Andre Vos and Ingmar Holst, Claudius Peters, introduce a new development in clinker cooler technology that utilises standard parts to optimise production processes and minimise CO_2 emissions.

Designed for smart modification!

Reducing CO_2 emissions during cement production plays an increasingly large role in the economy of a cement plant and therefore influences key decisions concerning capital investments into existing facilities.

In keeping with the Paris Agreement, the European Union is supporting the industry with public funding to achieve the 1.5°C target within reach while monitoring the success of its support.

Based on the technical advantages of the ETA cooler it was successfully placed in a number of optimisation and CO_2 reduction projects in existing cement plants supported by EU funding. One of these is the replacement of a grate cooler in Českomoravský cement's Mokrá plant near Brno, which has been in operation since 1969. The age of the cooler became a burden on the plant's bottom line due to its maintenance cost, inefficiency, and availability. The grate cooler is operated at clinker bed heights of approximately 600 mm which offers a limited benefit, referring to lower thermal efficiency at a higher cooling air demand. Both having a negative impact on the CO_2 emissions of the pyro line.

To ensure the economic efficiency of the pyro line and to improve the sustainability of the facility, the decision was made to replace the existing cooler with a modern 5th generation clinker cooler, and a contract for a new Claudius Peters ETA Cooler was signed in July 2020.

Smart design

Maximise standard parts and proven solutions for a customised project

The design of the ETA Cooler is not only well suited for new kiln lines but also for the replacement of existing clinker coolers.

The smart design of the cooler enables the utilisation of standardised parts for a brownfield modification while offering a solution tailored to the individual customer's requirements.

The standardised parts ensure the quality, efficiency, and the robustness of the core machine.

The cast Mulden plates on the static inlet with protected air inlet are designed for low-pressure loss while preventing clogging during operation or due to maintenance work. The transport system is made in Germany and ensures the availability due to the robust design. This does not only apply to the support roller design but also to the moving floor (aerated lanes) which are equipped with a self-protecting layer of pebbles giving the heat, wear, and foreign material in the clinker no point of attack. The moving floor principle enables clinker bed heights of > 1 m during operation to maximise the retention time of the clinker and thermal efficiency, whilst requiring lower amounts of cooling air. Furthermore, it is important to underline the optimal width of the lanes to utilise the maximum width of the existing housing realising the maximum possible aeration area.

The design of the longitudinal sealings is standardised over the width of the cooler. It ensures the robustness against red river and clinker spillage and is protected in the side walls by the refractory.

The tailored design is focused on adapting the project-specific interfaces of the core machine's existing surroundings. This is usually reflected in the design of the support structure, fan ducting, hydraulic piping, and in the case of the Mokrá plant, also the chloride bypass gas duct to the new clinker cooler.

The challenges referring to the design are similar for the replacement of a grate cooler or other clinker cooler types by an ETA cooler. Claudius Peters can draw from a pool of proven solutions for these customised projects, thanks to more than 90 ETA cooler modification projects. This gives the company the advantage of a matured learning curve since every new project adds to optimising the proven solutions and modification concepts.

For the specific project and the required turnaround time, the ETA lane units have been installed on a pre-erection support structure outside the existing cooler casing and were pulled inside to the intended position on hard-faced rollers.

Figure 1. Českomoravský cement's Mokrá plant.

Figure 2. Walking floor made in Germany.

Smart erection

Maximise preassembly, shorten the down time

Each step of the clinker cooler replacement needs to be considered by the erection experts referring to the complexity of the overall modification job in close cooperation with the customer. This is essential so that everything works hand in hand!

A short kiln stop is a key focus point for many clients in these type of brownfield projects, to ensure the clinker production capacity is maximised over the year.

Accordingly, Claudius Peters has decided to follow the following processes:

Preassembly phase

Maximise pre-erection

Since the Mokrá plant's last kiln pier is executed as a portal a pre-erection frame was utilised to slide in the ETA lane units. The lane units were pre-erected to the highest degree, so the modules of the core machine are as large as possible. The lanes and sealings were aligned and so only the sealing on the sides needed to be installed after the modules had been brought to their final position to create the connection to the existing steel structure.

The hydraulic cylinders were placed in the lane units with the internal piping ready so that the hydraulic piping to the aggregate can be directly connected to the outside wall of the lane unit.

Place items outside the bottleneck zone

For the location of the new hydraulic room a free space was chosen, close to the clinker cooler. It was therefore possible to completely pre-erect this scope prior to the kiln stop to ensure the turnaround times.

Furthermore, temporary braces were installed to connect the existing upper part with the building structure so that the demolition can be executed safely, and no existing structures are exposed to static risks.

Referring to the clinker cooler replacement everything was then prepared and ready to turn the 'flame off' to start with the demolition work.

After the flame was turned off, all resources that had been deployed for a quick turnaround were activated for an efficient demolition and erecting phase with two 10 hour shifts.

Demolition phase

Work was executed in parallel both inside the cooler casing and outside

During the demolition phase the existing cooler internals had to be removed to give the new machine the space required. Taking the internals out of an existing cooler influences the static stability of the existing structure. This cannot be neglected since it influences the time required for the demolition.

During the final steps of the demolition work the hoppers had been removed and the bare concrete structure was thereby prepared for the installation of the new clinker cooler.

Outside the cooler housing the fans, fan ducting and mechanical grate drive had all been removed to enable the space required for the new installations.

Erection phase

The erection work was also executed in parallel both inside the cooler casing and outside

Inside the existing cooler housing a new base frame was installed. This is required so that the new ETA lane units can be positioned ideally in height and the forces of the future operation are directed into the foundations at the required locations. Furthermore, the base frame was utilised as a track to position the modules that had been erected prior to the kiln shut down.

The customer had decided to maintain the existing hammer crusher. The new interface between the lane units and the hammer crusher was installed in parallel to the new HE-Module which was placed in its final position as a static inlet.

Simultaneously, outside the cooler housing the fan foundations were installed and so were the new cooling air fans, including their silencers.

In the final steps, the interfaces to the existing structures had to be addressed. Many of these jobs could be executed in parallel. The outer sealings connecting the moving floor to the cooler casing on both the right and left side had to be ensured.

Furthermore, the hydraulic piping connecting the aggregate with the hydraulic piping on the side of the lane unit was connected to ensure a closed loop to the hydraulic cylinder.

To enable the cooling air flow to the aerated lanes of the moving floor the fan ducting was installed in order to connect the fans with the aeration chambers of the lane units.

Finally, the refractory was installed and dried according to specifications before the plant could be given the go-ahead for hot commissioning.

Once all installations had been finalised the kiln was brought back to operation. With the expertise of the Claudius Peters commissioning engineer and the CCR staff the new ETA cooler was able to prove its economic benefits in operation.

Smart operation

Potential due to operational settings for a variety of clinker characteristics

The ideal clinker cooler setup for the requirements of an individual cement plant can

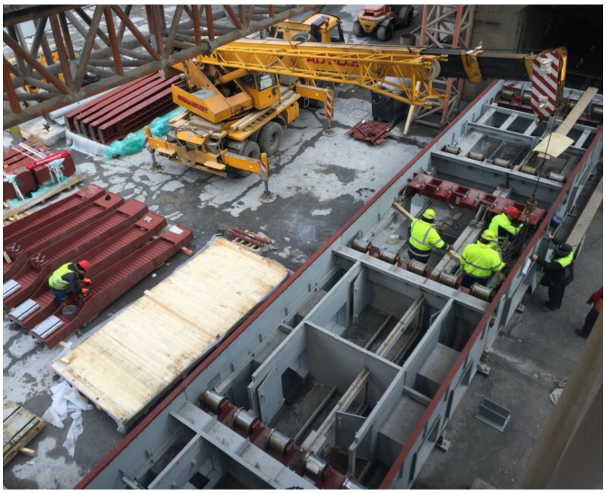

Figure 3. Preassembly of the ETA cooler modules.

Figure 4. Pulling new modules into their final position.

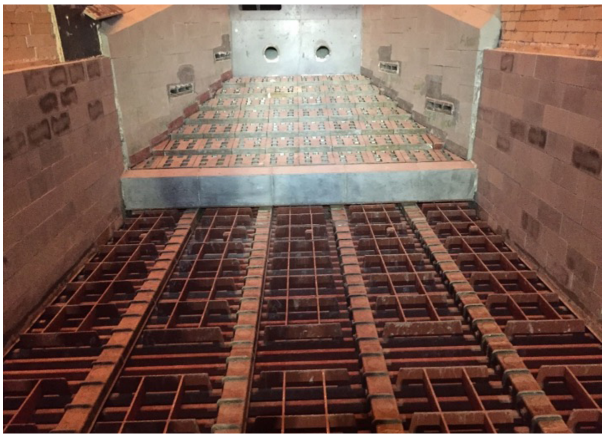

Figure 5. HE-Module static inlet.

be easily established through the various setup possibilities of the ETA cooler.

The cooling air distribution also in bypass mode is regulated by the HE-module aeration flaps. The basic principle is to throttle the air flow on the sides and to force the main air flow through the clinker drop zone. The amounts and distribution of cooling air are key when it comes to thermal efficiency, prevention of snowman formation, and its segregation of clinker fines.

A further unique feature of the ETA cooler is the Controlled Side Aeration (CSA) and independent lane movement for the moving floor.

The controlled side aeration combined with the independent lane movement make it possible to control the aeration as well as the retention time of the clinker on both sides of the cooler. Typical problems such as red river are prevented by reducing the cooling air pressure while the clinker cooling efficiency over the cooler length is maintained by reducing the specific lane velocity.

The ETA cooler design has no dead zones between the static inlet and the moving grate. This allows for an automatic cooler control that is utilised during start up as well normal operation and can also automatically prevent overflow conditions i.e. during kiln upset. The cooling air fans are equipped with frequency controls and are an integral part of this control. Furthermore, the VFDs offer an advantage referring to the electrical efficiency.

All required parameters are available to the process experts of the plant, allowing them to optimise the ETA cooler to their individual process requirements, and therefore the ability to change the operational settings of the cooler has been proven, once again, to ensure process optimisation.

Smart results

Highest operation performance

During the performance test, the ETA cooler was able to prove the KPI was relevant for the client. The clinker discharge temperature was documented at 48˚C above ambient and the clinker cooler's efficiency proved to be 77.8% was above the guaranteed values.

Českomoravský cement's Mokrá Plant chose the ETA Cooler because of its high availability and efficiency.

Summary

The lane unit system, with a high degree of pre-erection, made a smart modification possible, combining excellent operational values with a short kiln stoppage to achieve a sustainable pyro line. ■