



THE ART OF CLINKER COOLING







GREETINGS

PENDULUM COOLER®

Overview	6
Pendulum Cooler®	8
KIDS®	10
Coanda Wing®	12
Mobile frame with LPS®	14
Roll Crusher	16
Waste Heat Recovery	18

SOLUTIONS & SERVICES

Solutions & Services	23
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COMPANY

Facts and Figures	26
IKN Worldwide	27



Klaas Windmüller / Justus von Wedel

GREETINGS

Our goal is to provide you with the best possible solution for your clinker cooler and pyro system. With more than 500 customised installations worldwide, we are proud to be the number one choice for clinker cooling technology.

The initial development of the IKN Pendulum Cooler® started more than 30 years ago. Today, the latest design features state-of-the-art Coanda Wing® technology for optimised aeration and the LPS® supporting the mobile frame. The modular construction of the Pendulum Cooler® allows for quick and easy replacement of existing clinker coolers or the smooth integration in a greenfield project.

Even though cement is a commodity, the diverse fuels and raw materials throughout the world as well as local regulations demand an open-minded and flexible approach to each individual challenge. With our staff of over 150 dedicated employees in our organisation, we are prepared for those challenges and will support you before, during and after the project phase no matter how distant your plant or how special your request!

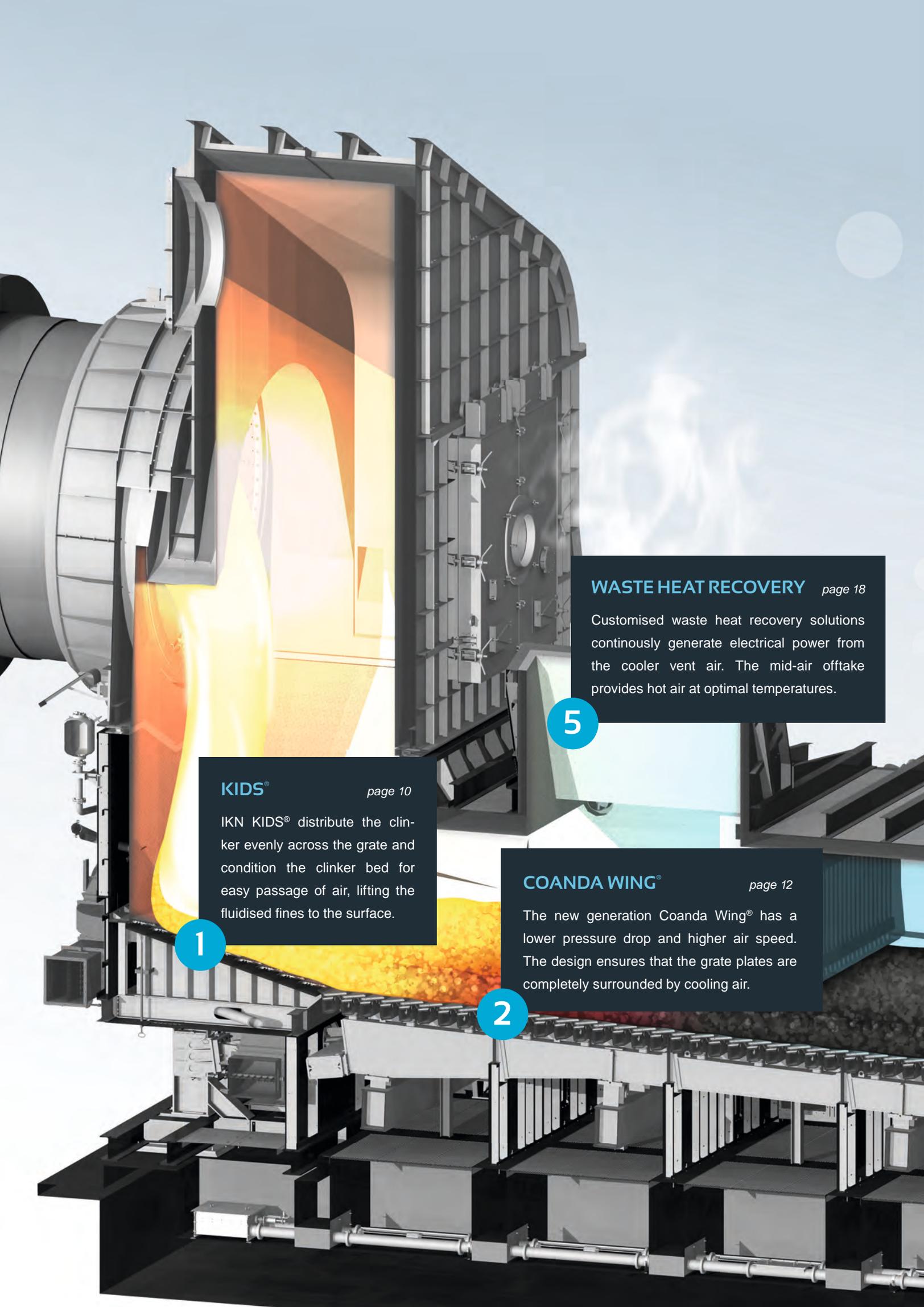
Our curiosity and ambition drive us to constantly work on the refinement of our products and the development of our skills. Expect the highest standard from our organisation.



Justus von Wedel



Klaas Windmüller



KIDS®

page 10

IKN KIDS® distribute the clinker evenly across the grate and condition the clinker bed for easy passage of air, lifting the fluidised fines to the surface.

1

COANDA WING®

page 12

The new generation Coanda Wing® has a lower pressure drop and higher air speed. The design ensures that the grate plates are completely surrounded by cooling air.

2

WASTE HEAT RECOVERY

page 18

Customised waste heat recovery solutions continuously generate electrical power from the cooler vent air. The mid-air offtake provides hot air at optimal temperatures.

5

COOL DOWN

The IKN Pendulum Cooler®

Over 500 installations of Clinker Inlet Distribution Systems (KIDS®) and the Pendulum Cooler® worldwide prove that IKN's products are at the forefront of technology. They are designed to reach the lowest clinker outlet temperatures at the highest recuperation rates.

MOBILE FRAME WITH LPS® page 14

The forward movement of the mobile frame is accomplished by an easily accessible hydraulic drive system and supported by wear and maintenance free spring steel straps.

3

ROLL CRUSHER page 16

IKN Roll Crushers are operating in coolers with a capacity of up to 13.000 t/d. They offer low power consumption and low mechanical wear.

4

PENDULUM COOLER®

In modern cement plants, the clinker cooler is the key to high recuperation efficiency and low clinker outlet temperatures at the lowest possible energy consumption.

+ Compact design

+ Low power consumption

+ Efficient clinker cooling

DESIGN AND FUNCTION

The Pendulum Cooler® is designed as single grate with a roll crusher at the end or as double grate with intermediate crusher. Uniform clinker bed aeration is ensured by grate plates, equipped with IKN Coanda Wing® technology, which purges the fines out of the clinker bed up to the surface with the required 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 sintered clinker leaves the outlet of the kiln with an estimated temperature of 1,400°C and drops onto the static inlet (KIDS®) where the clinker is initially cooled and conditioned for uniform distribution to the pendulum-supported grate. The clinker is transported by the linear strokes of the pendulum section where every third row is movable. Further down the cooler the material passes different air off-takes which provide hot air for drying and/or for a waste heat recovery system. At the end of the cooler, the clinker is discharged into the roll crusher and is broken to a size of less than 30mm before being transported to the storage facilities.

COMPETITIVE ADVANTAGE

IKN was awarded the contract to supply the three largest clinker coolers ever built, which reach capacities of 13,000 t/d. After intense technical discussions, the decision was made due to the low specific energy consumption, reduced expected wear rates and related savings in terms of maintenance costs and higher efficiency. Furthermore, IKN's broad experience in building high-capacity clinker coolers contributed to the decision.

MAIN FEATURES

- Low electrical power consumption
- High thermal recuperation efficiency
- Low construction height
- Modular design allows for easy assembly
- Pre-assembled parts reduce installation time
- Outstanding availability



3D layout



Inside view



Cooler during erection

KIDS®

The KIDS® is a revolutionary technology in clinker cooling both mechanically and process wise. It generates a uniformly distributed clinker bed just before the clinker reaches the mobile grate by evenly spreading the clinker and transporting the fines to the upper layer.

+ Uniform clinker bed

+ Improved recuperation

+ Low maintenance

DESIGN AND FUNCTION

The KIDS® converts the flow of clinker from the kiln into an even clinker bed for best possible heat exchange along the entire length of the cooler. The clinker lands on the cooler centre line near the cooler front wall. The criteria for optimum offsets between kiln and cooler are the kiln diameter, kiln speed and the angle of repose of the clinker. In addition to cooler offset, equally important performance parameters are shape of the refractory side dam, dropping height, inclination, length and the transit step to the downstream grate.

As the V-shaped refractory opens up, the clinker pile at the landing area spreads to the width of the grate and is converted into a uniform clinker bed. Shape and movement of the clinker pile can be controlled by the aeration of the KIDS® area. Typically the KIDS® area is divided into three zones: the clinker landing area and downstream the left and right side cooling zones. Strong aeration of the landing area prepares the clinker for optimum cooling. The fines are transported to the surface. The voids inside the clinker bed become more even, reducing the pressure drop and enabling uniform aeration across the bed.

Left and right aeration by separate cooling fans controls the cooling air to the coarse and fine side on the KIDS®. As the fine side requires less cooling air, a more gentle aeration of the fines prevents red river formation on the movable grate section. On the contrary, the coarse side requires more air for efficient cooling of the larger clinker size.

Smooth transition from the KIDS® to the cooler grate area is facilitated by the CFO (Controlled Flow Optimizer). The CFO is inclined at the same angle as the KIDS® rows and is equipped with a special seal to allow proper transition to the first movable row of the grate area.

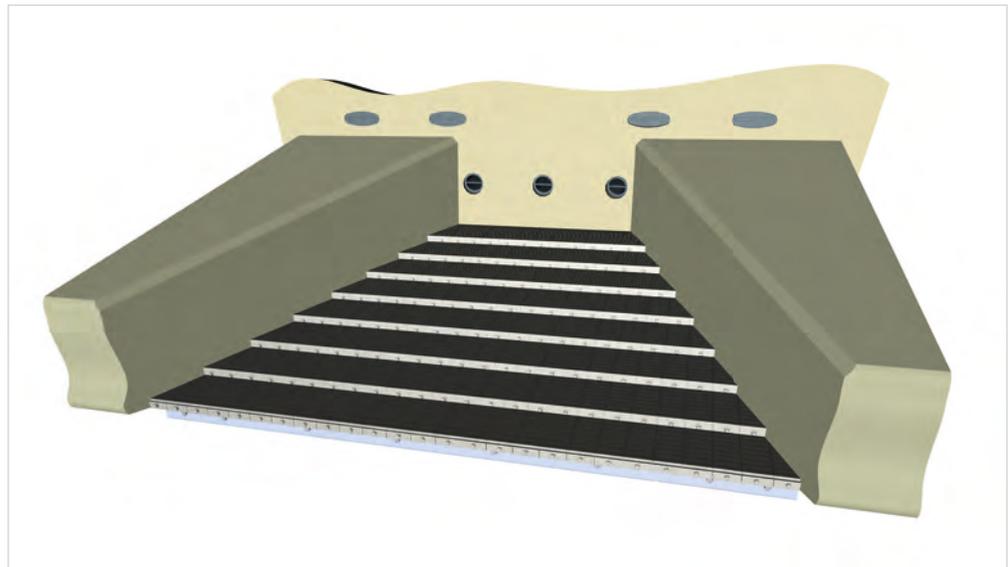
MAIN FEATURES

- **Uniform clinker distribution across the grate width**
- **Improved transport of the fines to the bed surface**
- **Lower clinker outlet temperature**
- **Stabilised kiln and cooler operation**
- **Heat savings of 20-100 kcal/kg**
- **Easy installation into existing coolers**

KIDS® PERFORMANCE

Guaranteed reduction in cooler losses leading to an improvement in kiln fuel consumption. The table shows the improvements achieved after the installation of an IKN KIDS® at a customer's 3,900 t/d 3-stage Fuller kiln:

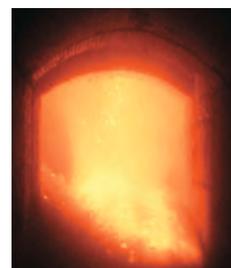
	BEFORE	AFTER	CHANGE
Spec. cooling air vol. (Nm ³ /kg)	2.23	1.91	-14.3 %
Spec. vent air vol. (Nm ³ /kg)	1.31	1.05	-19.8 %
Clinker outlet temperature (°C)	163	111	-31.9 %
Heat recuperation (%)	67.3	76.4	+13.5 %
Power requirement (kWh/t)	11.9	5.85	-50.8 %
Heat consumption (kcal/kg)	902	839	-7 %



KIDS® layout



KIDS® module



Before and after installation of KIDS®

Coanda Wing®

The revolutionary design of the Coanda Wing® ensures optimum airflow into the clinker bed. Fines are swept to the clinker bed surface and the Coanda plates are completely surrounded by cooling air. During normal operation, temperatures between 30° C and 40° C are measured close to the grate surface.

+ Direct air flow

+ Self-cleaning

+ Less pressure drop

DESIGN AND FUNCTION

IKN introduces its latest design of the grate surface, the Coanda Wing®, which is now part of all new coolers and can also be used to upgrade existing grates.

The optimised shape of the Coanda Wing® provides a better airflow and significantly reduces turbulences at the grate surface.

The newly designed slots not only enhance the entire flow of air but also provide a continuous self-cleaning effect. This new design is highly precise and robust, making it ideal for the rough atmosphere of the modern cement factory.

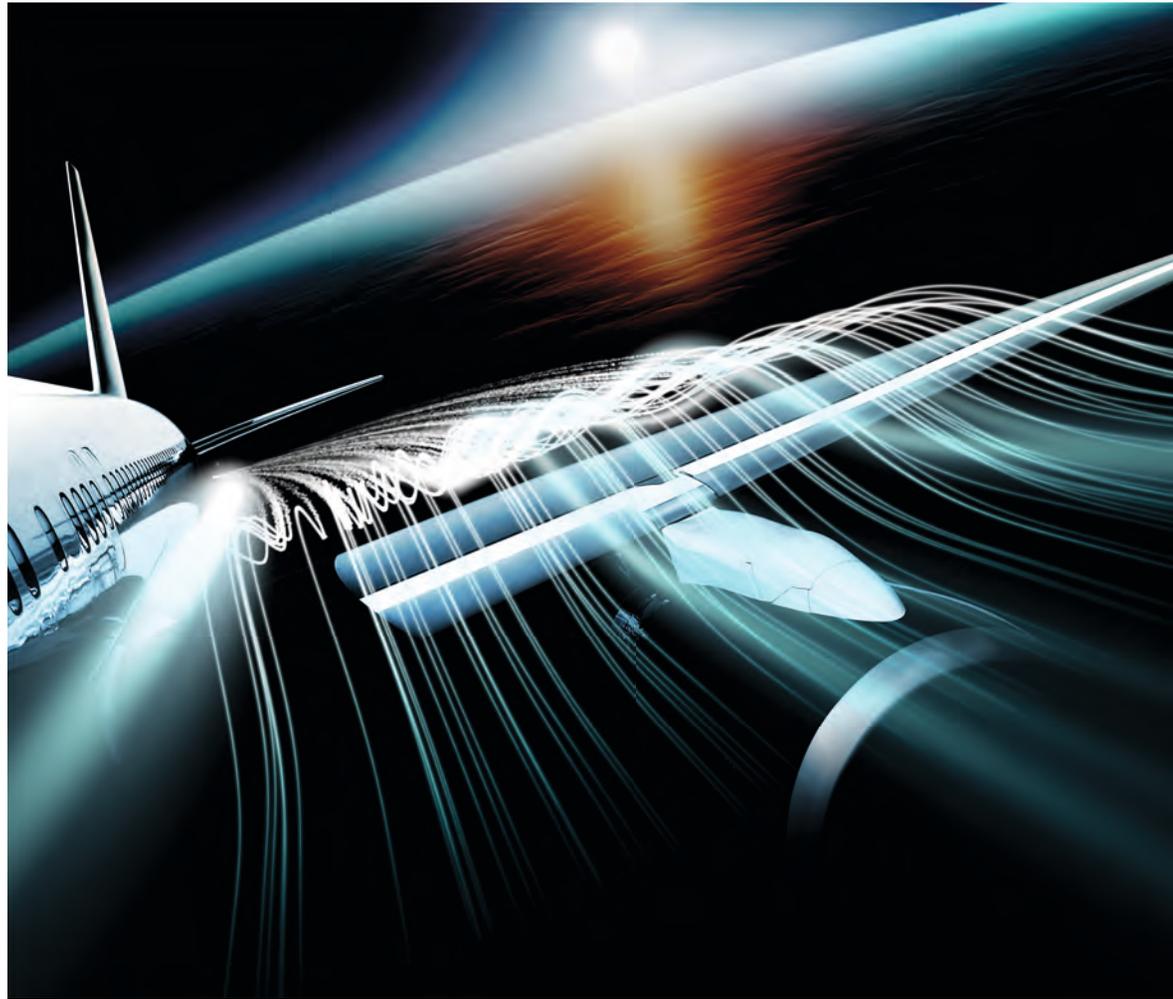
GRATE PLATE

The Coanda Wing® is embedded into a newly designed and precision manufactured box. These boxes provide optimum dimensional accuracy, allowing for seamless installation into the whole grate area.

The newly designed front plate meets the critical requirements regarding temperature resistance, low wear and easy maintenance. Grate plates with new Coanda Wing® technology are fully compatible with existing plates and can be upgraded compartment-wise within current surfaces. The best location to start upgrading is the first compartment right after the fixed inlet.

MAIN FEATURES

- Increased air speed
- Lower pressure drop
- High-precision slots
- No welding required
- Compatible to existing IKN grate plates
- Self cleaning



Shape of the new Coanda Wing®



Grate plate

Mobile frame with LPS®

The Pendulum Cooler® is the only cement clinker cooler designed without any active or lubricated components within the cooler housing. Together with the wear resistant and maintenance free spring steel straps of the LPS®, this design ensures that access to the inside of the cooler is only required for inspection during the annual shutdown.

+ Maintenance-free spring steel straps

+ Hydraulic components located outside the cooler housing

DESIGN AND FUNCTION

The IKN grate consists of fixed and mobile rows. The mobile rows are mounted on top of a mobile frame. The frame is suspended on the patented Linear Pendulum Support (LPS®). The fixed rows are mounted to the side walls of the cooler housing.

In contrast to all other grate coolers, every third row is mobile which allows for perfect alignment between fixed and mobile rows. During installation of the cooler, the LPS®, which is installed inside the cooler housing to give maximum flexibility in grate width, is aligned once to provide precise linear motion of the mobile frame. The combination of the robust mobile frame and the LPS® ensures that the individual rows remain in the exact same position during the lifetime of the cooler. The exact positioning of the rows together with the linear motion of the mobile portion of the grate minimizes the thrust gaps allowing for optimum aeration through the grate plates.

The Pendulum Cooler® is operated with slow and variable forward speed movement while the retract movement of

the grate is completed in a fixed time of approximately one second. This type of operation improves transport efficiency and balances the discharge into the clinker conveyor. By adjusting the number of strokes per minute, the bed height can be dynamically adjusted to varying operational parameters. One or two hydraulic cylinders for each grate are located in front of the cooler underneath the KIDS section. The operating position outside the cooler housing protects them from clinker dust and improves accessibility for the minimal maintenance required.

MAIN FEATURES

- **Wear and maintenance free**
- **Perfect linear movement**
- **No lubrication required**



LPS® installed in cooler housing

Roll Crusher

The IKN Roll Crusher is equipped with up to six rolls for cooler capacities of up to 13,000 t/d. Compared to a hammer crusher, there are no chain curtains, no grizzly bars and no kiln stops caused by large lumps or coating pieces.

+ Reduced wear

+ Uniform clinker size

+ Easy maintenance

DESIGN AND FUNCTION

IKN Roll Crushers operate in coolers with capacities of up to 13,000 t/d. They offer low power consumption and low mechanical wear compared to other types of crushers.

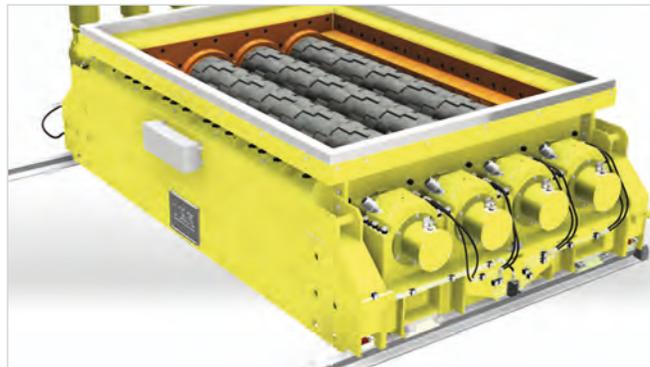
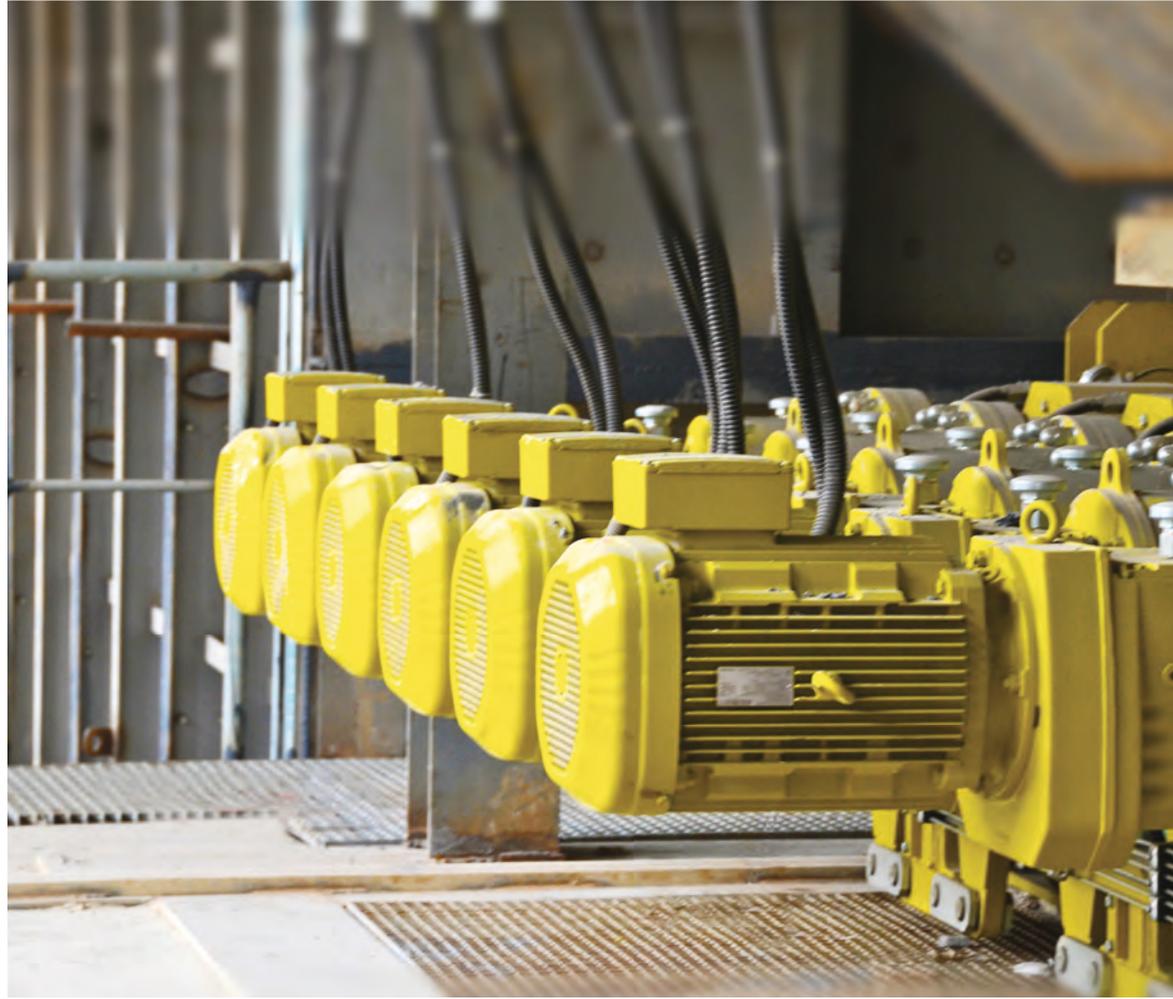
The crusher can be installed at the cooler discharge or as a mid-cooler crusher for intermediate crushing. The rolls will automatically reverse at high torque protecting the crushing rings against damage caused by foreign matter. Water cooling of the crusher shafts is an option for hot operation.

Each roll is driven by an electrical gear motor with a planetary gear unit. Typically 95% of the crushed clinker is reduced to a particle size of less than 30 mm depending on the size of the gap between the rolls.

For any maintenance work the IKN Roll Crusher can be moved to a maintenance position at which all components are easily accessible without entering the cooler.

MAIN FEATURES

- **Electrical drive with low power consumption**
- **Rail mounted for easy maintenance**
- **Reduced wear due to low roller speeds**
- **Hard-faced roll teeth for long service life**



3D layout



Installation on site

Waste Heat Recovery

Based on the experience with pyro process and cooler solutions, IKN offers Waste Heat Recovery Systems (WHRS) for industrial applications.

+ Compact design + High efficiency even at partial load + Easy integration

WASTE HEAT RECOVERY

Energy is too valuable to be wasted. Therefore, IKN offers tailor-made Waste Heat Recovery Systems for the cement industry.

Due to their special design characteristics and high efficiency, IKN Pendulum Coolers® are perfectly suited for a wide range of waste heat recovery applications. Ventilation concepts can be adapted to the special requirements within the plant and optimised for maximum output or customised for auxiliary applications.

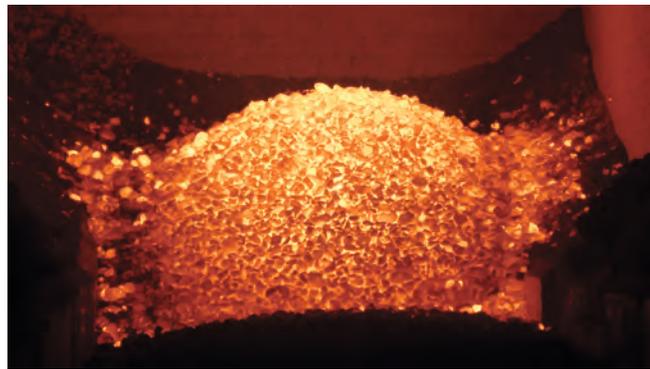
POWER GENERATION

Flexible - compact - efficient. These are the main features of power generation plants based on ORC and similar approaches, such as supercritical CO₂ and others. Power generation in a cement plant can be implemented at different positions. Typical hot air tapping points are at the preheater and/or the clinker cooler.

Profound knowledge of the entire pyro process, from preheater to cooler, allows IKN to identify and to engineer suitable solutions for entire kiln lines.

MAIN FEATURES

- Independent energy generation
- Improved environmental footprint
- Low maintenance
- High efficiency even at partial load



Recovering energy from the cooling process



Industrial plants offer manifold options for WHRS

IKN SOLUTIONS & SERVICES

**What can we
do for you?**





SOLUTIONS & SERVICES

IKN offers customised solutions to increase capacity and efficiency while decreasing operating costs. The IKN support includes mechanical and electrical maintenance and repair, training, phone assistance and individual service packages.

SOLUTIONS

IKN solutions comprise three main areas: Upgrades and modernisations, satellite conversions and turnkey installations.

IKN improves existing kiln lines, while retaining as much of the original equipment as possible. Performance upgrades are accomplished by replacing existing grate coolers with a Pendulum Cooler® within the existing cooler housing. These upgrades are facilitated by the small dimensions of the LPS®.

One of IKN's specialties is the replacement of satellite coolers to increase heat recuperation and plant availability at lower clinker temperatures. The demolition of the existing satellite cooler and the installation of a preassembled Pendulum Cooler® are accomplished during a routine annual outage.

Large-scale projects are realised by the expertise of the IKN project management and service teams. Our knowledge and experience ensure effective management of sub-contractors to achieve precise project execution, both on time and within budget.

SERVICES

IKN will carry out equipment assessments to assist in developing customised solutions for proposed modifications. Furthermore, regular inspections of installed IKN equipment contribute to improved reliability.

Our experienced team of project managers controls the project execution from the kick-off phase through installation and to the final handover to the customer. Firm control of the schedule and a focus on avoiding problems before they occur lead to the successful completion of a project.

IKN employs specialists for mechanical installation as well as cold and hot commissioning. Our supervisors monitor the quality of delivered equipment and coordinate the erection works.

Customised training sessions qualify your operators in the correct use and maintenance of our equipment. The aim is to promote a better understanding of our technology and its application. After installation and commissioning, our after sales service continues to stay in close contact with the operators.

IKN COMPANY

Experts in clinker cooling.





COMPANY

IKN GmbH is a globally operating, medium-sized company located in Neustadt near Hanover, Germany. The company specialises in the supply of plant components for the production and cooling of cement clinker.

FACTS AND FIGURES

At the beginning, IKN revolutionised the cement industry with the development of the clinker inlet distribution system, the KIDS®. Whereas it was introduced as an upgrade to existing clinker coolers, today it forms an integral part of the IKN Pendulum Cooler®.

Further innovations, such as the highly precise and wear-less mobile frame support – the LPS® – manifested the company's success.

In 2002, IKN extended its activities further by acquiring PSP in the Czech Republic. With the integration of the PSP Pyro engineers, the company has widened its competence towards the entire kiln burning line under the name of IKN.

IKN WORLDWIDE

With more than 550 installations worldwide since 1982, IKN has become the market leader in the field of clinker cooling technology. References include smaller coolers with a capacity of 650 t/d as well as the three largest clinker coolers ever built – each sized for a capacity of 13,000 t/d. A significant set of references for burning lines has been established in Europe and the Middle East.

Customers rely on local offices for service and sales in China, Singapore, USA, India and Brazil, whereas engineering remains concentrated at IKN's head office in Neustadt.

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