POLYCOM®
high-pressure grinding roll.
Outstanding results are obtained with the high-pressure grinding roll for the comminution of brittle minerals. Since the POLYCOM® was introduced onto the market in 1985 by Krupp Polysius, over 200 have been sold. More than half of the 400 mills operating on the interparticle comminution principle world-wide thus bear the name POLYCOM® and stand for «made by Polysius».

The excellent operating results, the substantial reduction in energy consumption with resulting cost savings, the enormous increases in the capacity of existing conventional grinding plants, the fact that uneconomical plant sections can be shut down, thus slashing operating and maintenance costs – these major advantages place the POLYCOM® at the forefront of modern grinding technology.

As every second interparticle comminution unit is a POLYCOM®, Krupp Polysius naturally possess correspondingly comprehensive application know-how. The POLYCOM® can be designed for throughput rates of up to 1,000 tph or above. The feed material can be dry or moist and the largest possible feed size can exceed 100 mm. The POLYCOM® can be used as a primary grinding unit, in combination with e.g. tube mills, or as an independent finish-grinding unit. The larger the amount of grinding work performed by the high-pressure grinding roll, the greater is the energy saving compared to other systems.

High-pressure grinding rolls are being used with great success in all parts of the world for grinding
- cement raw materials,
- cement clinker,
- granulated blast furnace slag,
- coal,
- ores and
- other minerals.

As the most energy-efficient of all types of mill, the high-pressure grinding roll has established itself world-wide as the centre piece of grinding systems. Modern, user-friendly regulating, monitoring and control devices, combined with advanced process technology, ensure reliable and effective operation.
Comminution in the POLYCOM® is based on the following principle: When a brittle particle of material is subjected to pressure between two grinding media, only that one particle is comminuted. However, when a particle is subjected to pressure between two other particles, all three particles are comminuted. This involves very little relative movement between the grinding media and the material being ground and between the particles in the layer of material.

The outcome is that the POLYCOM® needs less than half the energy consumed by a tube mill in order to achieve the same fineness of grinding.

The grinding media are two counter-rotating rolls, one fixed and the other floating, between which the material is pressed. The required comminution pressure is transmitted via the floating roll.

Whereas the grinding action of a tube mill involves a mixture of compressive and shearing forces, the POLYCOM® imposes virtually pure compressive force on the layer of material between the rolls. The compressive strains thus caused in the particles of material are more than five times higher than shearing strains, which explains the extremely high comminution effectiveness of this type of mill.

This pressure comminution produces compacted cakes of material containing a high proportion of fines. Moreover, the coarser particles show extensive cracking. Depending on the foreseen use of the product, the cakes can either simply be disagglomerated, ground further and, if necessary, classified or conveyed to a further downstream process.
POLYCOM® high-pressure grinding roll applications in the cement industry.

To meet the different application requirements of this industry, a variety of system configurations are available. These consist of the basic process stages
- flow-regulated feeding,
- comminution and
- separation.

Additional stages, such as
- drying,
- moistening,
- disagglomeration and
- storage
can be incorporated into the system as required.

**Finish grinding**

Use of the high-pressure grinding roll for finish grinding achieves the greatest energy savings. These can be as high as 50%, compared with conventional tube mill systems. Feed material with up to 4% moisture content is dried in the separator. Material with higher moisture contents is dried in a separate unit, for instance a shaft-type flash dryer.

**Combi grinding**

Used in combination grinding systems, the POLYCOM® brings energy savings of up to 40% compared with conventional tube mill systems, as well as increasing the throughput of existing tube mill grinding plants by over 100%. The product of the primary grinding circuit is classified material. In case of a new installation the ball mill can therefore be of a smaller size. Also, the defined size of the feed material allows optimum grading of the ball charge. The material is dried in the tube mill. This system allows the incorporation of several tube mills and permits separate primary grinding of different components.

**Hybrid grinding**

When operated in a hybrid grinding system, the POLYCOM® permits energy savings of up to 30% compared with conventional tube mill systems, as well as increasing the throughput of existing tube mill grinding plants by up to 70%. In a hybrid grinding system, part of the separator tailings flow is recycled to the POLYCOM®, where it is fed in together with the fresh material. Unlike the combi grinding system, compacted cakes form the product of the primary grinding circuit.
**Pre grinding**

When the high-pressure grinding roll is used for pre grinding, the throughput of existing grinding plants is increased by up to 40% and the energy requirement of the overall plant is reduced by up to 20%.

**Energy utilisation and comminution pressures with different clinker types**

**Grinding of coals with different hardnesses**
POLYCOM® high-pressure grinding roll applications in the basic material industry.

Compared with crushers, the high-pressure grinding roll produces a significantly higher amount of fines. Also, the particles in the POLYCOM® product have extensive micro-cracking. These differences have a great advantageous effect on the grinding process and on the metallurgy of the downstream processes.

**Lower operating costs – higher throughput rates**

The higher proportion of fines and the reduced Bond Work index mean that the downstream tube mills have a far lower energy requirement, which allows their throughput rates to be increased. At the same time, the specific wear costs of the tube mills is reduced.

Combined with the low wear and energy costs of the POLYCOM® itself, these effects significantly reduce the plant operating costs.

**Improved profitability**

Use of the high-pressure grinding roll increases the profitability of many processes in the various ore-preparation industries. For instance: returns in the diamond industry are boosted by the gentler liberation and higher yield; in the gold and copper industries comprehensive metallurgical studies prove an increased yield in many processes and in the iron preparation industry the superior characteristics of the POLYCOM® product improve pellet quality and permit process simplifications.
Application examples...

The POLYCOM® high-pressure grinding roll can be operated in open circuit or in compound operation with screens. When comminuting materials with problematical screening characteristics, a part of the product can be returned to the POLYCOM® in order to increase the product fineness.

The high-pressure grinding roll can be used as a pre grinding unit serving tube mills to increase the throughput rate and reduce the operating costs, as a result of the low energy and wear expenses. The POLYCOM® can take over the work of the third and fourth crusher stages, as well as that of a rod mill.

Also, the high proportion of fines in the POLYCOM® product means that a part of the tube mill's grinding work is shifted to the high-pressure grinding roll. In compound operation with a SAG mill, the POLYCOM® can be used for increasing the grinding plant's throughput.

Heap leaching processes also benefit from incorporation of the POLYCOM®. The ground product can either be conveyed directly to the heap or first undergo an agglomeration process. The fines can also be further processed by agitator leaching.
Innovative POLYCOM® design: the basis for high availability and economical continuous operation.

To meet the requirements imposed on interparticle comminution, such as:
- low stressing of the roll surfaces, in order to assure long service lives,
- energy-efficient production of the compacted cakes,
- optimum material draw-in performance, in order to assure maximum throughput and
- very smooth running, in order to protect the machine,

the POLYCOM® grinding rolls have a length to diameter ratio of between 0.3 and 0.6. The resulting large distance between shafts permits:
- large shaft diameter for absorbing the bending and torsional stresses,
- generously sized self-aligning roller bearings, assuring low bearing loads,
- relatively small distance between bearings, thus minimising the bending moments,
- thick wearing layers on the roll surface for long operating times,
- thick tyres for safe shrunk-on fit and
- clamped segments.

The fixed and floating rolls are both mounted in bearing blocks. The self-aligning roller bearings, which accommodate skewing of the rolls, all have a triple sealing system to prevent dust penetration and grease leakage. The bearing blocks of the fixed roll are bolted onto the machine frame, while those of the floating rolls travel in a slideway.

The grinding force, which can amount to several MN, is transmitted to the floating roll by 4 hydraulic cylinders. The use of 2 cylinders per side ensures that the power transmission is torque free. The floating roll automatically accommodates changes in feed material characteristics by moving outwards or inwards. Spacers prevent the rolls from touching. The fixed and floating rolls are of identical construction and can therefore be interchanged.

Several roll wear protection systems are offered by Krupp Polysius:

**Hard cast segments** are used for low comminution pressures and very abrasive feed materials
- service life 1,500 to 15,000 hours, depending on abrasiveness of the feed material,
- very quick to change,
- low stocking costs for spare parts,
- high wearing-metal thickness; up to 160 mm.

**Forged steel roll bodies with build-up welding and hard facing layers** are used for medium comminution pressures
- service life up to 17,000 hours, depending on stresses and mode of operation,
-10 to 12 mm wearing-layer thickness,
- rewelding can be carried out while the roll is mounted in the machine.

**Solid hard cast rolls** for high comminution pressures
- service lives of above 40,000 hours have been achieved so far,
- high wearing-metal thickness; up to 160 mm.
- pressure-resistant and durable base metal.

To maximise the material draw-in performance, the rolls usually have a welded-on profile or, in the case of particularly abrasive materials, have a ‘Durapin lining’. These profiles also minimise the relative movement between material and roll surface and thus reduce the wear.

The hydraulic system essentially consists of
- regulating device for continuously adapting the hydraulic pressure to the operating conditions,
● oil supply system with high-pressure pump and filter unit,
● hydro pneumatic spring system with pressure cylinders and piston accumulators,
● backward travel hydraulic system for moving back the floating roll and
● pressure and position measuring devices.

The main components of the central lubrication system are
● replaceable grease reservoir with grease pump,
● compressed air supply for the grease pump,
● grease distribution system for the slide rails of the floating roll’s bearing blocks and
● grease distribution system for the self-aligning roller bearings.

The grinding roll drive system consists of
● constant-speed or variable-speed electric motors,
● V-belt connection to the gearbox for units up to 300 kW,
● cardan shaft connection to the gearbox for units above 300 kW,
● hydraulic overload couplings for protecting the gear unit,
● planetary gear unit, possibly multispeed,
● detachable flange connections between gearbox and roll shaft.

The material feed device above the POLYCOM® grinding rolls is designed in accordance with the laws of bulk mechanics, so that the feed material is optimally fed as a mass flow to the grinding media. The feed bin can be mounted on weigh cells for continuous measurement of the filling level. The walls of the vertical feed chute can be adjusted during operation, in order to adapt the POLYCOM® throughput to current requirements.
To determine the comminution properties of different feed materials, Krupp Polysius have various laboratory-scale POLYCOM® high-pressure grinding rolls in the firm’s Research and Development Centre.

Especially if the high-pressure grinding roll is to be used for new applications, it is often useful to grind a large quantity of test material or to incorporate the high-pressure grinding roll into an existing pilot plant. For this purpose, Krupp Polysius provide mobile, semi-industrial POLYCOM® units on a temporary rental basis. These units are supplied with the complete drive and control systems in containers. The size of the machines and their throughput capacities of 40 – 60 tph permit realistic simulation of industrial processes.
### Technical data.

#### For the cement industry

<table>
<thead>
<tr>
<th>Roll diameter [mm]</th>
<th>10/4-1</th>
<th>12/4-2</th>
<th>13/5-3</th>
<th>14/5-4</th>
<th>15/6-5</th>
<th>16/8-6</th>
<th>17/10-7</th>
<th>19/10-8</th>
<th>20/12-9</th>
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<tbody>
<tr>
<td>Throughput [t/h]</td>
<td>110</td>
<td>160</td>
<td>200</td>
<td>260</td>
<td>330</td>
<td>420</td>
<td>540</td>
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<tr>
<td>Drive power [kW]</td>
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<td>560</td>
<td>900</td>
<td>1100</td>
<td>1450</td>
<td>1650</td>
<td>1900</td>
<td>2500</td>
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<td>L1 [mm]</td>
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<td>1650</td>
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<td>2500</td>
<td>2600</td>
<td>2600</td>
<td>2700</td>
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<td>6160</td>
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<tr>
<td>B [mm]</td>
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<td>2110</td>
<td>2230</td>
<td>2320</td>
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<td>2830</td>
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<td>3180</td>
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<td>H [mm]</td>
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<td>1855</td>
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<tr>
<td>Y [mm]</td>
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<td>3570</td>
<td>3875</td>
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<td>4800</td>
<td>5400</td>
<td>6000</td>
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#### For the basic materials industry

<table>
<thead>
<tr>
<th>Max. roll diameter [mm]</th>
<th>10/4 M</th>
<th>12/5 M</th>
<th>14/6 M</th>
<th>17/8 M</th>
<th>20/10 M</th>
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<td>Average roll diameter [mm]</td>
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<td>Roll width [mm]</td>
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<td>800</td>
<td>1000</td>
<td>1000</td>
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<tr>
<td>µ = D · L · u</td>
<td>0.48</td>
<td>0.82</td>
<td>1.41</td>
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<td>3.37</td>
<td>3.94</td>
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<tr>
<td>Throughput [t/h]</td>
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<td>Roll speed [U/min]</td>
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<td>20,0–25,7</td>
<td>16,5–23,0</td>
<td>13,0–21,1</td>
<td>11,0–20,0</td>
<td>11,0–19,1</td>
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<tr>
<td>Drive power [kW]</td>
<td>300</td>
<td>560</td>
<td>1100</td>
<td>1650</td>
<td>1900</td>
<td>2500</td>
</tr>
<tr>
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<td>2400</td>
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<tr>
<td>L2</td>
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<td>5700</td>
<td>6000</td>
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</table>

1) Adaptation to special requirements possible
2) Referred to \( m = 120 \text{ t} \cdot \text{s} / \text{m}^3 \cdot \text{h} \), average diameter
3) Lower speeds possible with reduced capacities

(dimensions subject to modifications)