

Industrial Solutions
Cement Technologies

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Industrial Solutions

Cement industry

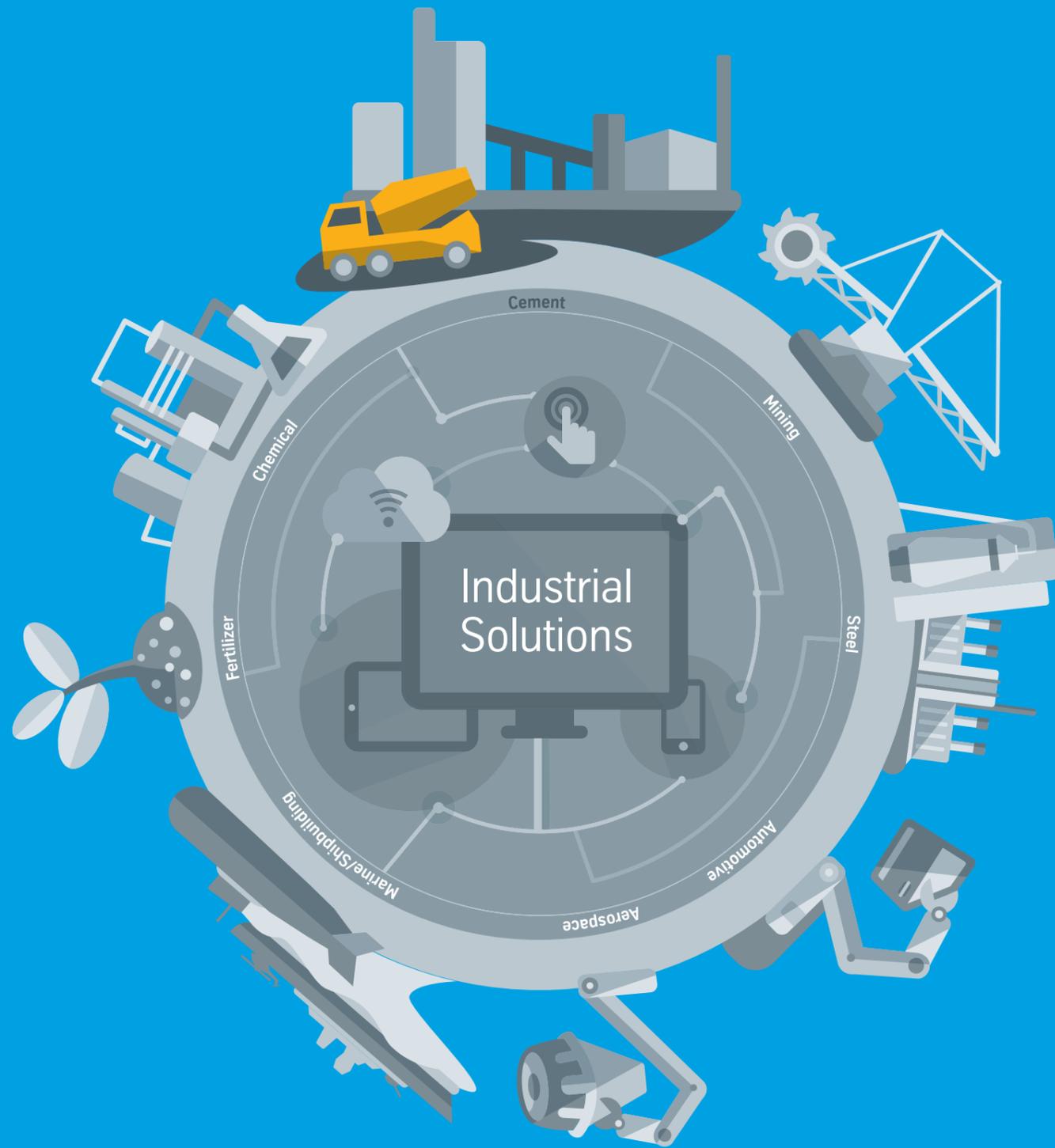
Sustainable, cost-effective
overall solutions – State-of-the-art
production processes



thyssenkrupp

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engineering.tomorrow.together.



The power of true efficiency

The Business Area Industrial Solutions of thyssenkrupp is a world leader for planning, construction and service in the field of industrial plants and systems. Together with our customers we develop solutions at the highest level and deliver efficiency, reliability and sustainability throughout the entire life cycle. Our global network, with around 19,000 employees at 70 locations, enables us to provide turnkey solutions worldwide which set new benchmarks with their high productivity and particularly resource conserving technologies.

We are at home in many different industries. Along with chemical, fertilizer, coking, refinery, cement and other industrial plants, our portfolio also includes equipment for open-cast mining, ore processing and transshipment, as well as associated services. In the naval sector, we are a leading global system supplier for submarines and surface vessels. As an important system partner to our customers in the automotive, aerospace and battery industries, we optimize the value chain and improve performance.

Individual requirements, optimal solutions

thyssenkrupp Industrial Solutions offers its customers a complete product portfolio and is therefore one of the few full-range suppliers in the cement industry. With more than 150 years of technological experience, thyssenkrupp Industrial Solutions is a competent partner that can find the optimal plant solution for every project. At the same time, thanks to the application of ultramodern production processes, our plants protect resources and the environment and can guarantee plant owners maximum productivity and economy of operation.

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Three questions for...



Frank Ruoss, CEO of the Business Unit Cement Technologies, and his staff are the people behind the products and services of thyssenkrupp Industrial Solutions in the cement industry.

Three questions, three answers – Frank Ruoss provides a personal insight into the challenges and specific nature of the industry.

In your opinion, what will be the most lucrative growth markets for the cement industry in the coming years?

Our market is the world! Every market needs cement, but of course there are differences: while service and spares dominate demand in highly developed regions, such as western Europe, and business is of a small-volume, although perhaps higher-margin nature, it is mainly the emerging regions

which, in the process of establishing and developing their infrastructure, offer volume business for complete plants. Examples of such regions include the Middle East, North Africa and also prospective markets in sub-Saharan Africa. The Americas and the Far East remain steady markets.

What particular advantages over its competitors does thyssenkrupp Industrial Solutions offer its customers in the cement industry?

We see ourselves as a full-service provider to the cement industry. This means that we provide our customers with all products and services from a single source: from each individual screw in the spares business and each individual machine in the supply business to complex plant sections and complete EPC plants. Add to this our comprehensive portfolio of services and there are few companies that can prove a match here in terms of the quality we offer. Moreover, our products and process technologies are renowned the world over and are subject to constant refinement with a view to future trends and demands of the industry, such as the use of alternative fuels, the abatement of emissions, etc..

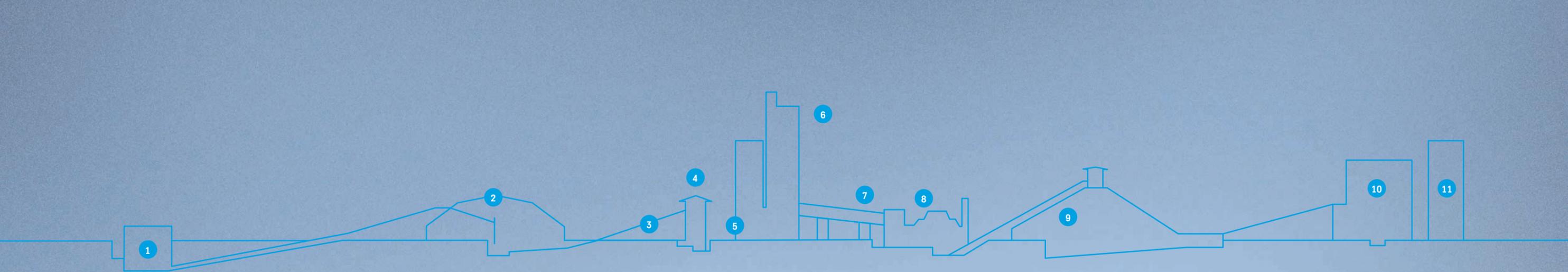
In your opinion, what is particularly important/appealing about major international project work?

In today's fiercely competitive environment, large-scale projects can only be implemented successfully if you are closely networked with suppliers, manufacturers and, in particular, with your own regional companies across the world. Practising these cross-border and indeed cross-continent structures and at the same time withstanding fierce competition is both a challenge and a personal experience offered by few other industries in this form.



„We provide our customers with all products and services from a single source: from each individual screw in the spares business and each individual machine in the supply business to complex plant sections and complete EPC plants.“

Frank Ruoss, Head of Business Unit Cement Technologies



Raw material preparation

- 1. **Crushing:** The raw material is crushed to the size of coarse gravel.
- 2. **Interim storage, blending:** The raw material is stockpiled or homogenized in blending beds.
- 3. **Dosing:** A dosing device feeds the raw material to the mill in the right quantity and composition.
- 4. **Grinding:** The raw material is ground to the required fineness in a raw mill and is simultaneously dried.
- 5. **Homogenizing:** The raw meal is homogenized and stored in silos to be subsequently fed at a controlled rate to the preheater.

Clinker manufacturing

- 6. **Preheating, calcining:** The raw meal is preheated and calcined in a cyclone preheater with calciner.
- 7. **Burning:** The raw meal is burned in a rotary kiln at a temperature of approximately 1,500 °C to form clinker.
- 8. **Cooling:** Most of the heat given off during clinker cooling is recovered for use in the production process.

Cement manufacturing

- 9. **Storage:** The clinker store is the source of supply for the cement grinding process.
- 10. **Grinding:** Additives are fed in during the clinker grinding process to achieve the required type and grade of cement.
- 11. **Storage, packing and loading:** The finished cement is transferred to storage silos. Finally, it is loaded into bulk transporters or bags.

Cement production – Processes and plants

The efficient manufacturing of high-grade cement products requires more than just a stringing-together of machines and individual processes. thyssenkrupp Industrial Solutions combines process and plant know-how to create innovative overall concepts.

In view of ever increasing throughput rates, it is of the utmost importance to correctly dimension the system and machine components that are subject to extreme mechanical stress. Our company possesses a high level of know-how in this field.



Raw material preparation



Circular blending beds from Industrial Solutions have a storage capacity of up to

54,000 m³

From the quarry to preheater feeding with raw meal

The cement manufacturing process starts with the extraction and preparation of the raw material. Even at this stage, the requirements are high because only with homogeneous and high-grade raw meal is it possible to manufacture high-grade cements in a cost-effective manner. Our experienced geologists determine the raw materials that occur in the quarry in order to analyze and evaluate them subsequently in the chemical, mineralogical and physical laboratories.

thyssenkrupp Industrial Solutions is committed to selecting individually matched production processes and to providing optimal technology.

Building on the results of the material investigations and the individual requirements of our customer, we specify the optimal production process, including the crushing, blending, storage, homogenizing, grinding and analysis technology. For this purpose, we use the databank-based software "ISAR", which simulates alternative plant and process configurations, including the resulting homogeneity developments of the raw material. In this way, we can guarantee a technologically and economically efficient process solution for every single project.

Clinker manufacturing

Maximum performance, minimum costs, low emission rates and highest quality – when it comes to clinker production, our customers' requirements are multifaceted.

Our innovative solutions make a convincing choice across the board. We reacted to the increasing shortage of fuels at an early stage and developed concepts for the use of substitute materials. Thus, not only do we make robust and reliable design and high operating reliability possible, we also enable low resource consumption, low operating and capital costs and process-integrated emission reduction concepts. Future-proof, cost-effective, reliable and resource-conserving – our customers benefit from the advantages of proven and innovative Polysius technology.



Today, plants from thyssenkrupp Industrial Solutions can be operated with

100%
substitute fuel

From the preheater to the clinker conveyor

In modern cement plants, the burning process is performed in three consecutive units. First, a multistage cyclone preheater with calciner, where the raw meal is preheated with kiln exhaust gas to approx. 800 to 900 °C and calcined. Then, there is the rotary kiln, where the sintering – a chemical-mineralogical process during which the cement clinker is formed – takes place at approx. 1,450 °C. Subsequently, the clinker minerals are "fixed" by the cooling process in the clinker cooler. The exhaust air from the cooler, which contains the recuperated heat, is used in the kiln as combustion air.

The optimized clinker manufacturing process is carried out in three stages:

1. Preheating and calcining of the raw meal in the cyclone preheater
2. Burning of the raw meal in a rotary kiln at a temperature of approximately 1,450 °C to form clinker
3. Cooling of the clinker

Tangential silos have a storage capacity of up to

30,000 m³



From the clinker store to the cement dispatch facility

In the final stage of cement manufacturing, the cement clinker that was buffer-stored in the clinker stores is ground to form high-grade cement in an economically efficient manner. The increasing substitution of cement clinker expands the product ranges of cement manufacturers. Alternative products such as granulated blast furnace slags, fly ashes, natural pozzolanas and limestone reduce capital costs and operating expenses and reduce the pressure on natural resources.

Cement manufacturing

Cement manufacturing takes place in line with the economic and ecological requirements of our customers.

Due to the increasing diversity of cement components, ever greater production outputs and our customers' desire to manufacture different cement types in a given plant, the complexity of cement grin-

ding systems is growing constantly and the plant design requirements are high. In addition to the grindability of the individual components and the differing finenesses in the cement, key aspects when it comes to designing a good grinding plant are the granulometric distribution and the thermal engineering of the plant to ensure drying of the moist components with waste heat. thyssenkrupp Industrial Solutions always takes up new challenges and, as well as the process technology know-how, offers the required portfolio of core equipment for cement manufacturing.

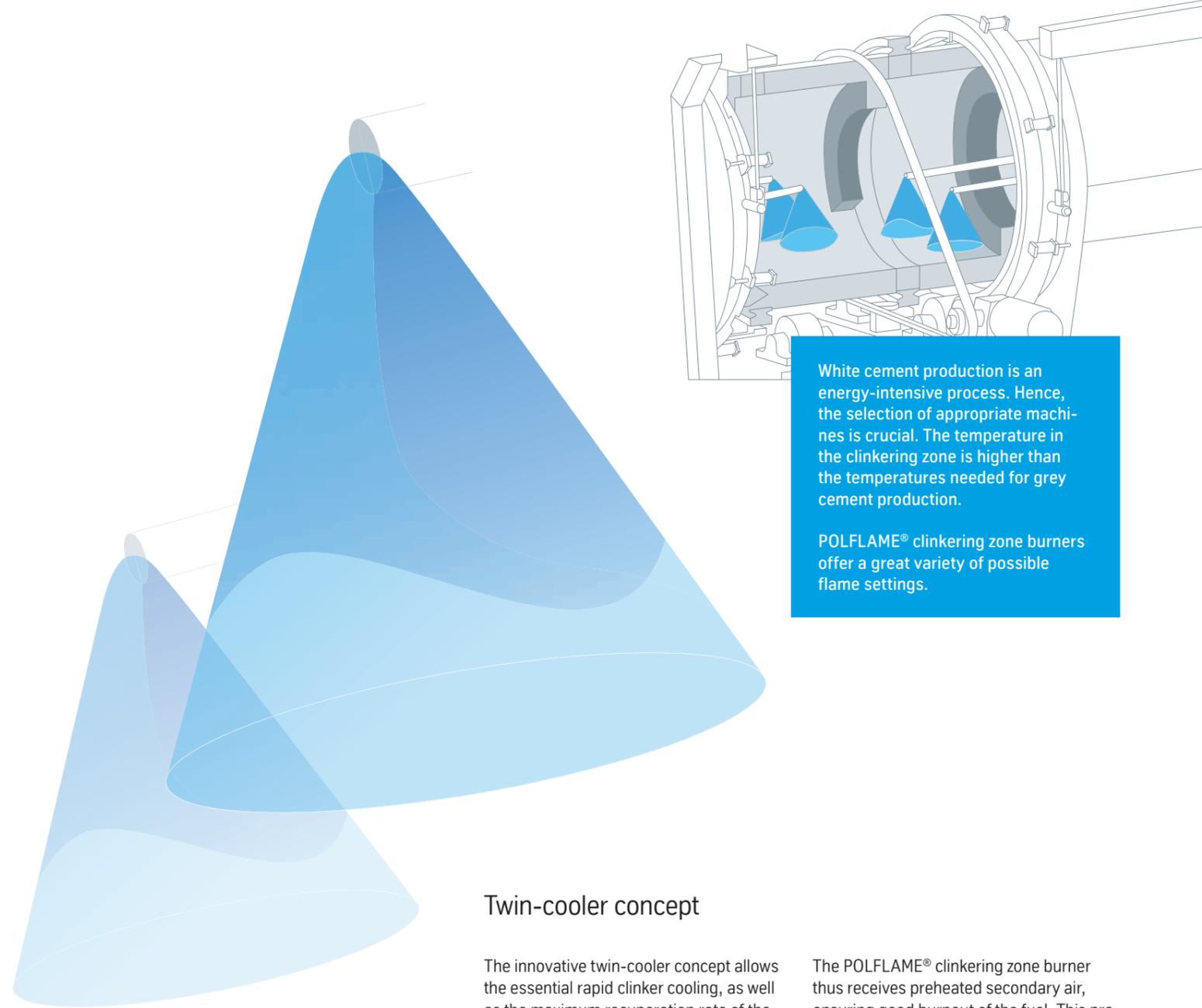
White cement

Special know-how



Production of the highly desirable building material “white cement” requires special machines and process technologies. The global implementation of numerous new projects and modernization projects underlines the special know-how that thyssenkrupp Industrial Solutions has.

White cement differs from grey cement due to its more specialized design possibilities. Its high color purity gives surfaces a bright and elegant appearance. It is therefore especially popular in the sunny countries of the Middle East and the Mediterranean region. What’s more, white cement can be easily colored, thus extending the design spectrum. For the demanding production of white cement, light-colored raw materials with a very low iron oxide content are needed. After the burning stage, the clinker has to be cooled down quickly in order to retain the whiteness. Using cooling systems specially designed for the production of white cement, thyssenkrupp Industrial Solutions can ensure consistent, top-class quality.



White cement production is an energy-intensive process. Hence, the selection of appropriate machines is crucial. The temperature in the clinkering zone is higher than the temperatures needed for grey cement production.

POLFLAME® clinkering zone burners offer a great variety of possible flame settings.

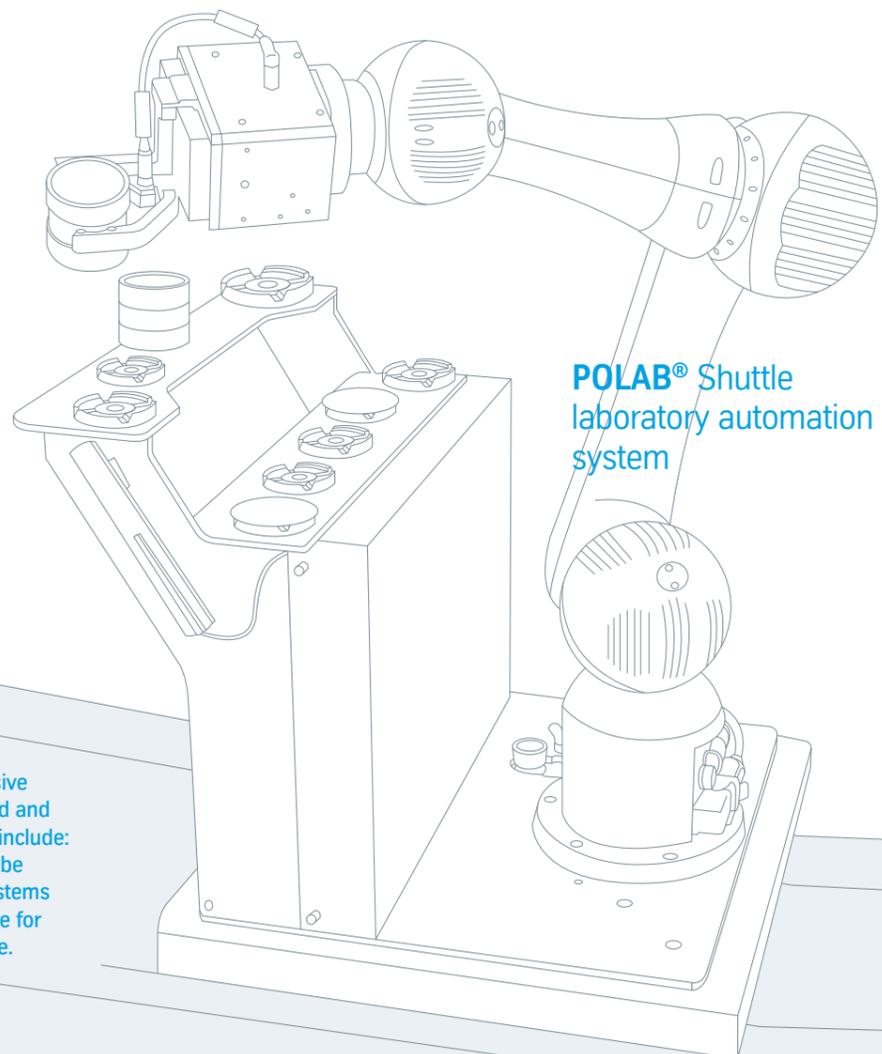
Twin-cooler concept

The innovative twin-cooler concept allows the essential rapid clinker cooling, as well as the maximum recuperation rate of the residual clinker heat for the burning process. This concept involves primary cooling of the clinker in a rotary cooler and final cooling in a POLYTRACK® cooler. In the POLYTRACK®, the clinker heat is recuperated for the secondary air and its temperature is raised by a hot gas producer.

The POLFLAME® clinkering zone burner thus receives preheated secondary air, ensuring good burnout of the fuel. This procedure also prevents premature cooling of the white cement clinker in the rotary kiln outlet, which would impair the whiteness of the cement produced.

Factory automation

Process control and quality assurance



With POLAB®, we offer an extensive product range of semi-automated and fully automated systems. These include: sampling systems, pneumatic-tube dispatch, sample preparation systems and the POLAB® AQCnet software for monitoring and quality assurance.

The challenges for our POLAB® laboratory automation system are alternative production concepts and the growing demands placed on the quality characteristics of cements.

With POLAB®, we offer our customers flexible strategies for ensuring the quality of all intermediate and end products in all phases of the production process. The range of products and services includes custom-tailored process-monitoring, control, regulation and optimization systems, as well as systems for ensuring constant product quality. Our global service ensures ultra-rapid support by means of remote diagnosis and can arrange service assignments at short notice.

The POLCID® process control system provides users with application software that is optimally configured for the cement and minerals industries. Thanks to our many years of automation know-how, as well as well-founded process and plant knowledge, we can guarantee the highest standard in this regard. The process control system is based on hardware and software components from world-renowned automation companies and allows unrestricted possibilities for adaptation.



Our view of service



So that complex plants can accomplish their tasks in an optimal manner and create and maintain value, professional support by competent experts is necessary – right from the start and at any point in time during the many years of a plant's life.

All work is individually designed and adapted for each customer

Save time when looking for our services

thyssenkrupp Industrial Solutions provides high-quality parts and extensive services as your lifecycle partner.

The Service Product Finder on www.thyssenkrupp-industrial-solutions.com offers an overview of all our service solutions.



Our service specialists take up your challenges

Hand in hand with the respective client, thyssenkrupp Industrial Solutions implements varied projects and, through expertise and many years of experience, ensures the successful erection of complex plants, even in difficult environments. However, it doesn't stop there: All customers around the globe can rely upon thorough, rapid and comprehensive support when it comes to looking after their plant. Moreover, these services are also available for plants from other manufacturers.

When doing so, they can rely on a huge trove of technical and economic know-how – and on globally networked, effective structures – when it comes to the necessary servicing and maintenance work. Our spare-parts management ensures the most cost-effective spare parts and the fastest possible delivery. In local service centers, we have the required know-how to offer our customers a helping hand. Our experts define the optimal operating and service intervals. Through modernization and maintenance, they increase the operating economy and service life of plants. Together with the customer, automation possibilities are adapted to individual requirements. The qualification of local employees is ensured through instruction and training courses. Integrated asset management helps the customer to reduce the overall costs for a plant.

Service from a single source



Asset Management



Revamps



Service Center & Field Services



Spare Parts' Supply & Management

Range of products and services

Raw material preparation

- Mobile, semi-mobile and stationary crushing plants
- Single-shaft/Double-shaft hammer crusher
- Impact crusher
- Jaw crusher
- Roll crusher
- Gyrotory crusher
- Cone crusher
- RollSizer
- Longitudinal stockpile/Longitudinal blending bed
- Circular stockpile/Circular blending bed
- QUADROPOL® roller mill
- Tube mill
- POLYCOM® high-pressure grinding roll
- SEPOL® high-efficiency separator
- High-efficiency cyclone
- Multi-cell silo
- Tangential blending silo
- Storage silo/bin
- AEROPOL® vertical conveyor
- FLUIDOR® pneumatic trough conveyor

Clinker manufacturing

- DOPOL® '90 cyclone preheater
- PREPOL® calcining systems
- POLRO® 2-support kiln
- 3-support kiln
- POLGUIDE kiln drive
- POLFLAME® burner
- Kiln temperature scanner
- POLYTRACK® clinker cooler
- White-cement clinker cooler

Cement manufacturing

- Clinker store
- Clinker silo
- POLYCOM® grinding systems
- Tube mill grinding systems
- QUADROPOL® QMC roller mill
- SEPOL® high-efficiency separator
- Fines cooler
- Flash dryer
- AEROPOL® vertical conveyor
- FLUIDOR® pneumatic trough conveyor
- Tangential silo
- Multi-compartment silo
- Cone compartment silo

Factory automation

- POLCID® process control system
- POLAB® sampling, pneumatic tube system
- POLAB® APM
- POLAB® ACT
- POLAB® AMT
- POLAB® Shuttle
- POLAB® AQcnet software