

LOESCHE-MILLS FOR SOLID FUELS



Loesche technology – always one step ahead



We have been successfully involved in the processing and grinding of solid fuels since 1925, with the main emphasis being on coal.

- 1927** First Loesche coal mill delivered for the Klingenberg power station in Berlin.
- 1953** 500th coal mill plant sold worldwide.
- 1961** Introduction of hydraulic spring assembly system.
- 1965** Construction of first pressure mill (LM 12.2 D).
- 1980** Delivery of first modular coal mill (LM 26.3 D).
- 1985** Delivery of first self-inerting coal grinding plant (LM 21.2 D) for the steel industry (PCI – Pulverised Coal Injection).
- 1990** Central coal grinding plant (LM 26.3 D) for gas and steam power station (coal gasification).
- 1992** Central coal grinding plant (LM 26.3 D) for the production of lignite (brown) coal dust.
- 2002** Coal grinding plant (LM 23.2 D) for grinding wood pellets for power stations.
- 2005** First 4-roller pressure mill (LM 43.4 D) becomes available.

Central grinding plant for lignite (brown) coal dust
Schwarze Pumpe, Senftenberg, Germany, 1997

Loesche designs, plans and constructs everything from individual machines to turnkey dry-grinding installations for all solid fuels. Loesche is certified in accordance with EN ISO 9001, and our grinding plants meet both national and international safety regulations.

“Keep it solid and simple” – this is the design concept behind Loesche roller grinding mills, ensuring their reliability and safety. Each of our dry-grinding installations thus represents our technological prowess, offering advantages that ensure the competitiveness of our customers:

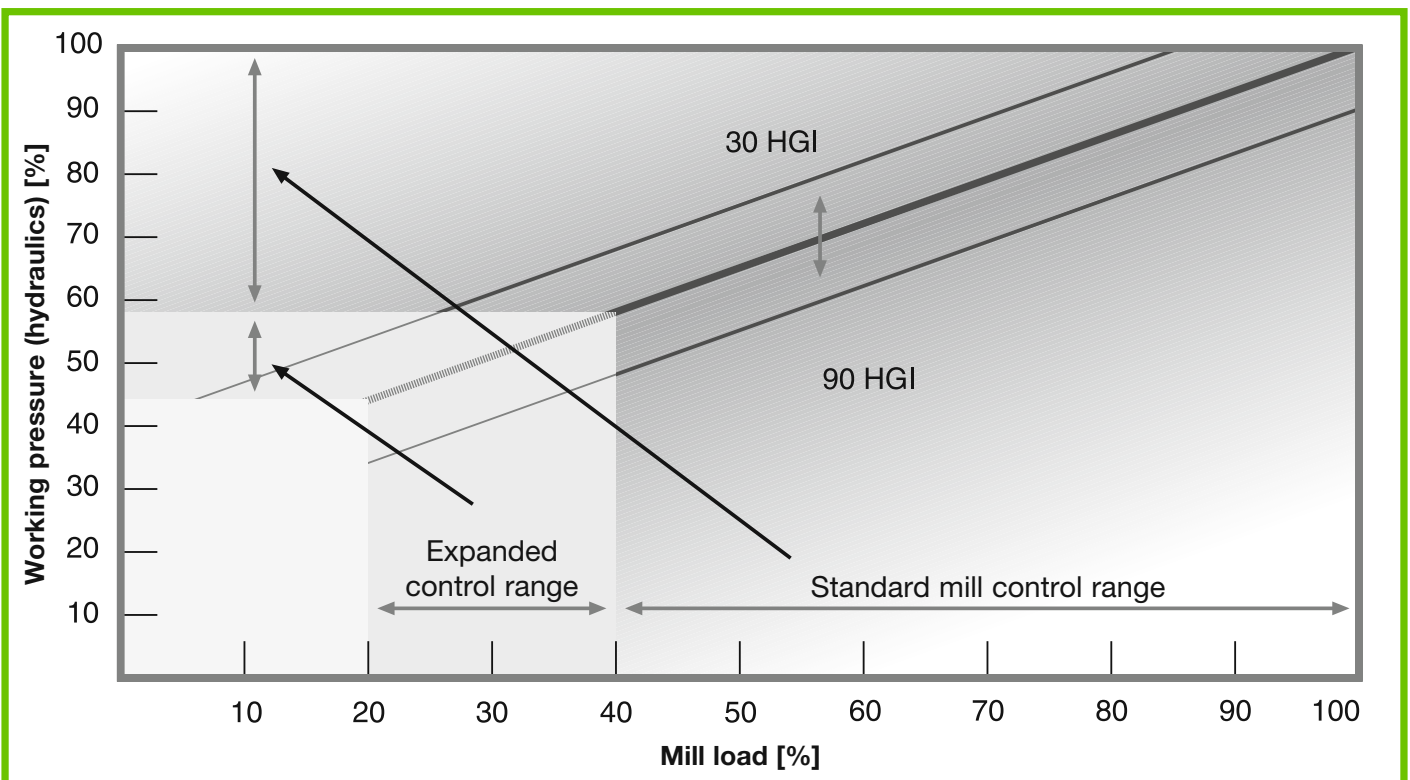
- No metallic contact between grinding components (even when a coal mill is empty), thus avoiding the generation of sparks.
- Particularly suitable for easily-combustible dust with a high proportion of volatile matter (e.g. brown coal, wood, etc.).
- Low-vibration mill running, even in partial load ranges down to 20% of the mill load, thanks to individually-guided grinding rollers.
- The specially-developed hydraulic roller relief system enables grinding of different fuels (both hard and soft) and improves the machine control response.
- Individual grinding mill design with a proven track record, encompassing 2, 3 and 4 rollers for fuel throughput rates up to and in excess of 200 t/h.

Loesche coal grinding mills are distinguished by other characteristics that improve efficiency, safety and environmental protection, from the standard version to top-of-the-range installations:

- Pressure shock resistance up to 3.5 bar (gauge).
- Horizontal grinding table with segmented grinding track and tapered grinding rollers, arranged at an angle of 15° to the grinding table.
- Hydraulic grinding roller swinging-out device for easier and quicker changing of grinding components.
- Constant product quality in compliance with specification achieved through static or dynamic classification.
- Product rate control from 40 to 100%.

Special versions are available with further characteristics that meet special safety regulation or output control requirements:

- Pressure shock resistance up to 8 bar (gauge).
- Grinding pressure control for expansion of the mill control range from 20 to 100%;
- Grinding table speed control with frequency converter.



Grinding output relative to hydraulic working pressure

Customer benefits and satisfaction are our top priority

Loesche grinding plants utilise energy and resources efficiently, and their quality and reliability are recognised internationally. We make every effort in all our activities (from engineering to customer service) to ensure on-time realisation of projects and maximum availability of every installation.

Our maxim is that every Loesche grinding plant should be a flagship of our technological know-how.

The cornerstones of our competence include:

- The construction of turnkey coal grinding plants
- Bespoke plant concepts, from the planning stage to commissioning
- Individual problem based solutions centered on optimised process engineering
- Customer consultancy service that includes advice to ensure effective plant operation and further technical development
- Unlimited spare parts delivery capability
- Certification in compliance with EN ISO 9001:2008.



Loesche mills, 10 x Type LM 28.2 D, Taiwan Power Co., Taichung, Taiwan, 2000



Loesche mill Type LM 28.2 D, Bremen, Germany, 2004

Mill Dimension Series – Drive Specification

Large promote excellent in-feed characteristics. Loesche provide a transition from two to three and four rollers to limit the dynamic load caused by the motion of individual masses.

The Loesche coal grinding mill range is divided into two serial types:

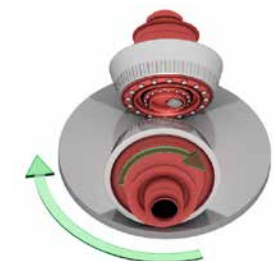
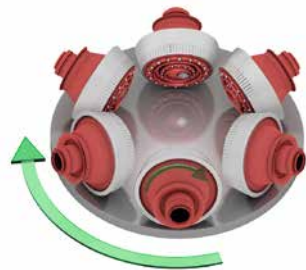
Small twin mills constructed to individual specifications (LM 12.2 D to LM 20.2 D), with table diameters from 1,200 to 2,000 mm.

Larger mills with two, three and four rollers and modular structures (LM 21.2 D to LM 43.4 D), with table diameters from 2,100 to 4,300 mm.

This range can be expanded beyond the LM 43.4 D without any design problems or operational risks being involved, and construction modules from mills in the cement industry that have proven their effectiveness under practical conditions are also available. These components have been in operation for many years without encountering breakdown.

Application areas:

- Steam boiler furnaces for electricity, steam, and heat generation
- Coal dust furnaces for cement rotary kilns and industrial furnaces
- Coal conversion plants (gasification, liquefaction)
- Direct firing of coal dust in blast furnaces.



Fineness

fine ← → coarse

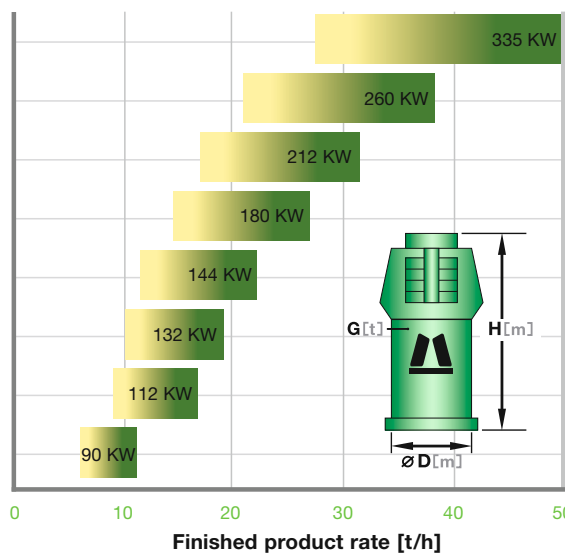


difficult ← → easy

Grindability

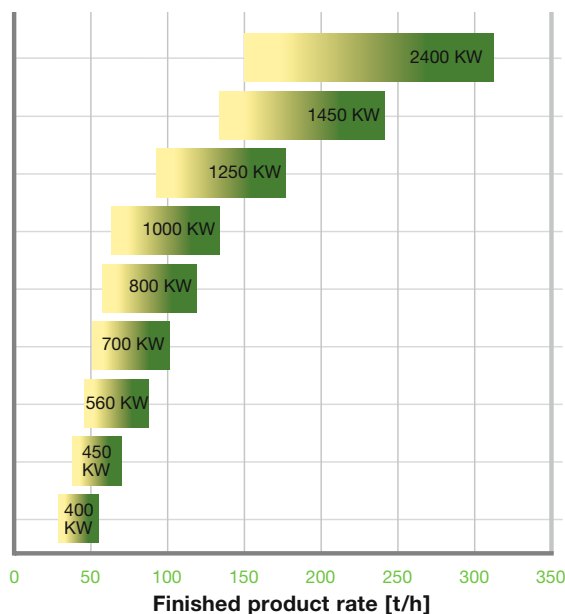
Small twin Loesche mills

LM 20.2 D
LM 19.2 D
LM 17.2 D
LM 16.2 D
LM 15.2 D
LM 14.2 D
LM 13.2 D
LM 12.2 D



Large modular Loesche mills

LM 53.6 D
LM 43.4 D
LM 41.4 D
LM 35.3 D
LM 28.3 D
LM 26.3 D
LM 28.2 D
LM 23.2 D
LM 21.2 D



* Remark: All dimensions are guideline values and cannot be considered as the basis for a binding planning.

The modular structure of larger roller grinding mills enables utilisation of the same components in different mill sizes. Module components include grinding rollers, rocker arms, pedestals and spring assemblies.

The principle behind this structure was patented in 1970 and is employed for coal grinding mills and mills in the cement and industrial minerals industry. 2, 3, 4 or even 6 grinding roller configurations for a single grinding table can be realised.

The first Type LM 26.3 D modular coal grinding mills were developed in 1980 and employed for 12 times 2x600 MW power station blocks in the Duvha power station, South Africa.

The LM 35.3 D has been frequently utilised with great success in the following applications:

- iron industry: Tubarão, Brazil, 1994 and 2004.
- cement industry: Nghi Son, Vietnam, 1998, Guangzhou, China, 2005.

Loesche developed the 4-roller coal grinding mill with four tried and tested modules for throughputs over 150 t/h. The development was first realised in 1970 for grinding mills in the cement industry.

This number of rollers also enables operation with only one pair of rollers to increase control response availability and flexibility.

Large Loesche coal grinding plants can be realised with ease using system components that have been employed for decades in Loesche mills in the cement industry. The operator can therefore enjoy the following advantages:

- Reduced project investment cost for associated electrical, instrumentation and control equipment
- Reduction of maintenance costs
- Reduction of costs for spare parts.



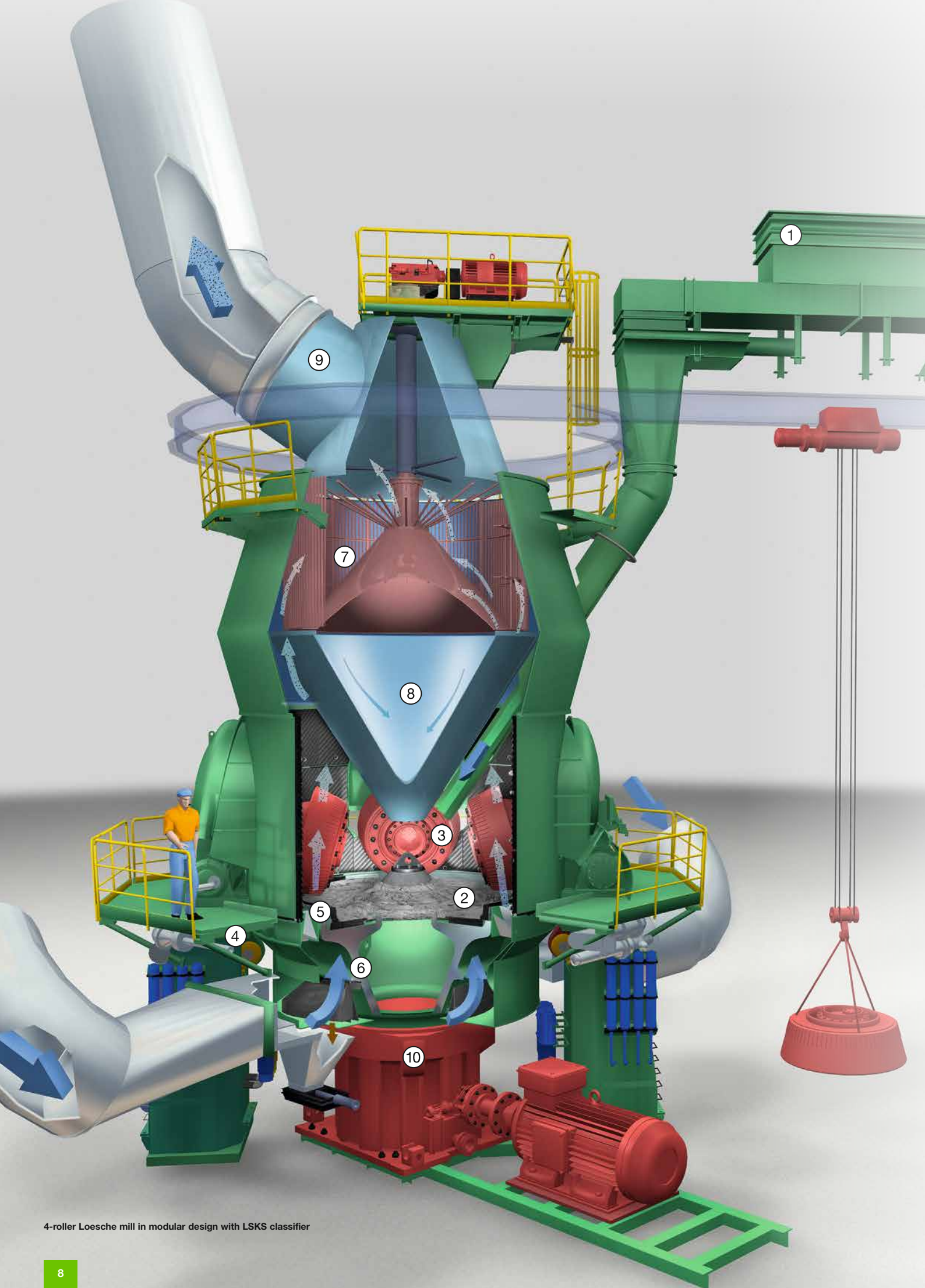
2-roller single-structure Loesche mill Type LM 20.2 D in Novi Popovac, Yugoslavia, 2002



3-roller modular grinding Loesche mill Type LM 28.3 D in Union Bridge, USA, 1999



3-roller modular Loesche mill Type LM 28.3 D in Kosice, Slovakia, 1991



4-roller Loesche mill in modular design with LSKS classifier

Functional Description

Grinding principle

The feed material is reduced in size in a Loesche roller grinding mill between the rotating horizontal grinding table and the fixed grinding rollers.

The axes of the tapered rollers are tilted at a 15° angle to the horizontal towards the centre of the grinding table, enabling the achievement of optimum grinding efficiency.

Rollers with large diameters can be arranged on the smaller grinding table surface. The importance of larger rollers becomes clear when one considers that grinding mill throughput increases relative to the square of the roller diameter.

In addition to a rolling movement, the large narrow rollers also achieve a sliding motion, as the roller axis and grinding table axis do not intersect at the grinding table level. The shearing forces thus create additional reduction of the grinding material.

Function and structure

The feed material can be introduced laterally ① or centrally from above onto the rotating grinding table ②. It is crushed over here by the rollers ③ and ground through the action of the forces emanating from the hydraulic roller spring assembly ④. When the mill rollers follow the contour of the grinding bed, the piston of the hydraulic cylinders coupled by the rocker arm and the rod head, moves up and down forcing oil in and out of the nitrogen charged accumulators.

The grinding material is spun outwards by the rotation of the grinding table. The upwardly-directed hot gas current ⑥ captures the material in the vicinity of the louvre ring ⑤ that surrounds the grinding table and conveys it to the classifier ⑦.

The immediate contact with the hot gas spontaneously evaporates any water contained in the grinding material, so that the desired mill outlet temperature of between 70°C to a max. of 130°C is already achieved in the grinding chamber.

Coarse material is rejected by the classifier (according to the grit size) and falls onto the grinding table again in the internal grit recirculation system ⑧ for renewed grinding. The final grinding product passes through the classifier and exits the Loesche mill with the process gas flow ⑨.

The mill is powered by a standard motor via a vertical gearbox ⑩. Segment thrust bearings in the gearbox absorb the roller forces.

The grinding rollers are raised hydraulically from the grinding table prior to commencing grinding. This is realised by reversing the oil pressure exerted on the spring assembly cylinders. The

View inside an LM 28.2 D



grinding mill can therefore be started in an empty or full state with a low starting torque (approx. 40% of the nominal torque). Direct online started squirrel cage motors are standard supply. An auxiliary drive is not required.

Metal to metal contact between the grinding rollers and grinding track is prevented by the adjustable stop buffer.

Grinding components subject to wear (roller tyres and grinding table segments) can be easily replaced.

Safety equipment

Solid fuels can, under certain circumstances, combust, flash ignite or explode as a result of:

- an increased O₂ content (> 12 %) in the process room
- ignition sources being present
- large quantities of volatile material being present
- an increased CO content in the process air
- the fineness of the grinding material
- the temperature of the material and process air.

As a result, there is a greater need for effective safety measures. These include:

- inert operating status with max. O₂ contents of approx. 10 % in damp process gas
- pressure-shock resistant structure
- adequate pressure relief surfaces
- O₂ monitoring
- CO monitoring (e.g. to detect smouldering when the grinding mill is stationary)
- quick-closure gate valves to isolate plant components
- avoidance of ignition sources (e.g. stop buffers preventing metal to metal contact)
- plant safety design in compliance with local regulations.

Nowadays, safety and monitoring measures are automated, monitored and remotely controlled through simple systems consisting of control consoles supported by process computers. Loesche customers benefit from the many years of experience we have gained in this area.

Loesche coal mill with explosion suppression system (ammonium phosphate)



Plant layouts

The safety of coal-grinding plants must be ensured in all operating situations. Safety aspects are laid down in regulations and ordinances. Nowadays inert and pneumatically-operated grinding plants can be designed with incorporated operational safety characteristics. The operator decides on the ultimate plant layout.

Direct-firing mills for coal dust are utilised as **non-inertised grinding plants** for steam boilers. An economical combustion method with reduced emissions (NO_x, CO) is achieved in every furnace system through the uniformity of the following parameters:

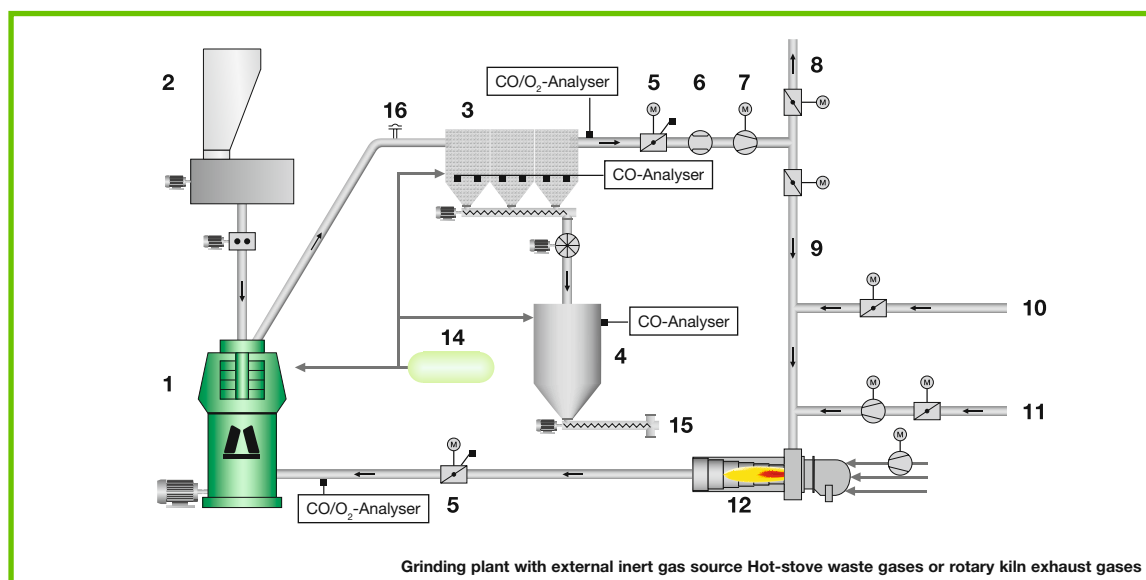
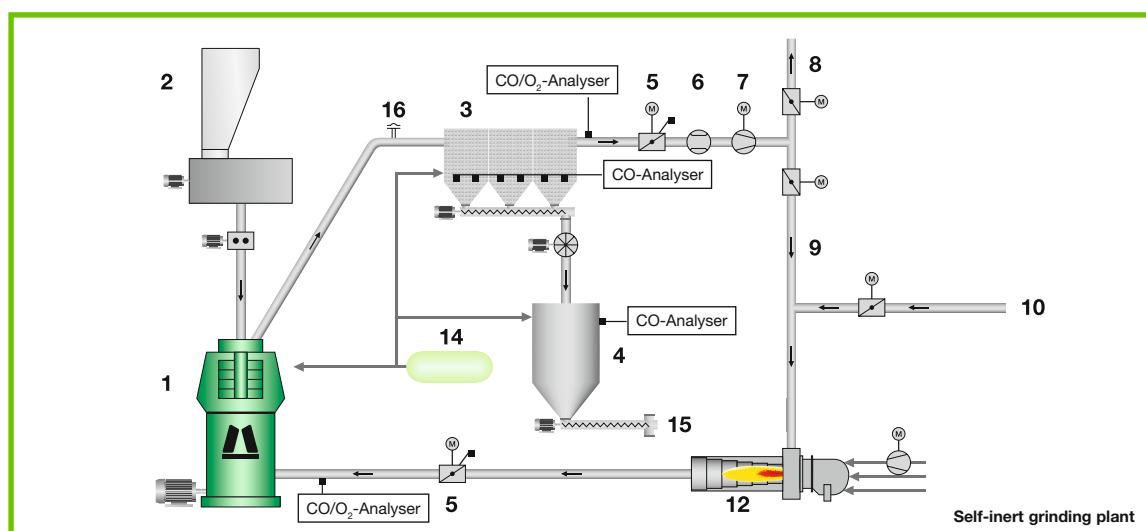
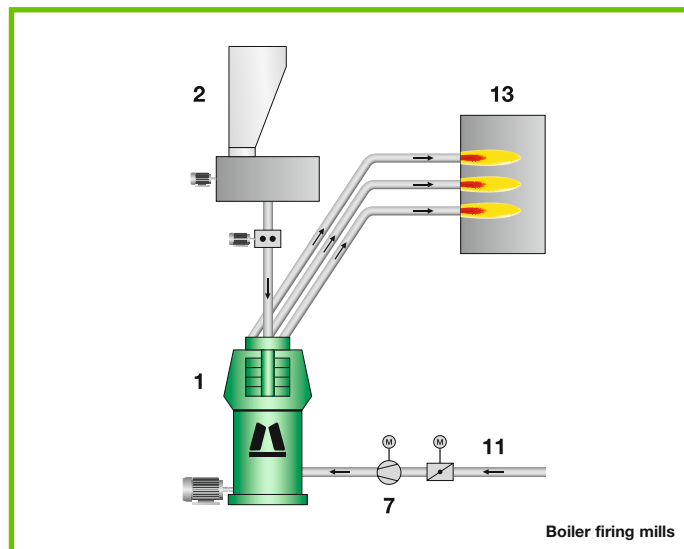
- air distribution
- coal dust distribution
- grit size distribution
- pressure.

A distinction is made between the two types of **inerted coal-grinding plants**:

- **Self-inert grinding plants** that utilise recirculated gases occurring in the installation system itself. The required process heat is provided by a hot gas generator that is an intrinsic part of the grinding plant.
- **Grinding plants with inert gas from an external source** that utilise process gases with a low oxygen content from other processes, such as rotary kiln exhaust gases from the cement industry, hot stove waste gases from the iron steel industry, nitrogen from air separation plants, etc.

Individual flow sheets illustrate typical plant layouts. A combination of the above mentioned inert coal grinding plant concepts is frequently used to obtain optimum system availability.

- 1 Loesche mill
- 2 Raw coal feed
- 3 Filter/Product separation
- 4 Product silo
- 5 Safety quick-closure valves (dampers)
- 6 Flow meter
- 7 Mill fan
- 8 Exhaust flue (stack)
- 9 Recirculation air
- 10 Fresh air
- 11 Hot gas from external source
- 12 Hot gas generator
- 13 Boiler direct-firing system
- 14 N_2/CO_2 Start/Stop and emergency inertization
- 15 Coal dust discharge
- 16 Explosion vent



Feed material – Areas of application



Loesche mill Type LM 28.2 D, Detroit Thermal Energy, Vicksburg / Mississippi, USA, 2005

Loesche coal-grinding mills are adapted to individual customer requirements. A change in feed material can be achieved without interrupting grinding operation. Loesche has gained extensive experience over many years with the following fuels:

- all bituminous coals,
- anthracite coals,
- petroleum coke of differing quality,
- hard lignite (brown) coals,
- pre-dried lignite coals,
- pre-dried and pre-ground timber (wood pellets),
- turf pellets and turf briquettes,
- sewage sludge.

Bituminous coal grinding

Bituminous coals are the most frequently used fuels. They are broken down into various subgroups (e.g. steam coal, coking coal, gas coal), depending on their level of volatile matter (between 5% and 50%) and ash (approx. $\leq 50\%$). Test grinding of these coals in a laboratory ball mill (Hardgrove principle) is a generally accepted method for determining grindability. A higher Hardgrove index (HGI) of, for example, 90°H indicates easy grindability properties. High ash contents detected at the same HGI lessen grindability and lead to increased wear. Materials with superior anti-wear characteristics are utilised to counter the resulting reductions in service life.

Petroleum coke and anthracite

Due to the low level of volatile matter (between 1–15%) contained in petroleum coke and anthracite coals a greater fineness is required to achieve the necessary surface for optimum product combustion. A fineness of 0.5% R 90 μm is achieved with the Loesche mill (LM 27.2 D, Beni Idir, Morocco) where coke is used.

Grinding blends of variable mixtures of bituminous coals and petroleum coke are also practised in the same grinding plant (as is the case at Nasicecement in Croatia). A Type LM 20.2 D Loesche mill was selected for a finished product delivery rate of 12.5 t/h with a fineness of 3.0% R 90 μm , and this commenced production in 2001.

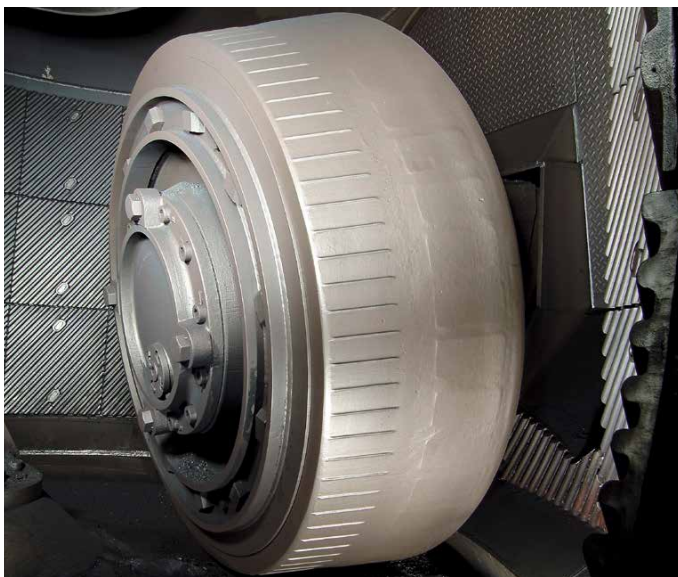
Mills of this kind are equipped with the following technological innovations to achieve the required petroleum coke grinding fineness:

- a grinding pressure control system that broadens the rigidity range of the hydraulic spring assembly system
- grinding table speed control.

Consistent product quality is achieved with the Type LSKS dynamic classifier from Loesche.



Loesche mill Type LM 20.2 D in Nasicecement cement works, Nasice, Croatia, 2001



Grinding roller and grinding chamber lining



Loesche mill Type LM 23.2 D, in Avedoere, Denmark, 2001

Wood pellets, lignite coals and turf

Hot gases with temperatures of up to 500°C are used to ensure complete drying of particularly moist feed material during the grinding process. Loesche mills can also be used to cool material during the actual grinding process. Loesche has supplied coal grinding mills to the following firms in the lignite coal industry in Eastern Germany:

- Mibrag, for the Deuben works, Type LM 26.3 D, 65 t/h with 8–30% R 90 µm in 1992 and,
- Lausitzer Braunkohlenwerke AG, Laubag, Senftenberg, Type LM 28.2 D, 52 t/h with 25–40% R 90 µm in 1997.

Pre-dried lignite coals are fed directly to the grinding mills from steam dryers at a temperature of 90–100°C on cold chain conveyors for cooling purposes. A product temperature of ≤ 60°C is legally stipulated in this respect.

Ambient air is used as a cooling medium.

Lignite coal from Lausitz has a fibre content of approx. 5%, which is effectively reduced through the shearing forces of the grinding rollers. Product fineness lies between 25 and 40% R 90 µm, with the largest fibre particles having a fineness of 0.4% R 0.5 mm.

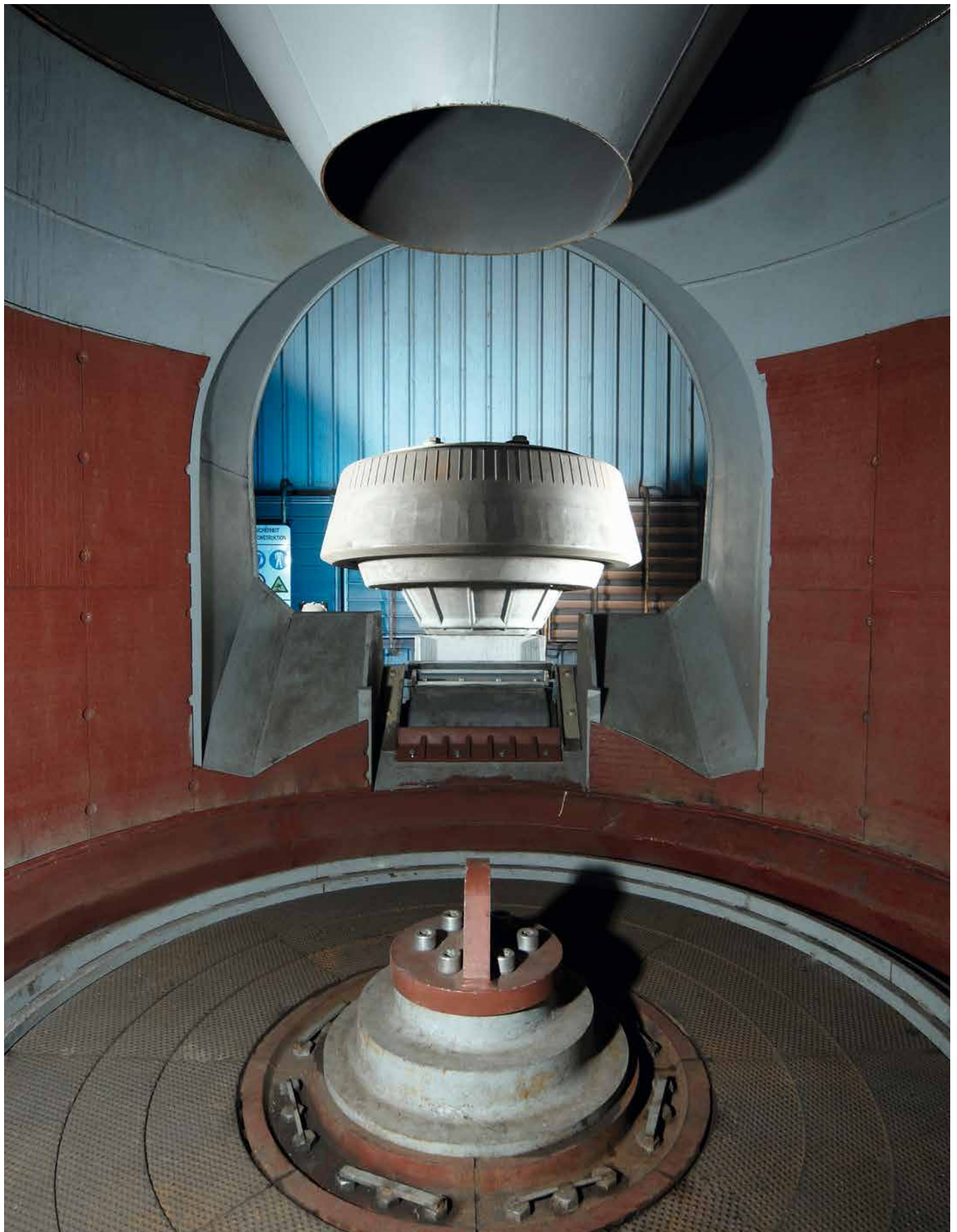
Lignite coal grinding plants in Germany supply the cement industry, smaller power stations and hot gas generator plants to deliver heat quantity for down stream processes.

Three Type 23.2 D mills were sold to Avedoere, Denmark in 2001. In addition to coal grinding, these mills also grind wood pellets with 70% R 0.5 mm at an output of 43.2 t/h.

Customer satisfaction led to subsequent orders, which also included the grinding capability for straw pellets.

Loesche mill Type LM 28.2 D, Schwarze Pumpe, Senftenberg, Germany, 1997





Complete grinding plants with components

In addition to supplying individual mills, Loesche also invests its know-how and competence in the production of complete grinding installations. These plants are mainly used in the cement and iron industry.

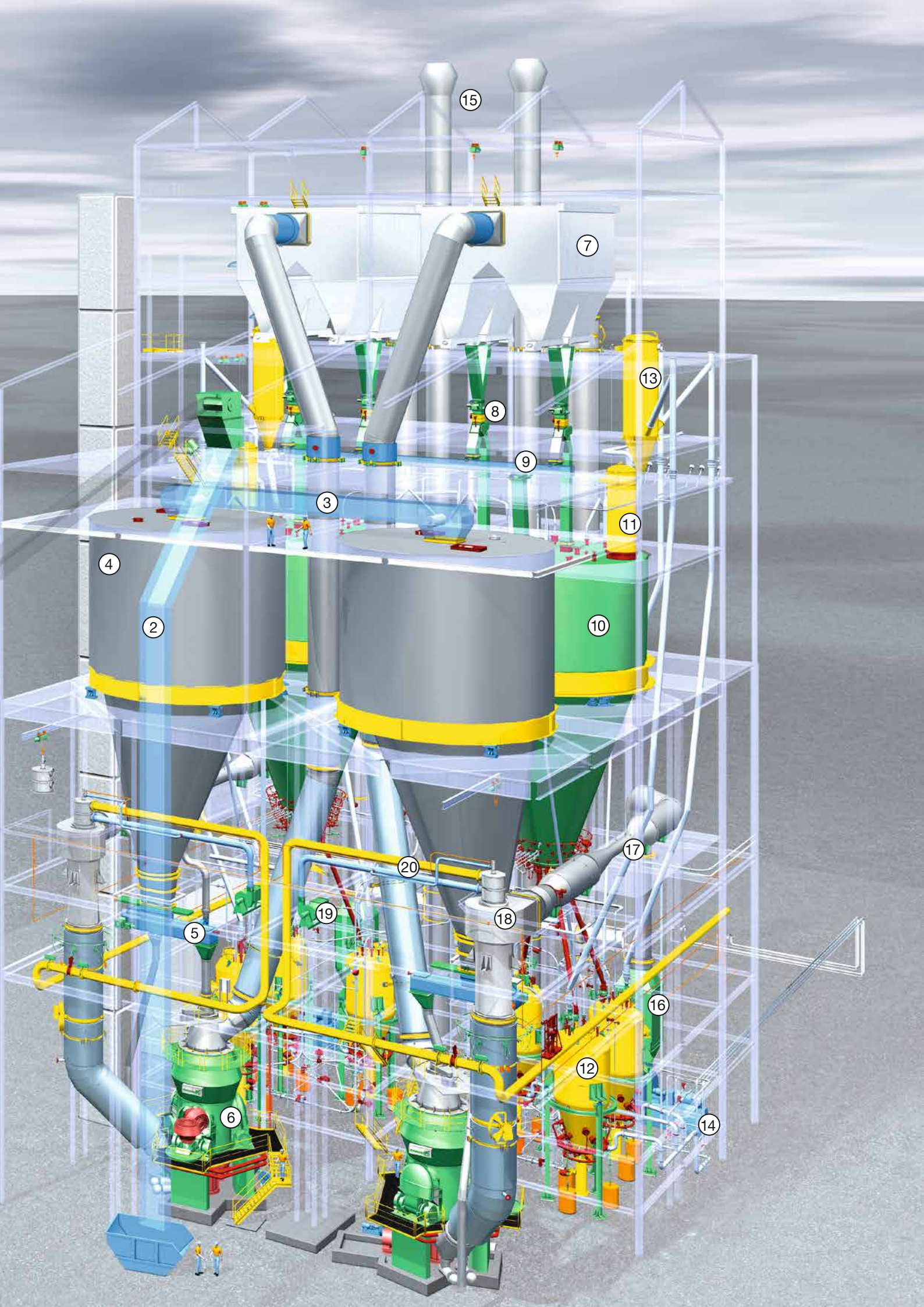
The adjacent illustration shows the basic structure of a coal grinding plant of this nature utilised for coal dust production for direct firing (PCI) in blast furnaces.

This application is distinguished by the use of gases from the blast furnace process (blast furnace gas, Cowper gas) as a heating medium for the grinding drying process.

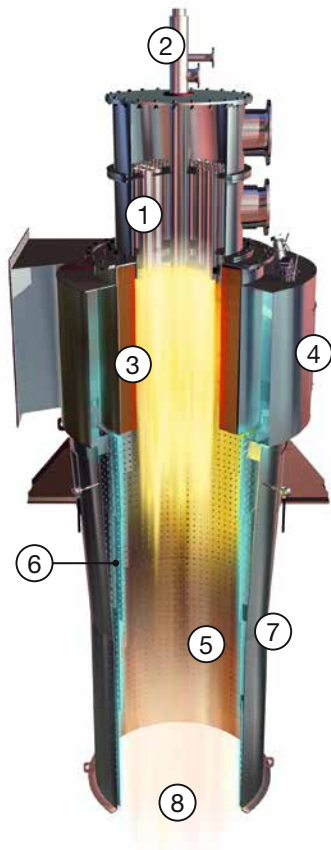
In addition to grinding mills, Loesche also develop hot gas generators and dynamic classifiers.

1

- | | |
|---|-------------------------------------|
| 1 Conveyor belt | 11 Filling bag filter |
| 2 Impurity rejection | 12 Conveying hopper |
| 3 Reversible filling conveyor for storage bin | 13 Depressurizing bag filter |
| 4 Raw coal storage bin | 14 Process gas fan |
| 5 Drag chain conveyor | 15 Stack |
| 6 Loesche mill | 16 Silencer |
| 7 Process filter | 17 Gas flow measuring device |
| 8 Rotary valve | 18 Hot Gas Generator |
| 9 Reversible drag chain conveyor | 19 Combustion air fan |
| 10 Pulverized coal storage bin | 20 Valve rack for Hot Gas Generator |



Loesche hot gas generator



Structure

- ① Multiple lance burner
- ② Start burner
- ③ Burner muffle
- ④ Spiral housing
- ⑤ Perforated sheath
- ⑥ Ring gap
- ⑦ Protective sheath
- ⑧ Hot gas outlet

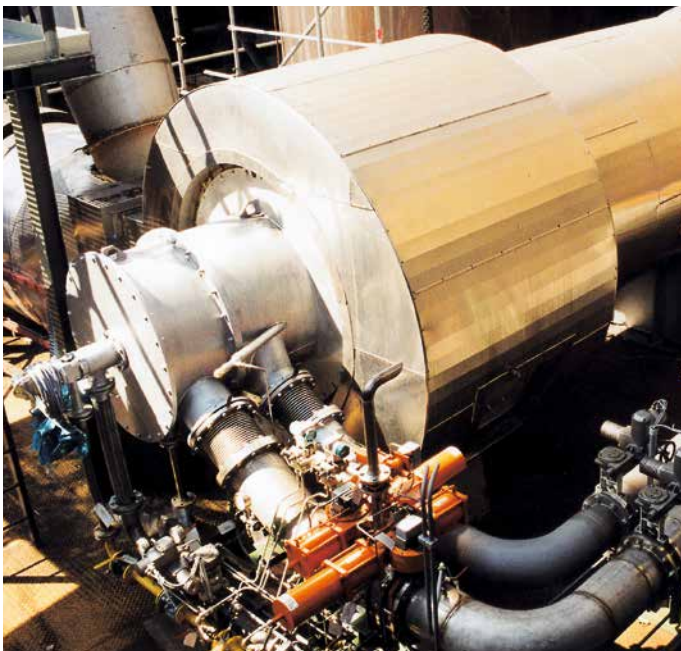
The perforated sheath furnace was developed by Loesche in mid-1960 and consists of a heat-resistant steel furnace chamber with a burner muffle. It has become known on the market as the LOMA furnace. LOMA furnaces have been employed all over the world for decades for different processes to achieve optimum thermal results.

LOMA furnaces are subject to continuous further development and meet state-of-the-art standards. More than 600 hot gas generators have been commissioned to date for heat flow rates of 100 kW to 64,000 kW.

Loesche hot gas generators are utilised where hot gas is required for direct drying (e.g. in the cement industry, power stations, steel, minerals industry, ore, timber, animal feed and chemical industry).

The Loesche hot gas generator employed for blast furnace gas combustion is a special Loesche development used in particular for the coal grinding drying process in the steel industry. The multiple lance blast furnace gas burner has a control range of 1:10 and can burn blast furnace gas from a calorific value of 2,500 kJ/m³ (STP) upwards without support burners.

LOMA furnace Type LF 20 with Type MLB 4 multiple lance burner for blast furnace gas for Dillingen steel plant, Germany, 1999

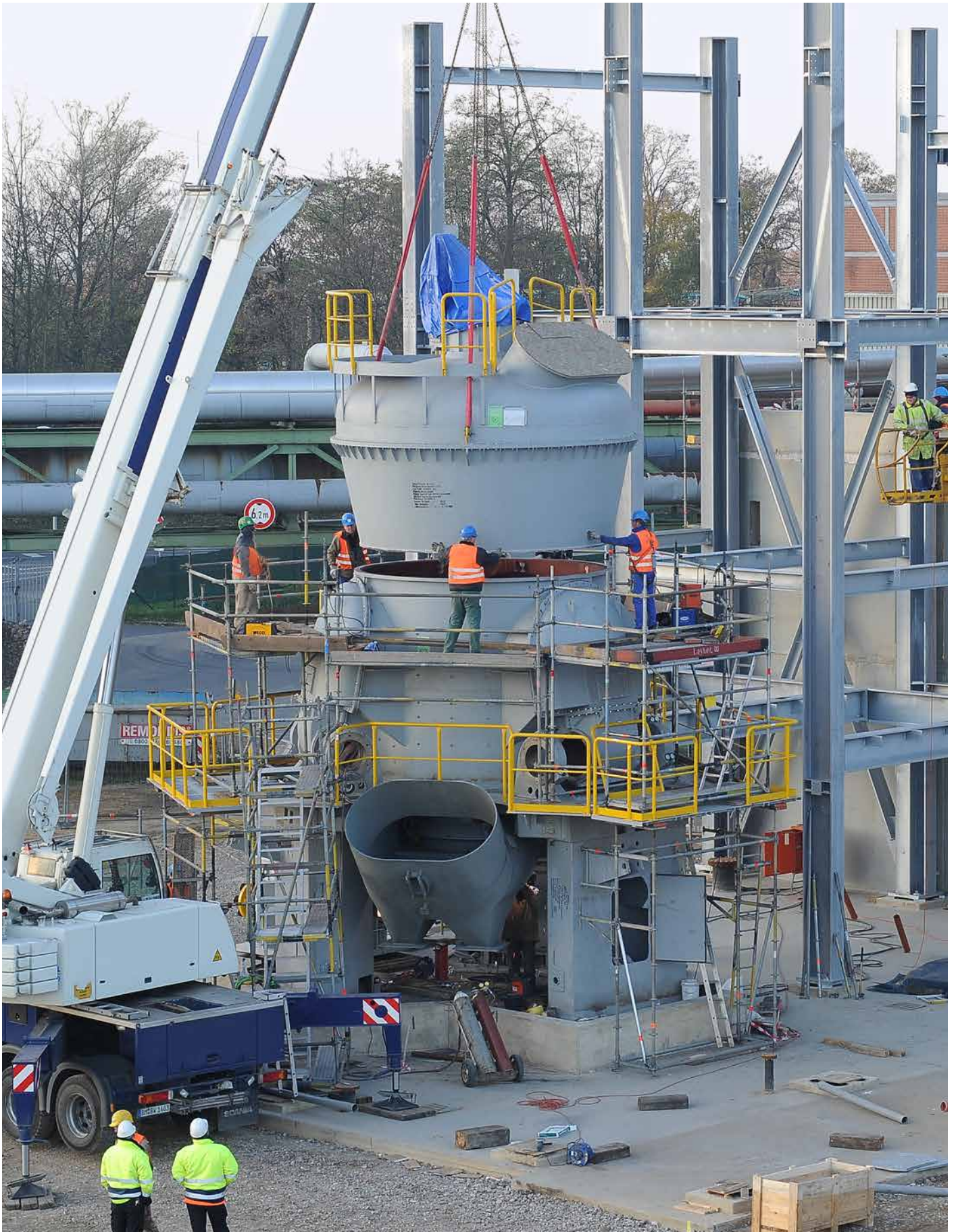


LOMA furnace Type LF 25 for blast furnace gas, for the steel plant Tubarão, Brazil, 2004



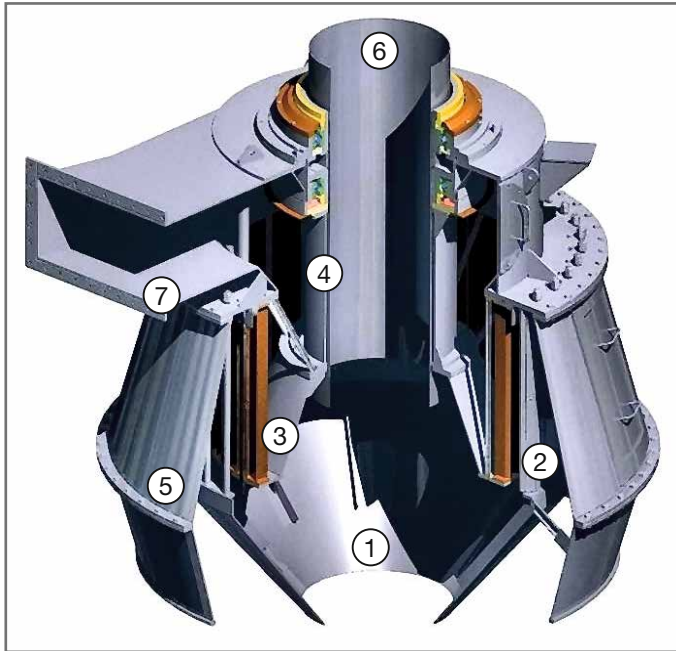


Loesche mill Type LM 43.4 D, in Kotputli, India, 2006



Loesche mill Type LM 28.3 D, in Berrenrath, Germany, 2011, under construction

LSKS dynamic classifier



LSKS classifier with central inlet and lateral product discharge for central coal grinding plants

Structure:

- | | |
|---------------------|---------------------|
| ① Grit cone | ④ Rotor shaft |
| ② Guide vanes | ⑤ Housing |
| ③ Rotor with blades | ⑥ Coal feed tube |
| | ⑦ Product discharge |

The Loesche classifier consists of a housing with adjustable vanes and grit return cone, a rotor and a drive with variable speed. The housing can resist pressure shock up to 3.5 bar (gauge). The classifier achieves product finesses < 1 % R 90 µm and ensures close product particle size distribution and an excellent level of efficiency.

The gas flow rising from the mill conveys the reduced particles into the classifying chamber where they are subjected to a deflective centrifugal force generated by the classifier rotor. Coarse particles are recirculated back to the grinding process via the grit cone, relative to the rotor speed.

Efficient classification is particular important in power station applications. A steep product particle characteristic curve ensures that optimum combustion is achieved in the boiler while keeping emission rates at a low level.

Wear protection is adapted to suit the abrasiveness of the feed material. The feed material can be introduced laterally or through a central vertical drop tube where high feed moisture is involved.

LSKS on LM 28.2 D



LSKS rotor with replaceable rotor blades



LSKS classifier with central inlet and 4 separate product discharges for direct-firing boiler plants



LSKS for LM 28.2 D



The Loesche test facility for raw materials testing, Research and Development

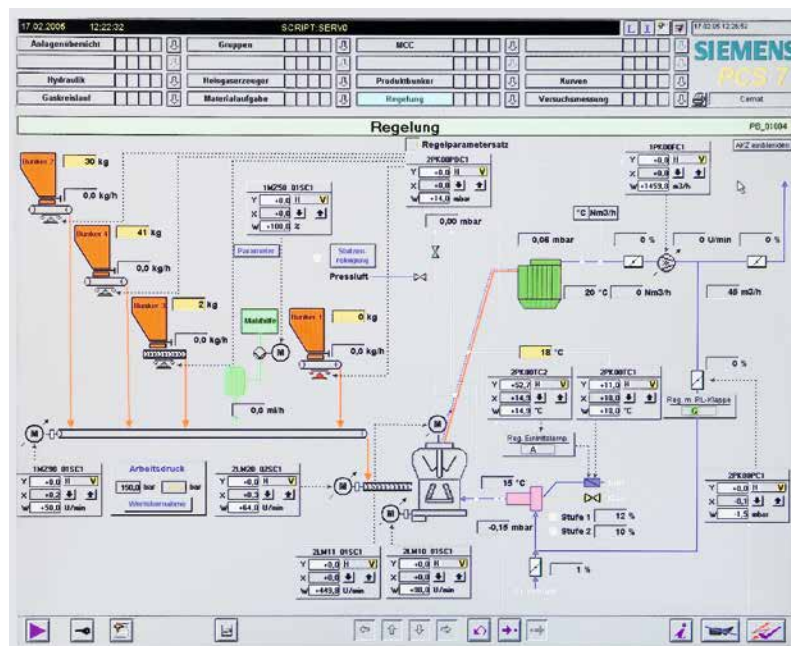
Calibrated standard grinding tests for mill sizing

Loesche has many years of experience in designing grinding mills. The most important prerequisite for correctly designed grinding mills is an exact knowledge of the physical properties of the materials to be ground.

The most important characteristic values of a material to be ground are the Loesche grindability factor and the specific power demand in relation to a defined fineness. Depending on the geological formation of the material to be ground, materials with highly different properties are found in nature, even with materials which appear visually to be similar.

Three well equipped laboratory LM 3.6 grinding mills are available in the Loesche test plant for performing standard grinding tests.

Fully-automatic operation with PLC



Analysis possibilities

- Pure density determination with gas pycnometer
- Determination of mass-related surface according to Blaine
- Grain size analysis with Cilas laser granulometer
- Sieve analyses with Alpine air-jet screening method
- Sieve analyses with Retsch vibrating sieves
- Grindability according to Hardgrove
- Grindability according to Zeisel
- Microscopy with Zeiss Stemi SV11
- Drying ovens for moisture determination
- Coal testing (C fix, volatile matter, ash content)

Technological development through practical laboratory grinding tests

One of the first steps in introducing new technologies is the practical laboratory test.

Within the framework of our research and development projects the following actions are carried out:

- New materials for grinding of future market requirements are examined
- Optimised mill settings for special products are determined
- Plant components and process configurations are optimised
- New wear materials and concepts are tested

Our test plant is constructed in such a way that various modes of operation and plant process configurations can be simulated in the tests.

LM 3.6 laboratory mill



Loesche – worldwide presence

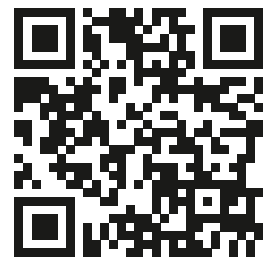
Loesche is an export-oriented company run by the owner, which was established in 1906 in Berlin. Today the company is internationally active with subsidiaries, representatives and agencies worldwide.

Our engineers are constantly developing new ideas and individual concepts for grinding technologies and preparation processes for the benefit of our customers. Their competence is mainly due to our worldwide information management.

This ensures that current knowledge and developments can also be used immediately for our own projects.

The services of our subsidiaries and agencies are of key importance for analysis, processing and solving specific project problems for our customers.

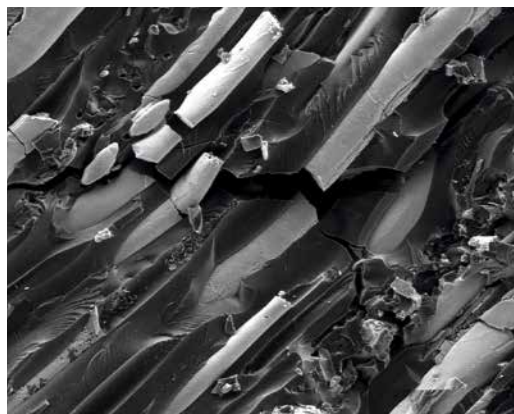
Please visit our homepage at **www.loesche.com**
for up-to-date information on our overseas companies.





Bituminous

1 cm

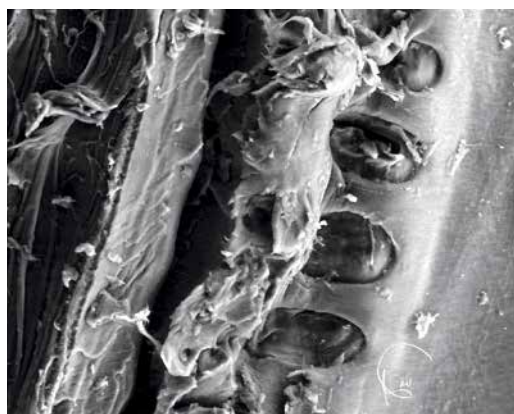


50 µm

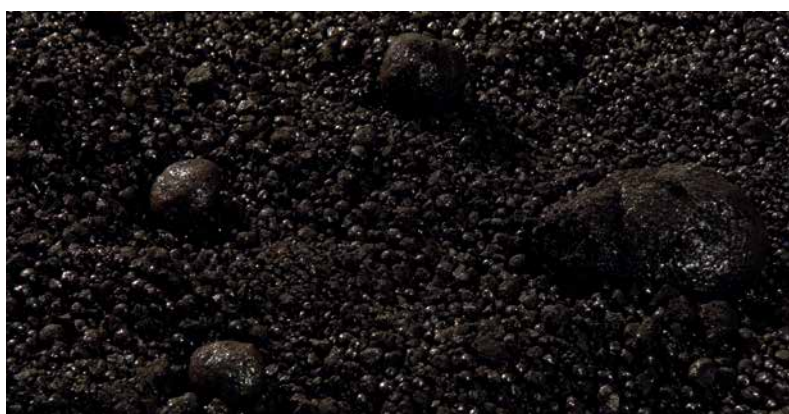


Wooden pellets

1 cm

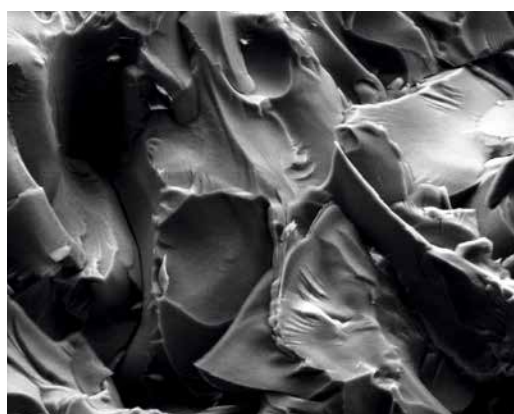


50 µm



Petroleum coke

1 cm

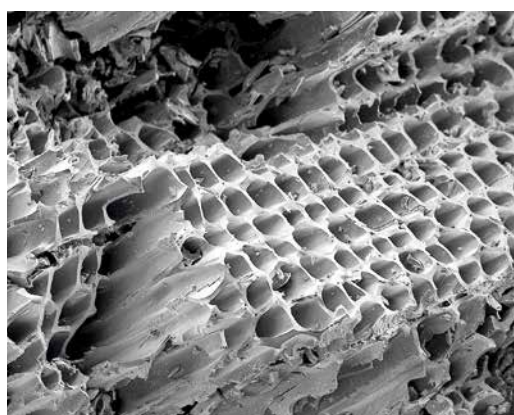


50 µm



Charcoal briquettes

1 cm



50 µm

Pictures originated at the electron microscope laboratory of Bauhaus-Universität Weimar

12/2015 Printed in Germany

INNOVATIVE ENGINEERING

