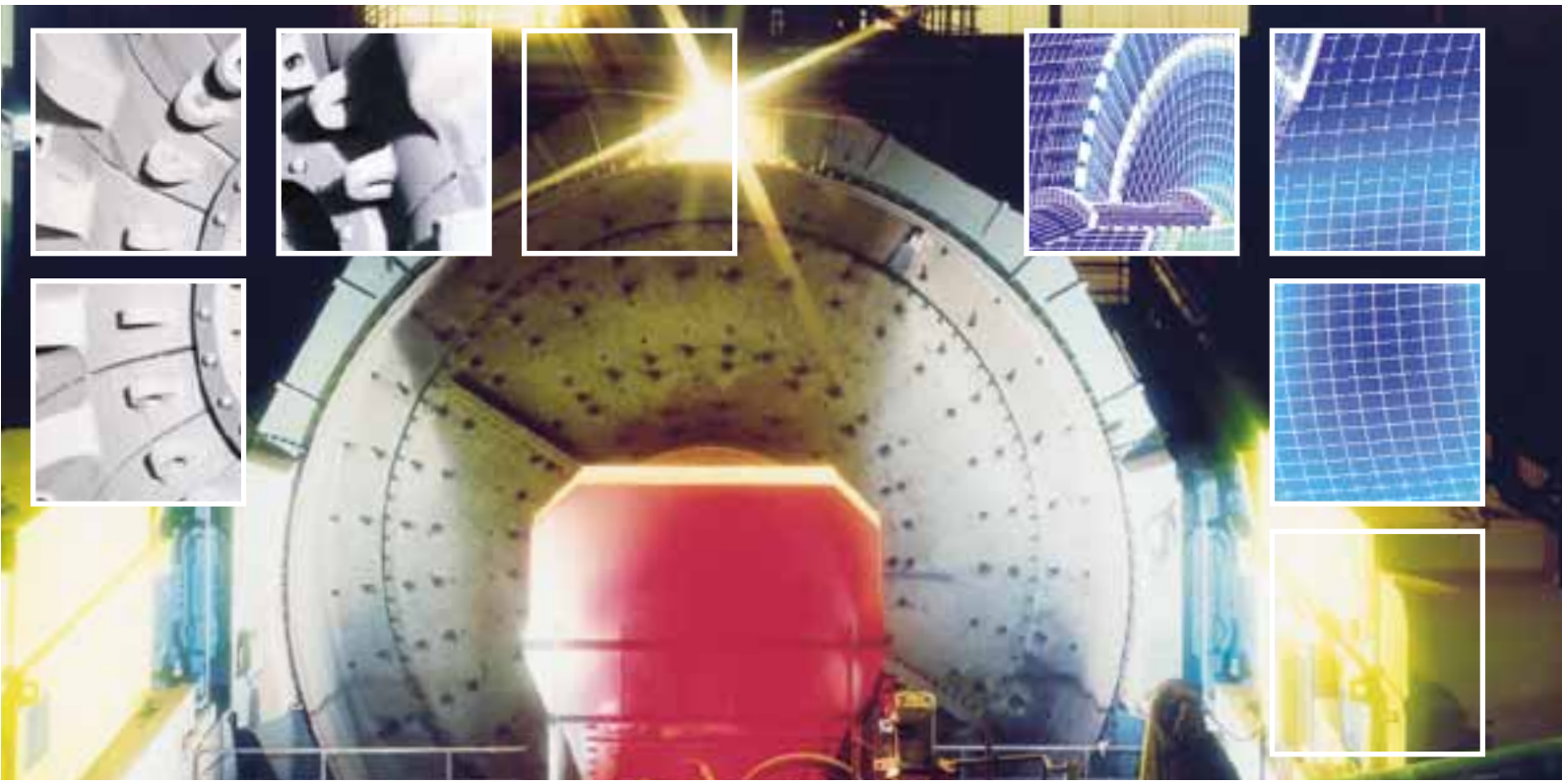
Autogenous mills, semi-autogenous mills and ball mills for wet grinding.



A company of
ThyssenKrupp
Technologies

Polysius

ThyssenKrupp

High-performance systems
for wet grinding applications.

Ball mill in iron ore beneficiation plant.

Ball mill with COMBIFLEX® drive for lead zinc ore grinding.

Ring motor driven SAG mill for gold ore grinding.

SAG and ball mills for comminuting gold/copper ore.

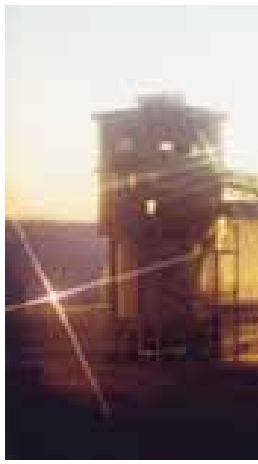
Site assembly of a large mill shell.

The comprehensive range of wet grinding systems from Polysius comprises of:

- Autogenous and semiautogenous mills,
- Ball mills,
- Rod mills and
- Scrubbers.

Polysius offers dry grinding systems comprising of the following equipment:

- AEROFALL type dry SAG mills,
- Dry grinding ball mills,
- Air separators,
- Dryers,
- POLYCOM® high-pressure grinding rolls.



High-pressure grinding rolls can be supplied to work in dry grinding as well as in wet grinding plants. They can be used for green field plants as well as for plant upgrades.

Plant supply

Our organisation is designed to handle system supply on a turnkey basis. We can draw upon professionals in offices all around the world to provide process engineering design & layout, contract management, inspection, shipping, expediting, purchasing, equipment erection, start up, training and customer service.

Simulation of grinding circuits

The capability to design entire grinding circuits with aid of state-of-the-art simulation tools allows Polysius to design and build complete grinding lines to meet the high standards demanded by our clients in the minerals and cement industries.

The in-house expertise allows Polysius to provide application-specific solutions for economical, reliable and energy efficient grinding of ores, cement clinker, coal and other materials. Polysius has been successfully designing and building grinding plants since 1880.

The resulting global know how of process and plant technology, together with the extensive grinding test facilities in our research and development centre provide the basis for an optimum design.

Grinding plants from Polysius have a long track record in wet grinding applications. They are operating in open or closed circuit mode. Polysius grinding mills can be of the overflow type or of grate discharge design.

In 1976 Polysius adopted the design of shell-supported grinding mills using slide shoe bearings. Since this time, the design has been perfected based on the experience of more than 180 units operating all over the world in various industries. Today Polysius grinding mills are exclusively built as shell-supported units.

SAG and ball mill for gold ore grinding.

One of three SAG mills with 9.75 m diameter and 2 x 4000 kW drive power. These mills operate in conjunction with ball mills for iron ore grinding in Iran.

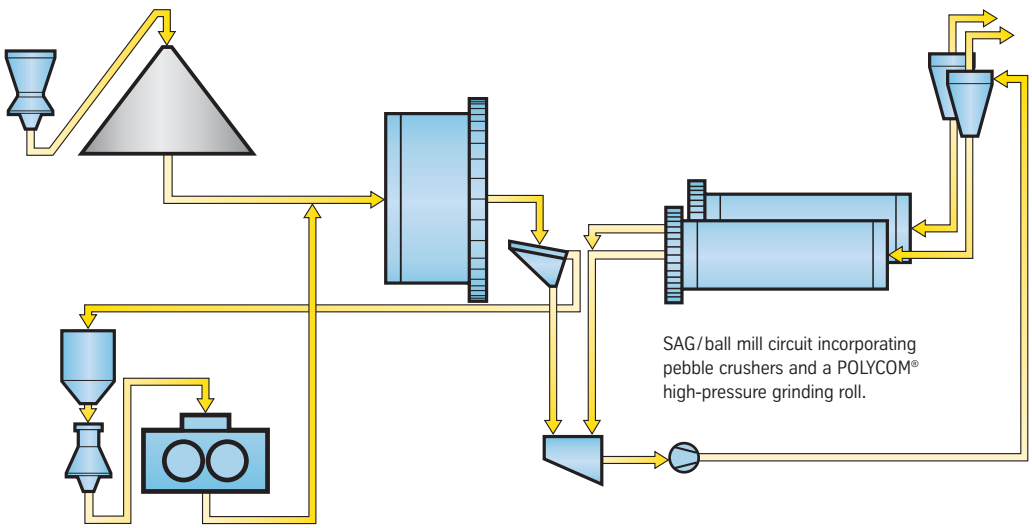
The design offers such benefits as:

- Elimination of castings and the structural risk associated with them.
- Feed and discharge designed to process requirements rather than to restrictions imposed by trunnion bearings.
- Minimised risk of feed blockage through short trunnions.
- Quick accessibility to mill interior.
- Lighter weight and lower number of flanges for ease of transport and erection.
- Lower space requirement for less foundation and civil cost.
- Ideal for ring motor drives.

Polysius grinding mills can be driven via ring gear pinion drives or the COMBIFLEX® drive for drive capacities of up to 16,000 kW. Higher drive power is reliably transmitted via ring motor drives.

Polysius standard range of grinding mills

Polysius has established a standard for grinding mills, which covers the requirements for a variety of applications in the minerals industry. The grinding mills can be equipped with ring gear pinion drives as well as with the COMBIFLEX® drive. The standardisation allows for short delivery times and minimisation of spare part inventory. If required, ring motor drives can be fitted to shell-supported grinding mills up to the largest sizes.



SAG/ball mill circuit incorporating pebble crushers and a POLYCOM® high-pressure grinding roll.

Reagent preparation systems for FGD
from limestone handling through to grinding.

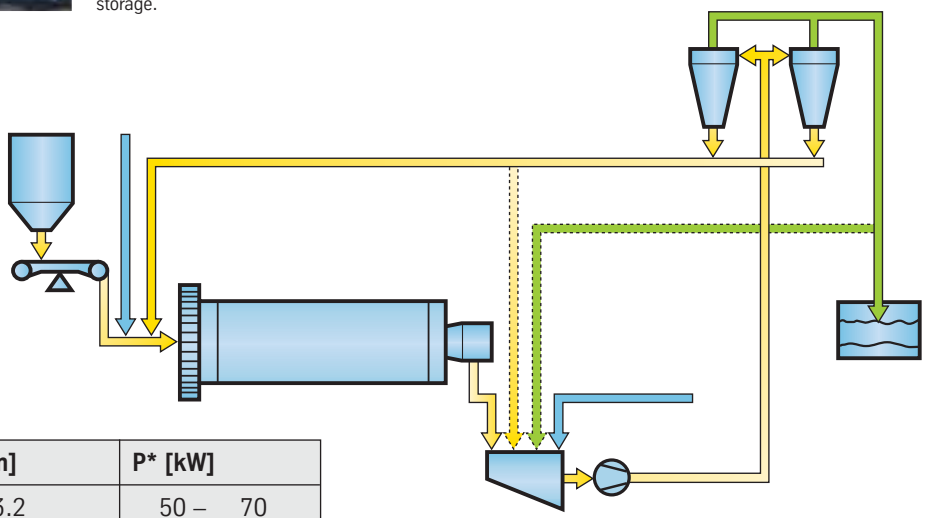
Ball mill for grinding limestone for a flue gas desulphurisation system in a Korean power station.

Limestone storage.

Polysius brings the benefits of its vast experience in limestone processing to provide an optimised total solution for FGD reagent preparation systems. The project scope can vary from the supply of a ball mill to the installation of a comprehensive system for limestone grinding or lime slaking.

We have the capabilities and expertise to take and expand the scope of a system to include all the limestone/lime handling, storage and product storage complete with automation. The system can be ordered as equipment supply or turn-key to best tailor the solution to your needs.

Ball mill for grinding limestone for flue gas desulphurisation systems in power stations.

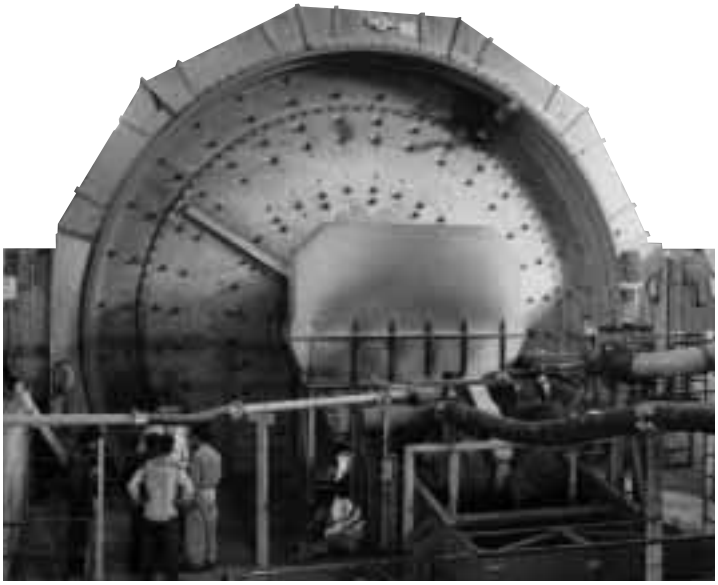


Di [m]	EGL [m]	P* [kW]
1.6	2.4 – 3.2	50 – 70
1.8	2.7 – 3.6	60 – 100
2.0	3.0 – 4.0	90 – 120
2.2	3.3 – 4.4	150 – 250
2.4	3.6 – 4.8	175 – 300
2.6	3.9 – 5.2	250 – 350
2.8	4.2 – 5.6	350 – 550
3.0	4.5 – 6.0	400 – 650
3.2	4.8 – 6.4	500 – 750
3.4	5.1 – 6.8	700 – 1000
3.6	5.4 – 7.2	800 – 1200
3.8	5.7 – 7.6	950 – 1350

*Motor power at 35% ball charge

…small diameter ball mills.

The standard range of...



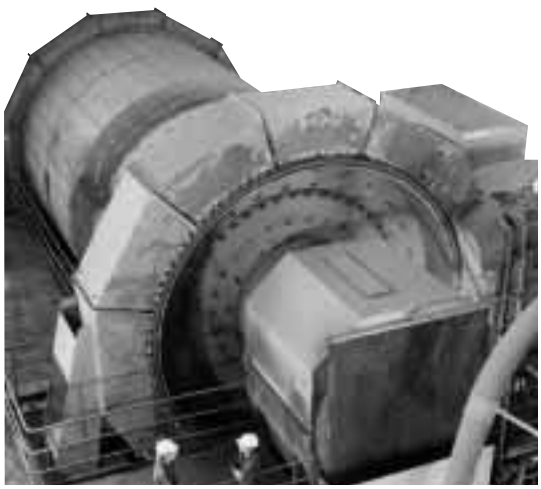
...autogenous and semi-autogenous mills.

Di [m]	EGL [m]	P [kW]
8.0	3.9	3800
8.6	4.2	5000
9.2	4.5	6400
9.8	4.8	8400
10.4	5.1	9900
11.0	5.4	12100
11.6	5.7	14700
12.2	6.0	17600
12.8	6.4	21300
13.4	6.8	25400

Di [m]	EGL [m]	P* [kW]
4.3	6.1 – 7.6	1600 – 2100
4.6	6.4 – 8.0	2000 – 2600
4.9	6.7 – 8.6	2500 – 3300
5.2	7.3 – 8.9	3200 – 3900
5.5	7.6 – 9.5	3800 – 4800
5.8	8.0 – 10.1	4600 – 5900
6.1	8.3 – 10.4	5500 – 6900
6.4	8.9 – 11.0	6700 – 8300
6.7	9.2 – 11.6	7700 – 9900
7.0	9.5 – 12.2	9000 – 11600
7.3	10.1 – 12.5	10000 – 13300

*Motor power at 35% ball charge

...medium size and big ball mills.



Mill drive systems.

Shell-supported grinding mills supplied by Polysius offer the flexibility for equipping with all drive systems available on today's market. The motor torque can be transmitted to the mill shell via a ring gear or a ring motor. The ring gear meshes either with a pinion in the case of a conventional drive or with the COMBIFLEX® reducer.

Self-aligning pinion

A self-aligning pinion can be applied if the ring gear is a spur type. Such drives then need no realignment of the ring gear and pinion mesh after the installation of the components. These case-hardened and precision ground-pinions can be either grease or oil lubricated.

Self-aligning drive pinions compensate wobbling and faulty alignment of the girth gear.

Rigid pinion drive

With this type of drive, the mill shell is driven via one or two pinions which transmit the motor power to the mill shell. Ring gear and pinion are usually of the helical type. Lubrication is effected through a greasing system. The operating conditions can be monitored by infrared devices. The pinion can be driven either via a reducer or a low speed motor.

COMBIFLEX® drive

The COMBIFLEX® drive unit combines the advantages of a ring motor drive, such as minimal maintenance requirement and high availability, with the advantages of a normal girth gear and pinion drive system, such as reasonable capital cost. The gearing with drive pinions, the girth gear and the sliding shoe bearing with slide ring and axial guide are integrated into a single unit enclosed in a common housing. Each COMBIFLEX® unit is equipped with its own auxiliary drive.

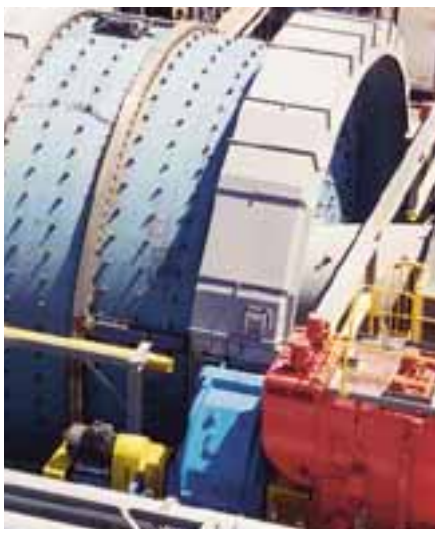
High reliability: The self-centring hardened and ground pinions and the simple oil lubrication system create optimum operating conditions.

Minimal maintenance requirement and low operating costs: no subsequent adjustment of the drive system is necessary. A central oil supply system lubricates the girth gear and pinion, substantially reducing the amount of oil used and thus also cutting the disposal costs.

Standardised design: Just four types cover a power range from approx. 1,200 kW to 8,000 kW. By using a dual drive system, drive powers of up to 16,000 kW can be transferred. Maximum use of identical components drastically reduces the required spare parts inventory.

Quality control: A portable gear involute measuring device allows on-the-spot manufacturing-quality control of the gear toothing

Two SAG mills with rigid pinion drives.



SAG mill with DOUBLE-COMBIFLEX® drive.

Ring motor drive

The ring motor transmits the motor torque to the mill shell through a magnetic gap. As no wear and tear occurs, high availability and long drive service life are assured. The variable speed capability comes with the drive as an inherent feature. Due to the investment cost the ring motor drive is usually applied for drive powers above 10 MW.

Shell-supported grinding mills offer special benefits to ring motor drives:

- Shell-supported grinding mills offer a high system stability to withstand the magnetic forces developed by

Synchronous motor drive with air clutch.

COMBIFLEX® drive (5,400 kW) with high-speed synchronous motor and fluid coupling.

Installation of a ring motor on a SAG mill.

Ring motor drive.

the motor and which have to be accepted by the mill structure.

- The hydraulic jack incorporated into the slide shoe support enables easy centring of motor stator and motor poles, which are attached to the mill shell.

Drive motors

In the case of ring gear drives, either wound rotor induction motors or synchronous motors can be used.

Induction motors

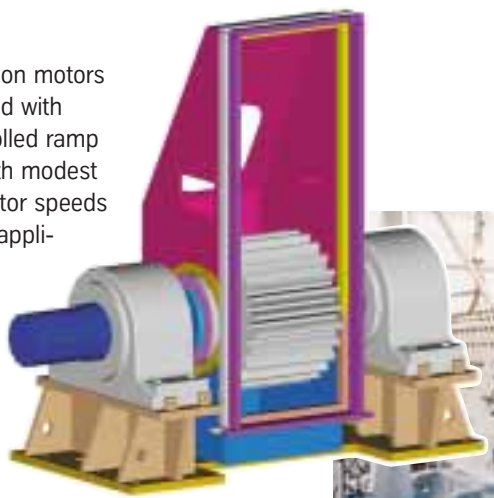
Wound rotor induction motors are usually equipped with starters for a controlled ramp up of mill speed with modest inrush currents. Motor speeds usually require the application of a speed reducer.

Synchronous motors

Synchronous motors are usually of the low torque type in order to reduce the inrush current and the load of the mill drive train. A starting coupling is required to limit the motor torque during mill start.

In the case of a high-speed synchronous motor a hydraulic coupling can be used.

Low-speed low-torque motors use air clutches for a controlled mill start.



Oil lubricated standardised pinion arrangement with induction motor.

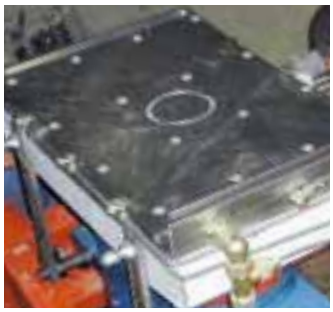
Hydrodynamic slide shoe bearing
for individual requirement profiles.

Slide shoe bearing

Depending on the size of mill, its shell is supported at the periphery by two, four or six slide shoes. The self-aligning support of the slide shoes compensates any slide ring wobbling and eccentricity caused by mill sag, thermal distortion and manufacturing tolerances. Hydrodynamic or hydrostatic lubrication systems can be used for this type of bearing.

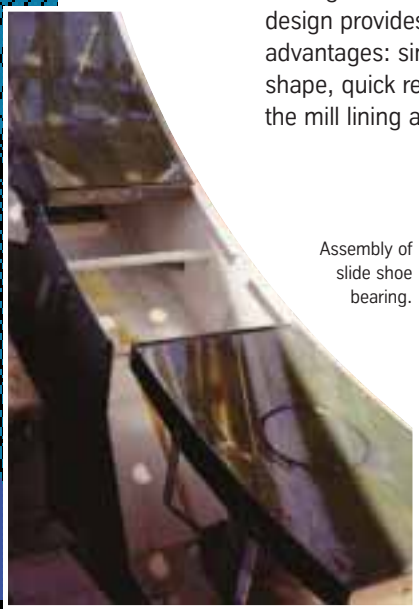
The mill can be lifted and positioned by hydraulic jacks installed in the base of the bearing to compensate for foundation settlements and allow replacement of bearing shoes without complicated supporting of the mill shell. It is also possible to install load cells in the base of the bearing in order to determine the weight of the mill.

Well-proven seals keep dirt and water out of the bearing housing and reliably prevent oil leaks. The mill shell is a welded structure without heavy and complicated end disc castings. The straight end disc design provides significant advantages: simple liner plate shape, quick replacement of the mill lining and free design of the mill inlet and outlet to suit process requirements instead of structural constraints.



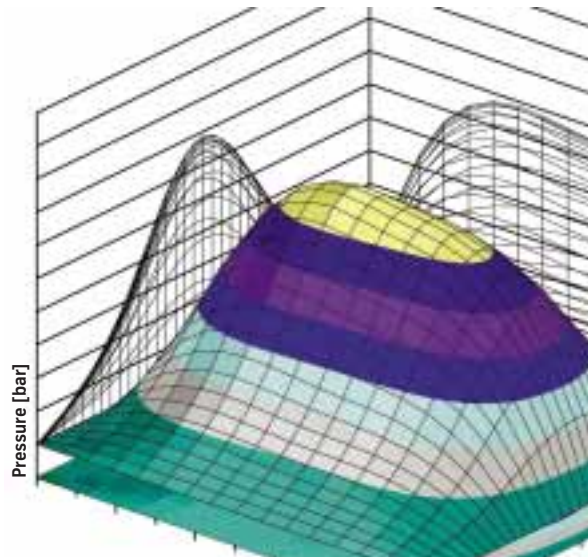
Preparation of measuring in a hydrodynamic slide shoe bearing.

Measuring compaign at hydrodynamic slide shoe bearing.



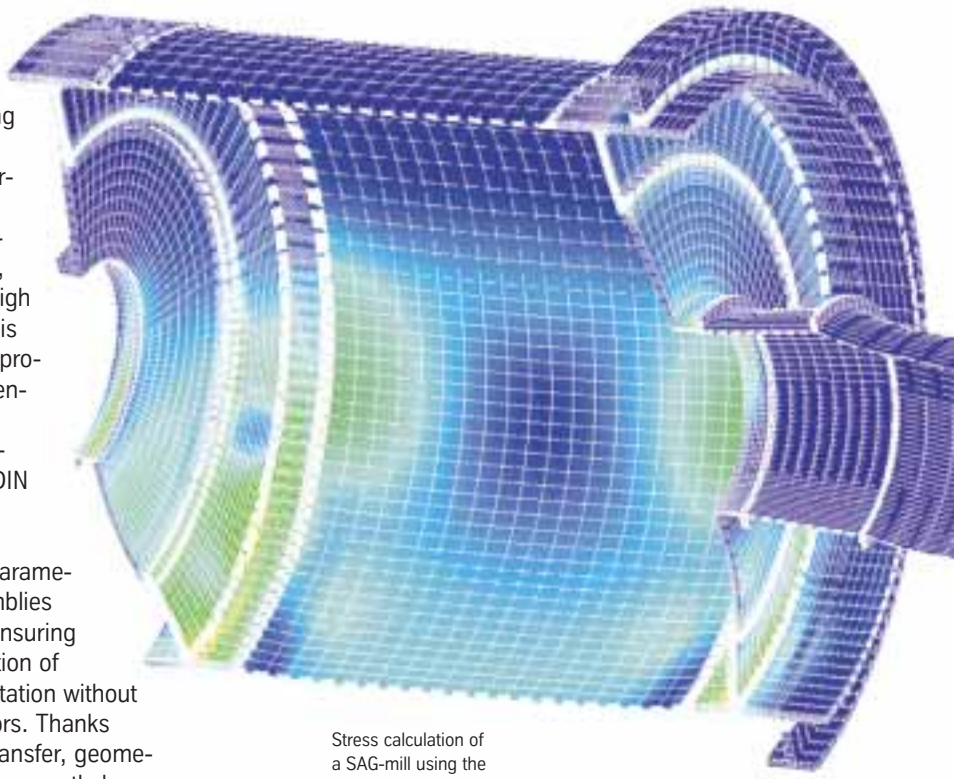
Assembly of slide shoe bearing.

Mounted slide shoe.



Reliable detail engineering maximises plant availability.

Polysius utilises the most modern Computer Aided Engineering tools in order to design top-performance products quickly and reliably. Furthermore, the company's high quality standard is overseen and approved by an independent certification institute in accordance with ISO DIN 9000.



Stress calculation of a SAG-mill using the Finite Element method.

CAD programs parameterise sub-assemblies and machines, ensuring efficient preparation of design documentation without transcription errors. Thanks to unified data transfer, geometry data can subsequently be taken directly from the plant-design department for use in calculations.

Safe and reliable dimensioning of the grinding plants supplied by Polysius is ensured by state-of-the-art hardware and software, combined with comprehensive calculation know-how.

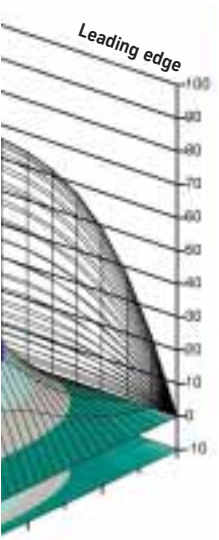
Polysius carries out:

- stress calculations using the Finite Element method,
- torsion and vibration analyses,
- heat transfer calculations,
- seismic analyses and
- field measurements at installed plants.

Field measurements at installed plants back up the calculations.

The findings also provide a database for the safe calculation of machines and the development of new components.

Pressure distribution in a hydrodynamic slide shoe bearing.



Erection, commissioning and comprehensive service from a single source.

Erection of a ball mill with flanged mill shell.

Undertaking the project engineering for a grinding plant is one thing – erecting and commissioning a grinding plant is another. But customers know that for these important activities they can also totally rely on Polysius knowhow.

Erection / Commissioning

Our experienced specialists assemble the plant with an expertise and care that assures successful commissioning and achievement of the contractually agreed performance data, regardless of whether a flanged, site-welded or one-piece mill shell is involved. The very large number of plants that Polysius has put into operation bears witness to this success.

Research and Development

The basis for the final design of the plant is usually provided by extensive material testing in the Polysius Research Centre during the project-planning stage. Our Research and Development Centre with its diverse facilities is also available to customers for the performance of their own tests and analyses.

Spare parts / Maintenance

Maintenance and service contracts provide customers with the certainty of obtaining high plant availability and operating economy despite the tough day-to-day operating condi-

Last inspection before the commissioning.

tions. This naturally also includes the Polysius spare parts service, because our customer-specific database assures quick availability of the right spare parts.

Plant optimisation

Even in the case of older plants that have been in operation for a long time it is still important to permanently keep an eye on the operating economy and competitiveness of the production process. If necessary, it can be upgraded to a future-oriented condition by integrating the latest technical developments. For this purpose, Polysius records the current operating condition of the plant and works out an optimisation concept that is tailored to the individual requirements of the customer.

Erection of a one-piece mill shell.

Field welding of a large mill shell.