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Burning Success

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Introduction

The Unitherm M.A.S. kiln burner is tailor-made to each specific application, be it the request to maximise the usage of alternative fuels, the requirement for low NO_x emissions, or the use of a specific fuel. The company offers a range of kiln burner designs to satisfy the variety of requirements of the market.

Requirements

Unitherm's history with kiln firing equipment goes back to the 1960s and 1970s, when simple 3-channel kiln burners were installed and operated. In the mid-1990s, the M.A.S. kiln burner started its career in the cement industry. In the past 7 – 8 years, the patented M.A.S. kiln burner has been constantly improved to meet present requirements and future objectives.

The success of more then 150 M.A.S. burner installations was achieved by consideration of the following criteria for the burner design:

- High usage of solid alternative fuels and high fuel flexibility, especially for the European market.
- Effective flame shaping and length control by patented M.A.S. flame setting system.
- Use of low grade standard fuels or hard burnable fuels (e.g. petcoke, antracite).
- Low kiln inlet temperature.
- Stable coating in sinter zone.
- Constant high clinker quality.
- Lower specific heat consumption.
- Lower NOx emissions.
- Burner automation for full remote control/lower operator effort.
- Reduction of wear by using special compound materials or ceramics to resist against coal/coke and alternative fuel abrasion inside the burner.
- Innovative concepts for burner refractory lining.

The following report describes a kiln burner installation in a German plant with a clinker production of 4800 tpd. Tables 1 and 2 show a comparison of a standard kiln burner, which was installed until 2003, with the M.A.S. kiln burner, which replaced the old kiln burner in 2004.

The plant had a long-term problem with the lifetime of the burner refractory, which caused frequent burner stoppages to repair the refractory damage. Chemical attacks, as well as clinker dust abrasion, led to a low refractory lifetime, usually below three months.

Figure 1. M.A.S. kiln burner for high usage of solid alternative fuels.

Figure 2. M.A.S. kiln burner with the patented 'sinter ceramic brick solution'.

Unitherm offered the plant two solutions to extend the life of the refractory. Both were tested, and finally the "sinter ceramic bricks solution" (patented) led to an improved lifetime of almost one year.

Production results

- Short, tight and high radiant flame despite increased alternative fuel rate at the kiln burner (plastic-textile mix, solvents).
- No increase of kiln inlet gas temperature was

Plant data: production of 4800 tpd dry kiln line with preheater, precalciner and grate cooler		
Table 1. 'Burner check' with a standard kiln burner in April 2003 (before)		
Primary air rate (based on lamda L MIN)		21.90 %
Specific axial burner momentum (incl. conveying air & fuel)		9.90 N/MW
Loading factor of coal conveying air		2.07 kg/m³
Exit-velocity of coal at the burner		26.70 m/s
Thermal burner capacity		64.80 MW
Thermal stress of sintering zone		4.30 MW/m²
specific heat-consumption of the entire kiln system		4123 kJ/kgKl.
specific heat-consumption of the kiln burner		1249 kJ/kgKl.
Fuel mix:		
Steam coal	3.8 tph	45.7%
Waste oil	3.4 tph	54.3%

Table 2. 'Burner check' with the M.A.S. burner in June 2005 (after)		
Primary air rate (based on lamda L MIN)		max.15.31%
Specific axial burner momentum (incl. conveying air & fuel)		6.90 N/MW
Loading factor of coal conveying air		2.54 kg/m³
Exit-velocity of coal at the burner		31.00 m/s
Thermal burner capacity		59.25 MW
Thermal stress of sintering zone		3.90 MW/m²
Specif. heat-consumption of the entire kiln system		3822 kJ/kgKl
Specif. heat-consumption of the kiln burner		1143 kJ/kgKl.
Fuel mix:		
Lignite	4.75 tph	48.9%
Waste oil	-	-
Solid alternative fuels	4.87 tph	51.1%

Figure 3 (above) and 4 (below). No significant wear of burner refractory after six months operation.

observed although the solid alternative fuels were increased to 6 to/hr at the kiln burner.

- Set point of primary air to 200mbar (installed p.a. fan 315 mbar) and flame setting device adjusted to a swirl of 7 - 8 (scale at burner).
- Reduction of specific heat consumption at the main burner.
- Operation with a primary air rate below 15 % (based on L MIN) possible.
- Easy, effective and reproducible adjustment possibility of the kiln burner according to objective criteria as:
  - Swirl number, primary airflow rate, primary air pressure.
  - Primary air & central air distribution, specific axial-burner momentum.
- High clinker quality.
- Stable free lime values in clinker (no clinker over-burning necessary to reach a free lime content below 1.5%)
  - Even clinker with an LSF up to 100 can be burned below a free lime content of 1.5% without problems.
- High calorific liquid fuels (waste oil) are no longer required for stabilising the flame or to increase the flame temperature.
- A "weak kiln condition" can be stabilised quickly by the flexible and effective adjustment possibilities (flame control settings) at the M.A.S. burner.
- Good results and an extended lifetime with the special burner refractory solution developed by the company.

Conclusion

Well-specified requirements and precise plant operation experience are the key ingredients for designing a high performance kiln burner using state-of-the-art combustion technology to successfully integrate the equipment into the process. ◆