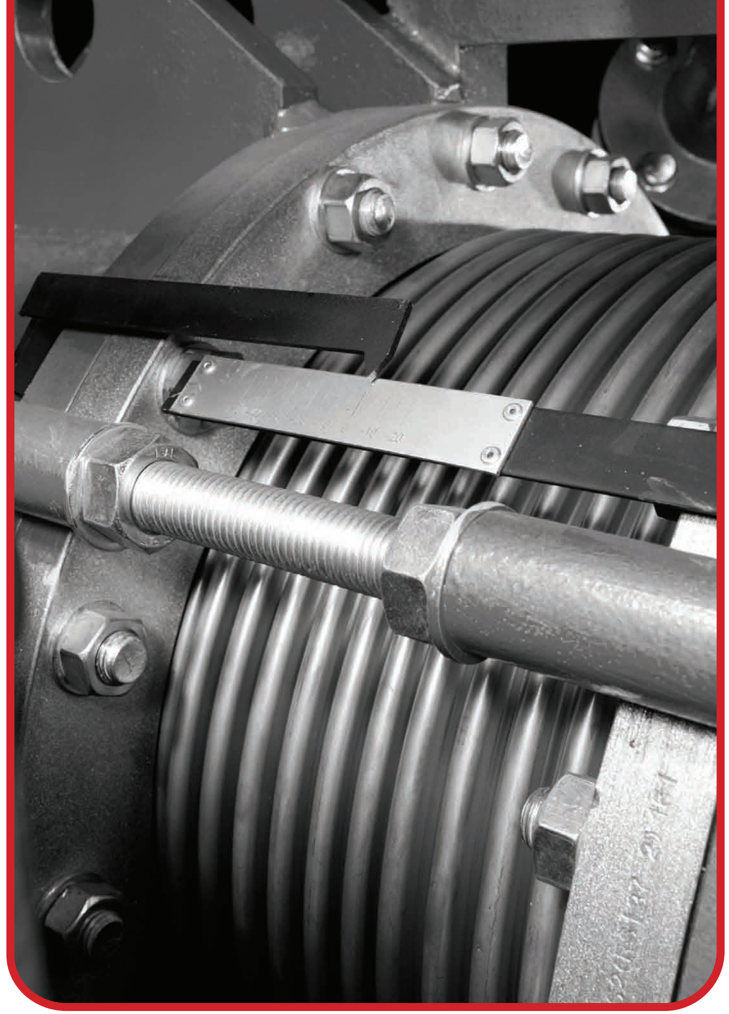
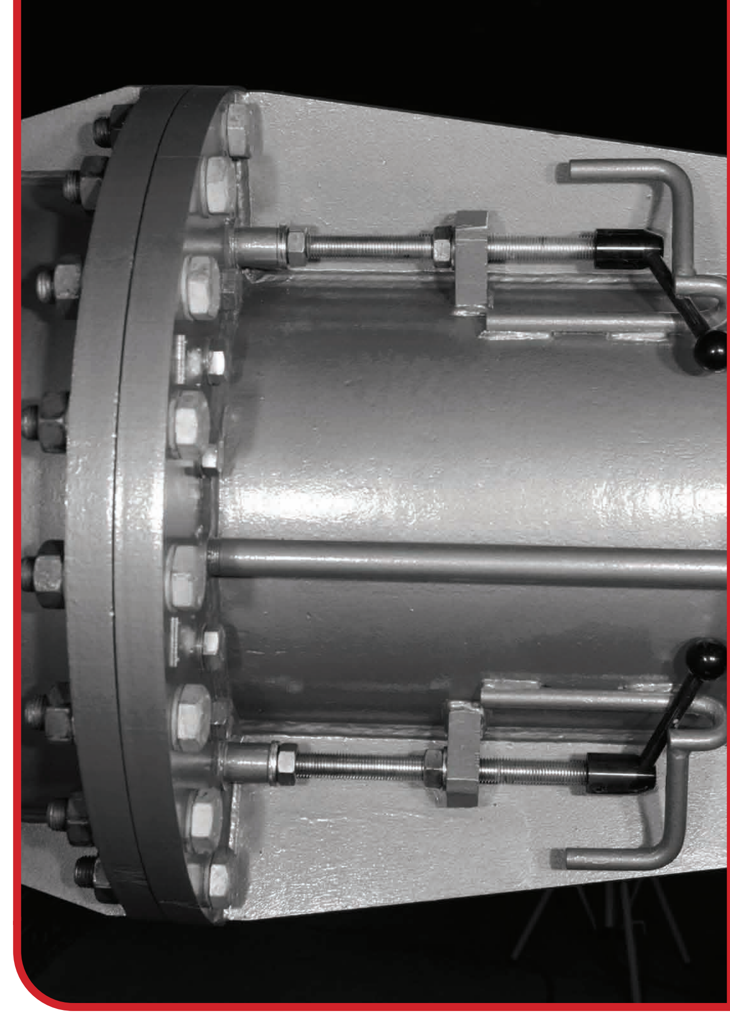
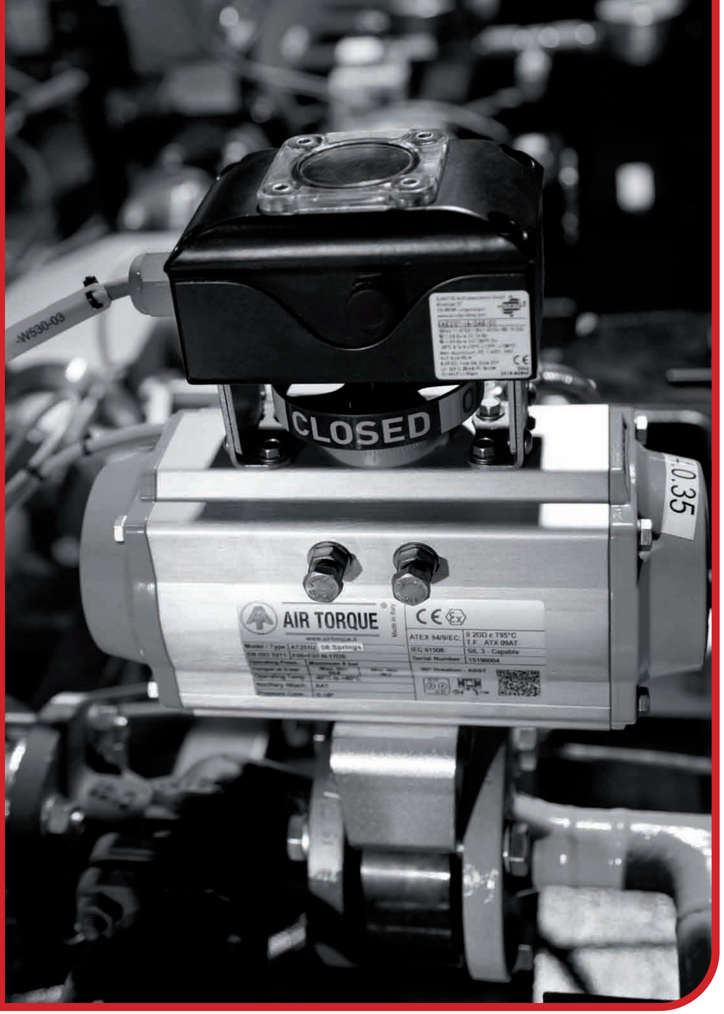
# M.A.S. Kiln Burner

## UNICAL Calciner Burner / M.A.S. GAS Burner


M.A.S.
Mono Airduct



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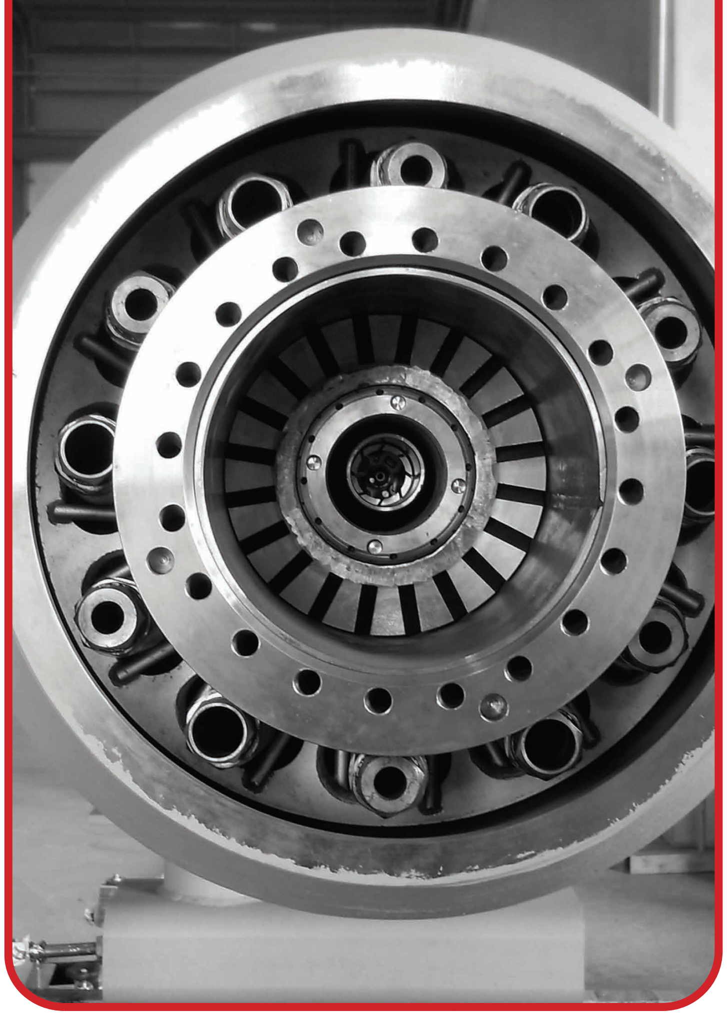
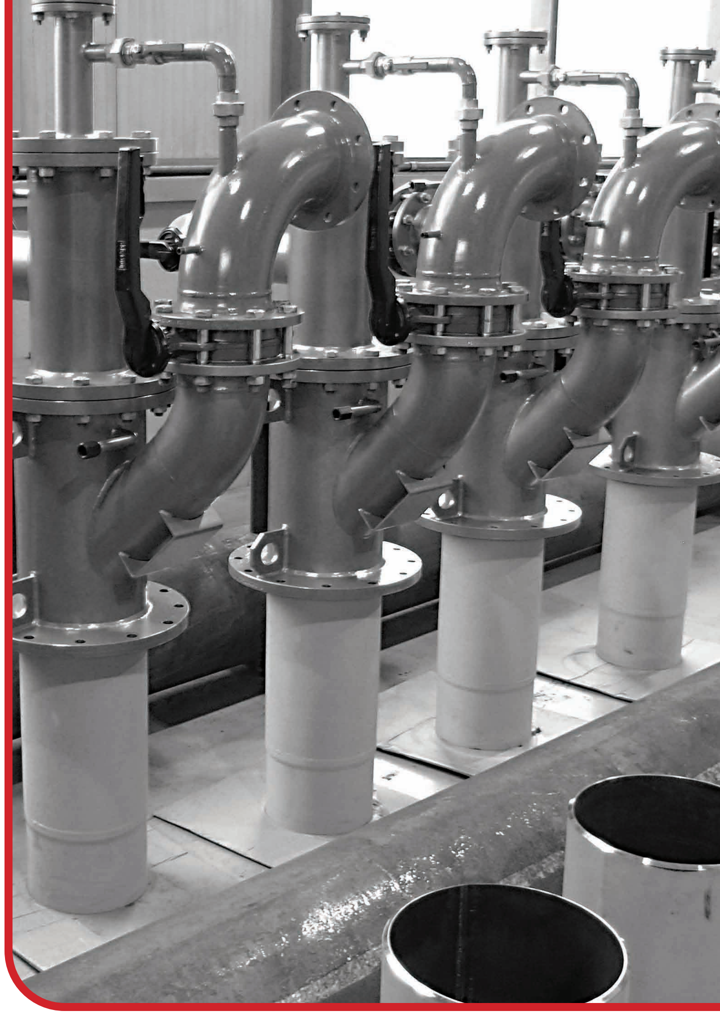
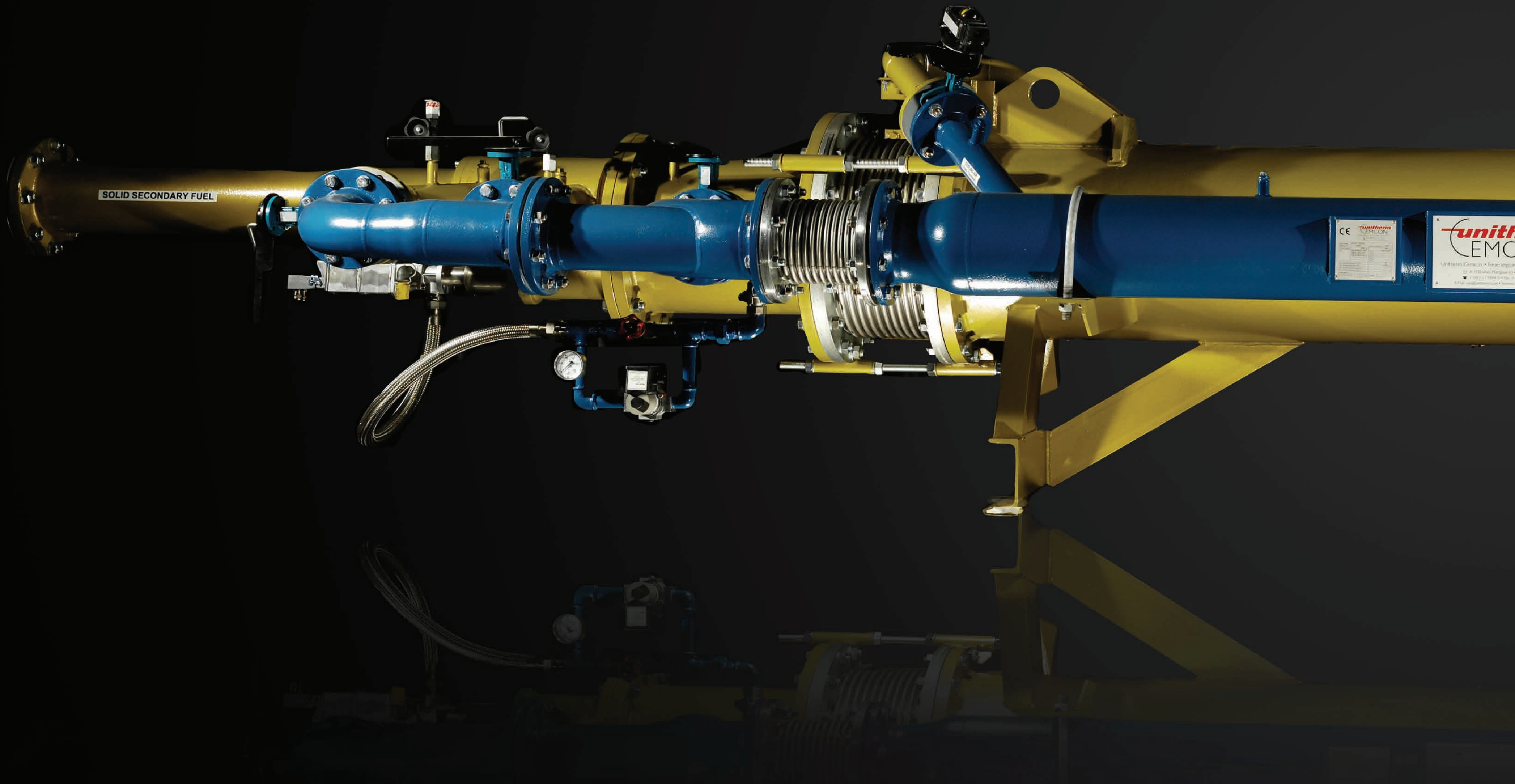




# UNIQUE BURNING EFFICIENCY




PRIMARY AIR


Mono
Airduct
System

# the innovative solution

## performance determines design

### M.A.S.© KILN BURNER

**The patented M.A.S. rotary kiln burner offers the user essential advantages compared to conventional burner systems.**

The innovative solution is to bring the complete primary air flow into an adjustable swirl, with a minimum loss of momentum.

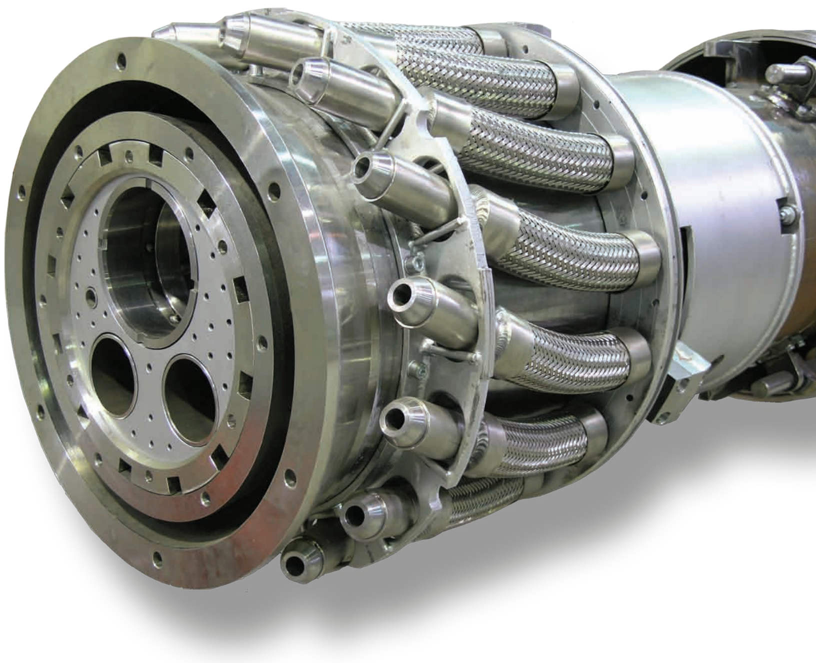
Since the introduction of the Mono Airduct System in 1993, several new developments were implemented to optimize the operation, handling and maintenance. Most of these advances were derived from the operational experience of more than 450 burners installed worldwide.

**Requirements for modern kiln burners:**
The necessity to reduce operating costs, as well as stricter emission limits, have forced burner manufacturers to find new solutions in burning efficiency.

Reaching high substitution rates with solid secondary fuels and keeping the $NO_x$ emission levels within legal restrictions depends on several parameters.

The physical properties (such as particle size and humidity) and the homogeneity of most of the solid secondary fuels differ greatly from primary fuels.
Therefore, it is necessary to adjust the burner to a more intense and compact flame, as with primary fuels. This causes a higher flame temperature to achieve complete combustion of the particles within the flame without affecting the clinker quality. In return, higher flame temperatures cause higher thermal $NO_x$ generation, which is to be avoided.

To find the optimum solution between high solid secondary fuel utilization and low $NO_x$ emissions, UNITHERM CEMCON has made innovative developments which are all combined in the M.A.S. burner.



„The goal is to control the flame and keep the combustion as efficient as possible."

# ... but why M.A.S.?

## PROCESS ENGINEERING FUNDAMENTALS

The aim is to develop a kiln burner with the capability to reach the maximum burner momentum at any flame shape, not only in one single point as with two primary air channel (or nozzle) burners.

**The burner momentum is the power available to the kiln operator to control the combustion process in the rotary kiln.**

The specific burner momentum *G* is defined as

$$G = \frac{\overbrace{M_{sw} \cdot v_{sw,ax} + M_{ax} \cdot v_{ax,ax}}^{\Sigma \vec{p}}}{Q_{fuel}} \quad \left[\frac{N}{MW}\right]$$

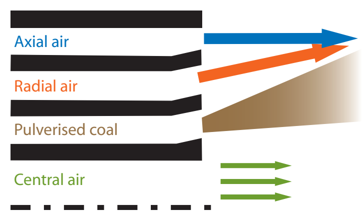
where the sum of all individual primary air momenta is divided by the thermal design capacity $Q_{fuel}$ of the burner .

Generally the maximum possible burner momentum is defined only by the primary air supply (quantity and pressure) of the installed centrifugal fan or rotary blower.

The task of the burner is to minimize the primary air energy losses inside and outside of the burner to reach the maximum burner momentum and to keep this maximum burner momentum at any flame shape, not only in one defined operation point.

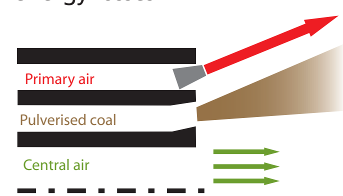
## THE MAIN DIFFERENCE

When operating a burner with two primary air components – radial and axial – it is necessary to change the primary air momentum (injection velocity or quantity of primary air) to control the flame shape. The control is done by decreasing the burner momentum (less radial air - longer flame, less axial air - shorter flame).




How to fulfill this task – to reach the maximum burner momentum throughout the whole range of flame adjustment? **There is only one solution: keep constant primary air quantity and pressure and only change the injection direction of the primary air.**

To meet this challenge it is necessary to use "flexible" nozzles. The mechanical solution was found by UNITHERM in 1993: the M.A.S. burner, using its patented flexible flame setting device, installed in only one primary air channel, to manipulate the direction of the primary air with a minimum of primary air energy losses.




## THE ADVANTAGES

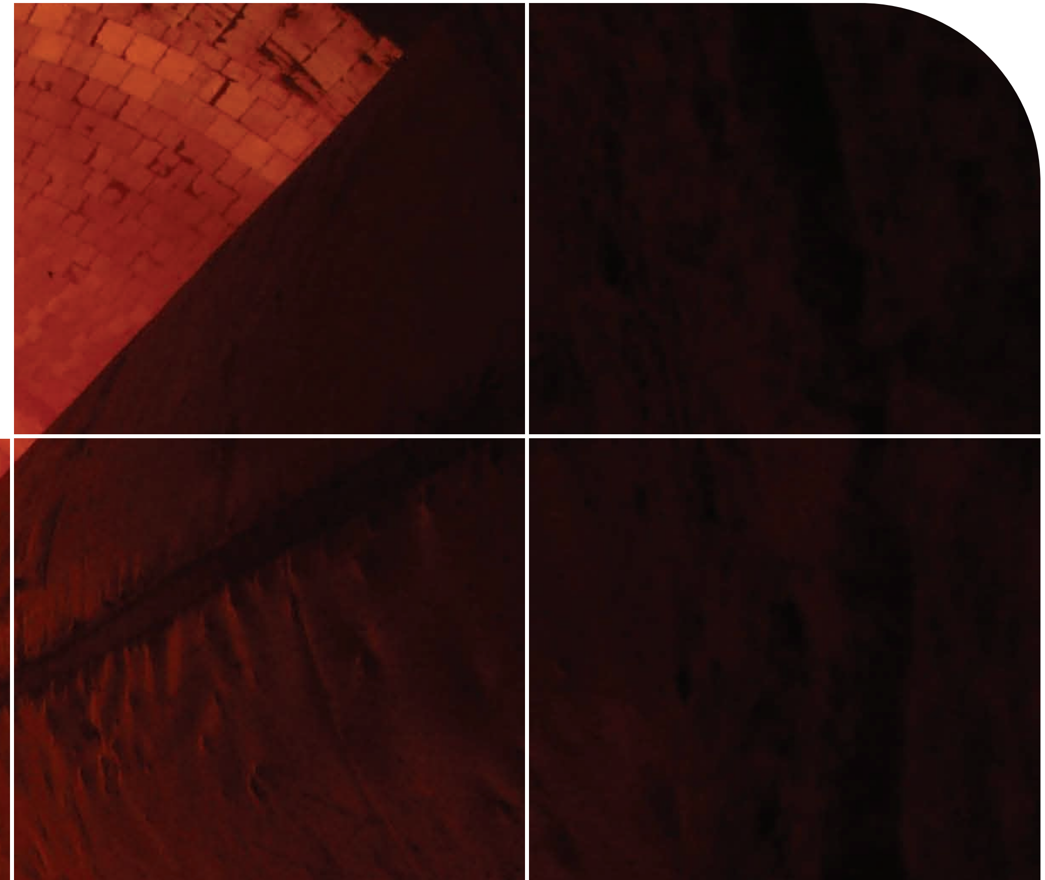
**Constant burner momentum:** by deflection of the M.A.S. hoses the burner momentum remains at its maximum during the entire operation range. Two channel burners reach the maximum burner momentum only at the design point, any change of the flame shape reduces the burner momentum.
*The momentum of a resulting air flow is always lower than the sum of the individual momenta of axial and radial air.*

**Single air jets:** Due to the relatively big M.A.S. nozzles at the end of the flexible hoses the mixing effect is maximized. This results in early ignition of the fuel and optimum combustion compared to two channel burners.

*A good combustion starts with good mixing.*

**Flame adjustment range:** The unique flame setting device allows continuous swirl adjusment between 0° and 40°. Two channel burners are limited in the flame adjustment range.

*Modern kiln burners require a high operation range to be adjustable to a wide variety of fuels.*



**Benefits:**

- Possiblity to burn 100% petcoke in white cement kilns with very low secondary air temperatures (150°C - 200°C)
- Higher fuel flexibility
- Significant decrease in power consumption
- More effective and simpler flame shaping and reproducibility of flame settings
- Easy burner maintenance

For this reason - M.A.S.

# operational improvements

# momentum maximation

## combination of the best ideas

### EVOLVED NOZZLE HEAD

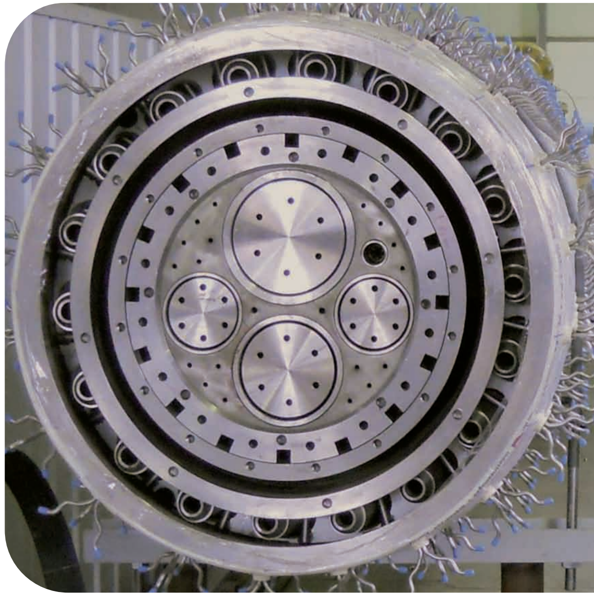
**What started as a rotary kiln burner for traditional fuels evolved into a high performance burner for maximum solid secondary fuel utilization.**

Since the first M.A.S. burner installation was introduced in 1993, the nozzle head of the burner has changed extensively.
Without doubt, high solid secondary fuel usage require a higher burner momentum than the operation with primary fuels. Therefore the aim of the new nozzle head was to maximize the momentum of the primary air.
But instead of installing primary air fans or blowers with higher pressure increase, the design of the M.A.S. primary air injection system was significantly modified.

The actual momentum available at the burner tip to shape the flame differs greatly from the calculated momentum at the primary air inlet.
Burners with two primary air channels suffer from higher pressure losses through the channels and especially through the nozzles. At constant primary air pressure the penetration depth of the primary air free jet is only depending on the nozzle diameter. Significant losses occur at the external mixing of axial and radial air outside the burner tip.
All these losses are avoided with the Mono Airduct System.

Another important fact is that with bigger burner diameters (required by bigger central channels for solid secondary fuel channels), the width of the primary air outlets become smaller. This causes higher pressure losses at the nozzles and reduces the penetration depth of the primary air.
The modified primary air system of the M.A.S. burner considers all above mentioned points to maximize the primary air momentum without the necessity of higher primary air pressure. The flexible hoses with the M.A.S. nozzles are now designed closer to the burner mouth and the gap in the corresponding air nozzle has been widened to allow unobstructed injection of the primary air jets into the flame.

Experience from the latest burner installations as well as CFD modeling show a significant improvement in secondary air entrainment into the flame root and therefore a much earlier ignition of the fuel.



*New nozzle head of a coal, oil, gas and secondary fuel fired M.A.S./8/KO.EG.SO.X kiln burner.*

# pneumo-deflector

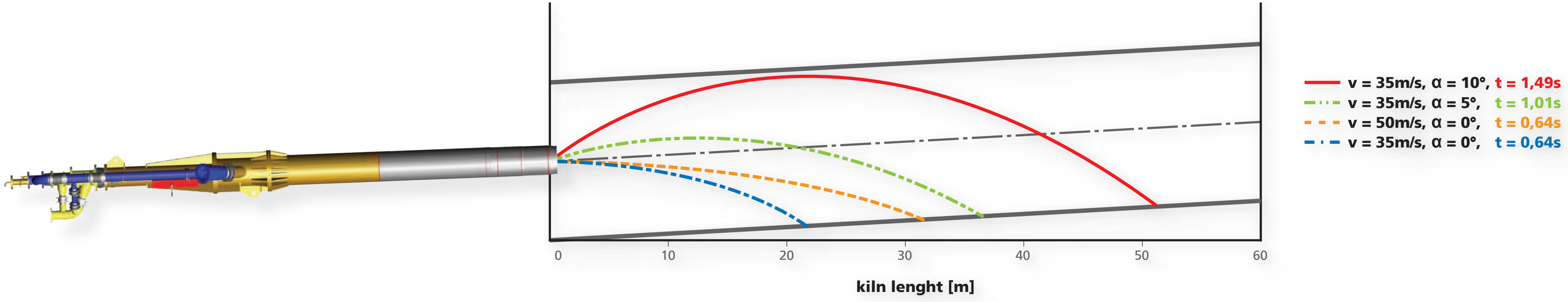
## EXTENDED RESIDENCE TIME

The acceleration of solid secondary fuels does not increase the **residence time (t)** of the material in the flame. Calculations have shown that solid particles with 35 m/s and 50 m/s **injection velocity (v)** have almost the same residence time.

The only option to increase the residence time is to change the **injection angle** (α) of the secondary fuel particles.

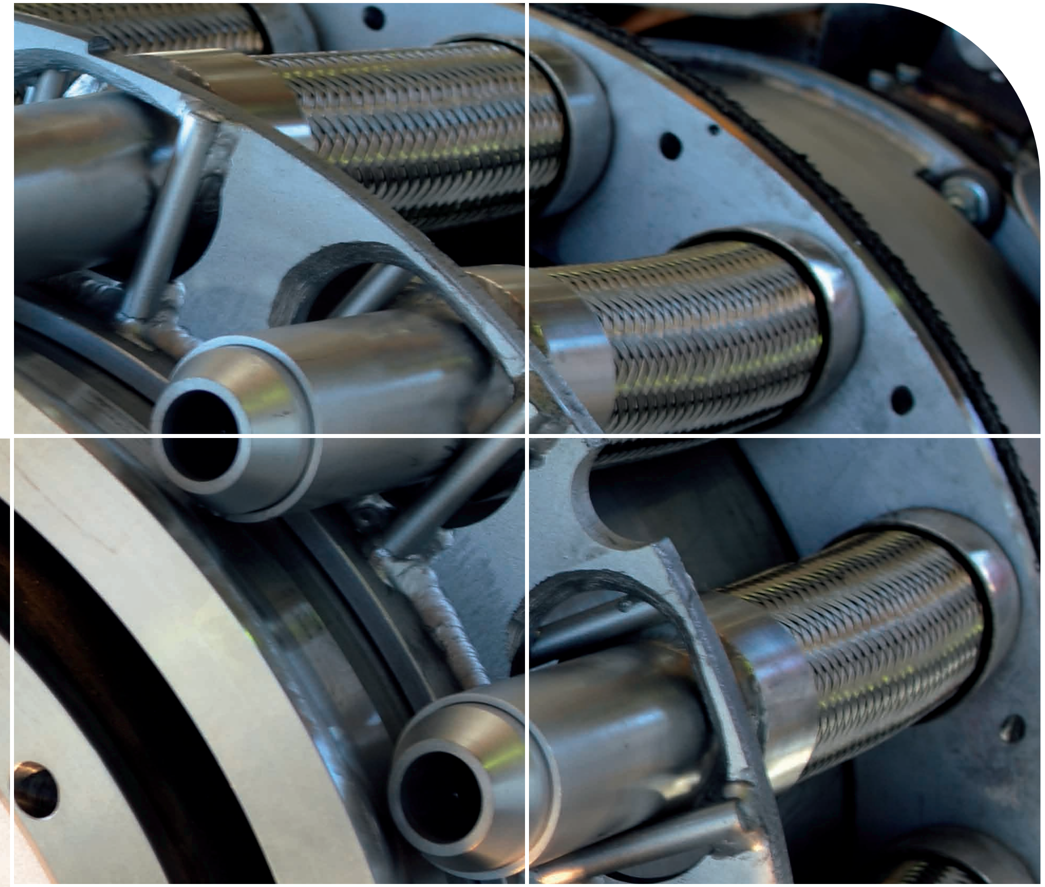
The **Pneumo-Deflector** enables the kiln operator to deflect the particles upwards (from the burner axis), increasing the residence time significantly. The deflection of the particle is either done by a portion of the primary air or with a separate blower.

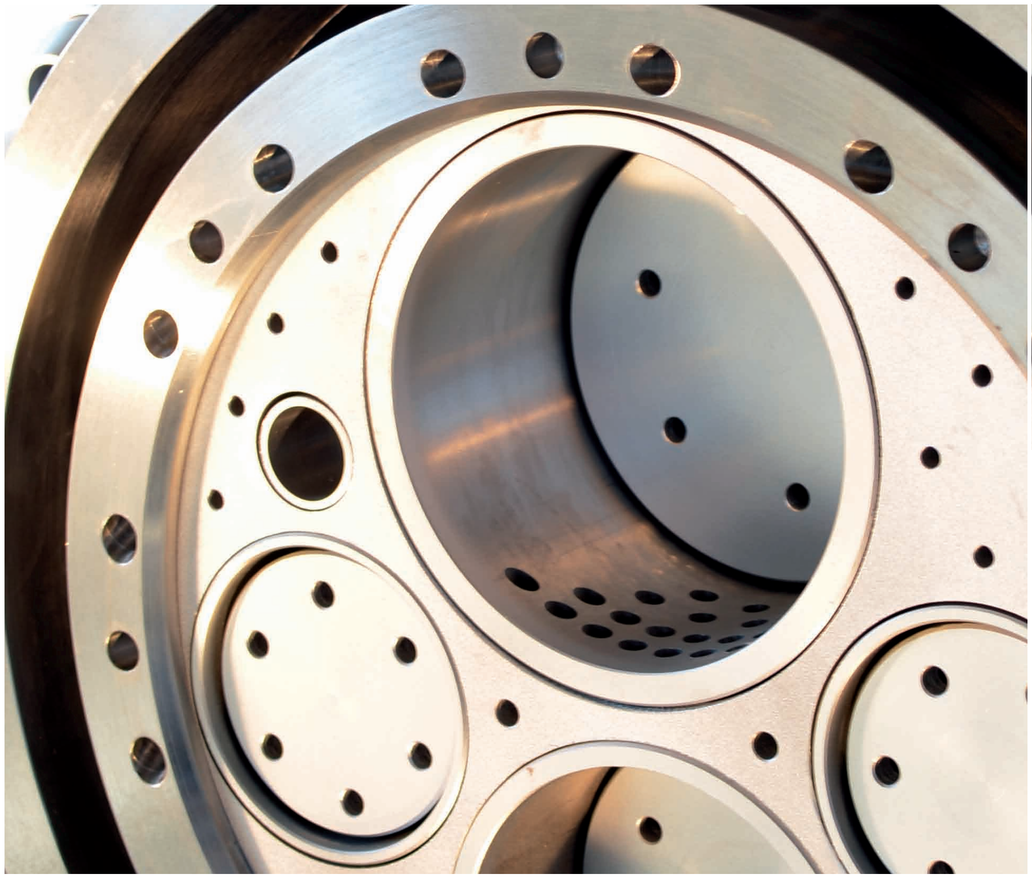
Experience shows that without changing of the operational parameters or the quality of the secondary fuels in use, the amount of solid secondary fuels through the kiln burner can be increased by up to 80%.



## INCREASE OPERATIONAL TIME

Similar to the coal dust channel, solid secondary fuel channels are subject to wear. Especially when using high abrasive fuels like sewage sludge, the wear is often much higher than in the coal channel. Considering fuel costs and $CO_2$ emissions, a continuous firing of solid secondary fuels (SSF) is necessary.
With the Unitherm M.A.S. burner, the **solid secondary fuel channel can be retracted during operation** in case the solid secondary fuel channel is damaged or blocked.





## EXAMPLE OF APPLICATION

Several plants are using this option to fire high abrasive fuels constantly through the burner by using a Unitherm M.A.S. burner with two solid secondary fuel channels. The burner is started with SSF through the upper channel. In case the channel is damaged, the SSF is connected to the lower channel and the **operation can continue without stopping** the burner. Meanwhile the upper channel will be removed from the burner and will be repaired.
Even if only one SSF channel is available, the replacement (if a spare channel is on stock) can be performed in a few hours without stopping the burner operation.

# simplified service

## DIVISIBLE JACKET TUBE

High temperatures and aggressive atmosphere in the kiln are a challenge for the lining of the burner jacket tube. Changing the complete lining of the burner jacket tube requires a lot of time and resources, which in return causes loss in production. To **shorten the process of changing or relining**, the M.A.S. burner jacket tube can be supplied in divisible execution. The divisible execution of the burner jacket tube consists of a rear and a front part.

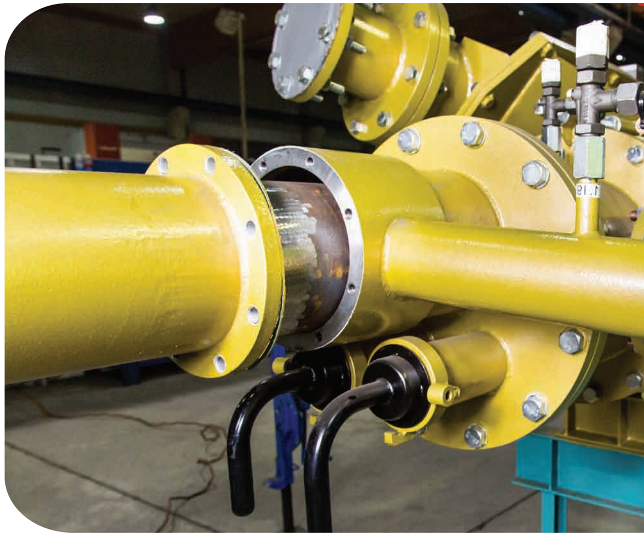
While the rear part of the jacket tube can remain on the burner, the front part can be dismantled separately when the lining is damaged. Then it can be either turned by 180° (if the refractory damage is only on the lower side of the jacket tube) or it can be replaced by a pre-casted front part.
With a length of only 1.3 meter, an additional advantage of the divisible jacket tube is the small space requirement for dismantling and installation. With the divisible jacket tube **only 2 meters of space are required** to remove the front part.

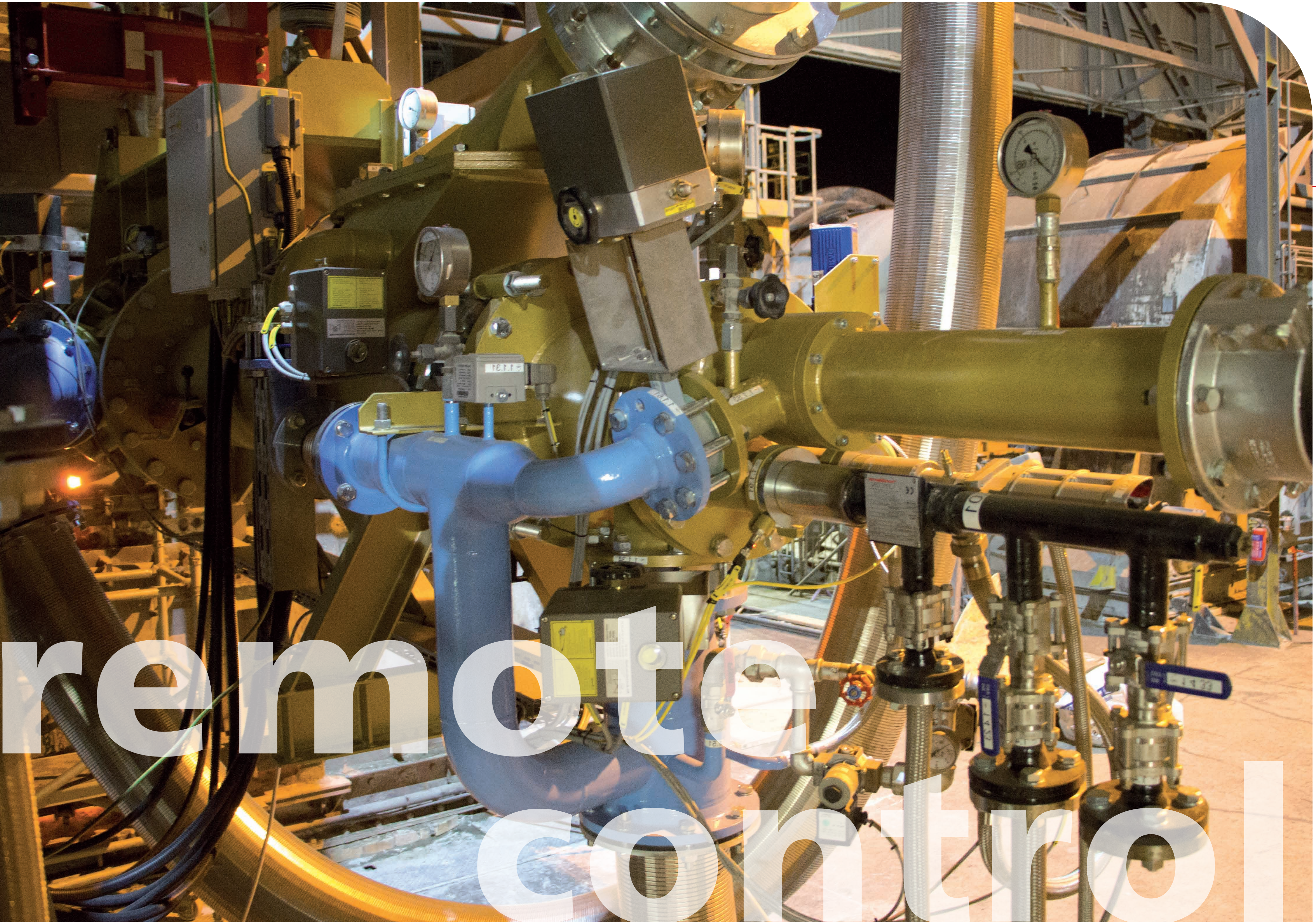
## SCREW FASTENED NOZZLES

To simplify the change of the burner nozzles, all M.A.S. burner nozzles are executed with threaded ends. A special tool which is delivered with the burner is used to replace the worn nozzles with minimum effort.

## REMOVEABLE FUEL PIPE

The secondary fuel pipe can easily be dismantled to perform maintenance work or carry out repairs. This can be done during operation and thereby cut both time and space needed.





# remote control

# burner automation

## OPERATION AND MONITORING

The M.A.S burner and the valve trains are generally automated through a BMS (Burner Management System) and can be controlled from the CCR as well as locally.

Through interconnection via industrial bus standard (Profibus, Profinet, Modbus,...) the BMS can be controlled remotely from the CCR to make operation and monitoring of the system easy and effective.

The burner settings such as the M.A.S swirl, primary air pressure, central air pressure and coal channel pressure can be monitored and controlled directly from the CCR.

## INTERFACE

A touch screen makes local operation, monitoring and optimisation of the burner easy through its graphical interface.
The operation panel shows process data, release conditions and control parameter of the burner.The device is equipped with particularly durable aluminum die-cast fronts which makes it well suited to the harsh environment of the cement industry.


*A local operation panel mounted at an oil station*


100%
natural gas

# M.A.S. GAS burner

## peak perfomance of burner momentum

**The SWIRLGAS kiln burner is specifically designed to burn 100% NATURAL GAS.**

The entire flame setting device is equivalent to the UNITHERM M.A.S. system. Gas instead of air is lead through the M.A.S. hoses.

### Efficient use of gas momentum

The main idea for the M.A.S. gas burner is the reduction of the primary air amount to a minimum and the use of gas for flame shaping. The result is a burner, where the range of flame setting, flexibility and cost efficiency are unchallenged in its field of operation.

For the use with bright materials such as white cement or lime, the burner was improved with a two stage combustion. In the first stage the main gas stream is preheated by a short and hot flame (5 – 20% of total gas) with substoichiometrical conditions. In the second stage the gas is completely combusted. With this method the radiation coefficient is significantly increased to maximize the heat transfer to the material.

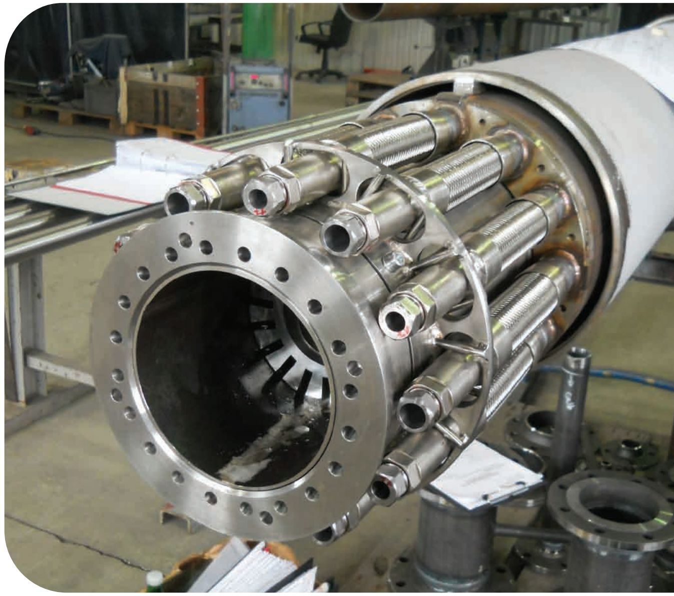
### Performance range:

between 5 - 150 MW per burner

### Accessories:

- Burner trolley
- Fuel supply systems
- Burner management system

UNITHERM CEMCON provides the M.A.S. gas burner for the cement, lime, gypsum and mineral industry.



*Gas kiln burner M.A.S/2/EG/SG with the divisible jacket tube removed.*


low CO
emissions

# UNICAL calciner burner

## universally applicable

Calcination is one of the key points in the cement production. Therefore UNITHERM CEMCON developed an enhanced burner system to increase the quality of the material entering the kiln. As an effect of continous improvement comes a high combustion efficiency combined with a low $NO_x$ burner execution. UNICAL burners can be installed on the most commonly used calciners.

**Fuel types:**

All UNITHERM CEMCON calciner burners can be designed for natural gas, heavy fuel oil, coal dust, petcoke, solid secondary fuel firing or a combination of these fuels.

**Performance range:**

between 0,5 - 165 MW per burner

**Horizontal installation:**

Fuel is injected perpendicular to the raw meal flow. The design changes in dependence of the fuel or combinations of fuels fired.

**Vertical installation:**

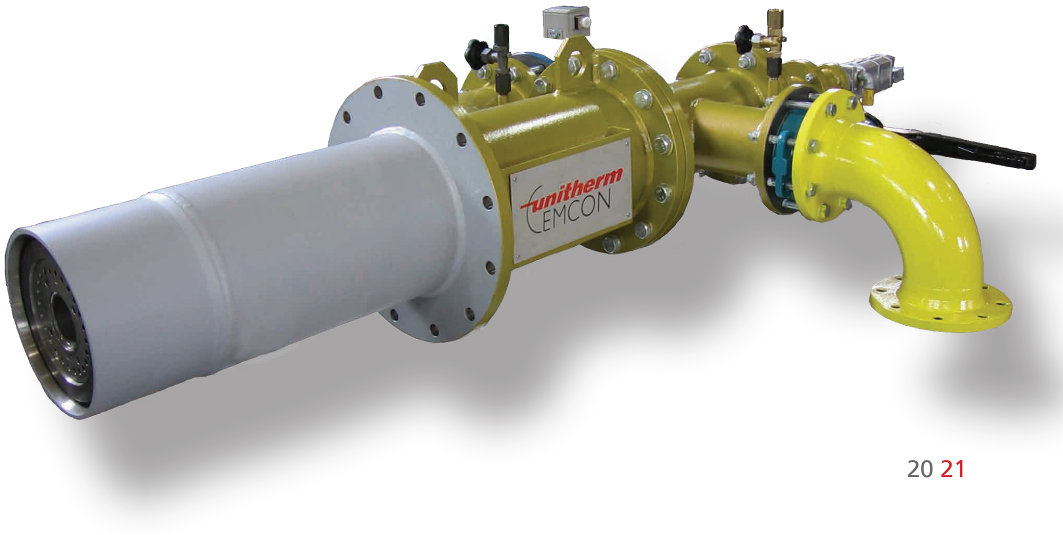
Fuel is introduced along the direction of raw meal flow which has been taken in through a swirl chamber.

**Features:**

- installation: flanged or moveable with burner trolley
- suitable for waste fuel

**Accessories:**

- Burner trolley
- Fuel supply systems
- Burner management system




sustainable
quality

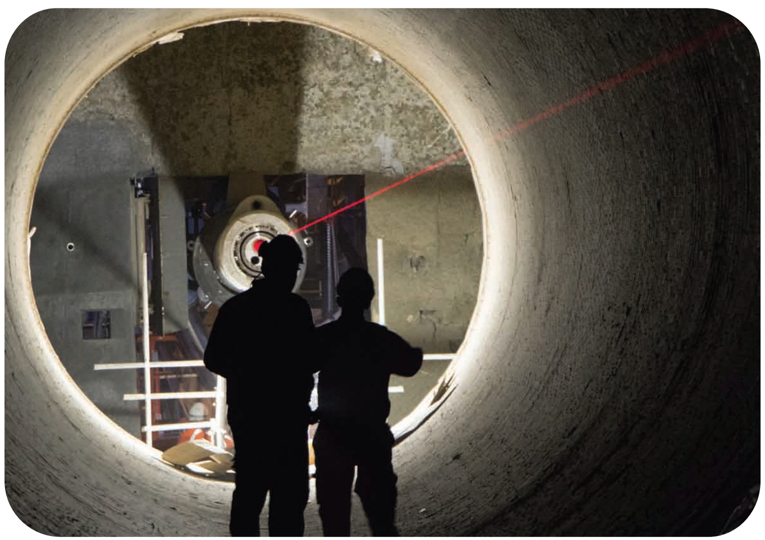
# service and maintenance

## high value - low cost

Regular maintenance and service is vital for a high and reliable performance of our product. Thanks to the efforts of our engineers, UNITHERM CEMCON is known for its high quality products all over the world. Our product can be operated for many years without major investments in maintenance.

Visit us at **www.unitherm.at/service**

We offer:
- World wide service
- Supervision of erection
- Commissioning and staff training
- Maintenance assistance



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