

POLYCOM[®] high-pressure grinding roll for the minerals industry.



A company
of ThyssenKrupp
Technologies

Polysius



ThyssenKrupp

POLYCOM® high-pressure grinding roll.

The economic and gentle processing solution.

The high-pressure grinding roll has proved extremely effective for the grinding of mineral raw materials. With more than 250 POLYCOM® installations in different industrial sectors, Polysius is the worldwide market leader for this technology.

60 % of the high-pressure grinding rolls installed in the minerals industry are from Polysius: the POLYCOM® operates convincingly all around the world, comminuting ● copper ore ● gold ore ● iron ore ● diamond ore ● platinum ore ● coal ● granulated blast furnace slag ● limestone ● cement clinker and ● other mineral raw materials.

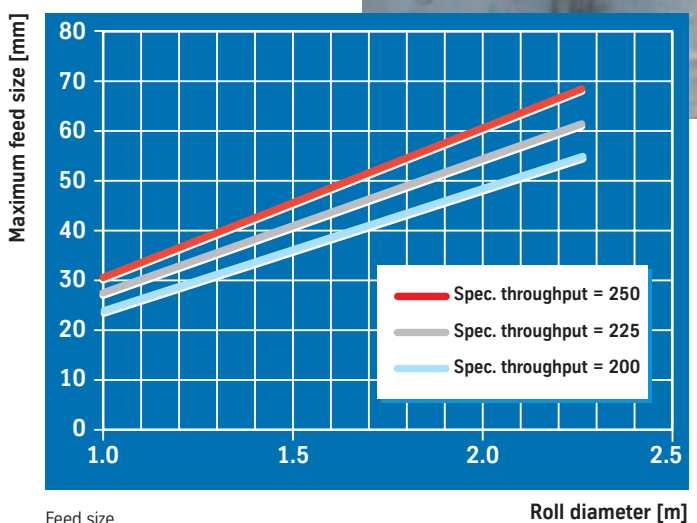
This type of mill offers the minerals industry numerous benefits:

Low operating expenses: in comparison to other systems, both the power consumption and the costs for wear parts are significantly lower.

High throughput rates: a high-pressure grinding roll can replace several reduction crushers.

Metallurgical advantages in the downstream process stages.

Shorter delivery and commissioning times than can be achieved with other systems.



Feed size in relation to roll diameter.

Roll diameter [m]

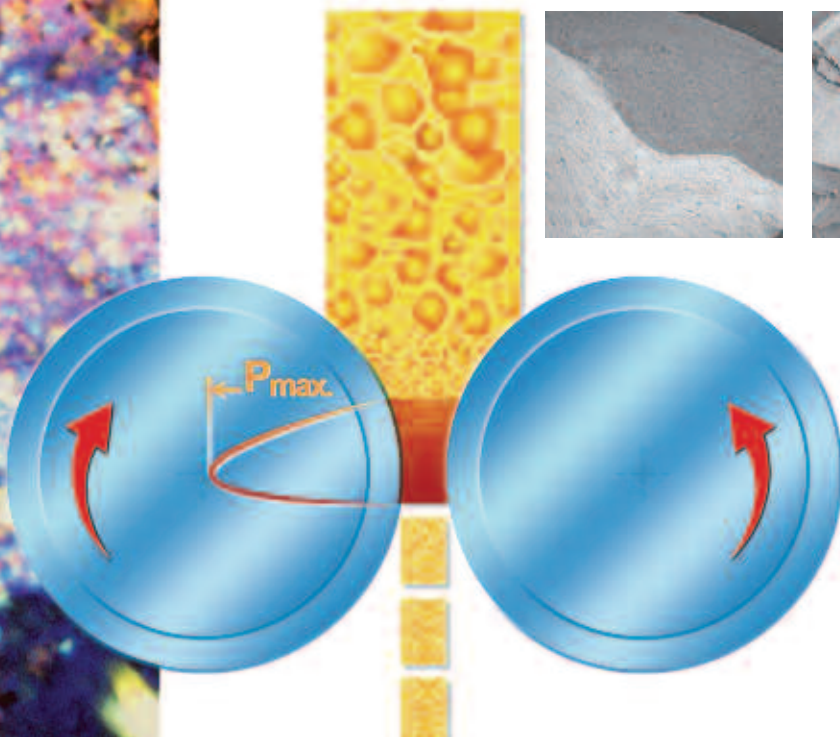
Compared to the crusher product (left-hand picture) the POLYCOM® product is extensively cracked.

POLYCOM® units are designed for throughput rates in excess of 3,000 tph. The mill feed material can be dry or moist and with particle sizes ranging from below 1 mm to more than 75 mm. If required, the material can be dried in screens or air separators in a closed circuit grinding system.

The new low-maintenance wear protection systems for roll surfaces permit even the most abrasive materials to be efficiently ground. **Because of**

the short material dwell time in the mill, the settings of the machine can be altered within a very short time by the touch of a button, making the process easy to control and permitting quick compensation for fluctuations in the properties of the feed ore.

Modern, user-friendly regulating, monitoring and control devices, combined with advanced process technology, ensure reliable and effective operation of the plant and an efficient process cycle.





The grinding elements of the high-pressure grinding roll are two counter-rotating rolls, one fixed and the other floating, between which the material is crushed.

The required comminution pressure is transmitted by a hydraulic system via the floating roll.

The following features distinguish the POLYCOM® high-pressure grinding roll from other grinding systems:

- A hydropneumatic spring system builds up a pressure of up to 250 Mpa. During operation of the machine it is possible to alter the pressure and thus change the product fineness.
- Highly wear-resistant roll surfaces achieve service lives of 4,000 to 10,000 hours when grinding abrasive hard rock. When softer materials are involved, the service life can even exceed 20,000 hours.
- The feeding device ensures that the machine permanently runs with the optimum filling level - the precondition for efficient operation and a high service life of the rolls.

- The drive system can be equipped with variable speed motors in order to compensate for throughput variations in the upstream and downstream process.

Whereas the grinding action of a tube mill involves a mixture of compressive and shear forces, the POLYCOM® imposes virtually pure compressive force on the layer of material between the rolls. The compression stress thus caused in a particle of material is more than five times higher than shear stress would be.

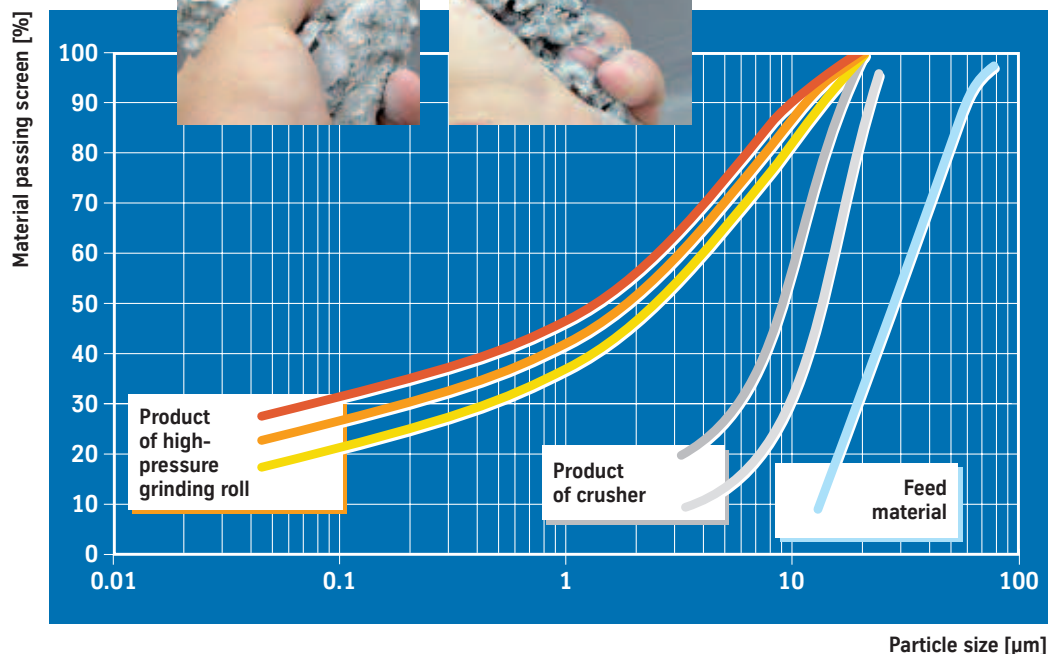
Comminution in the POLYCOM® results in a product that has a far higher percentage of fines

than can be achieved with the crusher method. Moreover, the coarser particles show extensive cracking which reduces the amount of grinding work to be performed in the downstream mills and improves the liberation of metal from the ore.

The benefits are particularly noticeable in the heap leaching process, where the POLYCOM® product demonstrably increases the yield and thus the operating economy of the facility.



POLYCOM® particle size distribution.



Innovative POLYCOM® design.

The guarantee for high availability and economical continuous operation.

In order to fulfil the expectations placed on the high-pressure grinding roll, such as ● high roll surface lifetimes ● optimum feed material pull-in capability for maximum throughput rates, even of moist materials ● straightforward replacement of worn out roll bodies, the POLYCOM® rolls have a length to diameter ratio of 0.3 to 0.7.

This provides the following advantages:

- large roll diameters allow the feeding of lumpy ores
- minimised wear costs,
- thick roll tyres permit refurbishment of the roll bodies (a further wear-cost-reducing aspect),
- self-aligning roller bearings dimensioned for a safe and reliable operation,
- quick and safe mounting and dismounting of the gear unit during roll changes because it is only bolted onto the shaft.

Self-aligning roller bearings compensate skewing of the floating roll.



The fixed and floating rolls are both mounted in bearing blocks. The self-aligning roller bearings, which compensate for skewing of the rolls, have a multiple seal system to prevent dust penetration and grease loss. The bearing blocks of the fixed roll are bolted onto the machine frame, while those of the floating rolls travel in a longitudinal slideway. The fixed and floating rolls are of identical construction and can therefore be interchanged.

The grinding force is transmitted to the floating roll by 4 hydraulic cylinders.

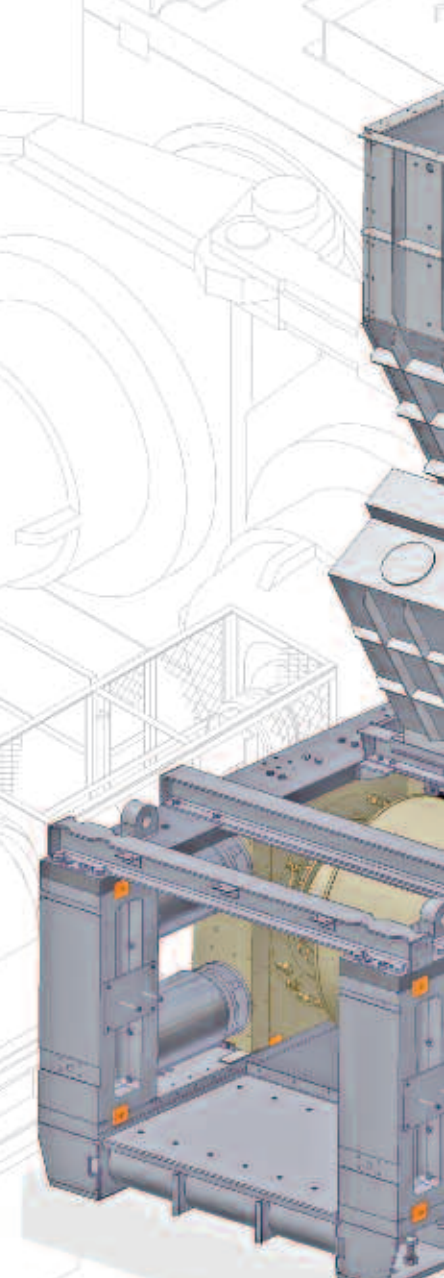
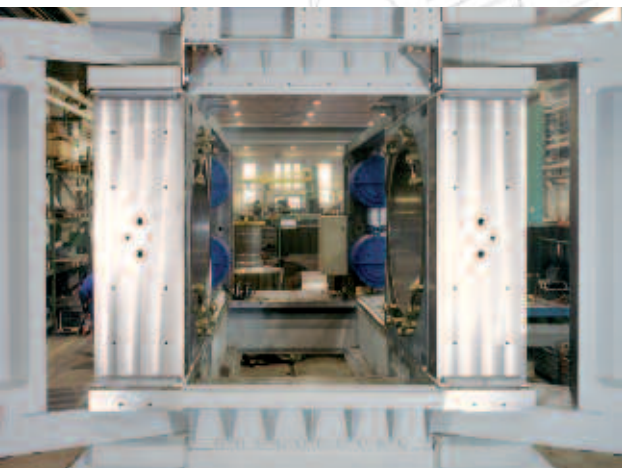
A hydropneumatic spring system allows the setting of different pressure characteristics and different control methods to enable optimum application of the grinding pressure in the roll gap and to protect the machine against possible overloading. The floating roll automatically accommodates changes in feed material characteristics by moving outwards or inwards. Spacers prevent the rolls from touching.

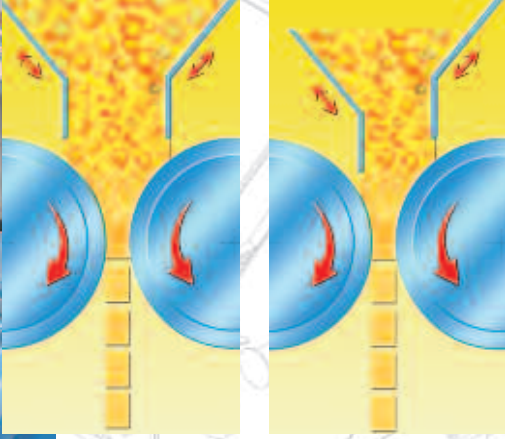
The roll drive system consists of: ● constant or variable-speed electric motors ● V-belt connection to the gear units up to a drive power of 300 kW per motor ● cardan shaft connection to the gear units > 300 kW ● mechanical overload coupling for protecting the gear unit and ● planetary gear unit.

The feed chute is an important component for the assurance of reliable and optimum operation of a high-pressure grinding roll. ● For moist and sticky feed materials (such as iron ore concentrates), Polysius installs vertical feed chutes with straight walls. ● For lumpy feed materials, chutes that assure mass flow are installed.

In order to ensure uniform distribution of the drive power to the two drive motors, the vertical feed chute can be equipped with infeed guide plates to adjust the distribution of material flowing through the mill. If this feeding device is installed, the material filling level is monitored by means of load cells.

Frame design variant enabling simple and quick roll change.





Principle of feed shaft adjustment.



Autogenous wear protection: ground material accumulates between the hard metal studs and thus minimises roll surface wear.

Since the introduction of the POLYCOM®, the wear protection concept has been constantly refined and adapted to the requirements of the different industries. Polysius offers:

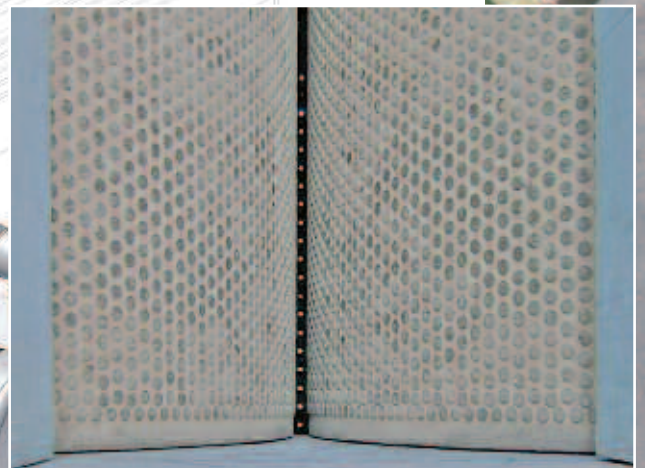
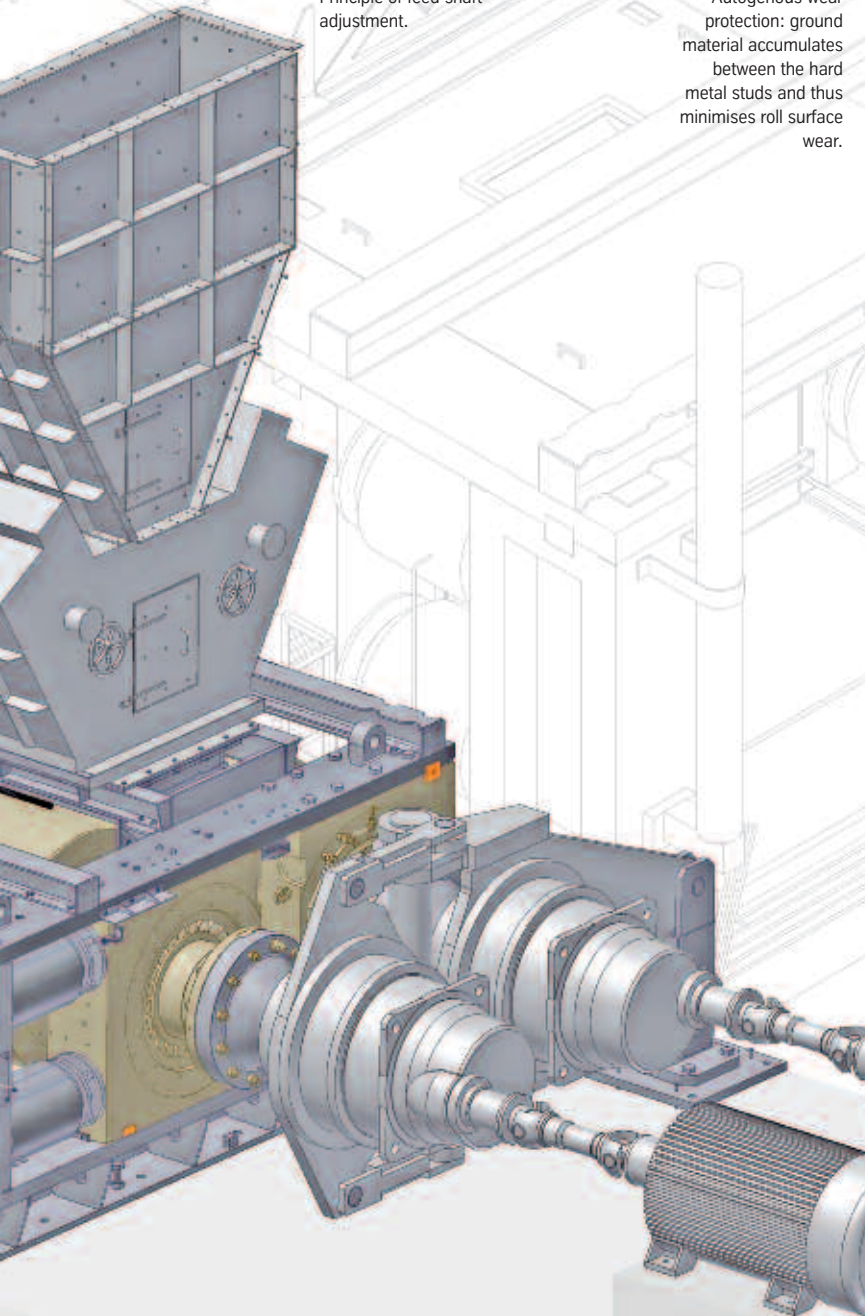
- forged, hardfaced roll bodies,
- chill cast alloy tyres made of bainite,
- roll bodies made of compound casting and
- roll bodies with hard metal studs.

For abrasive materials, roll bodies with surfaces protected against wear by hard metal studs are generally used.

This version ensures a long service life and therefore high plant availability and the lowest maintenance requirement. It also enables moist and sticky materials to be ground.

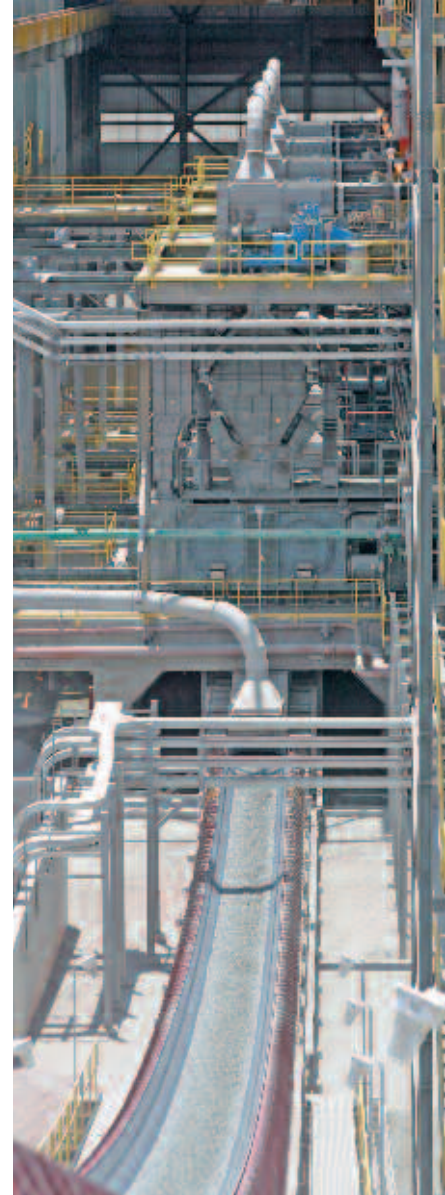
The design of the hard metal studs (geometry, hardness and metallurgical composition) and their arrangement on the roll surface are selected to suit the operating conditions and feed materials.

Nowadays, the achieved roll service lives are 4,000 to 10,000 h for hard rock, 6,000 to 12,000 h for diamond and iron ore and 12,000 to 30,000 h for iron ore concentrate. Depending on the operating parameters, higher values are also possible.

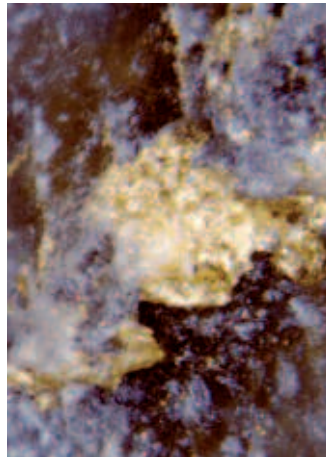
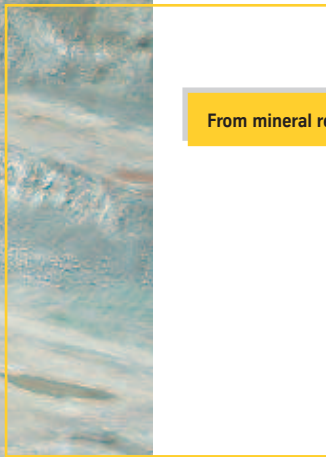


Application examples. High-pressure grinding rolls in preparation plants ...

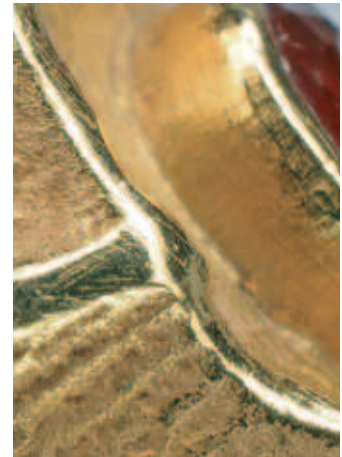
Compared to crushers, the POLYCOM® produces a significantly higher percentage of fines. Moreover, the comminuted particles have a large number of micro cracks. These product features provide enormous economic and process technological benefits for the various preparation industries...



Ground platinum ore.



The first step on the way to gold jewellery is the liberation of gold particles.



From the natural rock via liberated copper ore to the copper coin...



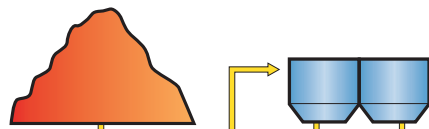
... for gold, platinum and copper ore.

For new plants the POLYCOM® is an economically superior concept compared to conventional systems, such as reduction crushers or SAG mills.

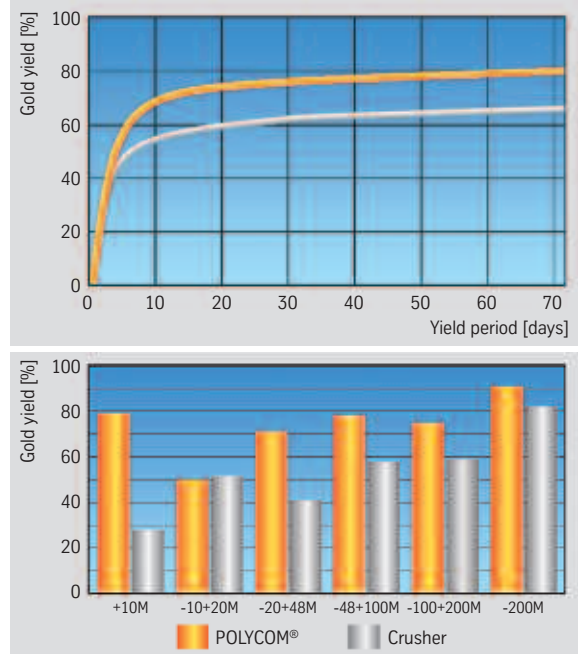
The prospect of achieving maximum increases in the throughput of existing grinding plants also make the POLYCOM® a popular machine for plant extensions. Thanks to its low space requirement and high capacity in relation to machine size, the POLYCOM® can be easily incorporated into existing plant configurations. Used as a

primary grinding unit upstream of ball mills, the POLYCOM® can boost the throughput by 20 to 30 %.

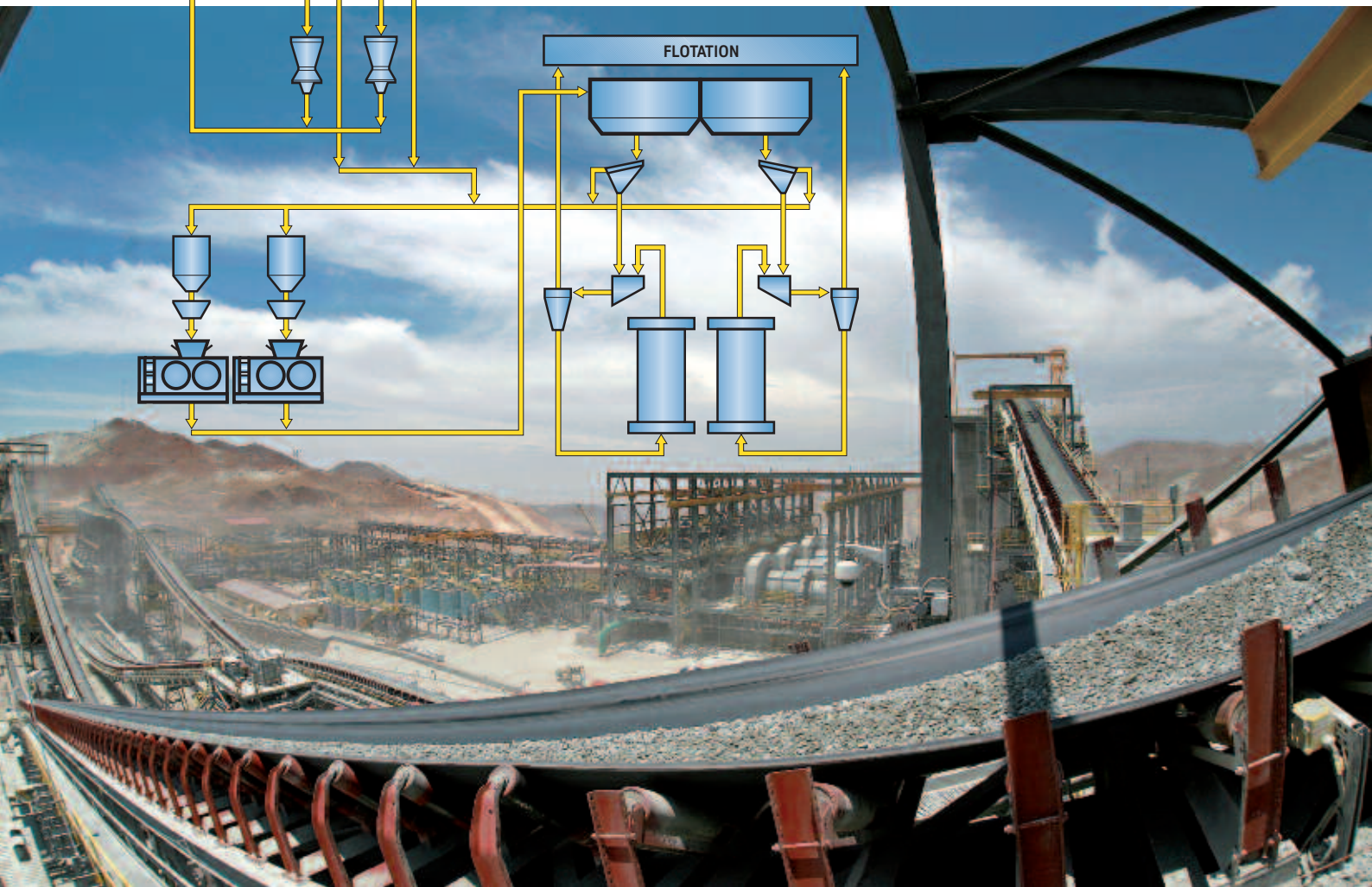
The POLYCOM® also brings substantial benefits to the heap leaching process. The yield of valuable substance and thus the operating economy of the facility are significantly raised. The ground material can either be conveyed directly to the heap or first go through an agglomeration stage. If finer qualities are required, the POLYCOM® product is first screened.



Comparison: gold yield rate of a crusher and of a POLYCOM®.



Copper ore grinding in Peru: four POLYCOM® units (2,500 kW drive and 2.4 m roll diameter) perform the primary grinding. Four wet process ball mills (7.3 m diameter and 12 MW ring motor drive) are used for final grinding – throughput 108,000 (!) tonnes of rock per day. Energy-saving and low-wear technology.



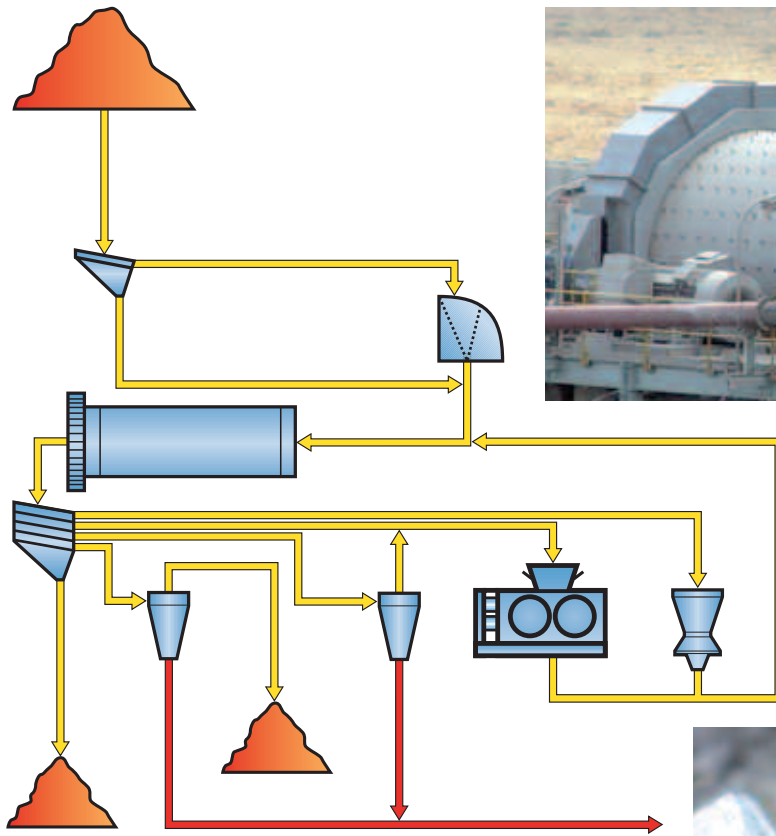
... for diamond ore.

Breaking the diamond-bearing rock in a high-pressure grinding roll is a gentle method of liberating the diamonds.

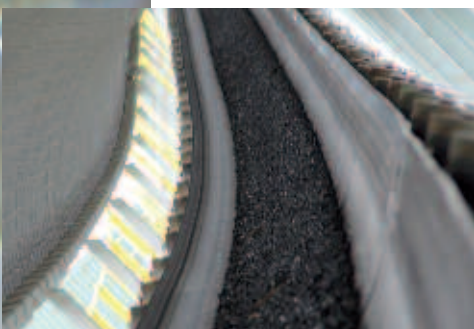
The surrounding rock is broken while the hard diamond remains undamaged and is recovered in a downstream process stage.



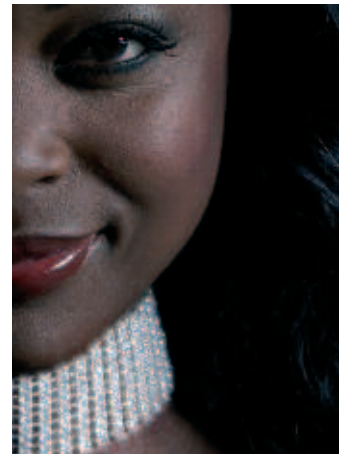
POLYCOM® for diamond ore liberation in South Africa.



POLYCOM® and scrubber from Polysius: core process technological components of a diamond ore processing plant.



For scientists they may be just the material with hardness value 10, but for the ancient Greeks they were the »tears of the gods«. Today we know that every diamond was created billions of years ago by enormous underground forces. They only see the light of day if the lava of erupting volcanoes carries them to the earth's surface.



... for iron ore.



The iron ore industry uses the POLYCOM® as a reduction crusher for lump ore.

Its high throughput rates, combined with the production of a high percentage of fines, bring clear operating and capital cost

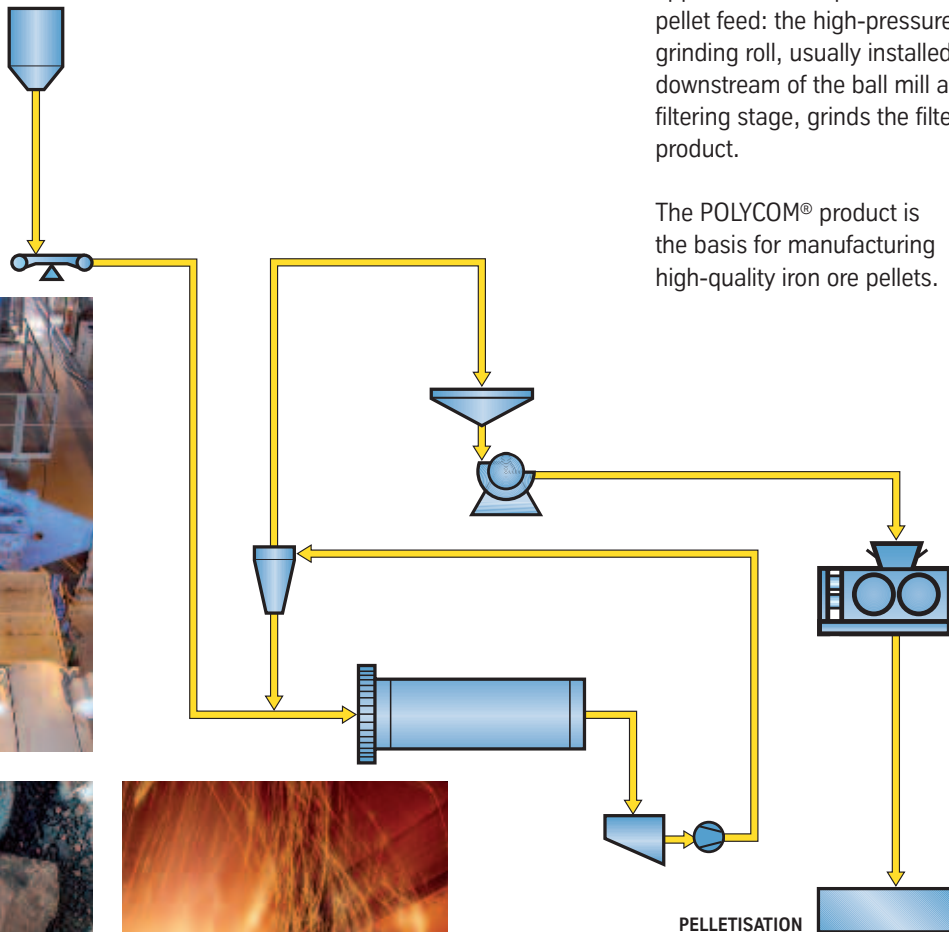
benefits: one POLYCOM® can replace several crushers.

This also significantly reduces the maintenance expenses of the plant.

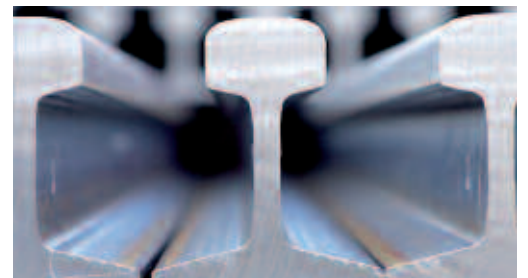
The main field of POLYCOM® application is the production of pellet feed: the high-pressure grinding roll, usually installed downstream of the ball mill and filtering stage, grinds the filter product.

The POLYCOM® product is the basis for manufacturing high-quality iron ore pellets.

POLYCOM® for iron ore grinding in Brazil.



From iron ore via the molten metal to the finished product.



One solution for all applications ...



To determine the operating expenses and maintenance requirement of a high-pressure grinding roll, the necessary characteristic data for the service life of the roll surfaces are provided by ATWAL (a small HPGR).



The data concerning granulometric distribution, power consumption and required grinding forces that are needed for dimensioning the POLYCOM® are determined with the aid of the semi-industrial high-pressure grinding roll REGRO.



Preliminary test series, which provide fundamental information regarding the comminution behaviour of different material samples, are performed in the high-pressure grinding roll LABWAL.

The Polysius research centre is equipped with POLYCOM® units of different sizes for grinding tests in open circuit or closed circuit grinding systems.

... **must remain a dream.** But Polysius has the knowhow and the equipment (the Polysius research centre with its ultramodern machines is one of the world's leading development establishments for basic material technology) to provide a suitable plant concept for the individual properties of the respective ore.

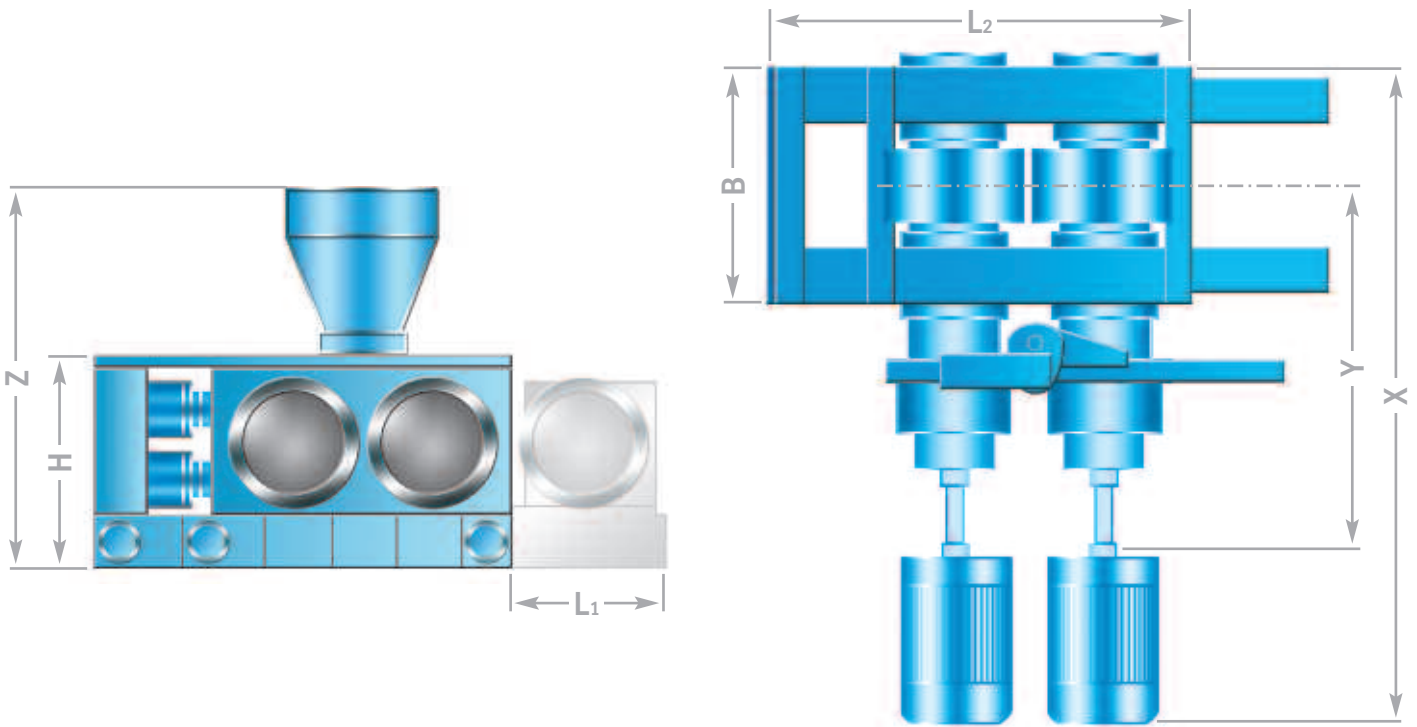
From laboratory-scale to industrial reality:

Following the material analysis, the ores are compared with the comprehensive Polysius material database to quickly and reliably obtain the data regarding their grindability, hardness, abrasiveness and agglomeration behaviour that are needed for designing the plant configuration.

High-performance simulation programs support the selection of machines and systems and forecast the energy requirements, mill circuit material balances, wear rates etc., thus assuring future-oriented, custom-tailored plant solutions with the lowest possible operating expenses – no matter whether a new plant or the upgrading of existing facilities is concerned.



If the high-pressure grinding roll is to be used in a new field of application, it is good policy to grind a large quantity of test material or to incorporate a high-pressure grinding roll into an existing plant. The MAGRO, a mobile, semi-industrial POLYCOM® is available for this purpose. With its throughput range of 50 to 100 tph it realistically simulates industrial processes.



Construction size		0			1		2		4			5	
Type		9/7			11/7	11/8	14/7	14/8	15/10	15/11	17/10	17/12	17/14
Roll diameter	[mm]	950			1,100		1,400		1,520	1,520	1,700	1,700	
Roll width	[mm]	650			650	800	650	800	950	1,100	1,000	1,200	1,400
Grinding force	[kN]	2,700			3,400		4,300		7,000			8,600	
Max. motor power	[kW]	2 x 220			2 x 450		2 x 500		2 x 800			2 x 1,600	
L1	[mm]	1,150			1,300		1,600		1,720	1,720	1,900	1,900	1,900
L2	[mm]	2,785			3,190		3,735		4,305	4,305	4,490	4,870	4,870
B	[mm]	1,860			2,150		2,164		3,030	3,030	3,030	3,000	3,500
H	[mm]	1,371			1,685		1,895		2,095	2,095	2,220	2,390	2,370
Y	[mm]	3,620			4,430		4,497		5,316	5,316	5,230	6,273	6,523
X	[mm]	4,550			5,500		5,600		6,900	6,900	6,800	7,800	8,300

Construction size		6		7		8		9	
Type		19/15	20/15	20/15		22/16	24/17	26/18	
Roll diameter	[mm]	1,850	2,000	2,000		2,200	2,400	2,600	
Roll width	[mm]	1,500		1,500		1,550	1,650	1,750	
Grinding force	[kN]	11,000		13,500		17,000		20,000	
Max. motor power	[kW]	2 x 1,850		2 x 2,500		2 x 2,800		2 x 3,400	
L1	[mm]	2,050	2,200	2,200		2,400	2,600	2,800	
L2	[mm]	5,220	5,365	5,805		6,370	6,575	7,215	
B	[mm]	3,310	3,460	3,610		3,820	3,820	4,150	
H	[mm]	2,635	2,855	2,795		3,160	3,180	3,510	
Y	[mm]	6,757	6,727	7,336		7,401	7,401	7,550	
X	[mm]	8,400	8,500	9,200		9,300	9,300	9,600	

– the stated dimensions are subject to alteration in the course of technical advancements –