technical assistance for their first Maerz PFR Lime Kiln.

The kiln will be operated using coal dust, producing 200 tons of lime per day with a limestone grading of 45 to 80mm. The new kiln is currently under construction and is planned to go into operation by the end of this year. The contract contains the option for a second kiln.

**CELCO S.A., ROMANIA**

Celco S.A., located in Constanța, Romania, signed a contract with Maerz for the supply of engineering, license, know-how, material, equipment and technical assistance services for one solid fuel firing system for the existing 150 tpd natural gas fired Maerz HPS single shaft kiln built in 2013.

The contract also includes inspection of the installed system at the end of the erection phase and commissioning of the firing system, which has been entirely delivered by Maerz. The commissioning and going into operation is planned to take place during summer 2015.

**XINJIANG YIHUA CHEMICAL INDUSTRY CO., LTD., CHINA**

At the end of 2014 a contract was signed between the three parties SUMEC International Technology Co., Ltd, Shanghai DiBo Engineering Technology Co., Ltd, and Maerz Ofenbau AG for the supply of engineering, key equipment and technical assistance during erection and commissioning of a total of 2 R4S type PFR Lime Kilns for Xinjiang Yihua Chemical Industry Co., Ltd. for their Urumqi plant.

The kilns will be operated using coal dust, producing 600 tons of lime per day each (1’200 tpd for the total plant) with a limestone grading of 40 to 80 mm. The new kilns are planned to become operative towards the end of 2015.

**GRUPO REGIO CAL S.A. DE C.V., MEXICO**

Grupo Regio Cal S.A. de C.V., located in Monterrey, signed a contract with Maerz for the supply of design, engineering, equipment and technical assistance during erection and commissioning of a H4-1D type HPS single shaft lime kiln. In addition to the material & equipment supplied by Maerz, ThyssenKrupp Industrial Solutions Mexico will supply the steel parts and all structural steel for the kiln.

The kiln will be operated using natural gas, producing 200 tons of lime per day with a limestone grading of 40 to 80 mm. It will be built in the existing plant of Grupo Regio Cal, adjacent to two existing single shaft kilns already in operation since decades. The new kiln is planned to be commissioned in the first half of 2016.
IMPROVEMENTS ON ROUND MAERZ PFR LIME KILNS

INTRODUCTION

Since its introduction onto the market in the late fifties of the last century, Maerz has installed more than 600 Parallel Flow Regenerative Lime Shaft Kilns – PFR Kilns in short – world-wide. Due to its unique operating principle this kiln type offers the highest thermal efficiency of all modern lime kilns, thus becoming the most wide-spread quicklime production facility globally.

As a standstill in development actually means falling behind, Maerz is relentlessly working on improving technical, safety and economic features related to the design and the operation of the PFR Kiln. Whilst the operating principle – the parallel flow of limestone and combustion gases in the kiln burning zone and the regenerative preheating of combustion air – hardly allows any further optimisation, there is definitely room for further improvements in the operating flexibility, e.g. the use of cost-effective fuels and the increase of the limestone quarry yield, in kiln operation safety and in reducing investment, operating and maintenance costs.

In the following a number of improvement projects investigated, designed and implemented by Maerz on the circular type PFR Kiln and exceeding the present state of the art in the lime production industry are listed, followed by a short description.
IMPROVEMENT AND OPTIMISATION PROJECTS

ENHANCED PROCESS FLEXIBILITY

- Extended grain size spectrum of the limestone feed
- Optimised combustion due to controlled grain size distribution inside the kiln shafts
- Improved bulk movement in the burning zone
- Improved lime cooling process for increased operation reliability when processing decrepitating limestone

REDUCED INVESTMENT, OPERATING AND MAINTENANCE COSTS

- FEM (Finite-Element Method) optimised design for kiln shell and support structure
- Modular design for easy retrofit of additional firing systems
- All kiln parts designed for transportation in containers
- All structural steel designed for easy erection with reduced welding work
- 75° elbow at burner lances facilitates replacement
- Reduced cleaning work due to dust enclosures

ENHANCED SAFETY AND RELIABILITY IN KILN OPERATION

- Maximised functional safety due to HAZ-OP (Hazard and Operability) analysis and SIL (Safety Integrity Level) classification
- All kiln traps close with the internal pressure of the kiln
- Safe maintenance due to mechanical locking devices
- Burner lance protection covers equipped with high temperature safeguard
- Exchangeable lance protection covers
- Skip winch with large secondary brake at the drum

ENHANCED PROCESS FLEXIBILITY

Today’s lime producers are facing new challenges with regard to steadily increasing fuel prices and decreasing availability of high quality raw material deposits. High quality limestone and dolomite with consistent chemical and physical properties is often not available or scarce. Varying contents of carbonates and impurities can cause problems with inconsistent product quality and troubles in kiln operation such as sintering phenomena with subsequent block formation.

The use of primary and secondary gaseous, liquid...
and solid fuels, separately or mixed, of lower quality with regard to impurities and/or calorific value can cause problems identical or similar to those described above.

It is therefore essential and sometimes even indispensable for the kiln operator to have maximum control over variable operating conditions with regard to raw material grain size distribution, fuel combustion and internal air and gas flow in the kiln.

EXTENDED GRAIN SIZE SPECTRUM OF RAW MATERIAL FEED

An important factor for the economic viability of lime plants is an optimal use of the limestone resources from the quarry. The Maerz Finelime® Kiln offers the possibility to process stone grain sizes from approx. 15 mm up to 40 mm at a thermal efficiency similar or even higher than with standard PFR Kilns.

The smaller the particle sizes of the limestone the higher the importance of controlled grain size distribution becomes when charging the kiln.

Specially designed rotary hoppers allow charging to the centre and/or to the outside of the kiln shafts without any sensible mechanical equipment protruding into the kiln shafts.

Fig. 1 shows a typical arrangement of the kiln charging system implemented on round Maerz PFR Kilns for selective and controlled charging of limestone, comprising the following key components:

- Dust extraction
- Feeding belt conveyor with dust hood
- Reversible belt and chain conveyor with dust hood and sound absorbing panels
- Rotary hopper with rubber lining, dust hood and sound absorbing panels.

OPTIMISED FUEL COMBUSTION IN THE BURNING ZONE

State of the art is to control the amount of fuel at the individual burner lances to achieve uniform lime quality over the cross section of the kiln shafts.

Controlled grain size distribution inside the kiln shafts provides a control mechanism to optimise combustion. Consequently, the heat distribution becomes even more uniform and the emissions of unburnt or partly unburnt fuel are minimised.

Depending on limestone quality – both chemically and physically – and type of fuel, different operation modes may be required to achieve the optimal thermal profile in the kiln shafts. Complex and elaborate tests have been carried out by Maerz to evaluate the influence of controlled charging of different limestone grain ranges.

Operation mode 1: Equal grain sizes charged to the inside and the outside of the kiln shafts - the standard procedure in many kilns.

Operation mode 2: Different grain sizes charged to the inside and the outside of the kiln shafts - well known technology from our Finelime® kiln series.

Operation mode 3: All material charged to the outside. This mode can be used with 1 or 2 grain sizes - in this mode the gas flow is forced towards the center of the shaft.

Operation mode 4: All material charged to the inside. This mode can be used with 1 or 2 grain sizes - here the gas flow is diverted to the perimeter of the shaft.

OPTIMISED BULK MOVEMENT IN THE BURNING ZONE

The inside kiln shaft diameter at the lower end of the burning zone is slightly larger than the diameter at the upper end. This type of shaft design offers the following advantages:

- Disaggregation of the bulk and less agglomeration tendency
- Better flow of combustion gases
- Better heat distribution
- Improved consistency of burnt lime quality.
ENHANCED SAFETY AND RELIABILITY IN KILN OPERATION

LIME DISCHARGE AND COOLING AIR SYSTEM

The most up-to-date design of the quicklime discharge and cooling air system meets the following requirements to optimise lime cooling and discharge:

- Best possible cooling efficiency with lowest amount of cooling air even for large diameter cooling zones
- Low product temperatures at the discharge tables
- Uniform temperature gradient with horizontal isothermal lines over the cooling zone height
- No re-carbonation of the product
- Simple and rigid design (support structure of displacement body in cold area)
- Accurate air flow control to burning and non-burning shaft
- More operational reliability even for limestone with high decrepitating tendency.
- New cooling air distribution system

Limestone with an increased tendency for decrepitation in the course of thermal treatment represents a special challenge in vertical shaft kilns as far as channelling of air and gas flow as well as clogging of material is concerned. To overcome these problems Maerz has investigated gas flow and temperature patterns in the cooling zone area of the PFR Kiln.

- Cooling air at the burning shaft enters only through the displacement body, the air is delivered by one blower only
- Cooling air to the regenerative shaft enters only at the outer periphery, the air is delivered by two blowers

As shown in Fig. 2 (patent pending) controlled air admission to both burning and regenerative kiln shafts results in a more uniform air flow and at the same time a uniform temperature gradient in the cooling zone.

ALL KILN TRAPS CLOSING WITH THE INTERNAL PRESSURE OF THE KILN

To reduce the risk of internal leakages, sometimes difficult to detect, all kiln traps, particularly shaft closing traps and combustion air/waste gas reversal traps are designed to use the internal kiln pressure in addition to hydraulic pressure to keep them tightly shut.

To facilitate maintenance work, all traps are equipped with two service openings. All hubs are clamped and the bearings mounted with tapered sleeves.

REDUCED INVESTMENT, OPERATING AND MAINTENANCE COSTS

FEM (FINITE-ELEMENT METHOD) OPTIMISED DESIGN FOR KILN SHELL AND SUPPORT STRUCTURE

The strict application of this calculation method ensures optimum design and minimum weight required for the kiln steel structure.

The standard design applied considers earthquake loads of up to 0.4 g. The support structure as well as the kiln shell can be adequately reinforced for higher earthquake loads.
STRUCTURAL STEEL DESIGN

All steel parts are designed in modules which, after having been manufactured in the workshop, can be shipped to the site in standard 40’ containers. The modules are designed for easy erection on site, not requiring any site welding.

SKIP WINCH FROM LIEBHERR
SPECIALY DESIGNED FOR MAERZ LIME KILNS

The safe and reliable operation of the limestone charging skip hoist is a vital factor for trouble free kiln operation. Maerz entered a cooperation with Liebherr Group, a leading German construction machinery manufacturer, for the supply of the skip winch with all associated control and safety equipment.

SAFE MAINTENANCE DUE TO
MECHANICAL LOCKING DEVICES

Wherever required for safe maintenance work, e.g. at skip hoist winch, reversal and closing traps, etc. mechanical locking devices are installed to prevent any problems with failing electric and/or hydraulic equipment.

OPTIMISED KILN TOP ARRANGEMENT

- Skip winch (1)
- Dust extraction (2)
- Rotating bucket (3)
- Shaft closing trap (4)
- Burner platform (5)

The design optimisation of the kiln top area resulted in the following improvements:

- Reduction of structural steel weight and thus investment costs
- Noise level reduction
- Reduction of dust emission
- Increased safety for operating and maintenance measures.

SUMMARY AND OUTLOOK

The Maerz PFR Lime Shaft Kiln is – first and foremost due to its unrivalled high thermal efficiency – the first choice when it comes to installing new or replacing existing lime kilns. Since its introduction in the late fifties of the last century, Maerz – as the market leader – has built more than 600 PFR Kilns world-wide. The unique functional principle of this kiln type virtually does not offer any potential for process improvements. On the other hand, the necessity to burn limestone and dolomite of lower quality, as far as chemical and physical properties are concerned, and to use fuels with lower and also variable calorific values, requires more and better control of the burning process.

Maerz investigated and developed sophisticated control mechanisms to manage both variations in raw material grain size ranges as well as fluctuations in chemical and physical properties of limestone and dolomitic stone.

Furthermore, Maerz realised important measures to increase flexibility and at the same time safety of kiln operation. And last but not least optimisations, particularly in the steel structure and refractory design, are cutting investment costs thus increasing economic competitiveness.