MPS: more than meets the eye

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Vertical roller mills are not only used for grinding cement raw materials but also find an application in grinding a wide variety of coal types in cement and power plants. Gebr Pfeiffer SE (GPSE) describes its vertical roller mills for coal grinding and provides a case study of an MPS225BK installed at CBR's Lixhe cement works in Belgium.

Customers from all over the world rely on Gebr Pfeiffer's MPS and MVR vertical roller mill solutions for grinding cement raw material, clinker and granulated blast furnace slag. The MPS technology, however, is also applied in numerous installations simultaneously grinding and drying coal for use in cement plants, power stations and in the steel industry. In these plants very different coal types like anthracite, bituminous coal or lignite and also various kinds of petcoke are processed. Two mill systems are employed for most coal grinding applications in the cement industry. These are, on the one hand, vertical roller mills that have achieved a share of almost 90 per cent and, on the other, ball mills whose share is recorded at just over 10 per cent[1].

Mill design features and benefits

GPSE supplies stand-alone MPS coal grinding mills as well as complete coal grinding-drying systems. Both mill and grinding system can be operated under pressure or suction as well as under air or inert gas atmosphere. System configurations cover grinding plants with temporary storage of the pulverised coal in silos (cement works, blast-furnaces in steel plants, etc) and installations with direct injection into the combustion system (power generating plants). For over 40 years the MPS mills for power stations have been manufactured under licence by Hitachi Power Europe GmbH (formerly Babcock Borsig AG), headquartered in Oberhausen, Germany.

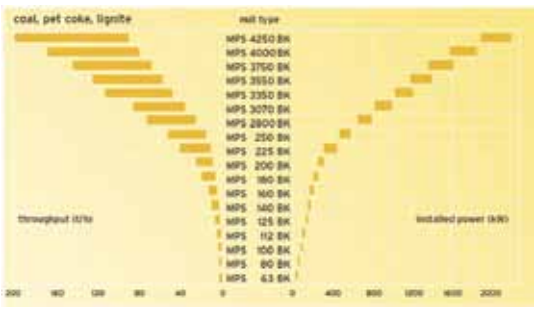

Figure 2: MPS series for coal grinding mills

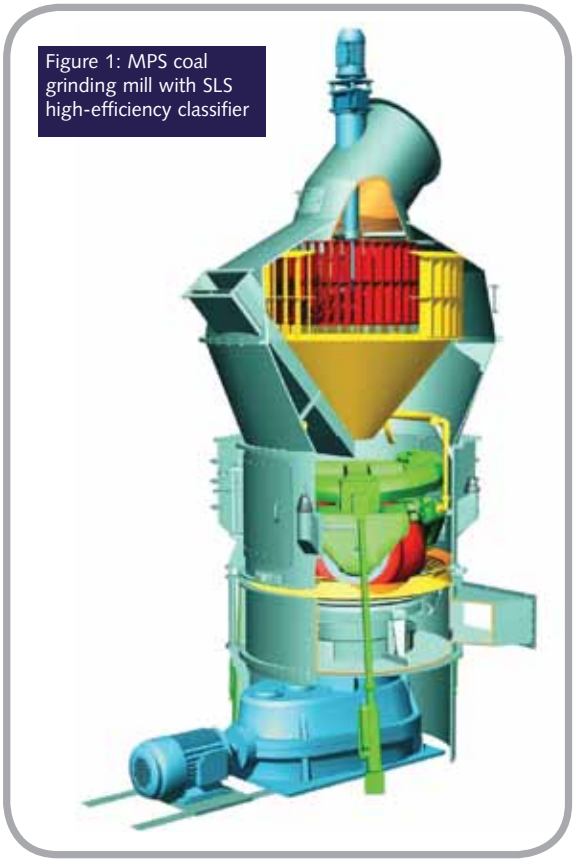

Figure 1: MPS coal grinding mill with SLS high-efficiency classifier

The MPS vertical roller mill is characterised by its statically-determinate system which consists of a pressure frame, three rollers and three external pull rods, and ensures the load is uniformly distributed to the grinding table. The table is driven by an electric motor and a gearbox. During start-up and maintenance the rollers can be lifted by tensioning cylinders.

A high-efficiency SLS classifier is mounted above the grinding zone. The feeding device for fresh material is arranged in this area where the fresh feed is also mixed with the grits rejected from the classifier (see Figure 1). The main difference between an MPS mill for solid fuels and other MPS mills lies in its pressure-shock resistance. Mill and classifier housing, feed unit and expansion joints are designed pressure-shock resistant. To avoid accumulations of coal dust as a source of spontaneous combustion, all surfaces in the grinding and classifying zone are vertical or inclined.

The key features of a coal grinding plant in a cement works are:

- special layout of the plant to avoid coal dust deposits
- pressure shock-resistant design of mill and classifier housing, filter and pulverised coal silos
- use of rapid-action flaps, rupture disks and explosion vents in certain parts of the plant
- monitoring of O_2, CO and dust concentration levels in critical places
- supply of CO_2 in the event of safety-relevant limit values being exceeded
- if possible, reducing the O_2 concentration level in the dust-laden gases to 8-12 per cent by using kiln exhaust gas and by minimising the amount of false air
- automated linking of all safety-relevant data and process control features of the entire plant

Figure 2 shows the MPS series for coal grinding mills. Depending on the fuel to be ground throughput rates of 5-200tph can be achieved in a fineness range

between one per cent R0.063mm and 25 per cent R0.090mm.

The MPS coal grinding mill with a high drying capacity is very suitable for grinding lignites with feed moistures of as much as 45 per cent. Depending on this high feed moisture, the mill rating is determined by drying whereas for anthracite, hard coal and petcoke the rating of the mill is determined by grinding. The great variety of solid fuel properties, such as grindability, ash content, volatiles as well as the required product fineness, calls for a wide range of operating states. The hydropneumatic tension system allows the stepless adjustment of roller force to suit the wide range of solid fuel feed materials. In combination with the adjustable airflow rate the mill control range is between 30-100 per cent. Part-load operation may become necessary as a result of load variations in injection-type grinding mills installed in power plants, changing fuel qualities and a grindability other than that specified in the design criteria.

CBR Lixhe case study

Project scope

In 2010 HeidelbergCement AG decided to set up a new, modern coal grinding plant at CBR in Lixhe, Belgium. The new plant was to replace the existing grinding technology with a view to increasing the energy efficiency and achieving environmental constraints. The coal grinding plant was ordered from GPSE in April 2010.

The target was to install a new grinding plant in accordance with technical and legal standards for coal grinding. Important conditions were attached to the order. The new coal mill had to be integrated into the present plant layout while existing foundations and building parts had to be reused. In addition, the shutdown of the complete plant was limited to two months, starting with the demolition of the existing plant and ending with the start of commissioning of the new grinding plant.

GPSE's scope of supply covered the following components:

- MPS 225 BK vertical roller mill,
- pressure shock-resistant, self-purifying rotary feeder
- airtight reject box
- SLS 1800 BK high-efficiency classifier
- set of dampers, safety dampers and expansion joints
- measuring and control equipment
- water injection system.

All required engineering services were provided by GPSE in very close coordination with HeidelbergCement Technology Center (HTC):

- detailed engineering
- quality inspection plans
- erection schedules
- maintenance and operating manuals
- preparation of ATEX certificates
- staff training on operation, maintenance and repair.

The customer who requested that the mill foundation and the building structure be reused was responsible for the filter, including explosion protection, the mill fan, the ductwork, the civil works, the electrical installations and the erection of the mechanical equipment.

Legal basis

The European Directive 94/9/EG dated 23 March 1994 (ATEX) defined for the first time basic health and safety requirements relating to non-electric equipment intended for use in areas with danger of explosion. In particular, this applies to the protection of workers against risks arising from the use of equipment and protective systems in potentially-explosive atmospheres. Belgium, as a member of the European Union, is subject to this directive and therefore, the new coal grinding plant at CBR Lixhe had to be planned, constructed and operated in compliance with the legislation. The basic requirements of the ATEX directive had to be complied with and evidence of compliance had to be provided.

This applied not only to the mill but also to the components supplied along with the mill such as rotary feeder or safety dampers. In particular the protective systems, eg the quick-action dampers, had to comply with the requirements laid down in this directive. The supplier had to issue an ATEX declaration of conformity. The documents submitted in connection with the coal mill in Lixhe were checked and certified by the TÜV Rhineland technical inspection authority.

Plant layout

Figure 3 shows the plant process diagram. The coal is fed into the MPS 225 BK (2) through a pressure shock-resistant, self-purifying rotary feeder (1). After being dried, ground and classified in the mill system, the finished product extracted from the classifier (3) is collected in a bag filter, discharged from the filter via screw conveyors and a rotary feeder. The product is then conveyed pneumatically to the coal intermediate silo.

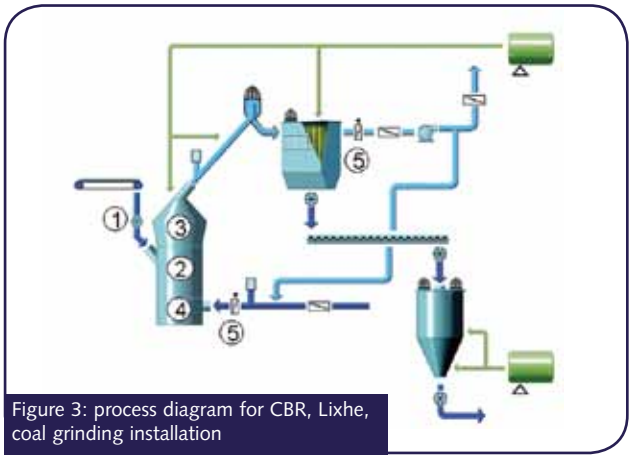

Figure 3: process diagram for CBR, Lixhe, coal grinding installation

Rapid-action dampers (5) are installed in the gas ducts before and after the mill, serving as a safety system in addition to the mill, filter and silo being inerted with CO_2.

The filter and silos are equipped with pressure relief valves to vent the shock wave and to release possible flames into the atmosphere in case of an explosion.

Measurements of CO, O_2 and dust are taken downstream of the filter for monitoring the grinding plant. CO and temperature are monitored in the pulverised coal silo. If the preset limits of CO and O_2 concentration are reached, the safety systems, such as safety dampers, CO_2 inertisation of the mill, filter and silo, are activated.

The MPS 225 BK has a grinding table diameter of 2.25m. The three ϕ1.5m grinding rollers are equipped with tyres made of Magotteaux-XWin® – a wear-resistant material consisting of granulated ceramic material combined with a high chrome alloy in a casting process. The installed power at the main gearbox is 500kW. The high-efficiency classifier SLS 1800 BK is equipped with a 22kW-rated drive. The rating of the mill was based on the well-known Hardgrove grindability test 2.

Figure 4 (above): the new foundation placed onto the existing floor rather than embedded in the ground

Figure 5 (right): the preassembled mill housing

Project execution and erection

The planning phase was followed by delivery, installation and commissioning. The installation phase was characterised by strictly-organised site logistics because not only erection activities were carried out but also the internal procedures of the cement works had to be taken into consideration. The foundation inside the building had to be reused. Figure 4 shows the new foundation that is not embedded into the ground but placed on the existing floor of the building.

Erection conditions were difficult due to lack of space. Figure 5 shows the logistical challenges of transporting the preassembled mill housing into the mill building.

A very narrow space was provided for the classifier platform and the classifier itself. Installation of the upper classifier parts was a challenge for the fitters and crane drivers (Figure 6). Ductwork was redesigned inside the building.

Optimised procedures enabled the erection inside the building and the completion of the plant within a period of only 32 days.

Operating experience

No-load tests of the coal grinding plant started in March 2011, followed by commissioning and plant takeover in April 2011. The performance test was conducted in June 2011 and the mill was guaranteed to grind 34tph of coal with feed moisture ranging between 8-16 per cent. The ash content of the coal lies between 13-22 per cent and the grindability according to Hardgrove between 64-67. The required fineness is less than seven per cent R0.090mm. Table 1 gives the guaranteed figures and the production figures that have been achieved. The new coal grinding plant fully meets the expectations in terms of production capacity and operating values.

General references in coal grinding

More than 1000 MPS mills are being used worldwide for processing various types of coal, ranging from lignite to petcoke, including different kinds of hard coal and anthracite.

Commissioning of many coal grinding mills is currently in progress – for example, in India where an MPS 3070 BK grinding 58tph of lignite at 15 per cent R0.090mm is in operation at Jaiprakash Associates' Balaji cement plant and an MPS of same size for hard coal grinding at a steelworks with a throughput of 60tph at 17.5 per cent R0.090mm.

In Ukraine, the erection of an MPS 200 BK for coal grinding is completed, and commissioning will start soon.

In Sudan, an MPS 250 BK set up at Al Shamal plant has recently passed the acceptance test, producing 30tph of petcoke at three per cent R0.090mm.

In addition, several MPS 3550 BK mills with an installed power of 1300kW that were sold to different cement plants in India are in the order processing stage.

Conclusion

To meet market demands for flexibility in terms of grinding and drying the most diverse range of solid fuels, GPSE has continuously developed and enhanced the process and design criteria of the MPS coal grinding mill. Vertical roller mills in general are the most energy-efficient and reliable systems for this broad range of applications.

References

[1]ONESTONE INTELLIGENCE GMBH (2009) "Cement Projects Focus 2013", *Multi-Client Market Report.* 12/2009, Buxtehude, Germany.

[2] KRAFT, B AND REICHARDT, Y (2005) "Grinding of solid fuels using MPS vertical roller mills" in: *ZKG International 58*, No 11, p36-47.

Table 1: guaranteed and achieved parameters for pulverised coal

Parameter	*Guarantee*	*Actually achieved*
Throughput rate – dry (tph)	34	36.2
Finished product fineness (% – R0.090mm)	<7	<6.7
Finished product moisture (%)	<1	1.29
Specific power consumption (kWh/t)	11.7	10.7
Vibration level (mm/s)	2.5	0.4
Differential pressure mill (mbar)	<67	37

Figure 6: inside the mill building