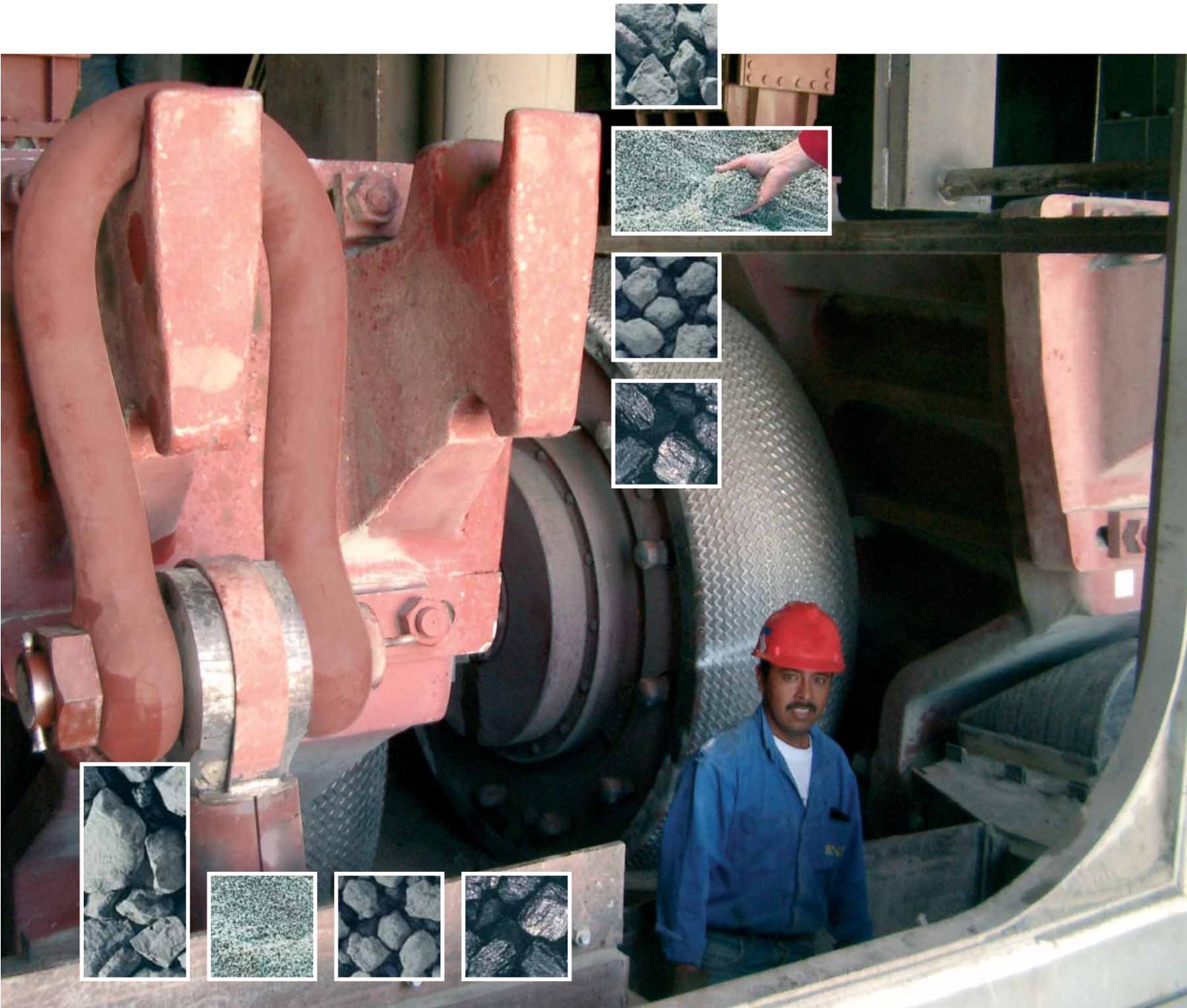


Polysius Roller Mills. For grinding.....



A company of
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Technologies

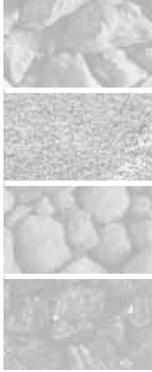
Polysius



ThyssenKrupp

Multitalent à la carte.

Roller mills from Polysius – suited to every application.



The extensive range of Polysius roller mills provides requirement-specific solutions for the economic, reliable and energy-efficient grinding of:

- raw materials for the cement manufacturing process,
- granulated blast furnace slag, trass, pozzolana,
- clinker for different cement qualities,
- hard coal, lignite, coke, petroleum coke and sewage sludge,
- clay, limestone, burnt lime and raw phosphate

... thus ensuring the efficient comminution of materials with greatly differing characteristics with regard to grinding resistance, abrasiveness, moisture content, granulometric composition and flow properties.

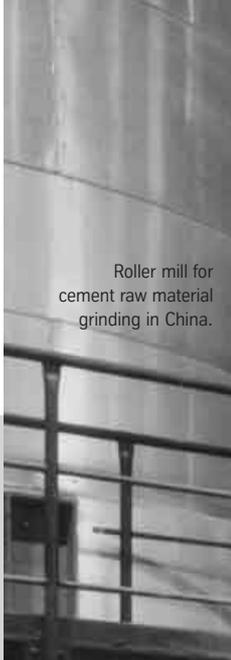
Our comprehensive process knowhow (including extensive data from raw material investigations and grinding tests), our continuous research and development work and our intensive co-operation with plant owners provide the basis for dependable machine design and are the reason for the immense success of Polysius roller mills all around the world.

The Polysius scope of supply not only covers custom-tailored

roller mill designs for throughput rates of up to and exceeding 600 tph and drive powers of up to 6,000 kW, but also the optimisation of existing grinding plants and a broad range of customer-specific services.



The Polysius Research and Development Centre uses the test-roller mill Atrol (throughput approx. 240 kg/h) for grindability testing and quantitative prediction of wear in industrial mills.



Roller mill for cement raw material grinding in China.



Roller mill for cement clinker grinding in Mexico.



Coal grinding plant in Poland.

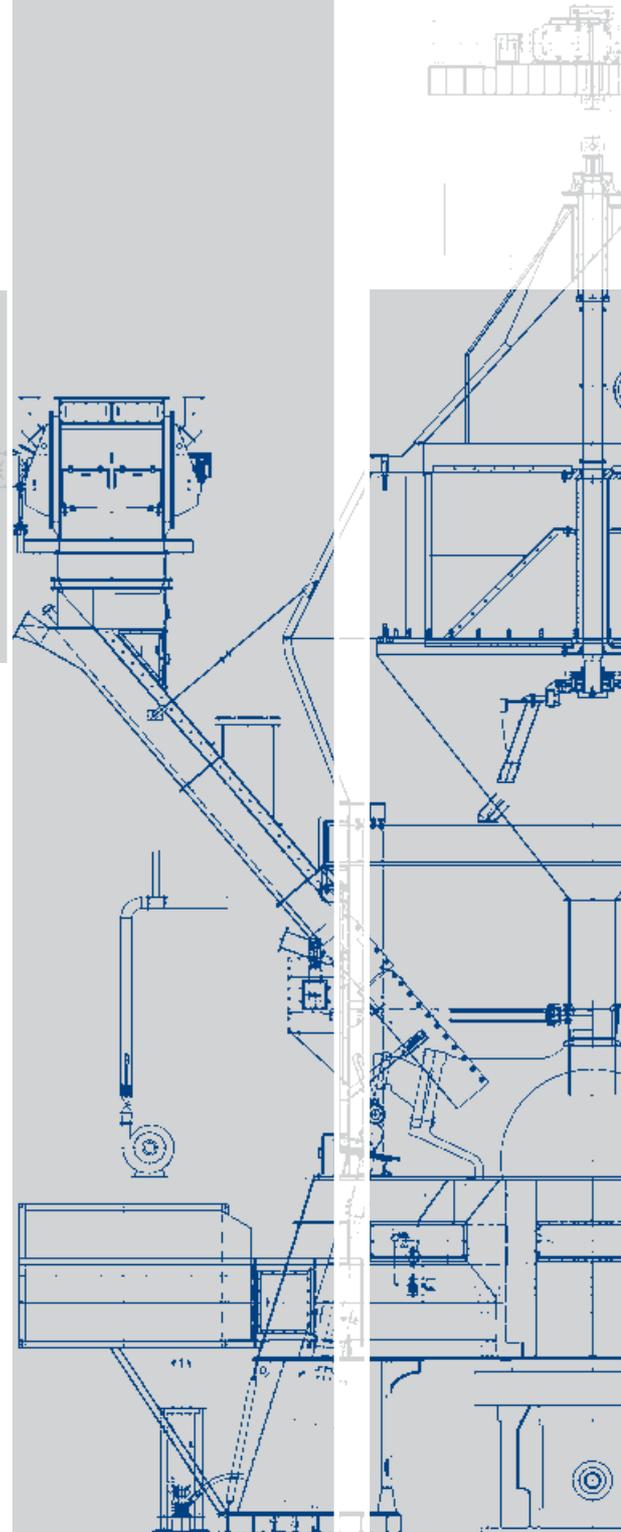


Roller mill for granulated blast furnace slag grinding in China.



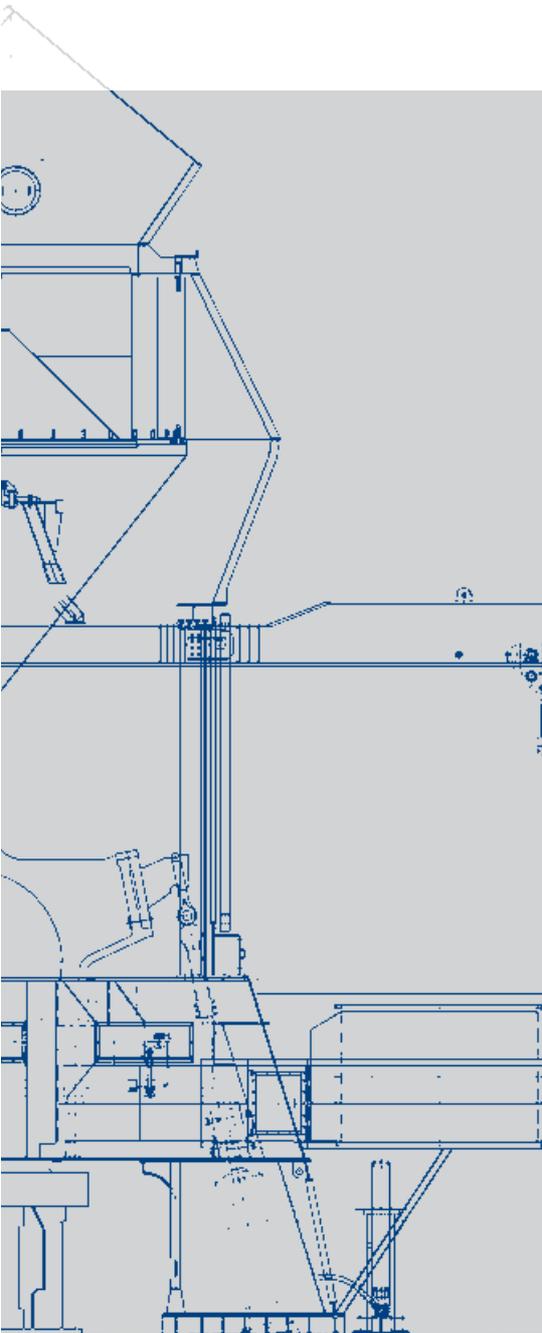
Advantages of Polysius roller mills at a glance:

- High operating reliability and availability, as well as easy system handling, due to the fact that grinding, drying and separation all take place in a single compact unit.
- Consistently high product quality with minimum energy requirement, due to the integrated high-efficiency separator.
- Housing contours of mill and separator optimally designed to transport finish-ground material quickly and reliably to the separator and reduce material circulations which disturb the grinding process.
- Additional reduction of the energy requirement due to the external material circulation.
- Very low pressure drop in the grinding system due to optimisation of the gas velocity and gas distribution by the adjustable nozzle ring.
- Optimum feed material pull-in conditions and grinding efficiency due to the double groove grinding table.
- Constant economy of operation due to infinitely variable pressure adjustment of the hydraulic system.
- Overall ease of maintenance due to the large doors, which are simple and safe to handle, and to the dismantling devices, with which the grinding rollers and table liner segments can be replaced quickly and without any problem.
- Outstandingly economic mill housing wear protection due to requirement-specific selection of materials.
- Use of economically optimum grinding element qualities – chrome chilled casting, hardfacing, ceramic materials.



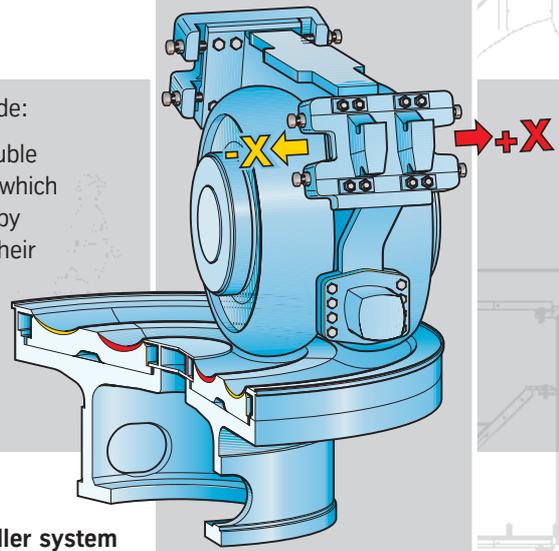
Assembly of a roller mill for granulated blast furnace slag grinding in China.





The core components of the roller mill include:

- the wear-protected grinding table with double groove grinding track
- two roller pair units which adapt independently to the bed of material by vertical movement and by pivoting around their guide pin
- the housing
- the adjustable nozzle ring
- the drive
- the high-efficiency separator
- the hydraulic system
- the discharge system and the external material circuit
- the feed valve and the feed chute.



Double grinding roller system

Two double roller pair units rotate on the driven grinding table. The principle of double roller pair units results in a low speed difference between roller and grinding table and thus in lower wear. The ability of the grinding rollers to move vertically enables them to automatically compensate for wear and maintain an optimum contact between the grinding element and the material being ground.

If one roller is lifted by the bed of material, the other presses down even more strongly. This interactive mode of working improves the grinding effect. Advantage: the throughput and the specific power requirement remain constant right until the end of the grinding elements' service life.

The different wear rates of the inner and outer rollers and grinding tracks can be equalised by infinitely variable adjustment of the point of force introduction into the roller carrier in the direction +X or -X. This adjusts the grinding force distribution to match the wear, thereby maximising the utilisation of the grinding elements. It is also possible to turn the roller pair around, so that the outer roller moves to the inside and vice

versa, which results in a uniform wear profile and thus in a long service life.

Double groove grinding track

In the Polysius roller mill, the double groove grinding track increases the retention time of the material on the grinding table. This is a particular advantage in the case of material with unfavourable grinding properties and a tendency not to form a stable bed.

The double groove grinding track also ensures that the bed of material is not too deep and minimises the amount of material passing unground between the rollers and the grinding table. This reduces the specific power requirement.

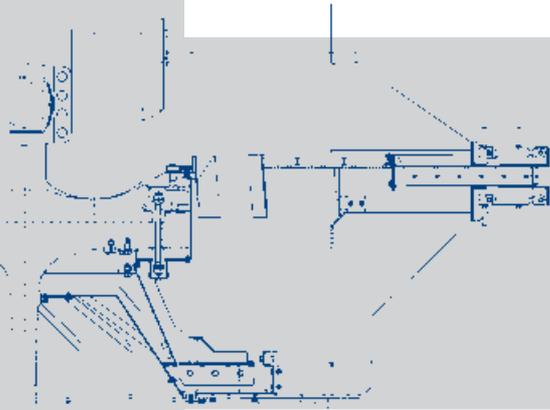
The details decide...



Adjustable nozzle ring

The gas required for transporting and drying the material inside the mill flows through the nozzle ring.

The gas distribution and velocity can be optimally adjusted to suit the required material loading or drying capacity, thus minimising the specific gas flow rate and the pressure drop in the grinding system.



Hydraulic system

The grinding force is applied to each roller pair unit by two hydraulic cylinders. Infinitely variable pressure control automatically adjusts the grinding force to the current operating conditions of the mill.

This ensures constant economy of operation over the entire throughput range (i.e. even under partial-load conditions). When the mill is starting and stopping, the grinding force is reduced by lowering the hydraulic pressure. Each hydraulic cylinder is connected to a piston accumulator which absorbs the grinding shocks.

Drive

The roller mill drive consists of the motor and a planetary gear unit that was specially designed for roller mills. This gear unit is equipped with a hydrodynamic axial thrust bearing with partial or full hydrostatic lubrication, which accepts the grinding forces and transmits them directly into the foundation of the unit.

An auxiliary drive ensures easy starting up of the mill, even

when it is loaded with material after an emergency stoppage, and allows quick emptying and positioning of the mill for maintenance work.

To allow the grinding of different materials and finenesses, a variable-speed motor or a speed-change gear unit adapts the grinding speed to the required product characteristics and product fineness.

Housing

The housing is fitted with special seals to prevent the inleakage of false air. Easy-to-open doors facilitate maintenance of the mill.

Special dismantling devices ensure straightforward turning-around or replacement of the grinding rollers through the maintenance doors.

The housing contour design guarantees an optimum material distribution, quick collection of the ground material and reliable conveyance of the finished material to the separator.

The design also promotes the formation of a stable grinding bed and greatly reduces the internal circulation of material, so that the mill can also be operated efficiently and stably at high product finenesses.

External material circulation

The gas velocity in the nozzle ring can be specifically minimised, so that a large portion of ground material is not entrained by the hot gas stream but falls through the nozzle ring onto a discharge ring rotating with the grinding table. This material is then returned via a discharge chute and bucket



Hydraulic cylinder of the roller mill.



...the availability and operating economy.



Stages in the assembly of a roller mill in Australia.



Heated material feed system of a roller mill.



View into the interior of the mill during assembly.

elevator to the grinding table or is conveyed to the high-efficiency separator.

The discharge ring is of modular design and made of highly wear-resistant elements for long service lives and simple maintenance.

The energy saving mechanical conveyance by bucket elevator reduces the pneumatic conveying of material in the grinding compartment itself. This has the effect of lowering the pressure drop, minimising the energy requirement and making the mill operation much smoother. Another advantage is that the bucket elevator facilitates emptying the roller mill for maintenance purposes.

SEPOL® high-efficiency separator

For separating the ground material into finished product and oversize, Polysius roller mills include a SEPOL® dynamic high-efficiency separator, which can be adjusted in accordance with various parameters. Due to its excellent selectivity, this separator drastically reduces the specific power requirement for the grinding process.

Material feed system

To ensure efficient feeding of the material and to act as an airlock, a rotary feeder for coarse material and an inlet chute

designed to suit the mill feed material are integral parts of the grinding system.

Both the coarse feed valve and the chute can (if necessary) be indirectly heated in order to ensure reliable operation even in the case of high material moisture contents.

Wear protection

Special materials, adapted to the abrasiveness of the material to be ground, are used for the roller tyres and the grinding track, while special linings are installed in the mill housing and separator.

These ensure effective wear protection and thus increase the service life and the operating economy.



Grinding table gear unit.

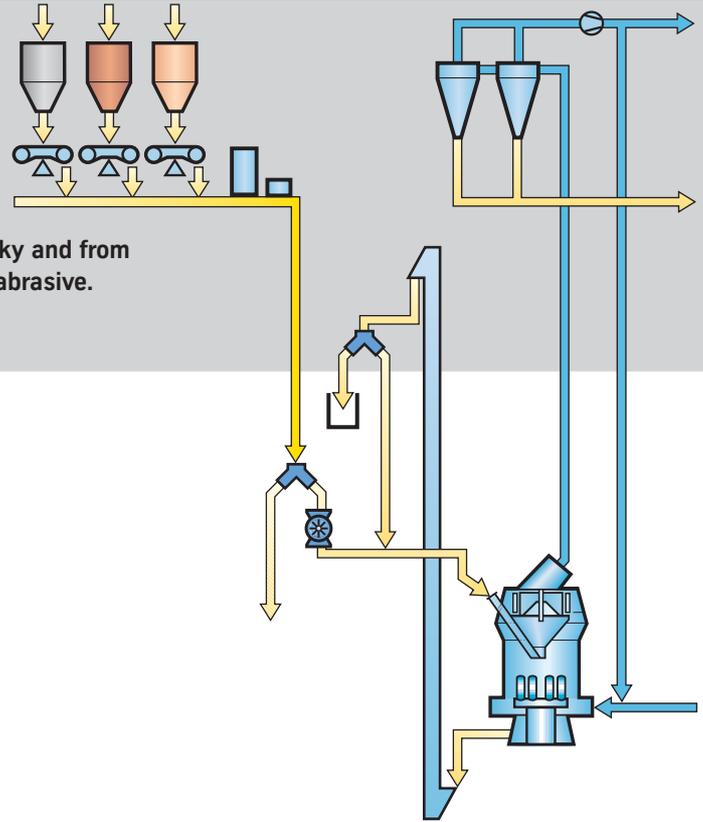


Coarse feed valve.

Polysius roller mills... ...for raw material grinding.



Roller mills from Polysius efficiently grind all raw materials for the clinker manufacturing process – ranging from soft to very hard, from dry and fine to very moist and sticky and from slightly abrasive to extremely abrasive.

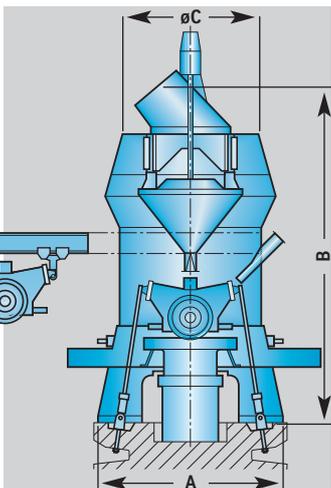


This grinding system includes a feed belt conveyor to the mill (equipped with crossbelt magnetic separator and metal detector), the diverter gate for fast removal of tramp metal, the coarse feed valve (optionally of heatable design) and the feed chute.

The external material circulation and the adjustable nozzle ring minimise the pressure drop of the mill and the energy requirement of the mill system fan.

In addition to the plant layout, design details such as grinding element qualities, the wear protection and the separator version are optimally suited to the raw material grinding requirements.

The parameters determined by the specific feed material, such as energy requirement, operating behaviour and wear characteristics, are established by means of the Atrol test mill and used as a design basis for the mill size, drive power, separator size, wear protection concept and grinding element quality.



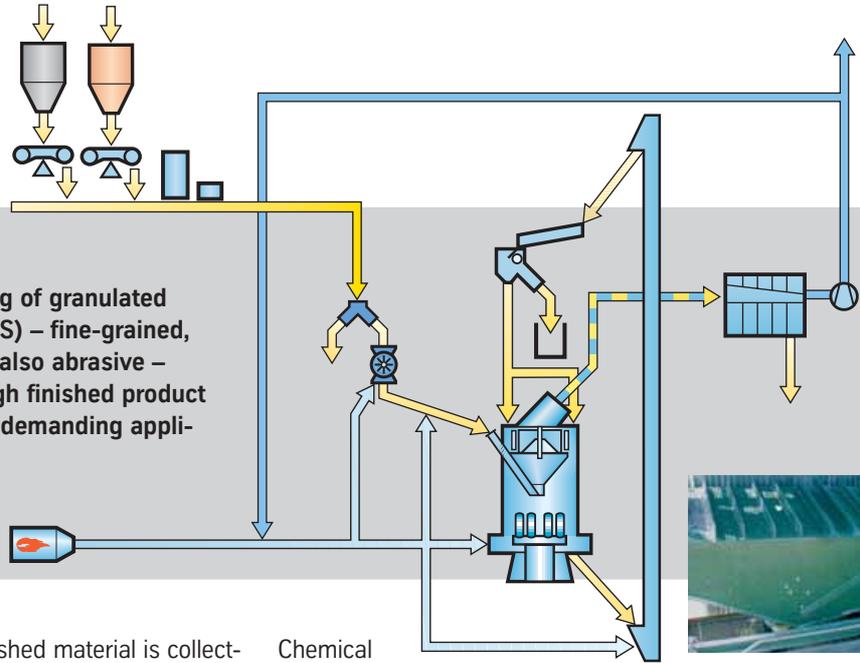
Basic design data.

Type RM		27/13	30/15	33/16	36/18	38/19	41/20	43/21	46/23	48/24	51/26	54/27	57/28	60/29	66/29
Installed power	kW	580	750	950	1190	1360	1650	1850	2190	2440	2840	3270	3750	4260	4800
Throughput <small>(Raw material of average grindability, 12 % R 0.09 mm)</small>	tph	90	115	150	185	210	255	285	340	380	440	500	580	660	740
A	mm	5700	6600	7300	8100	8400	8800	9100	9300	9700	10000	10700	11100	12000	13300
B	mm	10000	11000	12000	13000	14000	15500	16200	17000	17500	18000	19000	22000	25000	28000
C	mm	4000	4300	4800	5200	5700	6000	6600	7000	7500	7900	8400	9000	9300	10200

...for granulated blast furnace slag grinding.



Energy-efficient grinding of granulated blast furnace slag (GBFS) – fine-grained, usually very moist and also abrasive – to an extraordinarily high finished product fineness ... a specially demanding application.



Magnetic drum separator for fine iron removal.

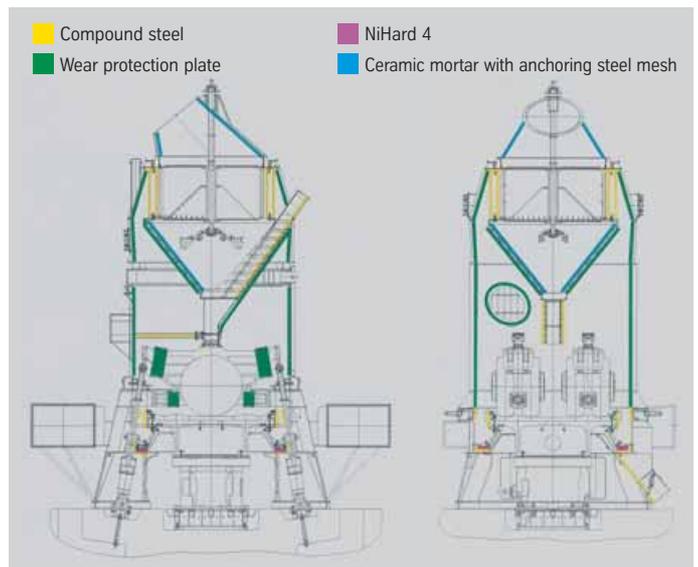
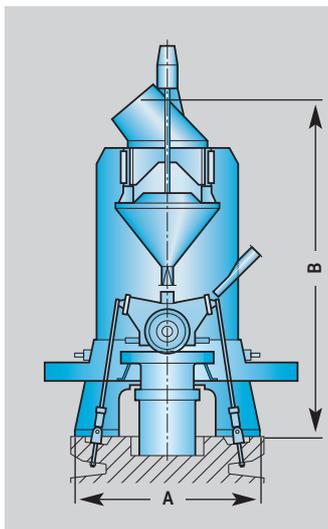
An important feature of the Polysius granulated blast furnace slag grinding system is a generously dimensioned external material circuit, in which the circulating material passes through a magnetic drum separator which removes the liberated fine iron from the process.

The finished material is collected in a bag filter, in order to protect the downstream system fan from abrasive blast furnace slag dust.

A hot gas producer installed for drying the granulated blast furnace slag heats not only the mill, but also the coarse feed valve in the new material feed system, the feed chute and the recirculating bucket elevator.

Chemical analysis of the granulated blast furnace slag provides information on the wear rate of the grinding elements and is thus the basis for selection of the wear protection material.

The mill is designed on the basis of the Zeisel test, which requires only 3 kg of granulated blast furnace slag but shows an excellent correlation to industrial operating results.



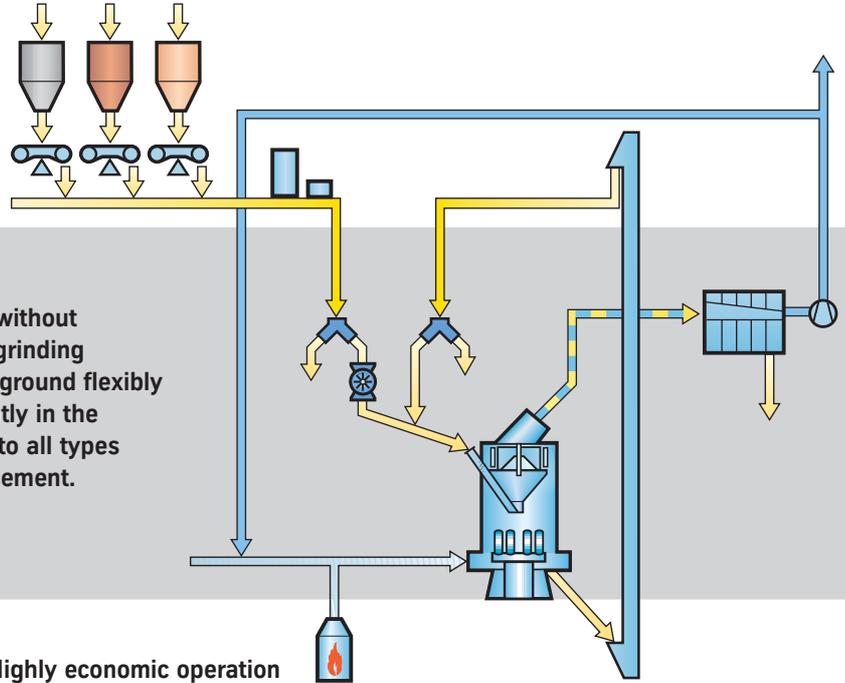
Wear protection for granulated blast furnace slag and clinker grinding.

Type RMS		30/15	33/16	36/18	38/19	41/20	43/21	46/23	48/24	51/26	54/27	57/28	60/29	66/29
Installed power	kW	700	900	1200	1380	1660	1800	2040	2370	2800	3000	3500	4000	4450
Throughput <small>(GBFS of average grindability, 4500 cm³/g acc. to Blaine)</small>	tph	22	28	37	43	52	56	64	74	88	94	110	124	139
A	mm	6600	7300	8100	8400	8800	9100	9300	9700	10000	10700	11100	12000	13300
B	mm	11000	12000	13000	14000	15500	16200	17000	17500	18000	19000	22000	25000	28000

...for clinker grinding.



Clinker – with and without additives and intergrinding materials – can be ground flexibly and energy-efficiently in the Polysius roller mill to all types of highest quality cement.



Apart from the simple system management, the main arguments in favour of using a roller mill for clinker grinding are:

● Highly economic operation
The electrical energy requirement is only about 60 % that of a tube mill system.

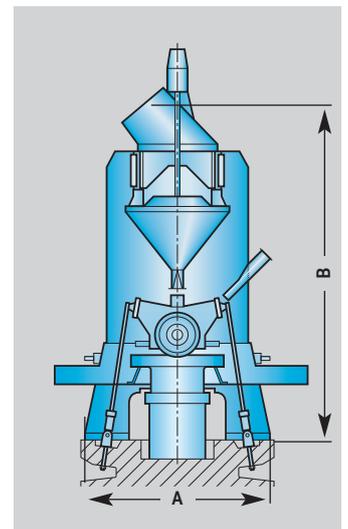
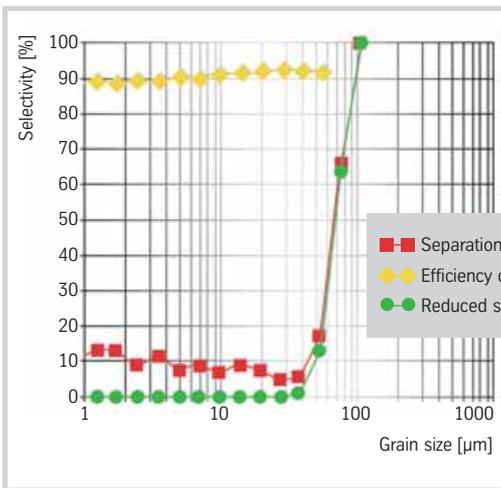
Due to the extraordinarily low wear rates, the service lives of the grinding elements are enormously high (in the case of OPC grinding, the grinding elements achieve lifetimes of above 20,000 hours - without any marked changes in contour and thus with consistently high grinding efficiency).

● Efficient grinding and drying
For composite cement production, the roller mill permits the simultaneous grinding and drying of large amounts of moist additives. For drying the additives and for specifically directed dewatering of the sulphate bearer, the mill can be heated with hot gas from a hot gas producer or with exhaust air from the clinker cooler.

● High flexibility
The short turnaround times permit a very rapid changeover to different product types.

● High product quality
The quality of the produced cements is comparable with that of tube mill products and in some cases is even better.

The outstanding selectivity of the SEPOL®-RMC separator is one of the factors responsible for the plant efficiency. The diagram shows an unclassified portion of only 5 % and a separator efficiency topping 90 % in the relevant grain size range.



Type RMC		30/15	33/16	36/18	38/19	41/20	43/21	46/23	48/24	51/26	54/27	57/28	60/29	66/29
Installed power	kW	502	649	857	984	1183	1276	1465	1698	2006	2147	2507	2834	3188
Throughput <small>(CEM of average grindability, 3000 cm³/g acc. to Blaine)</small>	tph	33	43	56	65	78	84	96	111	132	141	165	186	209
A	mm	6600	7300	8100	8400	8800	9100	9300	9700	10000	10700	11100	12000	13300
B	mm	11000	12000	13000	14000	15500	16200	17000	17500	18000	19000	22000	25000	28000

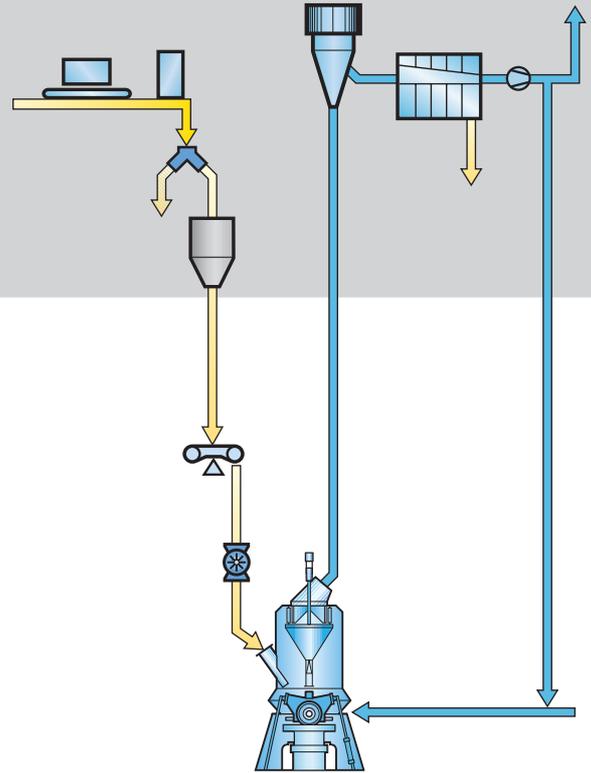
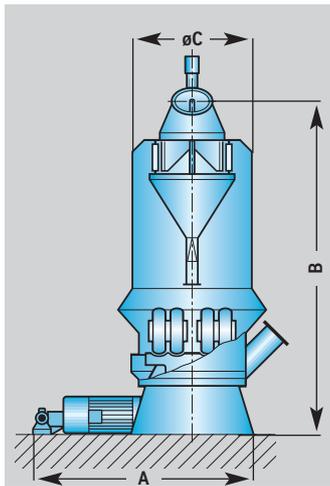
...for coal and petcoke grinding.



Coal, petroleum coke and similar solid fuels can be ground to the product fineness required for the combustion process while observing all safety-engineering requirements.

This grinding system is designed to ensure effective grinding, drying and separation of solid fuels such as coal and petcoke as well as safe handling of the ignitable and explosive powdery products.

The grinding plant therefore incorporates comprehensive safety features including a pressure shock resistant coarse feed valve for mill feeding, pressure shock resistant roller mill and separator up to 8 bar, pressure relief stacks before and after the mill, dust collection filter with explosion vents, quick-closing dampers before and after the filter and system fan and a return air duct equipped with control damper for temperature and gas flow control. Further safety-relevant plant components are the temperature and CO₂ monitoring system and a CO₂ inertisation system.



The mill interior is designed to largely prevent fuel deposits which could be a source of spontaneous combustion. There is no external material circulation. Tramp metal is removed via special discharge systems.

In the case of unknown fuel grades, it is good policy to additionally conduct a pilot test.

In the case of known fuel types, the plant is dimensioned on the basis of the Hardgrove Index and the chemical analysis (ash). In extreme cases and

ideally, the grinding plant is operated with an inert atmosphere (O₂ ≤ 12%). However, it is also possible to use hot air or flue gas with higher oxygen contents - provided that certain values for the hot gas temperature and volatiles content of the fuel are not exceeded.

Type RMK		8/4	11/5.5	13/6.5	15/7.5	17/8	19/9	21/10	23/11	25/12	27/13	30/15	33/16	36/18
Installed power	kW	30	65	100	140	190	250	320	410	500	610	790	1000	1250
Throughput <small>(Hard coal, 50° Hardgrove, 12 % R 0.09 mm)</small>	tph	2.2	5.0	7.5	10.0	14.5	19.5	25	31	38,5	47	61	77	96
A	mm	2250	2750	3500	4350	3200	4450	5000	5650	5900	6200	6700	7500	8500
B	mm	2500	3500	4800	5000	5800	8000	8300	8700	9400	11000	12500	14500	17000
C	mm	1150	1800	2200	2350	3000	3100	3200	3750	4200	4700	4900	5400	6000