

BACK TO THE **GRIND**

WORLD CEMENT GRINDING Q&A

World Cement interviewed thyssenkrupp Industrial Solutions AG for their thoughts on the topic of grinding & milling.

1) What do you see as the main challenges facing the grinding operations of cement manufacturers today? How can these be resolved?

thyssenkrupp Industrial Solutions AG
Over the years cement manufacturers have extended their product portfolios by offering larger portions of additive cements, containing, besides clinker, a bigger share of ground limestone, slag, pozzolana or fly ash. The continuous reduction of clinker is also

increasingly required in order to reduce the industry's CO₂ footprint. As a consequence, the fineness of cements with high additive content needs to be increased in order to maintain comparable cement properties.

Hence, within cement grinding plant projects, companies' aims range from achieving larger and larger throughputs to finer and finer products.

The combination of different cement grinding systems is the key to coping with the challenges of grinding different types of cements.

The Cement Technologies business unit of thyssenkrupp Industrial Solutions AG (tkIS) offers state-of-the-art grinding systems as well as common ball-mill grinding plants to serve specific customer needs:

- ▶ High-pressure grinding roll polycom®: This machine has the lowest possible specific power consumption, which reduces total energy costs and the CO₂ output. Especially, in conjunction with a ball-mill, the combi grinding system is an attractive solution regarding OPEX and CAPEX. No water spraying system is needed, but the machine offers a lower drying capacity than other grinding systems.
- ▶ The vertical roller mill quadropol® incorporates a compact plant layout and is often used for moist raw materials. Due to its flexibility in grinding different cement raw materials and the fact that high throughputs can be realised, these grinding circuits are popular with customers, even though they require big gear boxes and a re-welding of the grinding rolls from time to time.
- ▶ The polysius® booster mill is an agitated bead mill and is advantageous for producing high fineness cements. This fine grinder was recently introduced to the cement market. It is also an attractive solution for upgrade projects at existing cement works.

As cement producers are under constant pressure to reduce OPEX too, it is also important to ensure the right cement quality by using the best available laboratory equipment. Therefore, tkIS has developed different polab® systems, which work in conjunction with XRF, XRD and laser granulometry. The newest development is the calorimeter polabCal®, which serves with immediate reactivity data of clinker and cement on pace together with regular process control data. It is now possible to adjust reactivity during production, which helps cement manufacturers to reduce their OPEX.

2) What factors should be considered by cement manufacturers when making the choice between different types of mill?

thyssenkrupp Industrial Solutions AG

The right choice for a cement grinding system depends on individual customer requirements, which are always related to specific site conditions and to their local markets to be served, for instance, the type and number of different cements to be ground and individual product quality characterised by compressive strength (early and final), setting time, workability, water demand, and product fineness. Furthermore, the material compositions as well as the feed material

properties (grindability, wear rate, moisture content) and other operational aspects like total specific power consumption of the grinding plant, product flexibility and maximum envisaged throughput rates have a big influence on the process design.

It is important that cement manufacturers carry out an analysis of the incurred CAPEX and OPEX costs as well as consumables, spares, maintenance and labour costs, before making a decision regarding which cement grinding system should be installed.

3) What steps can be taken to ensure high separator performance?

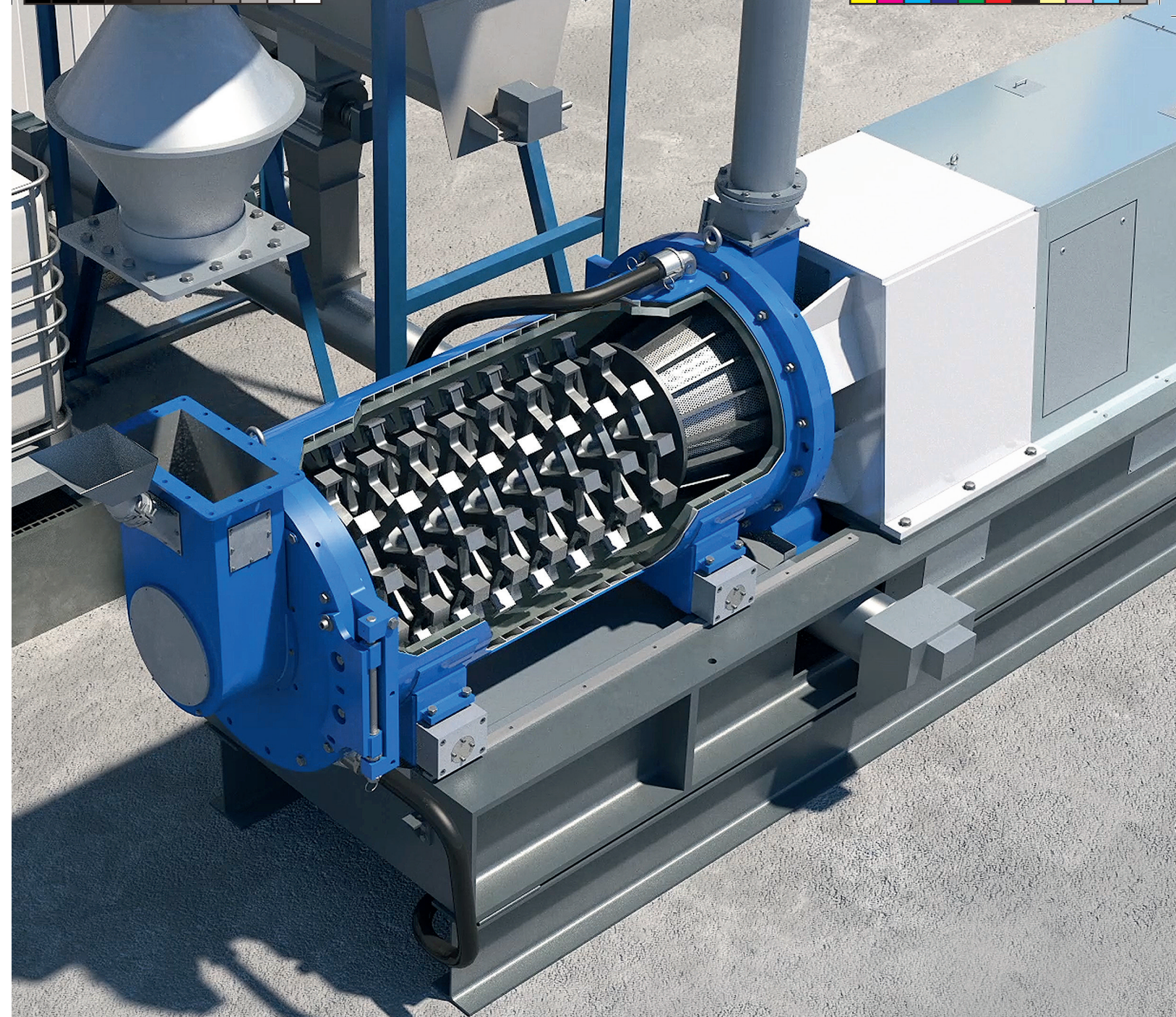
thyssenkrupp Industrial Solutions AG

- ▶ Adjustable guide vanes can be used to increase the energy level of separation: The design of the new guide vanes has been optimised for best flow pattern, and minimised wear, and enables the operator to adjust the separating gap between the edge of the guide vane and the outer edge of the rotor in a specific range. The separator performance is increased due to the better dispersion of agglomerates within the flow pattern outside the cage rotor.
- ▶ By installing a swirl breaker, pressure drop can be decreased: A dynamic separator needs swirl to generate centrifugal force. The rotation of the air in the separator rotor shows a flow profile in the form of a vortex. However, as soon as the fines have passed the rotor blades, the swirl inside the cage loses its procedural benefit. The swirl breakers slow down the rotational vortex, ensuring flow alignment, and lower tangential speeds. There is the same angular velocity at every point of the radius. This causes an even distribution of the outflowing air and a more even distribution through pipes, filters, and cyclones, which also reduces wear.
- ▶ Additional steps: It is important to supply enough separation air. By reducing the cage area of the separator, the air velocity and thus the energy for the separation process is increased. The equilibrium of forces such as the drag force created by air velocity, and gravity force created by the rotation speed of cage, have to be maintained. In the case of very fine product, the use of bag filter discharge is recommended instead of cyclones.

4) What advantages do modular grinding systems offer over more conventional set-ups?

thyssenkrupp Industrial Solutions AG

For years, the cement market has been volatile and with regard to grinding plants, there has been



Industrial Solutions for the cement industry

The polysius® booster mill – #boostgrinding with our new innovation.

On our transformation journey from #grey2green we have now come up with something new! The polysius® booster mill is a dry agitated bead mill that increases cement grinding performance and sustainability significantly. With this additional stage grinding solution, particularly efficient for finer grinding, customers produce ultra-high performance cements or sustainable cements with a lower clinker factor without losing grinding capacity and gaining flexibility.

For more information visit: www.thyssenkrupp-industrial-solutions.com

engineering.tomorrow.together.



thyssenkrupp

an increasing demand for fast installations, (semi-) mobile solutions and for closing white spots. The market is still driven by a decreasing CAPEX trend, new entrants, higher competition and less engineering capacities at clients' project engineering teams. All these market drivers are met by the concept of modular grinding plants.

This concept is ideal for capturing markets of up to 500 000 tpy, is suitable for greenfield or brownfield projects and offers several advantages compared to a conventional tailor-made grinding system. It is based on a stripped-down concept, which focuses on the core needs of the operation with optimised costs and less engineering, is fully standardised and incorporates pre-engineered equipment, plant layout, and procurement packages. The modular plant offers a very competitive solution with a low EPC price, short delivery time, easy installation and low maintenance. Modular grinding plants are allowing customers and even newcomers a fast entry into cement markets. Beside the low CAPEX with shorter payback periods, the modular concept bears low technical or financial risks for customers. Modularisation also facilitates the dismantling and re-erection of the grinding plant elsewhere, if commercial or market conditions change.

The polysius modular grinding plant ensures the quality and reliability of all equipment and maximises the performance of the plant, producing a high cement quality.

5) What role do you see for digital technologies, such as process automation solutions, in the grinding sector?

thyssenkrupp Industrial Solutions AG

Digitalisation is the connecting element between the process know-how of the suppliers, and the needs of the cement producers. Suppliers can benefit from accessing the data for process and machine optimisation and cement producers can achieve higher outputs, less energy consumption and higher plant availability with more reliable plant operation.

Today, this is possible as grinding plants are equipped with sensors to control the process and the plant equipment. The data from these sensors is collected and can be displayed on the dashboard in the control room for interactive real-time insights. The KPIs of the grinding plant can be visualised and by identifying anomalies, characteristic patterns and operational conditions, the plant operator can gain a more transparent view about the performance of the grinding plant.

By installing an artificial neural network together with optimisation algorithms, recommendations on plant operation can be provided to the operator. The intelligent model advises optimal set-points for process parameters in order to maximise targets for throughput and energy consumption, enabling the

operator to enhance the plant efficiency and reduce the operating costs.

In addition, remote assistance services by tkIS in combination with predictive maintenance or root cause analysis offer the possibility of increasing the availability of all machines from the grinding plant. A proper and timely supply of spare parts can be organised and maintenance work can be planned better in order to maximise plant availability.

6) Looking to the future – what do you see as the next steps in terms of grinding technology? What advances can we expect to see over the coming years?

thyssenkrupp Industrial Solutions AG

Along with increasing demand for pre-cast concrete, other high early-strength cement types, and low clinker cement, there will be a demand for finer grinding. One solution to achieve the necessary cement quality – and partially also to compensate for loss of capacity due to a higher fineness – is the polysius booster mill, a horizontal agitated bead mill. Rotating discs with mounted grinding tools rotate at high speed inside a fixed shell, stirring the small balls (beads) and creating a 'cloud' of beads and material.

This mill, established for decades in wet processes, has been jointly further developed by companies Netzsch and thyssenkrupp Industrial Solutions AG to be applied in dry processes for very fine grinding of cementitious materials. The modular, compact and highly energy-efficient system can be integrated into an existing grinding plant.

Results from a first reference, and from trials in a small-scale pilot plant, show that the clinker content of new cement compositions can be reduced significantly while maintaining previous – especially early – strength values. In other trials, ultra-fine cements were produced, achieving comparable quality even at lower fineness values.

In terms of quality, another add-on to the solution, and to grinding plants in general, is a calorimeter, recently introduced by thyssenkrupp Industrial Solutions AG. Instead of only using fineness or residue values as indications for quality, this solution measures heat from the early hydration process, allowing for an accurate prediction of the final quality within minutes. It has been tested and proven as beneficial in several plants, showing potential for faster cement quality control in the future.

Finally, in combination with process optimisations and the application of digital products at cement grinding plants, the polysius booster mill offers production opportunities for cement manufacturers worldwide. ■