

Preheater calciner systems



Successful on every level

Key benefits

- **Effective emission control**
- **Easy operation**
- **Highly reliable**
- **Optimised fuel and power consumption**
- **Excellent suitability for low-grade fuels**
- **Flexible design for easy upgrades**

An optimal process

Today's modern plant preheats raw meal to calcination temperature in a multi-stage cyclone preheater. Most of the calcination process takes place in a separately fired, stationary calciner, while the remaining calcination and clinkerization process takes place in a rotary kiln.

FLSmidth has precisely what cement producers need to make it an optimal process. With its low emissions, flexibility and ease of operation, the FLSmidth In-Line Calciner (ILC) preheater has been a success since its debut in 1976. And thanks to our continual development of the system ever since, the ILC is still at the forefront of technology. Flexible enough to meet future demands as well, the ILC can help plants stay in the lead for many years to come.

How the ILC preheater works

Raw meal is introduced at the inlet gas duct to the Stage I (top) cyclones. It is subsequently preheated by hot, countercurrent gas flow as it is continuously collected and passed down the other cyclone stages in the preheater to the calciner. Fuel is burned in the calciner to achieve 92-95% of the total material calcination before collection in the bottom cyclone and entrance into the kiln. Combustion air for the calciner is taken from the kiln via the riser duct and through a separate tertiary air duct from the cooler.

Proven NO_x reduction from high temperature "stage-less" combustion is incorporated into the standard design of the ILC preheater. It's a very uncomplicated and effective way to create low NO_x emissions with only one firing location, one meal split and one tertiary air stream entering tangentially to the calciner.

Our design is based on dividing the meal from the second-lowest stage cyclone to the kiln riser and the calciner. These feed points are separated by an expanded riser duct that forms a NO_x reducing zone. That is, the calcining chamber is built (at least partially) into the kiln riser. All of the calciner fuel is introduced to the kiln riser duct with less oxygen than required for complete combustion, thereby forming a reducing atmosphere.

Above the reduction zone is the main calciner vessel, which is divided into two or more sections separated by a notch. The changes in cross-sectional areas create turbulence that ensures effective mixing of fuel, raw meal and gas, improving heat transfer and combustion. The calciner outlet loop duct ensures optimum gas retention time, further mixing and complete fuel combustion.

Optionally, the second- or third-lowest stage cyclone material can be further split to allow for diversion of a portion of the meal directly into the upper

section of the calciner. This creates a “hot zone” in the lower section of the calciner that is conducive to burning difficult fuels and further NO_x reduction.

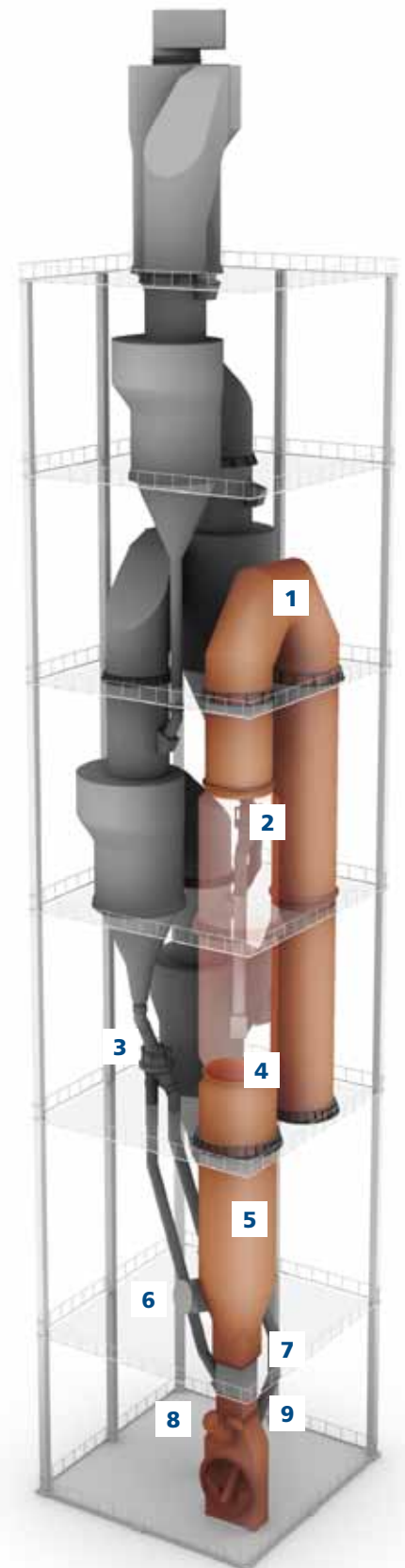
Design characteristics

- Full capacity range of today's plants of 13,000 tpd or more
- Built with single or multiple preheater strings with up to 6 cyclone stages
- Ratio of firing in calciner: 55-65%
- Calcination at kiln inlet: 92-95%
- Allowable bypass of kiln gas: 0-60%
- For bypass of kiln gas up to 100%, special ILC version applies
- Optional “hot zone” in lower section of calciner
- Available with or without the HOTDISC™ combustion device reactor for burning coarse alternative fuels

Operating characteristics

- High-efficiency cyclones with low pressure drop resulting in low fuel and power consumption
- Lowest NO_x emission from unique high-temperature reduction zone
- Simultaneous low CO emission specially due to calciner notch and outlet loop duct
- Uncomplicated operation with single entry locations of calciner fuel and tertiary air
- Suitable for firing both traditional and alternative fuels

- 1 Calciner outlet loop duct
- 2 Meal dividing gate for “hot zone”
- 3 Meal dividing gate for NO_x reducing zone
- 4 Calciner vessel notch
- 5 Optional “hot zone”
- 6 Tertiary air inlet
- 7 NO_x reducing zone
- 8 Optional kiln gas bypass
- 9 Calciner firing point



5 stage In-Line Calciner (ILC) preheater

Creating a system that meets unique needs

Burn coarse alternative fuels

Increasingly, plants are burning solid waste fuels to achieve a variety of benefits. By integrating the ILC with our HOTDISC combustion device, it is possible to achieve unsurpassed fuel flexibility with minimal impact on process stability and performance.

The HOTDISC is a safe, simple and effective combustion device that has proven to be the best available technology for substituting calciner fuel with coarse alternative fuels. With the HOTDISC, plants can burn all kinds of solid waste in sizes up to 1.2 metres. This eliminates the need for expensive shredding of lumpy waste material.

An optimal solution

Preheater and calciner design has a strong influence on operational efficiency, emissions and ability to effectively burn different types of fuels. Every FLSmidth preheater calciner system is optimised for the individual situation in which it is to be used. FLSmidth's decades of experience in this area enables us to deliver solutions that are ideal for each plant's specific challenges.

These are some of the key factors that go into designing an optimal solution:

1. Number of stages/cyclones

FLSmidth's preheater calciner systems are equipped with up to six stages of cyclones. The number of stages is normally determined by the drying requirements in the different grinding systems. Emission requirements or other use of the preheater exit gas can also affect the number of stages, as can practical matters such as local building codes/height restrictions.

2. Number of strings

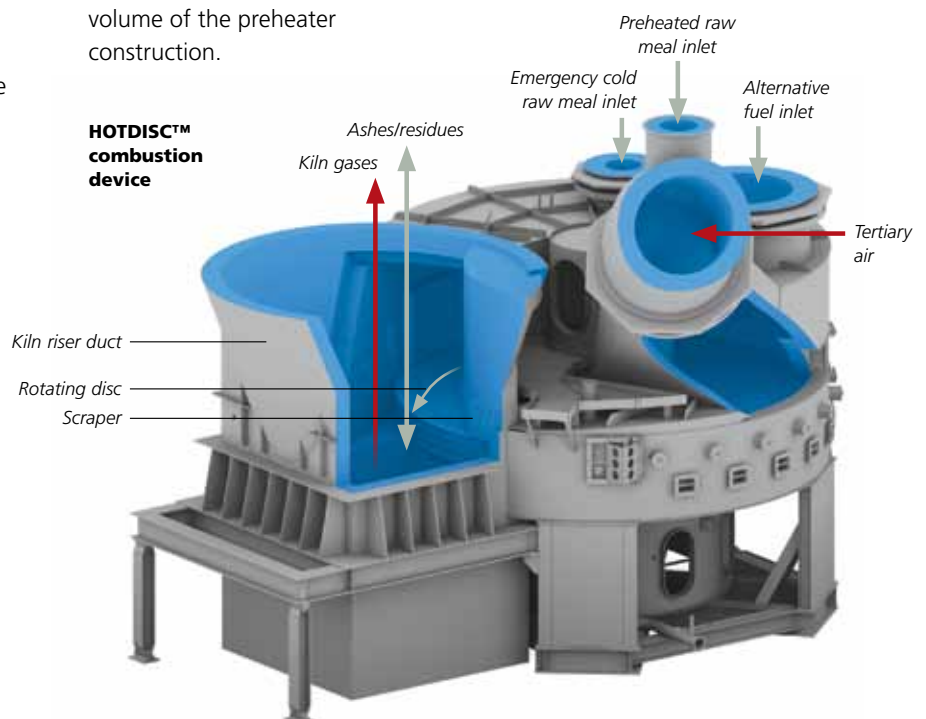
The number of strings of cyclones is generally related to the plant's capacity requirements – the more capacity needed, the more strings typically needed. Most commonly, the system encompasses one or two strings, but more may be considered for the largest of plants. A transition from one to two strings relates to the size of the cyclones and the resulting volume of the preheater construction.

3. Size of cyclones

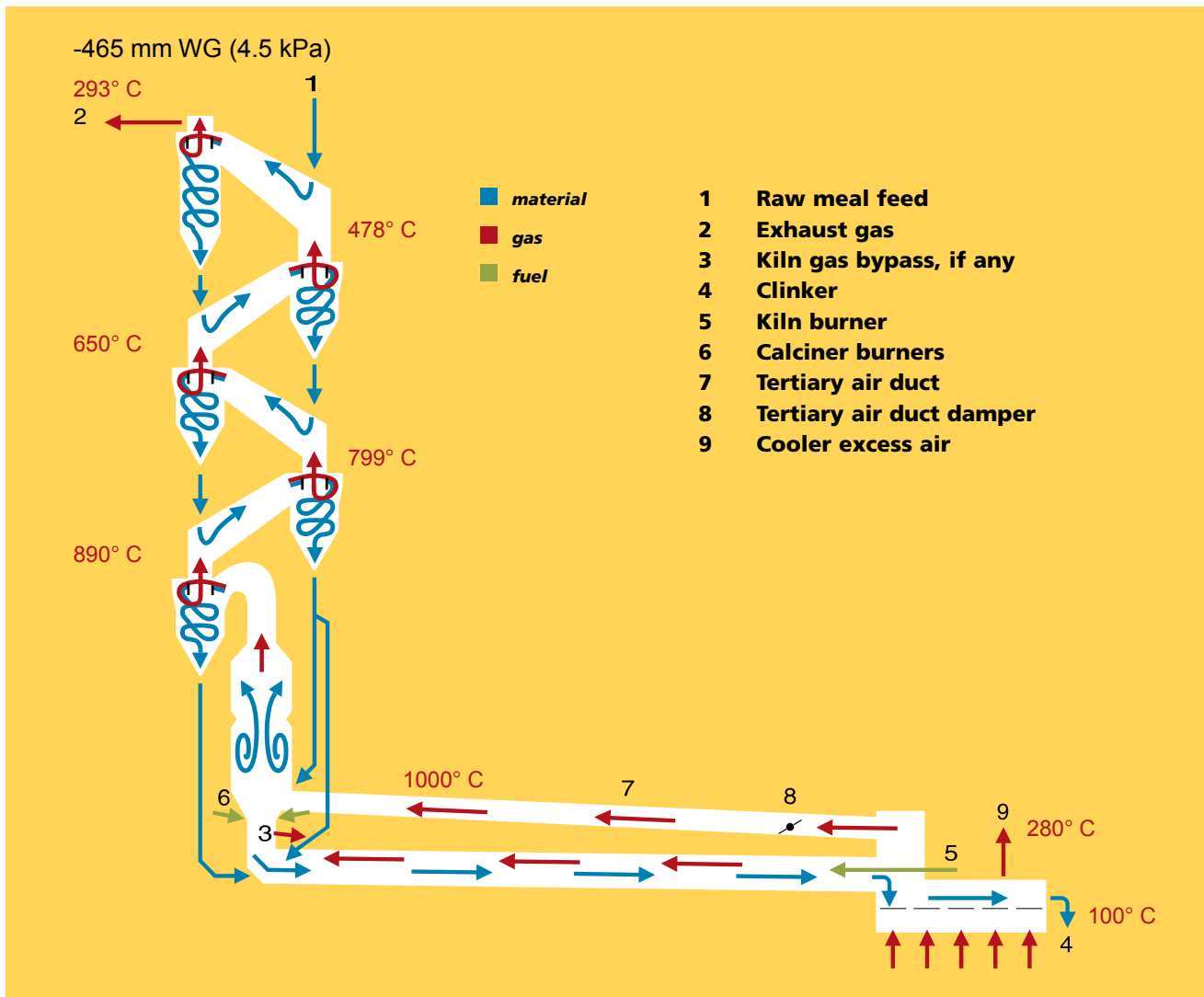
The selection of cyclone sizes is a balance of having the smallest cyclone dimensions while maintaining the lowest overall pressure drop through the preheater. This is to minimise the induced draft (ID) fan power consumption – the most power-consuming part of a kiln system.

The size of cyclones relates to the maintaining of desired gas velocity criteria and efficiency.

Increasing the preheater cyclone dimensions reduces the pressure drop. But for any given cyclone geometry, stable preheater operation (without raw meal falling through the riser ducts) requires a certain minimum gas velocity.



Typical process flowsheet of an ILC kiln system



Preheater components

Cyclones

FLSmidth preheaters have been based on proven low pressure loss (LP) cyclones. The unique design of the LP cyclone ensures high thermal efficiency and low pressure drop while enabling a flexible and space-saving layout. LP cyclones have no horizontal surfaces on the inside for material to accumulate, thereby securing stable operation. The top stage has a special geometry to provide the lowest dust loss while maintaining low pressure drop. LP cyclones are not just for completely new preheaters but may be individually fitted to upgrade existing preheaters.



Typical LP cyclone

Central pipes

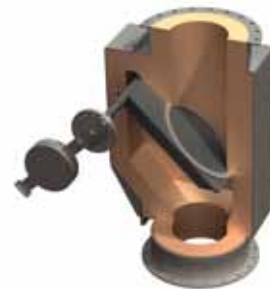
Central pipes (thimbles) are standard in all cyclone stages to provide high separation efficiency. The lowermost cyclones feature a cast, segmented design with a hanging suspension system and common elements throughout. This enables easy installation and maintenance.



Cast segmented central pipe

Sluice flaps and distribution boxes

To prevent gas from bypassing up through the material pipes between the cyclone stages, the pipes are equipped with sluice flaps (tipping valves) designed for full opening. Good meal distribution in the cyclone riser ducts is ensured by adjustable spreader plates in the distribution boxes.



Material pipe sluice flaps

Dividing gates

Robust dividing gates are used to precisely and consistently distribute meal to the different sections of the riser duct and calciner. One gate is capable of dividing meal into two, three, or four different streams.



Meal dividing gate

Tertiary air duct damper

To balance the combustion air flow between the kiln and calciner, a tertiary air duct damper is provided for reliable regulation of the tertiary air gases. The damper design features a solid refractory blade for long, reliable life.



Tertiary air duct damper

Upgrades and special solutions

ILC upgrades

It is possible to upgrade virtually any existing kiln system into the modern ILC – regardless of whether it comes from FLSmidth or another supplier. This includes not only conventional suspension preheaters (SP) and other calciner systems, but also complete transformations of long dry and wet kiln systems.

SLC-D preheater calciner system

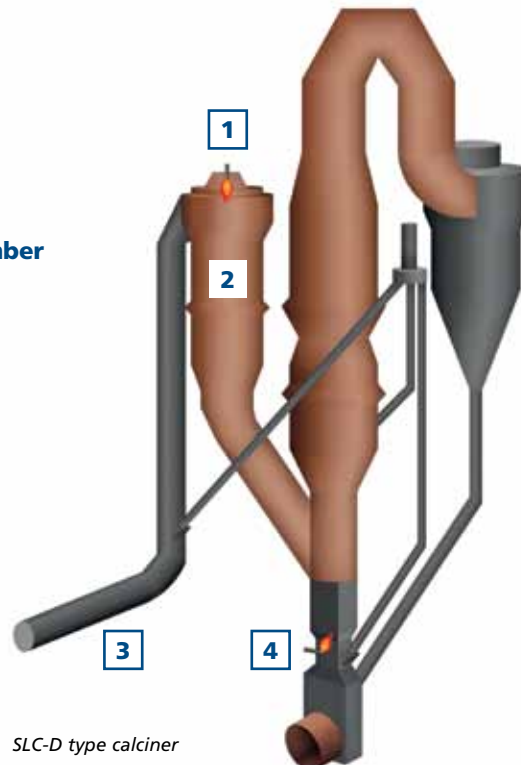
As an optional preheater calciner system, FLSmidth also offers the SLC-D. With its high-temperature pre-combustion chamber, the SLC-D (Separate-Line with Downdraft Calciner) offers unique flexibility in fuel use. Choose it as a new system, or quickly upgrade an existing ILC or SP preheater.

The separate-line features of this system enable a substantial portion of the total retention time to be located parallel to the kiln riser duct. The placement of the combustion chamber outside the preheater structure makes this calciner design well suited for upgrades, since downtime is minimal.

The SLC-D combines the advantages of separate-line calciners with the low NO_x features of the in-line calciner when a portion of the calciner fuel is directed to the kiln riser duct.

A hybrid arrangement that combines the SLC-D with a HOTDISC combustion device is also available to further optimize waste fuel firing.

- 1 Primary firing point
- 2 Pre-combustion chamber
- 3 Tertiary air
- 4 Optional firing point



SLC-D type calciner



Example of an ILC upgrade into an existing preheater

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