Krasnoyarsk's burner exchange

The burner system of Line 5 at the Krasnoyarsk cement plant in Siberia has been retrofitted from a direct-firing to a state-of-the-art indirect-firing system, courtesy of KHD Humboldt Wedag. The burner exchange project, primarily implemented to meet tighter emission regulations, yields further potential benefits for this wet-process plant.

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The Krasnoyarsk cement plant is located within the city limits of Krasnoyarsk in Siberia. It consists of three kilns with a combined capacity of 662,000tpa. The wet-process Kiln Line 5 is ϕ4 x 150m with a clinker capacity of 804tpd.

Until 2018 thermal energy was supplied by a direct-fired ball mill burner system. The replacement of this burner system was imminent due to more rigorous emission regulations, particularly NO_x, which could not be met with the existing burner.

Therefore, Krasnoyarskiy Cement selected ZAB Dessau, a subsidiary of KHD, as a project partner for the modernisation of the firing system. The €1.7m project included the delivery, erection supervision and commissioning of:

- modification of the existing intermediate coal dust hopper to coal dust silos
- coal dust collection filter
- coal dosing system with pneumatic conveying
- KHD PYROJET® kiln burner system with new burner carriage from KHD
- failsafe KHD Burner Management System with proprietary KHD control program
- start-up firing system with proprietary KHD valve train for diesel
- KHD kiln outlet with KHD kiln sealing system
- kiln inlet gas analyser.

The Krasnoyarsk cement plant in Siberia benefits from a burner retrofit for its 804tpd wet-process Kiln Line 5

Project overview

As the available space was limited, an exact assessment of the on-site situation was required. In August 2017 a joint team from ZAB and KHD visited the site to assess and confirm all dimensions.

Shortly afterwards the erection phase commenced. Installation of all the equipment was finalised in April 2019 and the kiln subsequently recommissioned.

Restarting of the kiln system followed on schedule and stable production was achieved within a short time. Operational results are shown in Table 1.

Table 1: operating results at the Krasnoyark cement plant

	Before modification	After modification	Benefits/improvements	
			Absolute change	Relative change (%)
Production (tpd)	790	814	+24	+3.04
Heat demand coal equivalent (kg/t clinker)	218.5	215.8	- 2.7	-1.24
NO_x at stack (mg/m^3)	1296	632	-664	-51.23
C_3S (%)	63	63	0	
Free lime (%)	0.72	0.68	-0.04	-0.04
28-day strength (MPa)	49.7	49.7	0	

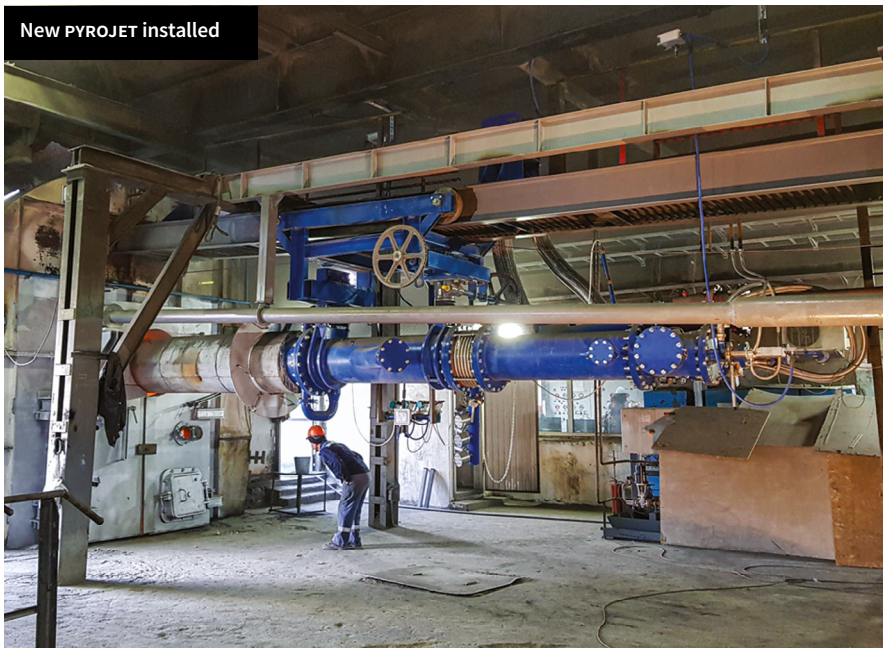
New PYROJET installed

Table 2: overview of the design numbers for primary air supply at Krasnoyarsk		
Jet air (%)	1.6	920mbar
Swirl air (%)	2.4	160mbar
Cooling air (%)	1.0	50mbar
Coal conveying air (%)	3.1	
Total	**8.1**	

Indirect benefits

As the sole energy source for the process KHD's PYROJET burner is designed with a distinct focus on efficient combustion to achieve a high clinker quality while keeping NO_x and CO emissions as low as possible. To maintain the high level of efficiency, KHD's PYROJET burners rely on a high-pressure jet air system which ensures sufficient burner momentum while the primary air rates remain low. Table 2 gives an overview of the design numbers for primary air supply at Krasnoyarsk.

KHD's state-of-the-art burner achieves a momentum of 5.4N/MW at the usual operational firing rate of 190GJ/h and 4.6N/MW at the guaranteed firing rate of 230GJ/h. The burner, which was specifically designed for use at Krasnoyarsk, offers the best-achievable balance between efficient combustion, low NO_x emissions and optimal utilisation of secondary air to guarantee a high overall thermal efficiency.

Although it is possible to design PYROJET burners for direct firing kilns, the indirect firing system has many clear advantages:

- more precise coal flow metering to achieve a near-stoichiometric operation of the entire kiln system
- significant reduction of conveying air
- higher system availability as mill stoppage has no direct impact on kiln operation.


Control cabinet


KHD valve train

Moreover, the reduction of long and large-diameter transport ducts for coal increases the safety of the entire pyroprocessing area of the plant.

In terms of operation, the new burner at the Krasnoyarsk plant runs on a state-of-the-art system for start-up and control. The essential parts of this system are the valve train for fuel (diesel), and the BMS (Burner Management System) which handles the complete start-up sequence and continuously monitors the entire process to ensure a safe burner operation.

The valve train is designed with an air atomiser system. When comparing pressure and air atomisers, the latter may have higher operating cost. But the following advantages clearly justify the use of the slightly more expensive solution:

- improved control over the entire output range without changing nozzles
- low operating pressure
- very fine atomisation even at small throughput
- efficient combustion in cold kiln conditions.

Together with the gas-electric ignition burner, the system enables a complete worry-free remote start of the burner without risky or challenging manual work.

Burner management system

The BMS is based on a failsafe Siemens PLC with KHD's propriety control program. The programming was undertaken while keeping easy commissioning and optimal visualisation in mind. As a result, the BMS provides users with the information required to operate and maintain the system easily and efficiently.

The communication between the BMS, burner and valve trains runs on Profinet. Compared to a classic, direct-wired approach, this technology significantly reduces the risk of wiring errors, as only a data connection and power supply are required. Hence, total commissioning time and effort can be reduced significantly.

Retrofit potential

The retrofit from a direct-firing system to a state-of-the-art indirect-firing system at Krasnoyarsk was no small investment. However, taking the significant improvements in the entire process into consideration, it yields huge potential for energy consumption, emissions reduction and also quality improvement. As a result, the project for Krasnoyarskiy Cement is a prime example of a beneficial and successful modernisation. ■