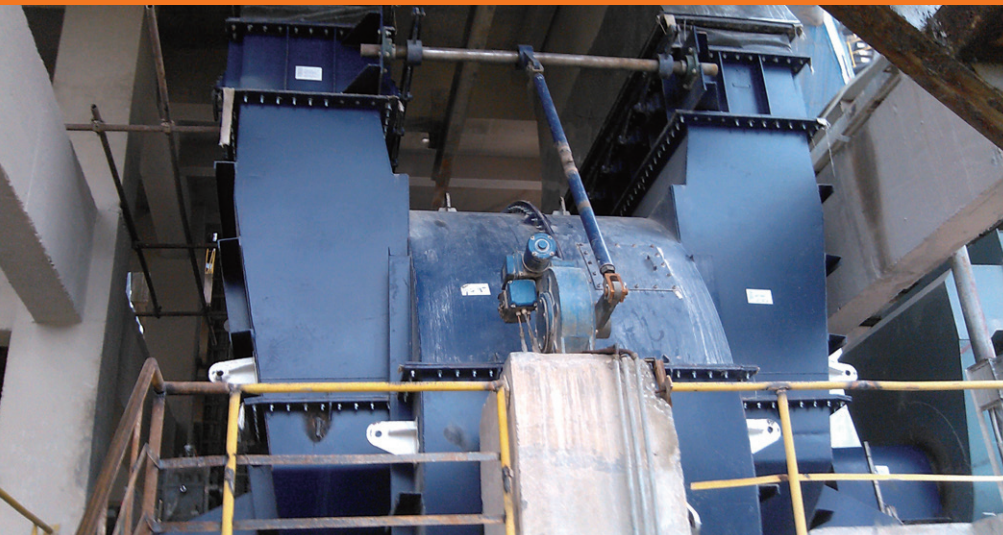


Changshan's new fan



Fans are some of the largest power consumers in a cement plant and the use of an energy-efficient model can significantly reduce the operating costs for a cement producer.

One cement producer to benefit from a cost-saving energy retrofit is Changshan South Cement, China. Changshan South Cement Co Ltd had equipped its two clinker production lines with MC-2x39No30.5F raw mill circulation fans, manufactured by a local company.

However, the low efficiency of the fans led to the motors being operated for a long time at an overloading current.

Moreover, the actual power of the motor had been far above the rated power, resulting in excessive energy consumption and a potential safety hazard. The challenge for the cement company was to reduce the energy demand of the raw mill fans as much as possible.

Road to improvement

To achieve this goal, Changshan South Cement Co Ltd asked Howden to improve efficiency and lower energy consumption with a retrofit of the circulation fan. Following a full analysis by Howden engineers, the fan supplier proposed to start renovations at the first kiln line to reduce the disruption of daily operations.

The fan's original design parameters are shown in **Table 1**.

To accurately determine the system's actual requirements in terms of the fan's air volume flow and pressure, and thus improve the efficiency of the renovated fan together with the existing system, Howden undertook an on-site performance test.

The test results (**see Table 2**) show that the low actual operational power of the fans had led to a considerable waste in energy as well as highlighting that the motors had been operating in an unsafe current range of 230-240A, which is above the rated current.

Table 1: Fan's original design parameters

Fan parameters		Motor parameters	
Flow (m ³ /h)	820,000	Rated power (kW)	3350
Total pressure (Pa)	10,200	Rated voltage (V)	10,000
Working temperature (°C)	90	Rated current (A)	233.8
Barometric pressure (Pa)	100,362	Rated power factors	0.863
Entrance density under standard state (kg/m ³)	1.4	Efficiency (0%)	96.21
Rotating speed (rpm)	980	Rated rotating speed (rpm)	No

Table 2: On-site performance tests results

Parameter	Test value
Flow at inlet (m ³ /h)	852,140
Total pressure of the fan (Pa)	9417
Motor power (kW)	3765
Fan efficiency (%)	60



Road to improvement

Based on the on-site test data and considering the system's situation and the production requirements, the design parameters of the new fans were confirmed (see Table 3). This included a reduction of the air pressure by 250Pa and an increase of the air volume by 60,000m³/h.

Reconstruction

Taking these new design parameters and the need to improve the fan's power consumption into account, Howden selected its more efficient L-series backward-curved blade fan (Model No L5N 2655.00.08 DBL6T). The detailed parameters of the new fan are shown in Table 4.

The new Howden fan was designed to use significantly less shaft power than the original one, enabling the old motor to be used. Moreover, special composite wear-resistant liners were used on the blades of the new Howden impeller, making them more abrasion resistant while increasing the efficiency of the fans.

The replaced components included rotor, housing, inlet cones, bearings and bearing housings, couplings and dampers. Components that were kept intact included the concrete foundation, anchor bolts, motor and actuators. In addition, the retrofitted fan has made full use of the original civil foundation. The main body of the foundation has been kept intact with only some partial reconstruction to shorten the installation time of the new fan.

Howden has also undertaken extensive on-site surveying and mapping to match the reconstruction work with the original cement foundation and reduce the ducting alteration as much as possible.

Table 3: Old and new design parameters of the raw mill fan

Parameter	Original design parameters	New design parameters
Inlet temperature (°C)	90	0
Inlet temperature under standard state (kg/Nm ³)	1.4	1.4
Flow (m ³ /h)	820,000	880,000
Total pressure rise of fan (Pa)	10,200	9950
Rotating speed (rpm)	980	980

Table 4: Parameters of the Howden L-series fan

Parameter	New design parameters
IBarometric pressure (kPa)	100.362
Inlet temperature (°C)	80
Inlet temperature under standard state (kg/Nm ³)	1.4
Flow (m ³ /h)	880,000
Total pressure of fan (Pa)	9950
Fan efficiency (5)	80
Shaft power (kW)	3015
Rotating speed (rpm)	980
Motor power (kW)	3350kW – using the current motor



For further information contact:

Howden

Old Govan Road, Renfrew
PA4 8XJ
United Kingdom

Email: cement@howden.com

New fan performance and economic analysis

The new fan was installed when the cement plant was overhauled. The old fan was removed and the new one tested for a trial run – all in the short time available. The comparison between the test value and the design value (see Table 5) showed that the actual operating point was close to the original design point, indicating that the original goals of the fans' actual operation efficiency were fully achieved.

The comparison between the test value of the raw mill fan before and after the reconstruction when the raw material system was under full load is shown in Table 6.

The test data show that the flow and total pressure of the fan have been improved and the fan efficiency has been greatly enhanced after the reconstruction. The motor power dropped from 3765kW to 2994kW and the current value range fell from 230A–240A to 170A–180A, indicating a significant saving of energy. This data shows that power consumption has been lowered by 771kW/h (3765kW–2994kW) while material output following the retrofit has remained the same. On the basis that fans are operational for 700h annually, this saves 771kW x 7000h = 5,397,000kWh of electricity.

At a cost of CNY0.55/kW, this amounts to savings of CNY 2, 968, 350 (US\$ 431,332) per year. This cost analysis shows that Changshan South Cement Co Ltd was able to benefit from an extremely short payback for this retrofit project.

Changshan South Cement Co Ltd also carried out a comparison between power consumption during the 72h before and after the fan reconstruction (see Table 7).

This showed that the average power consumption of the raw mill process has been reduced by 2kW/t under the same raw material output after the circulation fan retrofit.

Table 5: On-site performance test results of new fans

Parameter	Design value	Test value
Flow at inlet (m ³ /h)	880,000	860,767
Total pressure of the fan (Pa)	9950	10646
Shaft power (kW)	3015	2994
Fan efficiency (%)	80	81

Table 6: Comparison of test values of old and new fans

Parameter	Before the reconstruction	After the reconstruction
Flow at inlet (m ³ /h)	90	0
Total pressure of the fan (Pa)	1.4	1.4
Shaft power (kW)	820,000	880,000
Fan efficiency (%)	10,200	9950

Table 7: 72h power consumption detail of the raw mill circulation fan

Comparison between power consumption at the same output before and after the reconstruction				
Date	Equipment make	Power consumption (kWh)	Raw mill output (t)	Raw mill power consumption (kWh/t)
16 Mar	Howden	58,104	9992	5.82
21 Oct	Old fan	72,870	9583	7.60
17 Mar	Howden	58,169	10,133	5.74
22 Oct	Old fan	80,470	10,523	7.64
18 Mar	Howden	43,774	7823	5.59

Feedback

Changshan South Cement Co Ltd was very satisfied with the performance of the new Howden fan and has carried out several new cement fan retrofits with Howden since. The Chinese cement producer awarded Howden with a technology innovation award for the reconstruction.

This case study highlights Howden's ability to help customers maximise the efficiency of their fans with customised design, within all Howden designs available including Solyvent, Covent, Aeolus and Buffalo Forge, that takes into account the needs of the fan system as well as existing site conditions and configurations.