

Preheater-kiln lime calcining systems







Three Metso 18-plunger polygon preheater-kiln systems in Taiyuan, China

Proven experience

Metso has supplied more than 210 lime calcining systems, over 115 of them as preheater/rotary kiln systems. The worldwide total annual production capacity from Metso-supplied systems exceeds 30 million metric tons per year.

The Metso experience encompasses complete plant design including limestone crushing and screening, calcining (of both high calcium and dolomitic limestones), kiln firing, emissions, product handling and storage, and lime hydration.

Metso's worldwide experience and expertise allows for local sourcing of major system components, near the installation site, to minimize total project costs. In addition, with a local presence in more than 50 countries, Metso remains close to its customers throughout the service life of the calcining equipment and systems it provides.

Product quality

Using its proprietary Limestone Evaluation (LSE) procedures, Metso begins its lime plant design with laboratory testing of the proposed limestone feed to determine its physical and chemical properties. This evaluation of the feed material includes such things as chemical analysis, laboratory calcination and reactivity testing, as well as certain proprietary tests to determine the material's susceptibility to degradation. The evaluation results are used to perform the necessary process calculations, to select the proper type and size of calcining equipment, and to design the overall system required.

By thoroughly examining the proposed feed material, Metso is also able to forecast the quality of lime product that can be achieved, as well as estimate the rate at which utilities such as fuel and electric power will be consumed.

Efficiency and flexibility in operations

The KVS preheater/rotary kiln calcining system is selected when a uniform, high quality lime product is required. Metso can also supply long rotary lime calcining systems, but it is the KVS preheater/rotary kiln system approach to lime calcining that is the technology of choice for the more demanding applications.

The preheater-kiln system can be designed to process limestone feed as large as 75mm or as small as 6mm, with a nominal 4:1 ratio of largest to smallest. This tends to maximize quarried stone utilization, and in turn, minimize kiln feed preparation costs. This type of calcining system is fired with a single burner that can be designed to accommodate a wide variety of fuels, including coal, pet coke, natural gas, light and heavy oils, blast furnace gas and coke oven gas. Certain waste fuels can also be used. The firing systems can be designed to fire a single fuel, or combinations of two or three different types of fuels.



Metso lime kiln system features

Preheaters

The KVS preheater system includes an integral “live” stone storage bin. Stone flows by gravity from the bin to the preheater modules through vertical chutes, (which also provide an air seal between the process and ambient). Kiln exhaust gases enter the preheater at 1010–1095 °C.

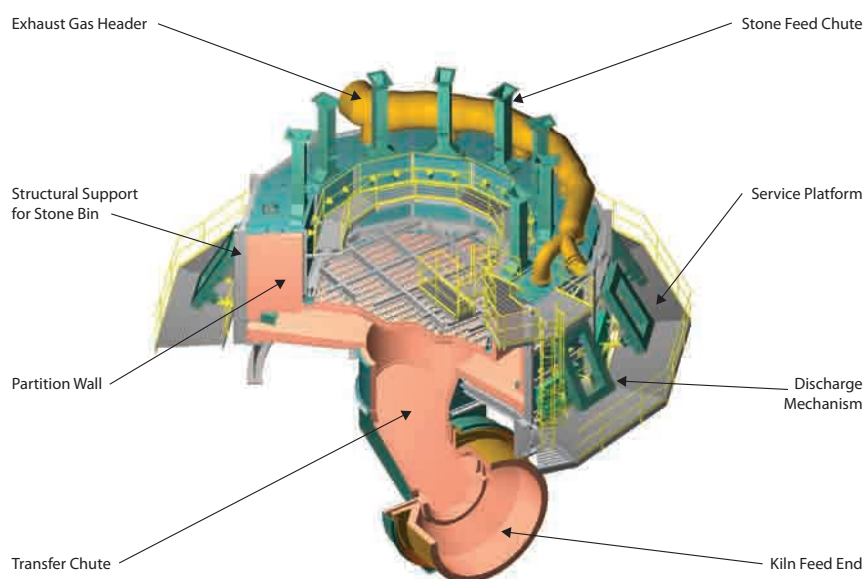
As these hot process gases pass through the preheater, heat is transferred to the bed of material within. This causes the release of 25–35% of the CO₂ from the limestone within the preheater. The partially calcined material is discharged from the preheater by controlled, sequential stroking of hydraulic plungers at its perimeter. The material then passes through the transfer chute and enters into the rotary kiln. Exhaust gases leaving the preheater have an average temperature of 230–260 °C and are typically filtered in a baghouse type dust collector, before being discharged to the atmosphere through a separate, free-standing exhaust stack.

The first KVS preheater-kiln lime calcining system was built over seventy (70) years ago, and over the many years since, Metso has made substantial improvements to its preheater design. The present-day configuration includes a partition wall between adjacent modules. With these partitions between the modules, by closing a damper provided at the outlet of a given module and “pinning” the stone feed chute of the same module, the module can then be stroked free of material to accommodate on-line maintenance without interrupting normal operation of the kiln system.

For system capacities between 300 and 700 TPD, a rectangular preheater design is supplied, and for capacities from 600 TPD to 1200 TPD and greater, the polygon style (shown below) is supplied. The number of modules in a rectangular preheater ranges from 6–10, and currently ranges from 12–22 in a polygon. The dimensional details of the preheater components are essentially the same for both designs.

In addition to being supplied as an integral part of a new lime calcining system, both the Metso preheater and the cooler (opposite page) are offered as upgrades to existing systems to improve operating efficiency and/or increase production capacity. Both pieces of equipment are extremely efficient heat exchangers and when added to an existing system can significantly improve the fuel efficiency of the system.

Polygon preheater configuration





The riding ring of a rotary kiln being re-surfaced in the field



Coolers

Metso's lime calcining technology includes the KVS/Niems high efficiency contact cooler. With heat recovery efficiencies in excess of 90%, this direct contact, counter-flow heat exchanger provides both extensive cooling of the lime product, and significant preheating of secondary combustion air for the kiln firing system. The kiln burner, the primary heat source for the process, is mounted in the firing hood, which is installed directly above the cooler. The firing hood and cooler are designed to be complementary assemblies to one another.

Ambient air is blown into the four quadrants of the cooler's lower chamber through a common cooling air duct. The cooling air enters the bed of hot granular lime product, uniformly, through a collection of fixed stainless steel louvers. The level of material in the cooler is controlled by how often the four vibratory feeders beneath the cooler are cycled between maximum and minimum speeds. Thermocouples mounted in each of the four cooler discharge spouts monitor product temperatures, and material flow through each spout is automatically adjusted to provide uniform cooling of the lime product, and at the same time, maximize heat recovery.

In addition to providing uniform product cooling and excellent heat recovery to the process, because it has virtually no moving parts—with the exception of the discharge feeders, the KVS/Niems cooler has the lowest of maintenance requirements, and offers optimum reliability.

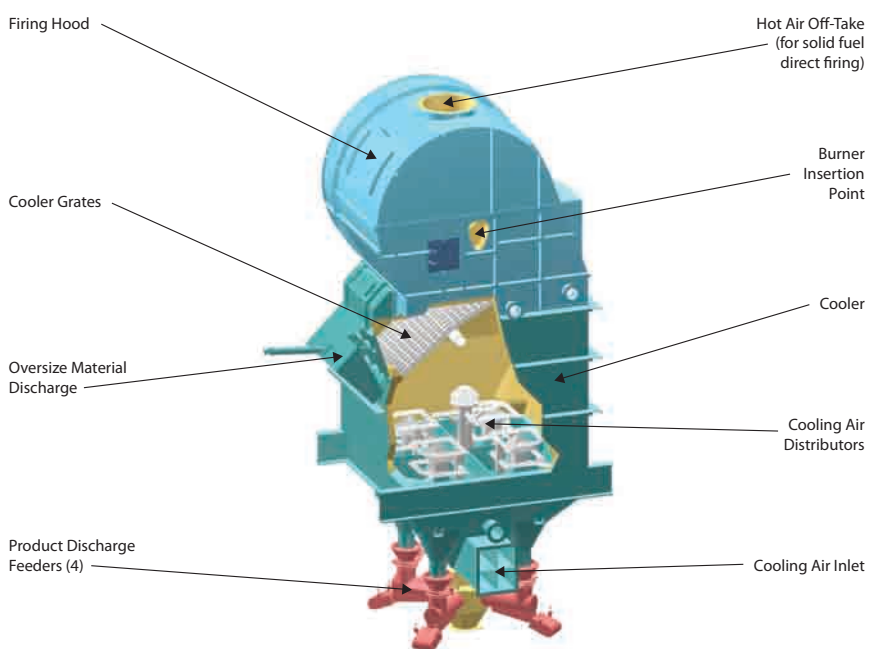
Specialized services

Field service engineers

In addition to designing and supplying original lime calcining equipment and systems, Metso offers specialized services to maintain or improve the performance of installed systems, with regard to both mechanical operation and the process within.

Our safety certified field service engineers are specialists with years of experience working on both existing and new lime kiln systems. These field service engineers work closely with Metso equipment design and process engineers to provide mechanical, electrical, instrumentation and control trouble-shooting expertise and advisory assistance for maintenance, repair or upgrade programs.

KVS/Niems cooler and firing hood

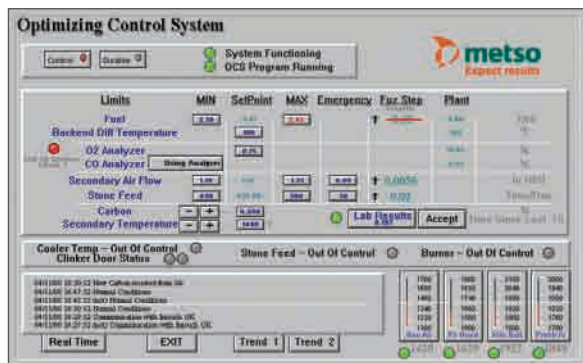


PLC-based control

Metso designs and supplies its own PLC-based, computer-applied process control system. At the heart of the system is a Programmable Logic Controller (or PLC), which carries out the monitoring and interlocking functions of the control system. Using control programming installed by Metso engineers, the PLC constantly compares actual operating data to pre-established setpoints for “normal” operation, and makes corrective changes to the process as needed to achieve the desired operating conditions.

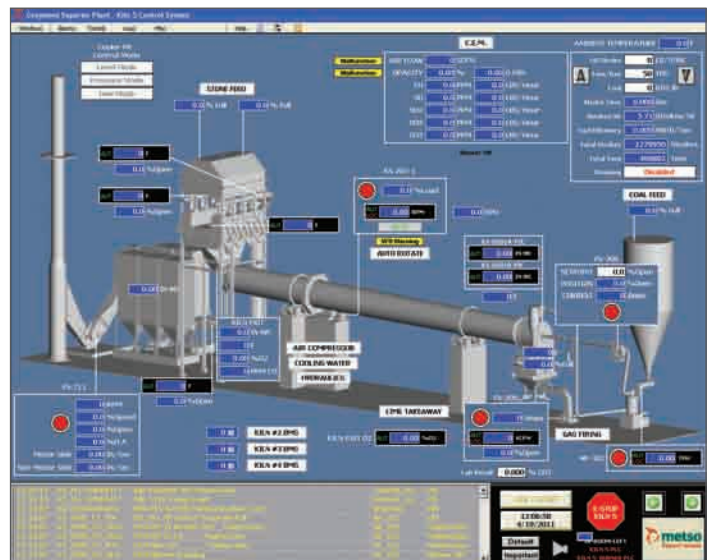
Access to the process control variables is obtained through industrial desk-top computers, using Man-Machine Interface (MMI) software also supplied by Metso. To simplify control of the calcining system, Metso offers user-friendly, 3-dimensional computer screen graphics to provide the kiln operator with a clear visual reference of the overall calcining system and the process within.

Advanced process control

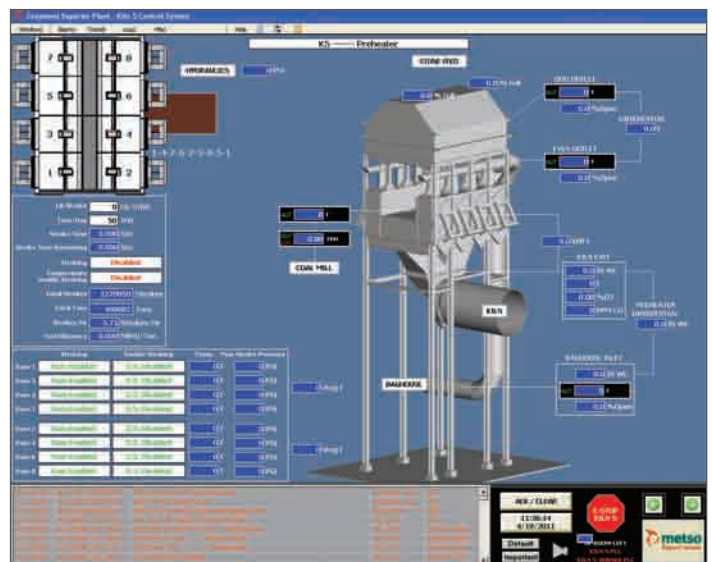


Metso has developed an advanced or “upper level” process control system called OCS, (an acronym for Optimization Control System). OCS is referred to as an upper level control system because it is basically installed over top of the more fundamental PLC-based controls. OCS process control is based on a proprietary set of operating “rules”, which, when applied to the various process variables, continuously evaluate and update control setpoints to optimize system performance. The addition of OCS to operating lime kiln systems can improve product quality, increase production capacity, and improve fuel and electric power consumption rates.

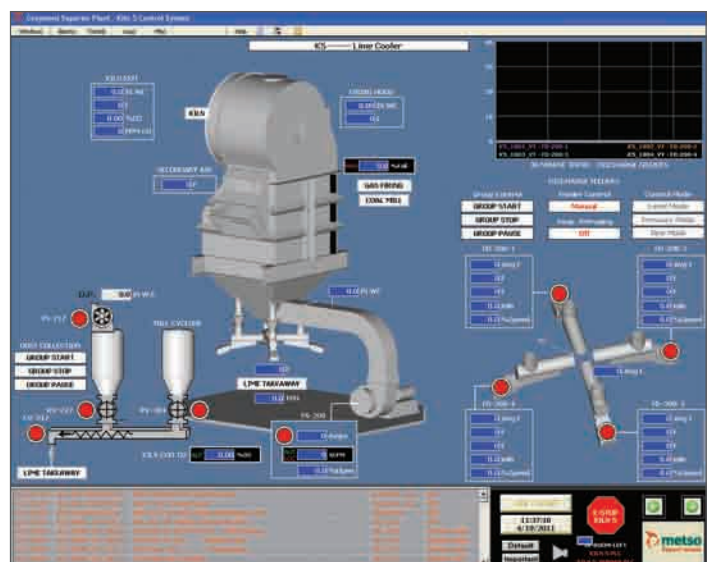
Typical screen graphics for a preheater-kiln lime calcining system



Overview screen



“Zoom” screen preheater



“Zoom” screen cooler





Expect results

Expect results is our promise to our customers and the essence of our strategy. It is the attitude we share globally. Our business is to deliver results to our customers to help them reach their goals.

