

Industrial Solutions

Pyro- processing for the minerals industry.

High-quality and innovative
solutions for individual application.



thyssenkrupp



ThyssenKrupp Polysius Minerals

Pyroprocessing

As one of the world's leading companies in the plant engineering field, ThyssenKrupp Polysius has the comprehensive know-how that is needed in order to supply the minerals, mining, metallurgical, refractories, lime and chemical industries with innovative but tried and tested processes, plants and system configurations.

ThyssenKrupp Polysius systematically consolidates process and plant know-how to create innovative concepts for the thermal processing of a very broad range of materials, offering optimum customised solutions, including drying, preheating, calcining, reduction, burning, sintering, cooling and pelletising systems.

ThyssenKrupp Polysius is a highly-competent partner for project development, project elaboration, design, delivery, erection, commissioning and comprehensive service activities.

Our strong performance applies across the board: to complete production lines, individual products and plant modifications.

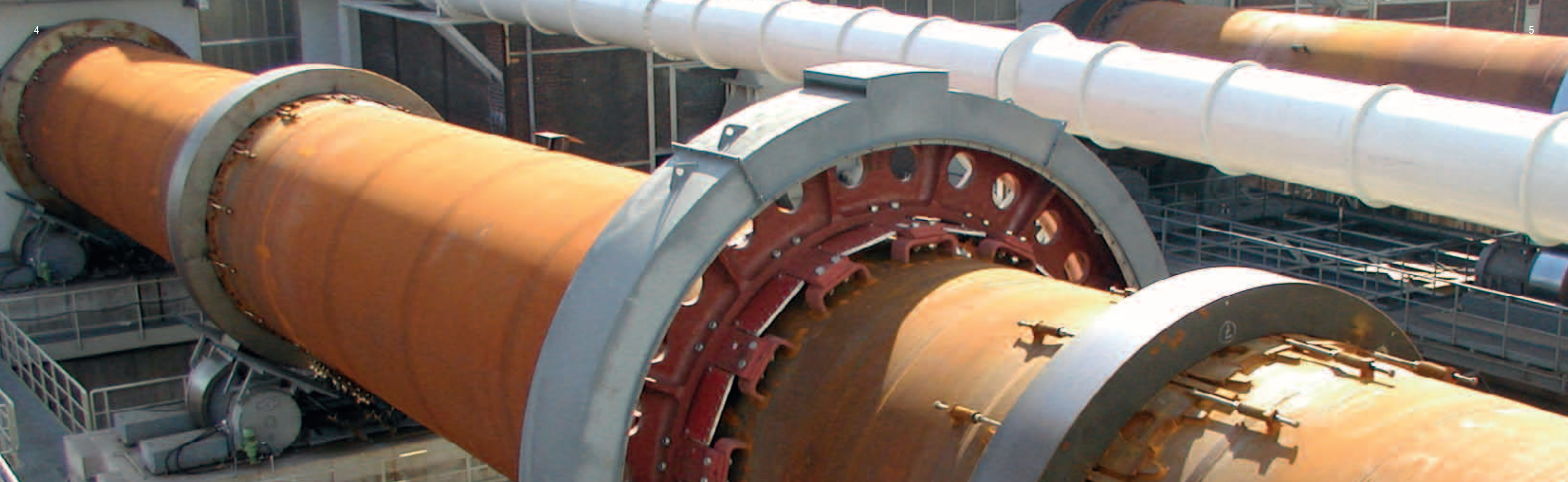
Excellent technological competence is the key to our success and simultaneously the day-to-day basis for developing first-class and innovative solutions for individual applications – an ability that is valued and trusted by customers all over the world.

The constant guiding principle of our engineers is to design innovative machines and processes to use the world's ever

declining mineral resources efficiently and to make intermediate products and residual materials usable.

Sustainability and the protection of our environment and climate is one of the central corporate objectives of ThyssenKrupp Polysius.

ThyssenKrupp Polysius supplies pyroprocessing systems for ...	
✓	the burning of lime
✓	the pre-reduction of nickel and manganese ores
✓	the direct reduction of direct reduction and chrome ores
✓	the treatment of mineral secondary raw materials, intermediate products and residues
✓	the calcination of aluminium, bauxite, magnesite, dolomite, titanium oxide, chrome ore, soda, phosphate etc.
✓	the sintering of magnesite and dolomite
✓	the production of expanded clay and flooring plaster
✓	the concentration of phosphates
✓	the extraction of oil from oil shale



Kilns: rotary kiln, preheater, multiple hearth furnace high temperature shaft kiln and ...

The core units of pyroprocessing systems are kilns. Our scope of supply and services not only includes the core equipment but also the upstream and downstream plant sections, the electrical equipment and instrumentation and the erection and commissioning. The requirements of the customer dictate the design criteria and the optimum kiln system for the customer's needs is then configured with the aid of laboratory test processes, computer simulations and calculations. Custom-tailored. Innovative. Reliable.

Rotary kiln: robust and reliable construction, low resource consumption, high operating reliability and low specific operating expense and capital costs are the most important factors in the success of ThyssenKrupp Polysius kiln systems.

Rotary kilns are used for burning, calcining, reducing, roasting, volatilising or sintering a very broad range of materials. The directly fired rotary kiln can be designed for either the wet or the dry process and can be combined with different preheater systems – e.g. with cyclone or shaft preheaters – to achieve high productivity while simultaneously reducing the energy consumption. Our scope of supply includes large-diameter rotary kilns on 2, 3, 4 or more supporting roller stations.

Preheater: today's requirement profile for rotary kiln processes is

directed at high production capacities with low operating and capital expenditure. For this reason, preheater/precalciner systems are important components of a modern kiln line. Depending on the material particle size range, multistage cyclone preheaters or shaft preheaters are used. ThyssenKrupp Polysius offers preheater/calciner concepts that are suited to a very broad range of production capacities and are ideal for both new plant investments and plant conversions.

The fundamental characteristics of a cyclone preheater are: minimum energy requirement thanks to effective heat recuperation and low pressure drop, outstanding efficiency due to high rate of material collection in the cyclones and uniform material distribution over the gas duct cross-section, and high availability due to time-tested, reliable design and execution.

Large picture: Waelz-processing kiln in Germany for processing filter dust from electric furnace steel plants into secondary zinc concentrate. **Pictures 1 & 2:** Plant for drying and pre-reducing nickel ore in Venezuela. **Fig. 3:** DOPOL® cyclone preheater. **Fig. 4:** Gas fired high temperature shaft kiln in Saudi Arabia for the hard burning of lime. **Fig. 5:** Two multiple hearth furnaces (17 hearths) for calcining natural magnesite.

Multiple hearth furnace: this type of furnace can be used for processing very fine-grained materials at very precise temperature profile settings.

The multiple hearth furnace is ideal:

- ✓ for calcining industrial minerals such as magnesite, dolomite, limestone and clay,
- ✓ for calcining flotation concentrates and filtercake, e.g. from synthetic MgO production,
- ✓ for the pyroprocessing of ores, minerals, earths and sands, or
- ✓ for the thermal treatment of residues.

High temperature shaft kiln: this type of kiln was developed in close co-operation with the refractories industry for sintering raw materials for refractory applications.

Main applications:

- ✓ direct sintering of magnesite, bauxite, fireclay, dolomite and
- ✓ sintering of calcined materials in a two-stage process for e.g. magnesia, dolime, alumina, magnesia-alumina spinels and chrome magnesia spinels.

The high temperature shaft kiln works with temperatures of up to 2,200°C. Its main characteristics are flexibility in the achievement of specific temperature ranges and profiles as well as its high thermal efficiency.



POLCAL® the gas suspension preheater with calciner

The POLCAL® system was specially developed for the short-time processing of fine-grained materials.

Materials with particle sizes of 0 to 2 mm are processed by the gas suspension method.

The POLCAL® not only performs the preheating, but also the calcining – without requiring an additional unit, such as a rotary kiln. It can be used in combination with a shaft-type flash dryer to process moist materials energy-efficiently.

Phosphate ore calcining plant: The ore is first comminuted in a hammer mill with shaft-type flash dryer and the dried product is then calcined in a POLCAL® gas suspension thermal reactor. Cooling takes place in a multistage flash cooler.



... for fine materials



One or more cyclone stages can additionally be used for the subsequent cooling.

The thermal energy transferred to the air as the material cools down can be reused in the process – a further bonus for the energy balance.

Natural gas, oil, coal and calorific offgases are ideally suited for use as fuels.

A POLCAL® system in the Netherlands for calcining FGD-gypsum.

Thanks to the modular design and the range of different cyclone types, tailor-made configurations can be created without any problem.





Rotary dryer for nickel ore in Brazil.

Shaft-type flash dryer in a lime production plant in Australia.



Dryers A large portfolio for.....

ThyssenKrupp Polysius offers a broad range of effective systems for drying mineral raw materials. Directly or indirectly working rotary dryers and shaft-type flash dryers are only two examples of our many different processes.

The **rotary dryer**, a reliable and low-maintenance machine for high throughput rates, can handle even materials with difficult properties. Whether installed as a stand-alone unit or in conjunction with other machines, rotary dryers are ideal for drying – and optionally for preheating/pretreating fine-grained and lumpy materials. They can be used for product-specific processing by changing-over between parallel flow and counterflow and by varying the temperature of the supplied hot gas. Energy-efficient and cost-effective operation is achieved by utilising hot offgas, for instance from a downstream kiln process. If required, the

rotary dryer can be combined with a screen in the discharge device in order to split the product into different particle size fractions.

The **shaft-type flash dryer** is designed for rapid and gentle drying of fine-grained materials. Excellent mixing of the material and good flow conditions assure very high drying speeds so that even extremely moist materials can often be dried in just a few seconds. The low material retention time makes the system very flexible, because it can be adapted quickly and easily to variations in the properties of the material, such as feed moisture content. The dried

product is normally collected in a cyclone. Hot flue gas from a combustor or offgases from other pyroprocesses are ideal drying media. The dryer can be combined with a hammer mill and a separator in order to obtain a required product grain size range. As a system component of a larger process, the shaft-type flash dryer is therefore excellent for equalising fluctuations in raw material properties.

In many plants it is necessary to cool down a thermally treated product before further processing or outfeeding. With rotary coolers, shaft coolers, flash coolers, fluidised bed coolers and, last but not least, the POLYTRACK® – the latest member of the cooler family – ThyssenKrupp Polysius offers a very broad range of products providing „cool“ solutions for widely differing applications. A common feature of all our coolers is that the waste heat from the cooling process is recuperated for the pyroprocessing, minimising the overall energy requirement.

The **flash cooler** operates according to the same principle as the shaft-type flash dryer. Ambient air is intensively mixed with the hot material in the riser pipe. The heated air can be used in other processes (e.g. as secondary air for burning processes).

Even if several flash coolers are connected in series, their footprint is often smaller than that of, for instance, a rotary cooler. Another advantage is that no water supply and treatment system is required.

If a flash cooler is used in combination with a cyclone, it is easily possible to discharge the dried material directly into the top of a

silo, so that no vertical conveying equipment is needed.

For many processes the robust **rotary cooler** is the optimum solution – either for direct cooling of the material with air or indirect cooling with water. High throughput rates, easy handling, great flexibility for coping with fluctuating material properties and quantities, high availability and low maintenance requirement speak for the rotary cooler.

The **fluidised bed cooler** is an excellent solution for indirect cooling of ultrafine materials, e.g. dusts. The compact

The Fluo Solid Cooler – a fluidised bed cooler – is specially designed for cooling ultrafine materials.



cross-current cooler without any moving parts contains tube coils through which water is circulated. A small volume flow of air or nitrogen continuously agitates the material and enables highly efficient heat transfer to the cooling water in the tube coils, thus assuring low product temperatures.

Coolersa very broad range of applications

Flash cooler in a lime production plant in Australia.





Plant owners demand coolers that are

- ✓ high-performance,
- ✓ compact,
- ✓ low-wear,
- ✓ flexible in use,
- ✓ favourably-priced,
- ✓ reliable in operation and
- ✓ easy to maintain.

This highly complex list of requirements is exactly fulfilled by the advantages reliably provided by the POLYTRACK® cooler. Its numerous innovative process and design details make POLYTRACK® a future-oriented mechanical and process technological solution.

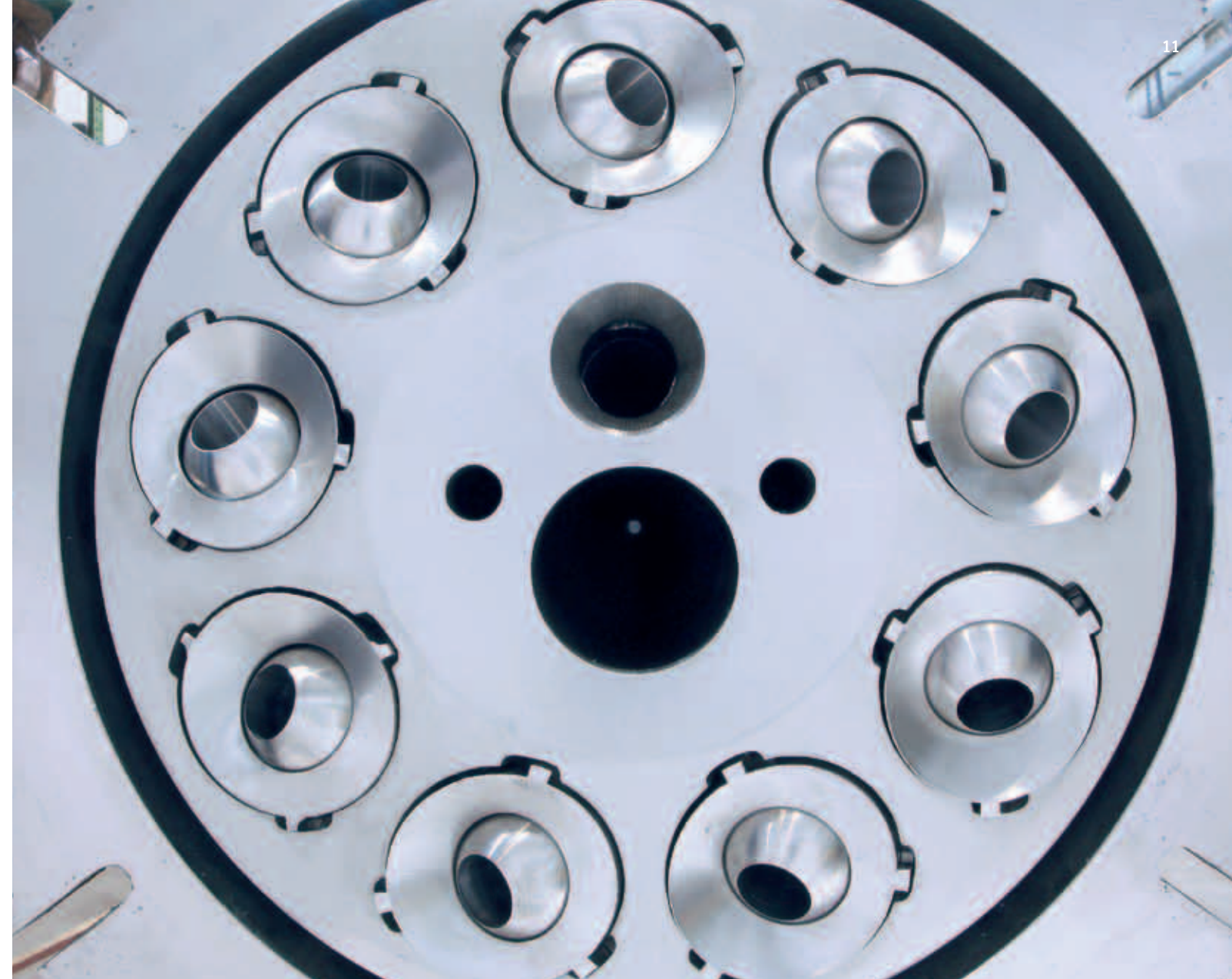
The variable forward stroke speed of the transport tracks results in optimum transverse distribution of the material over the entire width of the cooler, allowing compensation for off-centre material discharge from the kiln and reliably preventing fritting of the material on the grate.

Proven. Reliable. Future-proof. POLYTRACK® cooler made by ThyssenKrupp Polysius

POLYTRACK® advantages at a glance

The POLYTRACK® is a combination of a static, horizontal aeration floor and an above-floor material transport system. Its convincing advantages are the very high material transporting efficiency and strict separation of the functions of transportation and aeration, due to:

- ✓ optimum transverse distribution of the material resulting in uniform and efficient cooling of all particle size fractions over the entire width of the cooler,
- ✓ extremely low overall height,
- ✓ very high thermal efficiency,
- ✓ robust, low-wear and easy-to-maintain design providing outstanding availability and
- ✓ consistent modular construction.
- ✓ Moreover, the POLYTRACK® tolerates fluctuations in the kiln process; its flexible and high-performance material transportation system copes with even the most difficult operating conditions.



POLFLAME® The rotary kiln burner for numerous fuels

Modern rotary kiln burners not only have to assure full combustion of widely differing types of fuel, but also have to do so for frequently changing fuel mixtures. This far from simple requirement profile is reliably fulfilled by the POLFLAME® burner.

The POLFLAME® is designed for burning a very broad range of fuels – standard fuels or secondary fuels, as a single fuel input or as a complex fuel mixture.

Thermal outputs range from 10 MW to 300 MW.

Impressive POLFLAME® characteristics are:

- ✓ variable adjustment without interrupting operation
- ✓ complete combustion of the different fuels within the burnout zone
- ✓ high rate of fossil fuel substitution by secondary fuels
- ✓ constant combustion and high flame stability at different burner settings
- ✓ reproducible setting of the flame shape depending on kiln operating conditions and type of fuel
- ✓ and easy operability of the adjusting device.

These advantages make the POLFLAME® burner highly interesting, not only for new plants but also for system replacements in the course of plant upgrades.



Modern concepts for lime production.

Lime and dolomite are essential raw materials, for instance in the steel industry, the chemicals industry, agriculture, for building materials and for flue gas cleaning. They have made a crucial contribution to many achievements of our modern world.

Since the beginning of 2006, Maerz Ofenbau AG of Zurich has been a member of the ThyssenKrupp Polysius Group and became the lime competence centre within the Group as a result of the bundling of lime activities.

Maerz develops future-oriented standards on the basis of its comprehensive know-how. The firm offers a complete range of products for lime manufacturing, from the single machine to complete plants, in order to provide customer-specific solutions for the desired size of plant and the occurring limestone size range.

The company's range of products comprises diverse shaft kilns, rotary kilns, rotary kilns equipped with shaft or cyclone preheaters and POLCAL® gas suspension calciners.

Maerz parallel-flow regenerative lime shaft kiln in Mexico.

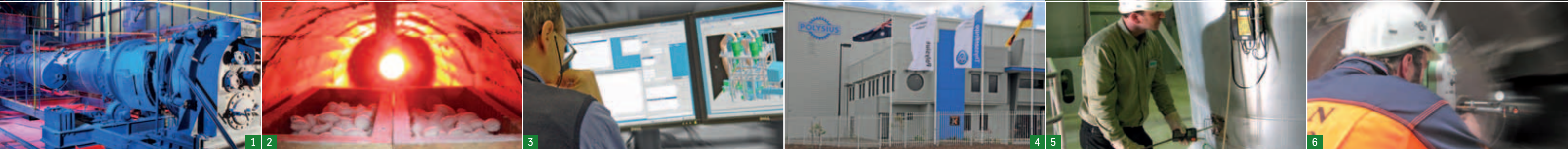


Annular shaft kiln in Saudi Arabia.



Rotary kiln with shaft preheater in Germany.

Lime production plant in Australia. The material – dune sand – is processed in a shaft-type flash dryer, cyclone preheater and rotary kiln before being cooled in a flash cooler.



Research, development and service Made for the Future

Excellent technological competence is the key to winning over and retaining customers, as well as to exploiting growth potential in existing and new markets.

Innovations are crucial for the economic success of the ThyssenKrupp Polysius Group – whether they involve the advancement of existing products or the opening up of new fields of application for proven technologies and services.

The crucial thing is to press ahead resolutely with the innovations and implement them quickly.

At ThyssenKrupp Polysius, development work is focused on innovations aimed at the efficient use of raw materials and resources, on achieving larger production

units, on improving the operating economy and on increasing the plant availability.

We also perform laboratory, testing and development work for customers on a contract basis.

The ThyssenKrupp Polysius Research and Development Centre is among the world's foremost establishments for technological development in the minerals, mining and iron and steel producing industries, as well as the refractories, lime and chemicals industries.

The R+D Centre has laboratories for chemical, physical and mineralogical investigations.

There are departments dealing with technical calculations, measurements and process and design development.

And there is the test plant facility, which contains "miniature production lines" (including mills, kilns and a workshop) where comminution tests, burnability tests and wear tests are performed, components tried out and environmental effects observed.

Large picture: Significant success factors for research and development work at Polysius are interdisciplinary teamwork and the capability to employ a broad range of different instruments, e.g. the scanning electron microscope with connected MLA (Mineral Liberation Analyser) software. **Fig. 1:** Rotary kiln for pilot plant tests. **Fig. 2:** High-temperature kiln for crucible tests up to 2,200°C. **Fig. 3:** CAD design. **Fig. 4:** ThyssenKrupp Polysius has built up a global network of service centers for the minerals industry. Located close to customers and equipped with top-end workshop machines, these ensure quick and expert maintenance and servicing of all wear-intensive machine components. **Fig. 5:** Gas analysis and temperature measurement. **Fig. 6:** POLSCAN® service for checking the rotary kiln geometry.

Our service concept. All around the world, plant managers on the raw material processing sector are coming under increasing pressure with regard to competitiveness and costs. The changing basic conditions on the world markets make it necessary to find a strong, reliable and innovative partner.

In addition to the everyday challenges of plant operation, the production process has to be constantly checked with regard to economy of operation and competitiveness. If necessary, the equipment has to be put in future-oriented condition by incorporating the latest technological developments or spare parts.

On the basis of our comprehensive knowhow, specialists from ThyssenKrupp Polysius diagnose weak points in the plant operation, offer solutions and assist in the elimination of problems.

ThyssenKrupp Polysius offers a broad range of services, stretching from plant inspection and maintenance to performance of measurements, supply of spare parts and implementation of complex plant conversion and modernisation projects.

Industrial Solutions
Resource Technologies

thyssenkrupp Industrial Solutions AG
Graf-Galen-Strasse 17
59269 Beckum, Germany
Tel.: +49 2525 99-0
E-mail: pyro.tkis@thyssenkrupp.com
www.thyssenkrupp-industrial-solutions.com

© 2016 Product specifications and prices are subject to change without notice or obligation. The photographs and/or drawings in this document are for illustration purposes only. The operation values are considered to be approximate and will be finally determined on the basis of the specific task and the material characteristics. The only warranty applicable to our equipment is the standard written warranty applicable to the particular product and sale and thyssenkrupp makes no other warranty of accuracy, reliability, completeness, merchantability or fitness for any purpose, express or implied. Products and services listed may be trademarks, service marks or trade-names of thyssenkrupp and/or its subsidiaries in Germany and other countries. All rights are reserved.

engineering.tomorrow.together.