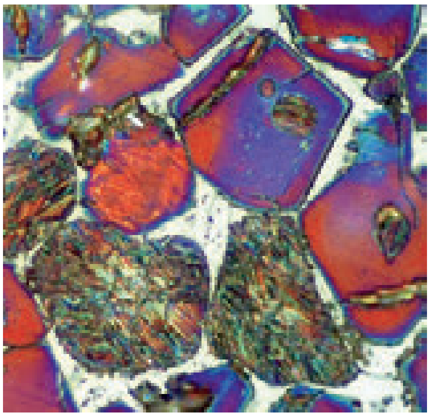
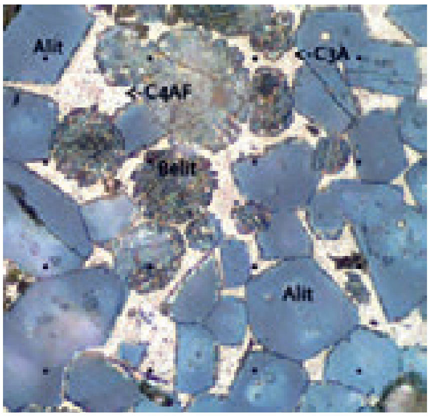
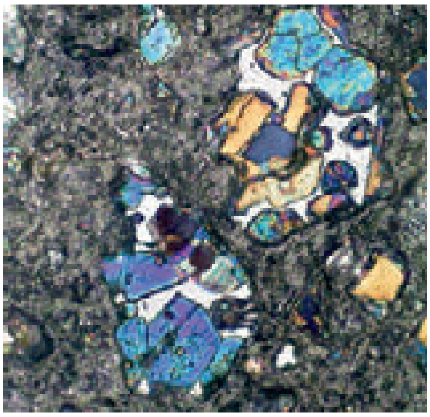


Etched clinker minerals under the direct light microscope — 20 µm

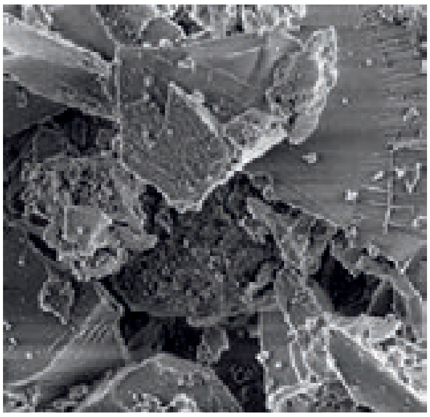


Typical clinker minerals under the direct light microscope — 20 µm

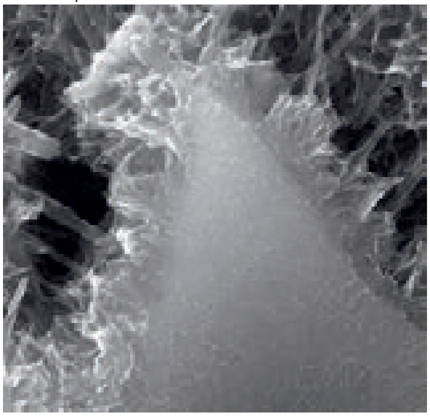


Ground section of cement grain with clinker minerals under the direct light microscope — 20 µm

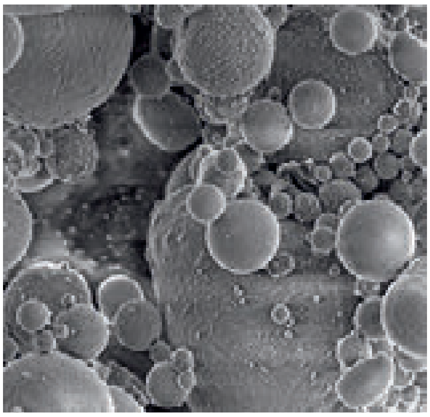
Granulated blast furnace slag grain after granulation — 20 µm



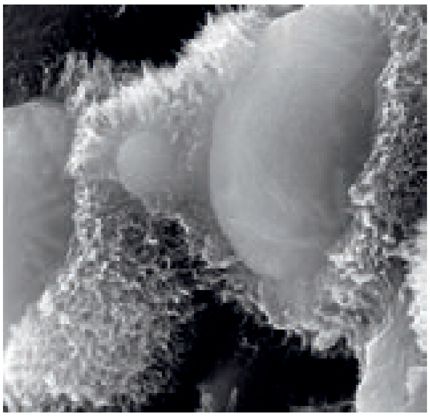
Ground granulated blast furnace slag — 2 µm



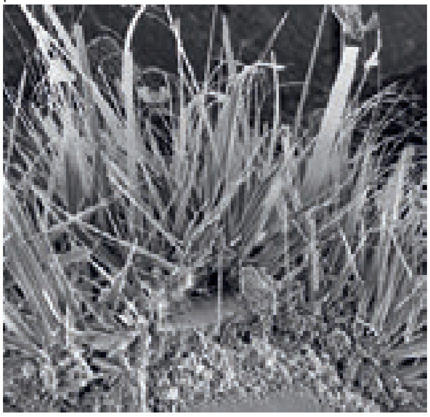
Granulated blast furnace slag grain with CSH phases — 2 µm



Bituminous coal flyash — 5 µm

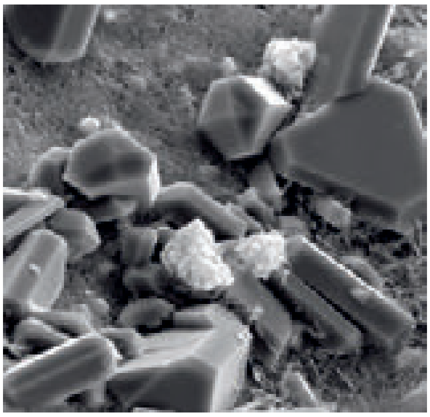


Bituminous coal flyash with hydration edge — 2 µm

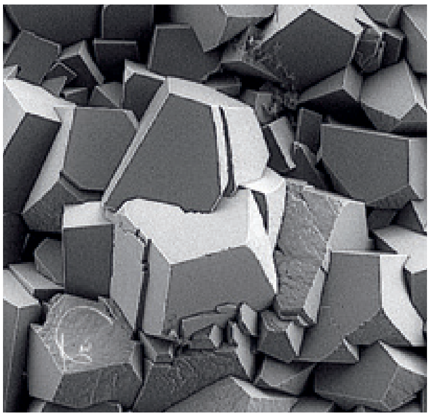


CSH phases — 5 µm

Natural gypsum — 20 µm



Gypsum formation in building material structure — 10 µm



Calcium carbonate crystals — 10 µm

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

143_LOESCHE-mills for cement and granulated blast furnace slag_EN
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CEMENTMILL

LOESCHE-MILLS FOR CEMENT AND GRANULATED BLAST FURNACE SLAG

LOESCHE®

INNOVATIVE ENGINEERING

Loesche technology – always a step ahead

Grinding of cement clinker and granulated blast furnace slag in roller grinding mills (vertical airswept grinding mills) is a technology introduced by Loesche. The first use of a Loesche mill, with a grinding track diameter of only 1.1 metres, was used as long ago as 1935. However, the breakthrough in grinding this type of material on the vertical roller mill did not take place until the beginning of the 1990's.

1935 The first Loesche mill for grinding cement clinker, an LM 11, was commissioned in Joao Pessao, Brazil. In the previous year E.G.Loesche had travelled there by Zeppelin to sign the contract.

1985 Mills for grinding cement and granulated blast furnace slag were installed in Asia under licence from Loesche.

1994 The 2+2 technology, which was specially developed for grinding clinker and granulated blast furnace slag, was used for the first time in an LM 46.2+2 for cement grinding in the Pu Shin mill works of Lucky Cement, Taiwan.

1995 An LM 35.2+2 went into production in Fos sur Mer, Ciments Lafarge, France, as the first mill for grinding granulated blast furnace slag.

1999 The first LM 56.2+2 was installed at Cementos Pacasmayo in Peru.

2004 The 50th Loesche mill with 2+2 technology for grinding cement and granulated blast furnace slag was sold worldwide.

2005 The first mill with 3+3 technology, an LM 56.3+3, was commissioned in the Rajgangpur works of OCL Ltd in India.

2006 The 100th Loesche mill for grinding cement and granulated blast furnace slag was sold worldwide.

2007 More than 140 Loesche mills for grinding cement and granulated blast furnace slag were sold world-wide.

Central grinding plant for granulated blast furnace slag LM 46.2+2, Dunkerque, France, 2005

The spring-loaded roller grinding mill for grinding coal was introduced by Loesche in the 1920's. Since the end of the 1930's Loesche mills have also been used for grinding cement raw material. The biggest breakthrough in this field of application took place in the 1960's.

Soon after this the cement industry expressed the desire to produce the final finished product, cement, using the more energy-efficient roller mill grinding.

The first practical trials in Asia with cement grinding using Loesche mills showed poor running behaviour of the mill owing to unsatisfactory formation of the grinding bed.

The application of this knowledge led to a patented solution in the form of a modified Loesche mill for fine grinding: LM – CS (cement / slag). In this mill preparatory rollers (support rollers) took over preparation of the grinding bed and the grinding rollers (master rollers) carried out the grinding.

The complete production process for cement was optimised in the 20th century. For a long time, how-ever, the energy-intensive clinker grinding process was not included in these developments. The quality requirements for the various types of cement products also caused a delay in introducing this state of the art technology to this sector.

With Loesche technology, success has been achieved in producing cementitious binders that conform to the current requirements of worldwide cement standards.

The materials for grinding listed below are used today as high quality feed stock in Loesche CS mills. Some would previously have been considered as waste products. They can be ground either individually or as a mixture.

Loesche mills can be adjusted so that in a few minutes a different product quality is achieved.

Materials for grinding, which are ground in different mixtures in Loesche-CS mills to produce binders

	Appearance	Grain Size/Fineness	Moisture Content
Clinker	**Hard, abrasive**	**< 30 mm**	**Dry**
Granulated blast furnace slag	**Vitreous, abrasive**	**< 5 mm**	**Up to 15%**
Gypsum	Mainly hard, REA* – soft, sticky	< 50mm	10% up to 25%
Limestone	Hard	< 50 mm	5% up to 10%
Puzzolan; Trass	Hard or soft	10 to 50 mm	Up to 25%
Flyash – moist	Sticky	Lumpy	< 25%
Flyash – dry	Powder	2.000 – 5.500 cm^2/g	Dry

*Gypsum from flue gas desulphurisation plants

Customer benefit and customer satisfaction are our highest goals

Quality and reliability right from the start. These are characteristic advantages of Loesche grinding mills that have been acknowledged all over the world. This is based not only on the number and size of the mills sold, but also on the large number of repeat orders. As early as 1928, when the first Loesche mill was put on the market, the grinding principle of the vertical roller grinding mill, with a driven grinding track and spring-loaded rollers was shown to be particularly energy-efficient and reduced the use of natural resources. These benefits of Loesche mills are becoming more and more significant today as plant sizes increase and the efficient use of primary energy becomes more important.

Furthermore a considerable saving in investment costs is possible through the high production rates of Loesche mills (up to 1100 t/h for cement raw material and 350 t/h for CS).

Loesche is a competent partner for customers – from engineering to customer service and from punctual project planning to handing over a plant with maximum availability.

Our principle is: “Every Loesche grinding mill must be a reference mill”.

Loesche mill Type
LM 56.3+3 CS,
Settat, Morocco, 2006

The following features are the basis of our competence:

- Planning and construction of turn-key grinding plants for cement clinker and granulated blast furnace slag
- Tailor-made plant concepts from design to commissioning
- Individual solutions through optimised process technology
- Component commonality solutions based mainly on exchangeable components for the cement clinker and cement raw material mills, and including the use of identical gear drives
- Customer service – a guarantee of reliable plant operation. Advice on further technical developments
- Unlimited spare parts supply (readiness to deliver)
- Certification according to EN ISO 9001: 2008

Loesche mill Type LM 56.3+3, under construction, Xin Zhou Clinker, China, 2007

Loesche mill Type LM 56.3+3 CS, under construction, Ras al Khaimah, United Arab Emirates, 2007

Loesche mill Type LM 46.2+2 S, Purfleet, Great Britain, 2001

Working principle, construction and function

Working principle of Loesche CS mills

The material to be ground is crushed between the rotating grinding track and the individually guided grinding rollers.

Grinding is carried out primarily through the application of compressive force vertically, the secondary effect being the horizontal shear force.

In comparison with the grinding of cement raw material, coal and other minerals, further influencing factors have to be considered for the fine grinding of granulated blast furnace slag and clinker. These factors are:

- Granulated blast furnace slag – feed grain size: 0 mm – 5 mm edge length
- Cement clinker-feed grain size: 0 mm – 25 mm edge length. Here the biggest quantitative fraction of the feed grain size of clinker is between 50 µm and 100 µm, i.e. in the range of the final product grain size of cement raw meal.
- Cement clinker is dry and hot, i.e. the temperature is typically > 100°C
- The product fineness in the grain size range is 2 µm to 50 µm

The axes of the rollers, which are inclined at 15° to the grinding bed, bring about optimum fine grinding and at the same time result in minimum wear.

Due to the different material structure of cement clinker and blast furnace slag compared to limestone and coal, higher compressive grinding forces are required, with a minimum of shear force.

This is achieved through the geometric design of the rollers (small roller width) and the increased distance of the roller from the centre of the grinding chamber.

The products to be ground differ from materials prev-iously processed in roller grinding mills mainly because of the required product grain size and the high material compressive strengths.

Ultra-fine products cannot be produced in an air-swept vertical roller grinding mill without specific measures being taken to prevent increased mill vibration.

Due to the prevailing frictional conditions, aerated dust behaves much like a liquid. Each roller has to prepare its own grinding bed through de-aeration and precompaction. These processes take place consecutively, and mill vibration is consequently difficult to avoid.

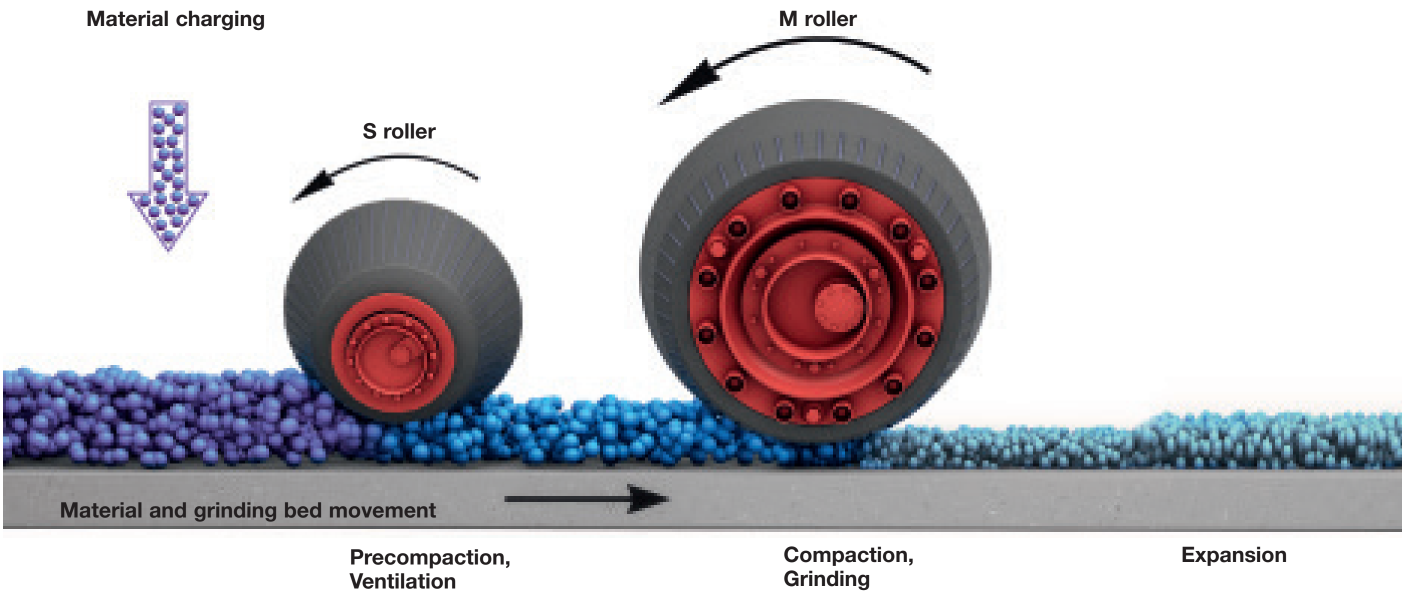
Construction of the LM-CS mill
With the new concept of the LM-CS mill, vibration problems are solved.

Rollers of different design are used for separate tasks in ultra-fine grinding – i.e. preparation and grinding.

The well known basic principle of a Loesche mill, with the modular system patented in 1970, is retained:

- Conical rollers positioned on a horizontal grinding track
- Individual guiding of each roller in a fixed rocker arm
- Support and precise guiding of the rocker arm in roller bearings, in a stand with integrated spring system

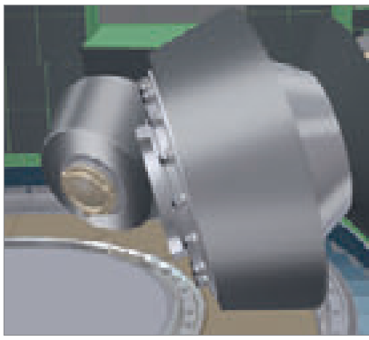
Working principle of the Loesche 2+2 / 3+3 system with Master and Support roller



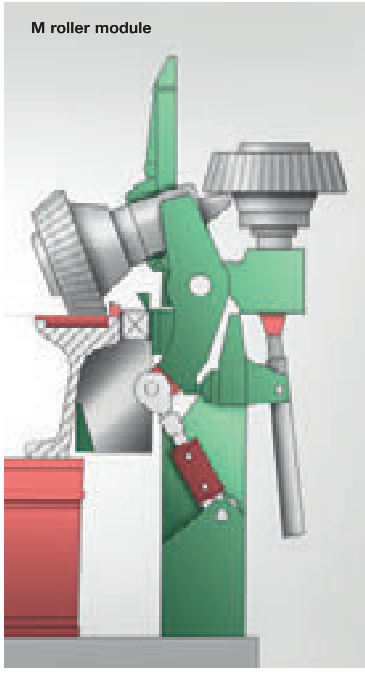
- Hydropneumatic spring tensioning of the rocker arm system.
- Parallel grinding gap between the grinding elements
- No metallic contact of the grinding elements whether the grinding track is empty or filled, through the use of a mechanical buffer stop.

The following features are new for clinker and granulated blast furnace slag:

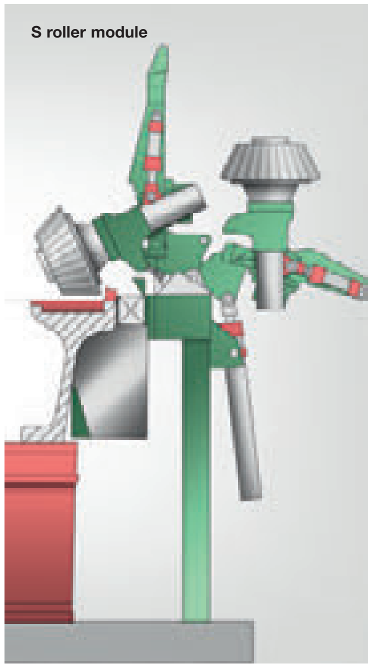
- Significantly higher specific grinding pressure
- Variable grinding pressure during grinding
- Magnitude of the grinding pressure depends on the required fineness (specific surface area according to Blaine)
- Combination of grinding roller with support roller as M+S system
- New mill designation, LM 56.2+2 CS or LM 56.3+3 CS, depending on the number of roller pairs used (C = cement, S = slag).
- Very low differential speed of grinding roller to grinding track
- Pure rolling motion of the S roller
- Low specific wear with ultra-fine grinding. Hard facing of grinding components within the mill is possible with mobile welding equipment. Hard facing accomplished using the integrated service drive on the main gearbox.



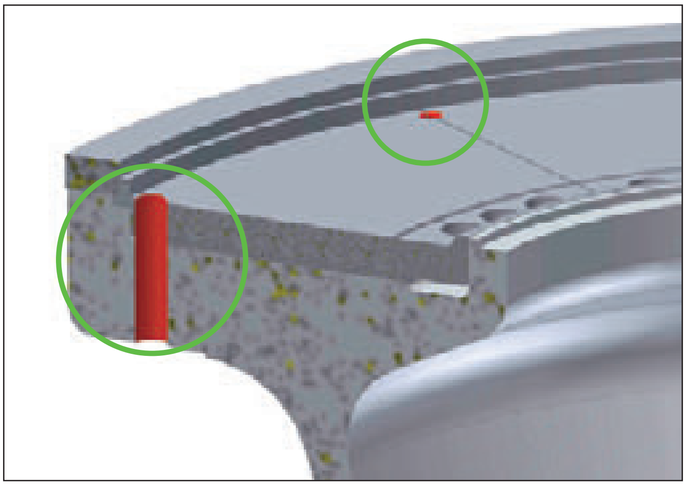
Master and Support roller of Loesche 2+2 and 3+3 technology



M roller and S roller in working position

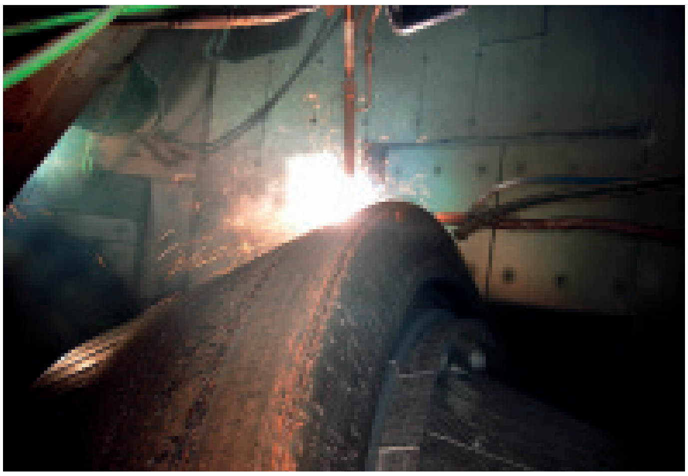


Outlet openings for foreign particles



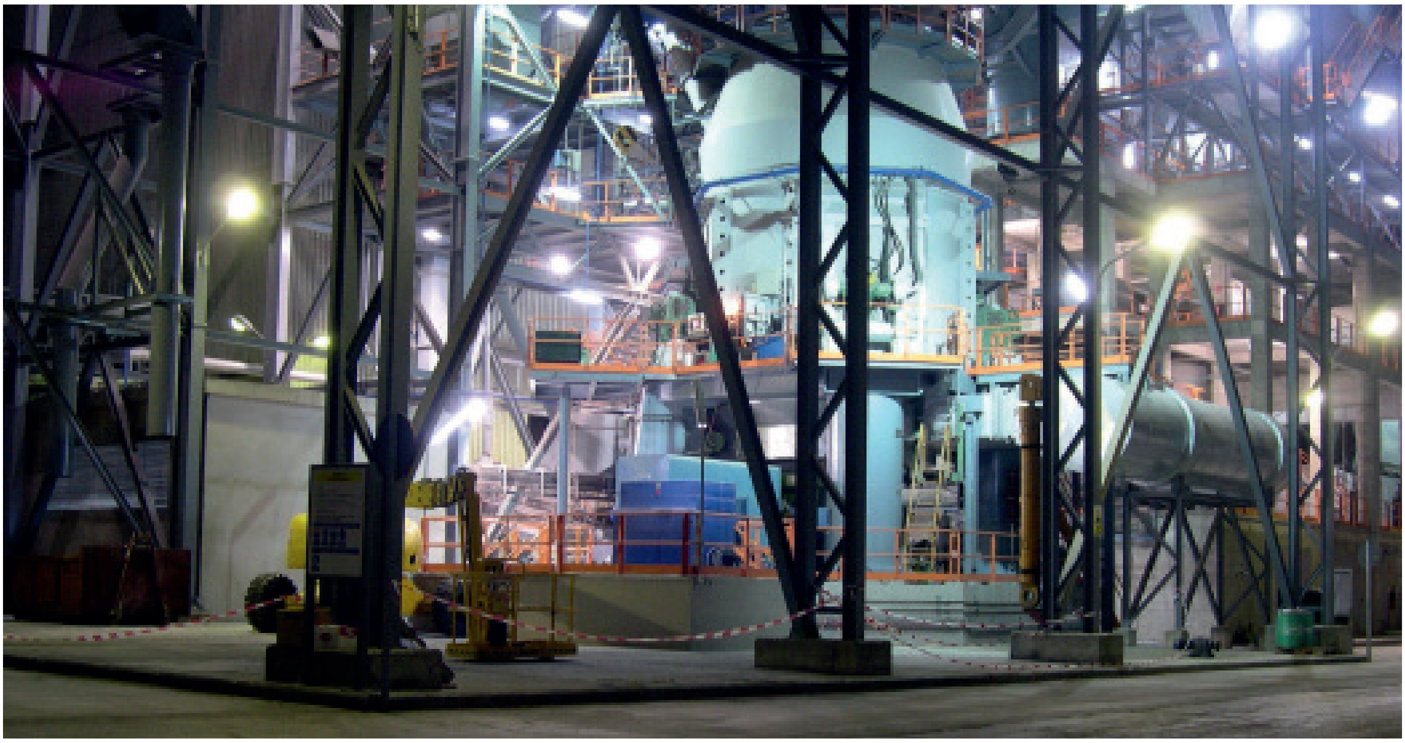
Outlet openings for foreign particles (schematically)

- Buffer for S roller for mechanical height positioning
- Continuous discharge of iron particles in the granulated blast furnace slag during grinding, i.e. significant increase in service life of grinding components
- Consistent product quality during the service life of the grinding components through mainte-nance of the parallel grinding gap to a large extent (constant contact geometry)
- Separation of tasks: S rollers prepare the grinding bed, M rollers carry out grinding – therefore the mill operates with low vibration levels
- In spite of the different dimensions the M rollers and S rollers can be swung out from the grinding chamber using the same hydraulic auxiliary equipment for fast and easy servicing
- The modular system of the cement and granulated blast furnace slag mills is supplemented by the new S roller module
- The S roller module consists of the roller, rocker arm, hydraulic pressure system and bearings which are all integrated into the housing cover. Owing to its simple construction and the low forces to be transmitted, the S roller module with its sub-assemblies is designed as a complete functional unit.
- The main components, such as rocker arm, M rollers, spring system, roller bearings etc. in the Loesche modular system can be exchanged between related mill sizes for cement raw material and cement grinding
- Identical gearboxes can be supplied for similarly sized raw material and cement mills.

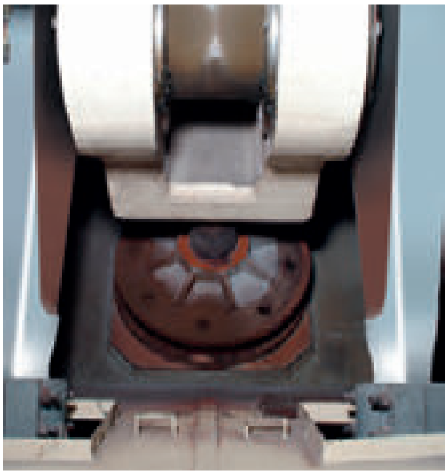


Welding of roller tyre in the mill

Service drive

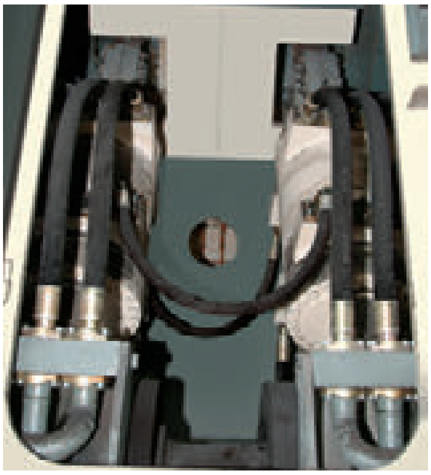


Loesche mill Type LM 46.2+2, Carboneras, Spain



Buffer

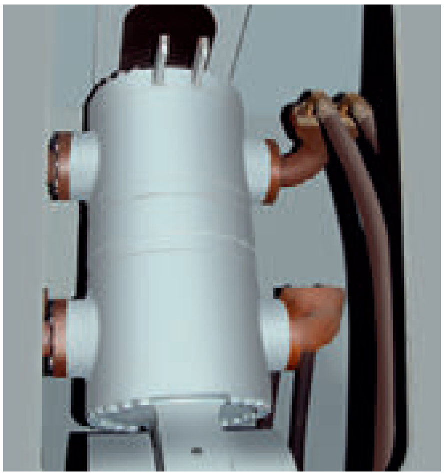
M roller: rocker arm in working position



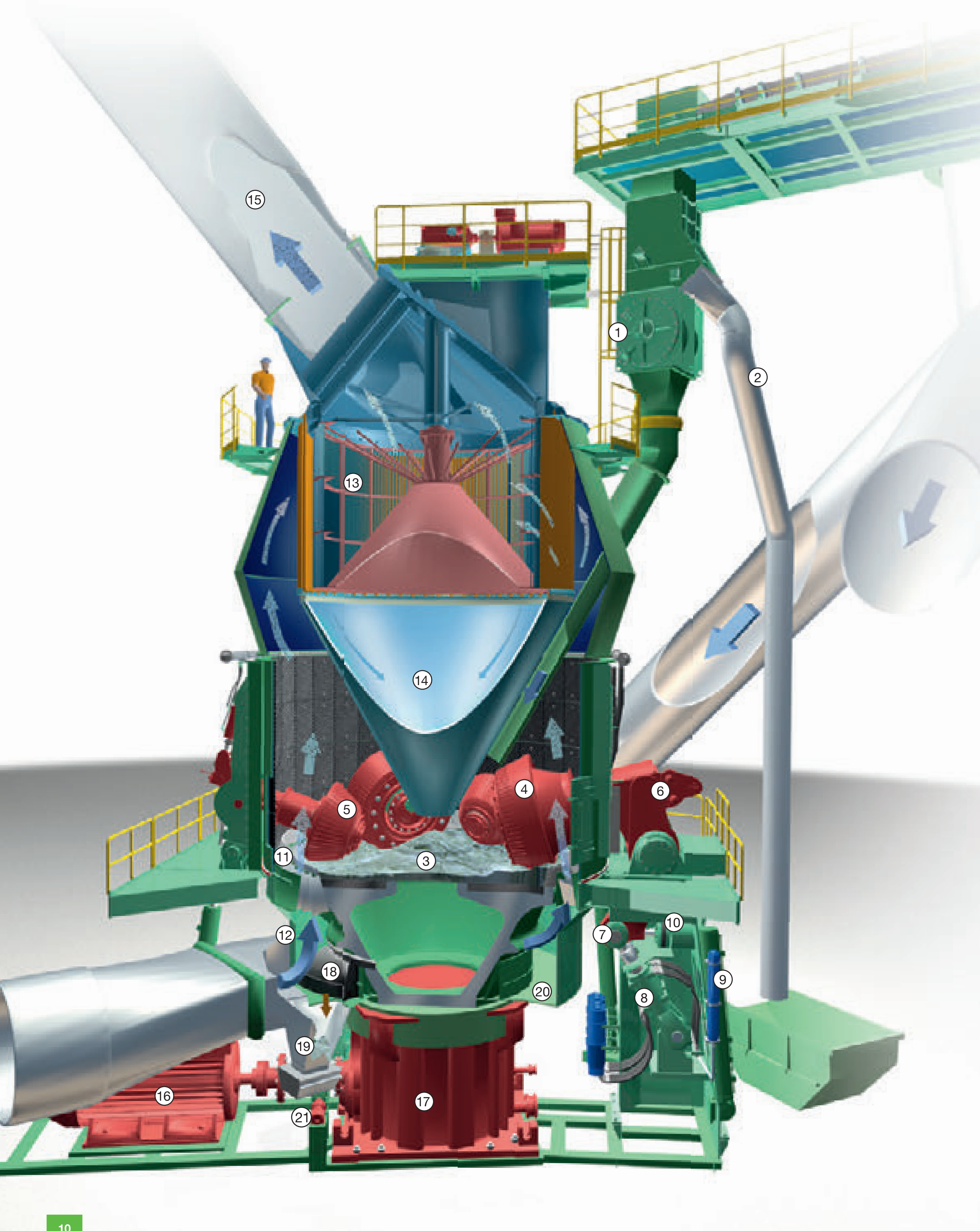
High pressure hydraulic hoses

Bladder accumulator

S roller: rocker arm in working position



Hydraulic cylinder



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Mill function

The feed material is discharged into the mill via an airlock and a downpipe to the centre of the rotating grinding table ③. Magnetic tramp material is diverted from the feed material before reaching the rotary feeder ① and is removed through a branched downpipe ②. The material to be ground moves on the grinding track towards the edge of the grinding table under the effect of centrifugal force and in this way passes under the hydropneumatically spring-loaded M rollers ④. These comminute the material while the smaller S rollers ⑤, which each operate between the M rollers, support preparation of the grinding bed by de-aeration and precompaction. The rollers are forced upwards as they roll on the material bed. At the same time the functional unit consisting of M roller ④, rockerarm ⑥, spring rod ⑦ and the piston of the hydraulic cylinder ⑧ are deflected. The piston displaces the oil from the upper cylinder chamber into the gas-filled bladder accumulator units ⑨. Nitrogen-filled rubber bladders in the accumulator units are compressed and act as gas springs.
The buffer stop ⑩ prevents contact of the grinding roller with the grinding track bed.
Scrapers ⑱ push the reject out of the ring duct ⑳ and into the reject-return conveyor ⑲.
Rotation of the grinding table causes the ground material from the M rollers to be thrown outwards over the edge of the table. In the area of the louvre ring ⑪, which surrounds the grinding table ③, the upwardly directed hot gas stream ⑫ captures the mixture of ground material and material still to be ground and conveys this to the classifier ⑬.
Depending on the classifier settings ⑬ coarse material is rejected. This falls into the internal grit return cone ⑭ and from there is returned to the grinding table ③ for re-grinding under the rollers. Final product material passes the classifier and is conveyed from the Loesche mill with the gas stream ⑮.
When grinding mixed cements and moist granulated blast furnace slag, the water contained in the feed material evaporates spontaneously through intimate contact with the hot gas stream. The required mill outlet temperature of 80°C up to max. 130°C is therefore already achieved in the grinding chamber.

Portland cement from pure clinker with the addition of gypsum is ground without hot gas in the Loesche mill (except during plant start-up). In this case the low moisture content is evaporated through the heat of grinding.

The mill is driven by an electric motor ⑯ via a vertical gearbox ⑰. Motors with increased starting torque are not necessary. A segmental thrust bearing in the top of the gearbox absorbs the roller forces.

Before starting the grinding process the M rollers are lifted hydraulically from the grinding track. For this, the oil pressure in the hydraulic cylinders is reversed from the spring-loading side to the counter pressure side. In this way the mill can be started (empty or full) with a low starting torque – at about 40% of the operational torque. The buffer and automatic lifting of the M rollers ④ ensure that no metallic contact between the grinding elements takes place when starting the mill without material. A so-called “auxiliary drive” for starting up at crawl speed is not required.

The support rollers ⑤ are also lifted when starting the mill.
The grinding components subjected to wear – roller tyres and table segments – can be quickly and easily replaced. Particles of foreign matter which are particularly difficult to grind (iron particles from granulated blast furnace slag) cause local wear when they accumulate on the grinding track. In this case mobile welding equipment which operates within the mill is available to hardface these parts. Rotation of the grinding components during welding is achieved by using a service drive ㉑ with very low power consumption.

Loesche mills for mere granulated blast furnace slag grinding are fitted with devices for continuous removal of iron particles. This method increases the service life of the grinding components significantly between hardfacing operations.

Mill selection sizing – Dimensions – Models – Drives

The standard parameters for sizing Loesche CS mills are:

- grindability
- moisture and
- product fineness

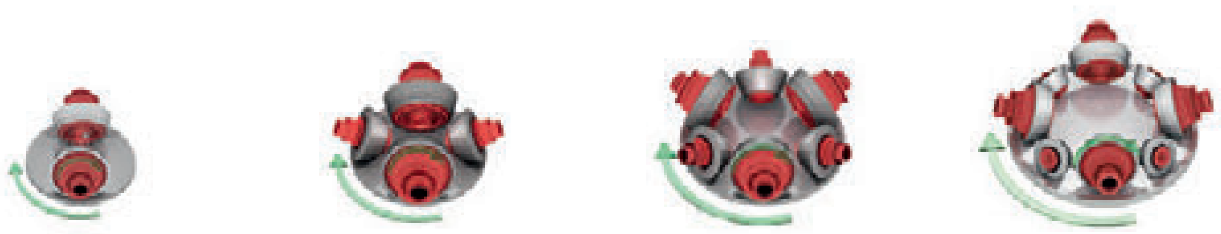
These are the decisive factors.

- The specific grinding pressure is approx. 30% to 40% higher than for cement raw material.
- The grinding principle is retained.
- The construction of the drive consisting of motor, coupling and gearbox with integrated segmental thrust bearing is retained.
- In specific cases when ordering a raw material mill and cement mill at the same time an absolutely identical gear-box for both applications can be used. This means that not only are the physical dimensions the same but also the installed power, the input and output speed, coupling and the mill motor.

Sub-assemblies and structural elements from cement raw material mills which have proved themselves in practice are still used.

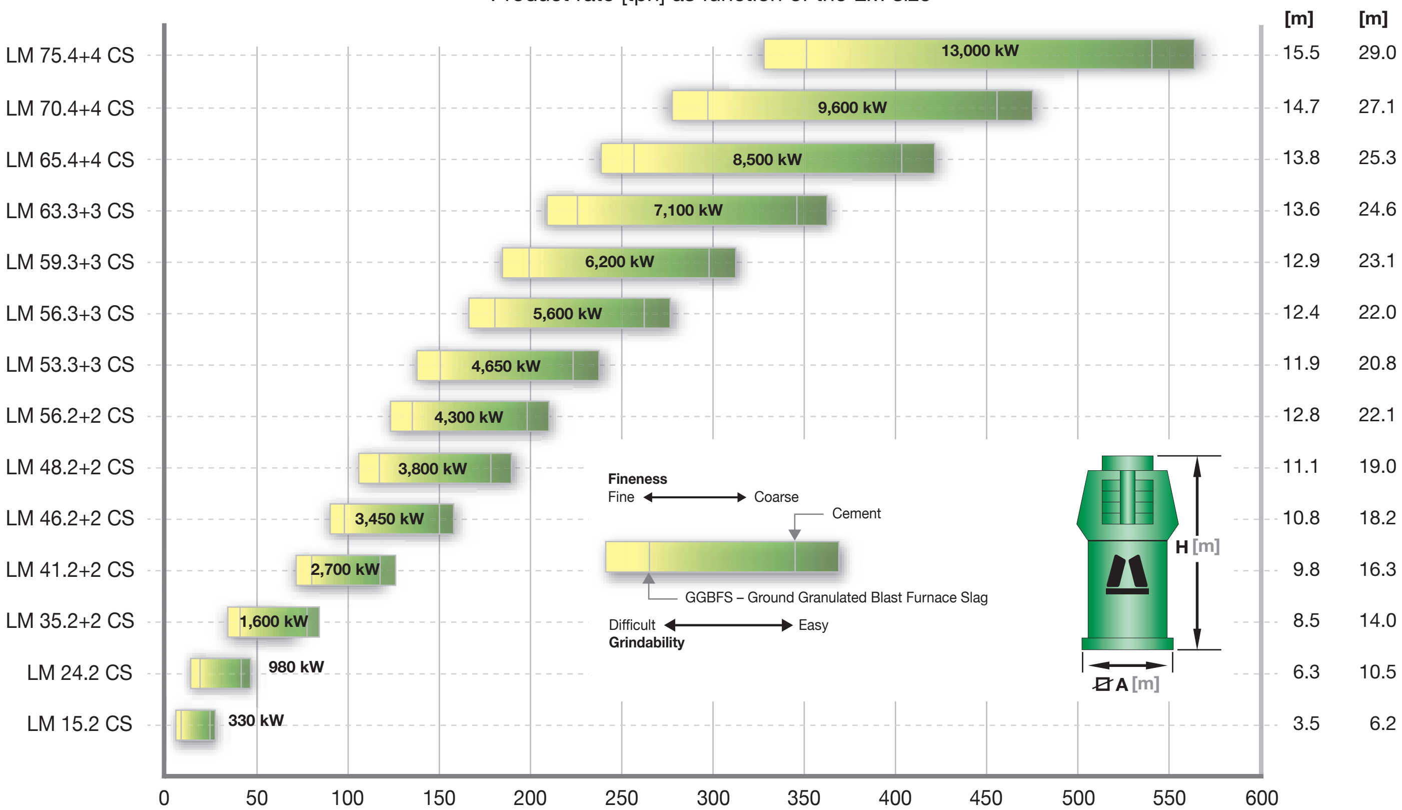
Mill types for cement and granulated blast furnace slag are shown in the following table. In their design they follow the M+S principle (with master and support rollers) according to the arrangment n+n, i.e. 2+2 or 3+3, corresponding to the number of M and S rollers.

Development of even bigger units with higher product through-puts is conceivable. Based on the modules already used in practice, both for the M rollers and the S rollers, solutions for mills in the 4+4 type of construction can easily be achieved. This would represent a logical size development from cement raw material mills to mills for ultra-fine grinding of clinker and granulated blast furnace slag.



LM for Cement and Ground Granulated Blast Furnace Slag

Product rate [tph] as function of the LM size



Product throughput [tph]

Prevailing conditions in process technology as well as the market and customer requirements will be the decisive factors in achieving this development target.

Naturally the mill drives also have to be adapted to the increase in size of Loesche mills.

As with Loesche mills, the modular method of construction has been consistently used for gearboxes. This makes further increases in mill drive capacity possible without the need to develop a new construction concept.

Loesche mill Type LM 56.2+2 Ras al Khaimah, VAE, 2007

Loesche mill Type LM 35.2+2, Rouen, France, 2003

Loesche mill Type LM 46.2+2 Dunkerque, France, 2005

Loesche mill Type LM 46.2+2, Bilbao, Spain, 2004

Raw materials for grinding

Loesche mill Type LM 35.2+2, Fos sur Mer, France, 1995

Cement is a construction material which on the basis of chemical reactions hardens with water and in use retains its hardness and durability both under atmospheric conditions and under water.

The main component is Portland Cement clinker.

For the production of clinker natural and secondary raw materials are used.

The raw material mixture for clinker production consists of the following:

- limestone
- lime marl
- clay
- sand and
- iron carriers

Raw material requirements are covered mainly by natural sources.

The cement industry is an energy-intensive sector, and as such is making every effort to achieve savings in primary raw materials and fuels.

To an increasing extent suitable secondary raw materials, which are produced as by-products in other industrial production processes, are used for clinker production. These include:

- lime sludge from drinking water treatment
- flyash from coal-fired power stations etc

In order to protect natural fuel and raw material resources and therefore to reduce the emission of climate-influencing carbon dioxide, secondary raw materials, secondary fuels and substitute materials for partial replacement of clinker in cement grinding are used.

Use of these substitute materials is not only environmentally friendly but also has an economic advantage since these by-products are normally available at considerably lower prices than Portland Cement clinker.

The following table shows the most important substitute materials which are used worldwide for clinker replacement.

Latent hydraulic materials harden after fine grinding and mixing with water with alkaline and / or sulphate initiators.	**Granulated blast furnace slag**
Puzzolanic materials contain only a small amount of calcium oxide and do not harden independently. Therefore they require a catalyst, which gives off $Ca(OH)_2$ after mixing with water, to bring about hardening	**Natural puzzolanas / flyash / boiler sand / silica dust / calcined rice**
Inert materials (or fillers) are not involved in a hardening reaction, or only to a small extent. They are used mainly to supplement the grain size composition, fill the voids between the grains, reduce the mixing water requirement and to compact the structure.	**Limestone**

Granulated blast furnace slag (HS, GBFS): Granulated, glassy blast furnace slag is obtained as a by-product of pig iron production in the blast furnace. It is formed from secondary components of iron ore, coke ash and possibly also additives such as limestone. The slag leaves the blast furnace as a viscous melt at a temperature of between approx. 1350°C and 1550°C.
For use in cement very rapid cooling is required. The liquid slag is cooled in a water bath so quickly that it solidifies to give mainly a glassy material.
The granulated blast furnace slag consists of splintery grains with an edge length of between approx. 0.3 and 5 mm, and can have a moisture content of up to 30%. After preliminary dewatering the granulated blast furnace slag is passed to the mill with a moisture content of < 15%.

Natural Puzzolanas of the most important economical significance are deposits of vulcanic ash. The name is derived from the Italian town, Pozzuoli, situated at the foot of Vesuvius. Their reactivity is based on their high glass content. The Puzzolanas also include Trass from Rhineland.

Artificial Puzzolana: Flyash (FA, Puzzolan) is the fine combustion residue from coal dust in steam boilers. The largest part (approx. 80%) of the combustion residues is discharged from the combustion chamber with the flue gas and separated by electrostatic precipitators, bag filters or cyclones. The remaining part of these combustion residues is the bottom ash which is produced at the base of the combustion chamber and is removed with a scraping device. A distinction is made between bituminous coal flyashes and lignite flyashes. Flyashes have mainly spherical, predominantly glassy solidified particles and are characterised by their high SiO_2 and Al_2O_3 contents.

Silica fume is obtained during the extraction of Silicon and Silicon alloys in the electric arc furnace. Silica fume consists mainly of very fine grained, amorphous silicon dioxide, SiO_2.

Calcined rice husks: The husks, which are obtained in large quantities during the preparation of rice, are burnt and used for energy production. The ash which is produced contains over 90% Silicon Dioxide. If the combustion temperature does not exceed 600°C the silicon dioxide is present mainly in the amorphous state in the form of very fine grained, irregular particles with a high puzzolanic reactivity.

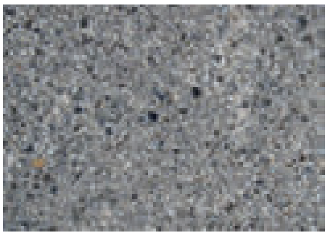
Calcium sulphate compounds are important as setting behaviour regulators and are used in different forms:

- gypsum ($CaSO_4 \cdot 2H_2O$)
- semihydrate ($CaSO_4 \cdot 0.5\ 2H_2O$)
- anhydrite ($CaSO_4$)
- or mixtures of these.

Apart from natural $CaSO_4$ materials these compounds are also obtained as by-products in certain industrial processes.
In order to fulfil the requirements of the building material industry an exact knowledge of the properties of the materials which are to be ground, individually or as mixtures, is required. There are considerable differences in the properties of these materials, depending on their origin and chemical composition. This is evident during comminution from the specific energy consumption and wear of the grinding components. Quantitative data on this can be obtained with the aid of grinding tests. In designing the mills two important test methods are used for determining the grindability parameters.

Grinding test 1: Loesche test grinding mill in continuous operation. Determination of the Loesche grindability factor "MF".
Grinding test 2: ZEISEL apparatus in the batch process. Determination of grindability according to ZEISEL (kWh/t).
The Loesche test is always used when sufficient quantities of material for milling are available. The ZEISEL test has to be used if only a small quantity of a representative sample of material for milling, which is insufficient for grinding in the Loesche test mill, is available.


Clinker


Granulated blast furnace slag


Iron ore


Clay

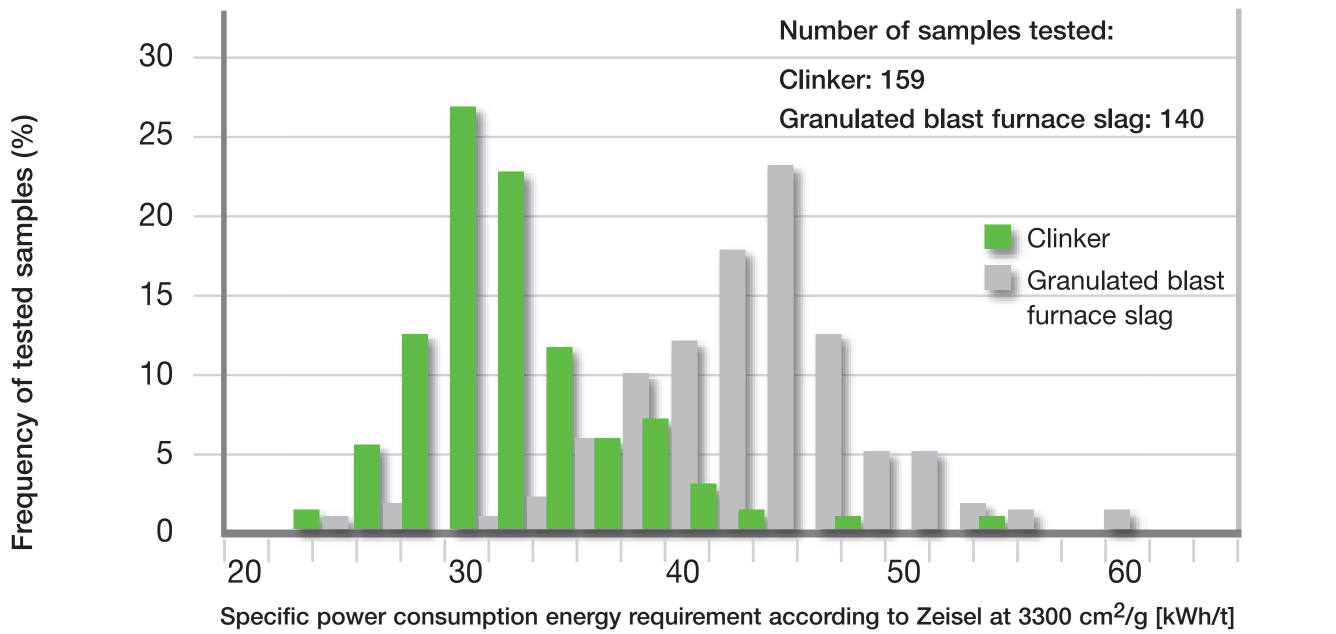

Limestone


Natural gypsum


Silica sand


Flyash

Grindability according to Zeisel of clinker and granulated blast furnace slag at 3300 cm²/g.



Loesche mill Type LM 56.2+2, Alathiyur, India, 2000

Complete grinding plants with components

Grinding plants using Loesche mills for grinding cement and granulated blast furnace slag are characterised mainly by their simple construction. The feed material for grinding is charged onto the feeding belt, the transporting capacity of which can be regulated with a variable speed drive. A belt magnet and a metal detector for separating larger metallic parts are situated in the path of the material to the mill. The material then passes into the mill through a rotary feeder. These rotary feeders, which act as an air seal, have been specially developed, taking into account the abrasive properties of clinker and granulated blast furnace slag, the tendency to cake of most granulated blast furnace slags and synthetic gypsum types and the high moisture contents of additive grinding materials, such as Puzzolanas. The rotary feeders are protected from wear and can be heated with process gas.

The material is ground in the mill and dried if necessary. The n+n mills have two hot gas inlets. The process gas is distributed uniformly in the grinding chamber by means of guide vanes. After leaving the grinding table bed the ground material is passed to the classifier with the gas. The powdered ground product leaves the mill and is separated in a filter mounted downstream. The classifier oversize material returns to the grinding bed together with fresh material.

As a result of the high dust collection efficiency of the filter the mill fan which is connected downstream of the filter, does not require any wear protection. The fan is generally fitted with a variable speed drive.

The heat required to dry the material to be ground is controlled through the process control system, i.e. the mill outlet temperature is maintained. The required heat energy can be obtained from various sources.

A separate hot gas generator is not necessary if sufficient hot waste gases are available from other processes, e.g. cement cooler exhaust gas, pre-heated waste gases from large diesel generators etc. In grinding cement clinker with gypsum the dry-grinding process does not require any additional heat input at all. A large quantity of the process gas is recirculated to the mill for utilisation of its heat content – the remaining part leaves the plant through the stack.

A fresh air flap is located in the recirculation gas duct to the mill. With increased clinker temperatures the mill can be partially or completely operated with fresh air so that a cooling effect is achieved. With clinker temperatures of e.g. 150°C it is possible to adjust to a temperature of 90°C at the mill outlet by reducing the recirculation gas and increasing the fresh air intake.

In this way the cement temperature, and therefore also the cement quality, can be influenced.

The material (reject) falling into the ring channel through the louvre ring is automatically cleared out and conveyed into a small hopper with a capacity of approx. 5 m^3 via an encapsulated conveyor and bucket elevator. The bunker stands on pressure load cells which control the discharge conveyor in such a way that the bunker filling level remains constant. This sytem also intervenes in the control of the fresh material stream, so that the flow of fresh feed material to the mill, as the sum of fresh material and reject material, can be kept constant. When grinding granulated blast furnace slag a magnetic drum for separation of iron particles is built into the reject transport system.

An important advantage of these grinding mills is that the complete grinding process takes place in the closed system of mill and filter and no external mechanical conveyors are additionally required. Thus not only are maintenance costs for conveying equipment and transfer points eliminated, but also the dust extraction equipment associated with this.

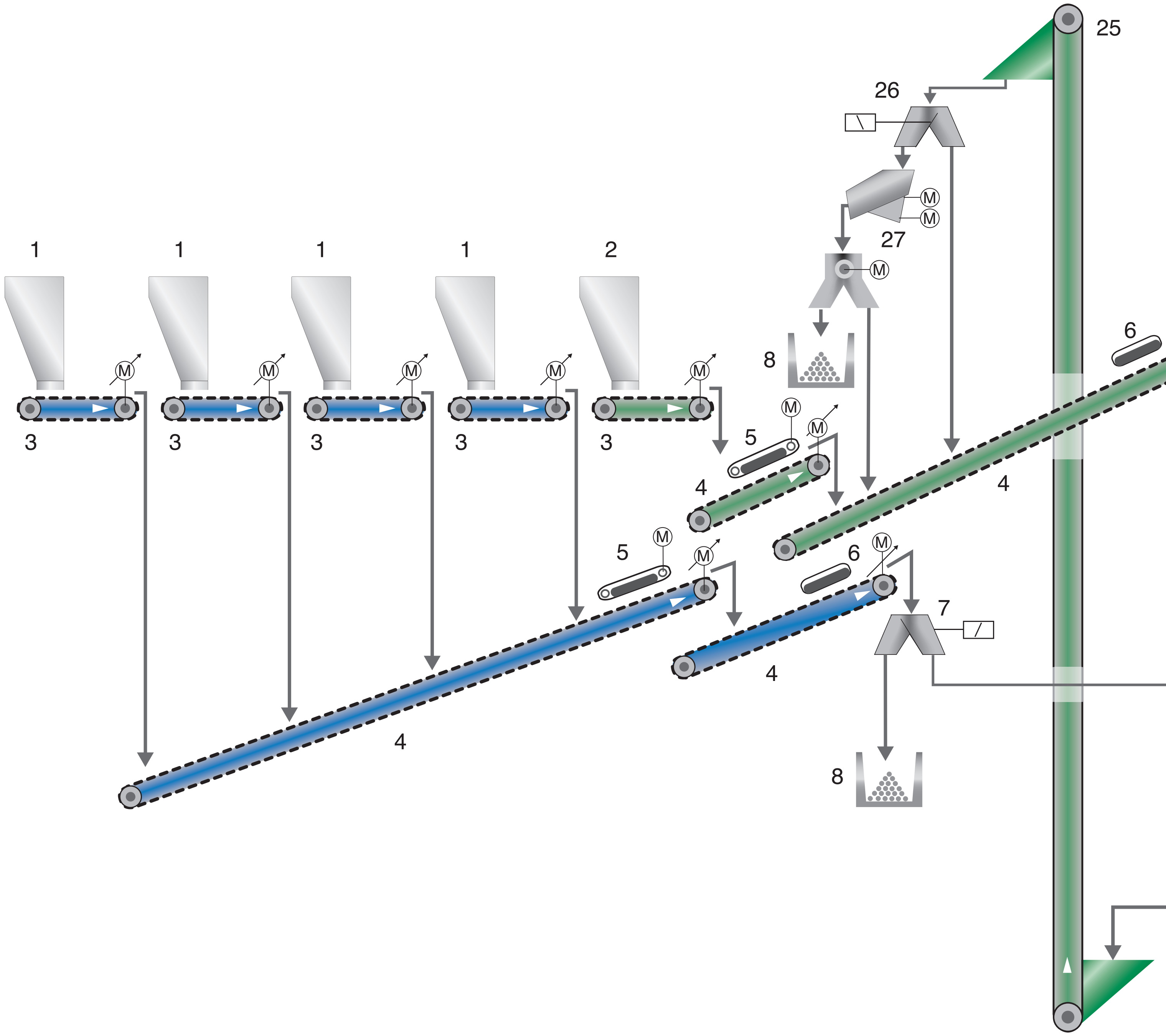
The heavy machines which cause dynamic loads, such as the mill and mill fan, are supported on their own foundations. Thus the necessary steel construction is limited to support structure for the filter and for the feed equipment. Most of the plants erected so far have been built in an open method of construction, i.e. without a building for the mill.

If a building is however required for the mill, expenditure for sound insulation is small compared with a ball mill plant thanks to the low noise level of the mill.

In addition to mills, Loesche also develops classifiers, hot gas generators and rotary valves feeders.

1 Material feed bunker* (moist material)
2 Material feed bunker* (clinker, dry material)
3 Weigh feeder*
4 Transport conveyor belt
5 Over belt magnet*
6 Metal detector
7 Diverter gate
8 Tramp metal bin
9 Rotary valve
10 Loesche mill
11 Rotary valve*
12 Sealing air line with fan*
13 Water sprinkling system*
14 Grinding aid dosing system
15 Material feed bunker for dry material of high fineness, particularly flyash*
16 Filter
17 Rotary valve
18 Gas flow measuring device*
19 Process gas fan
20 Stack with stack damper
21 Recirculation gas line with damper
22 Fresh air damper*
23 Hot gas generator
24 Reject system
25 Bucket elevator
26 Diverter gate
27 Drum magnetic separator

* These items are not shown here.



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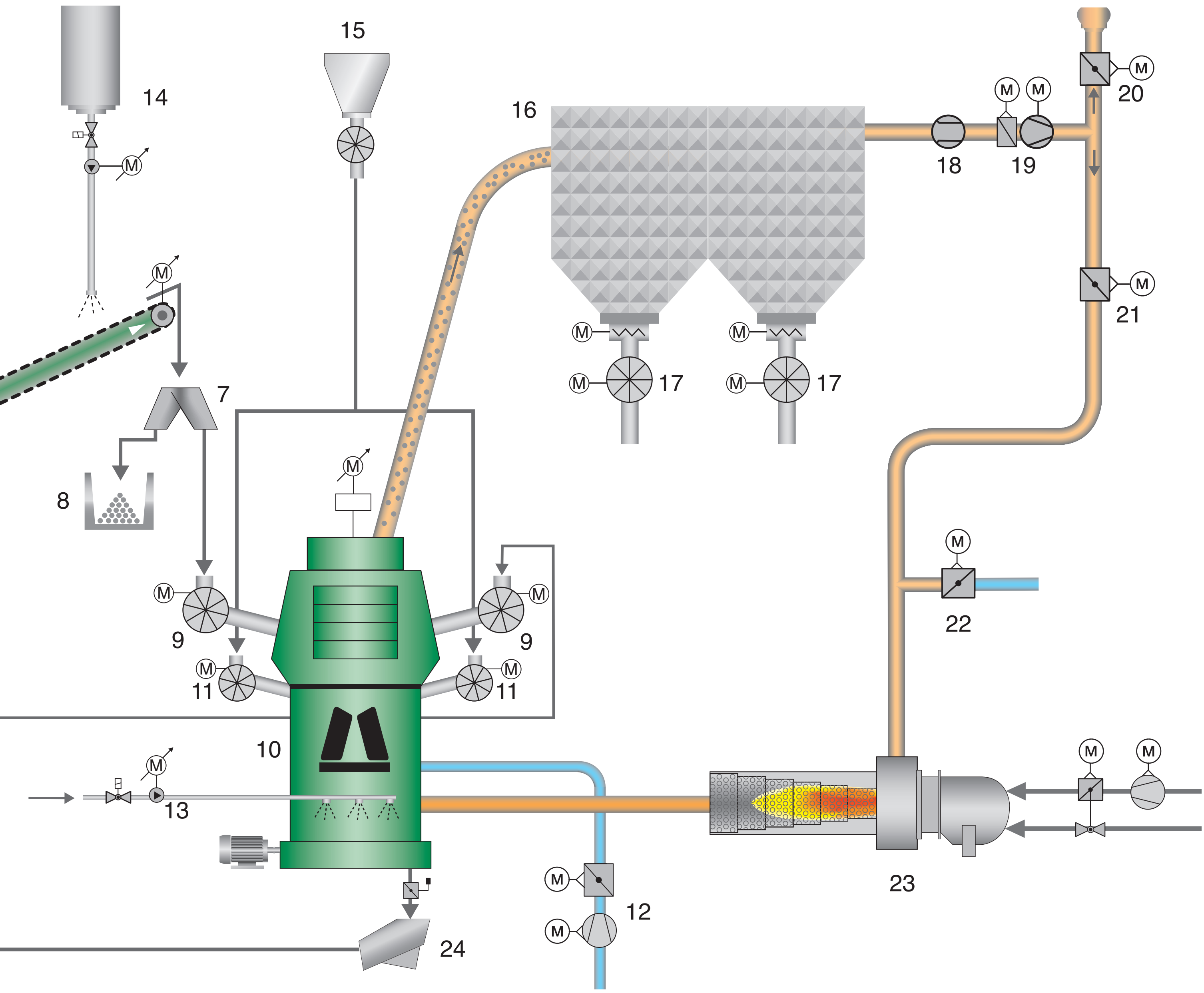

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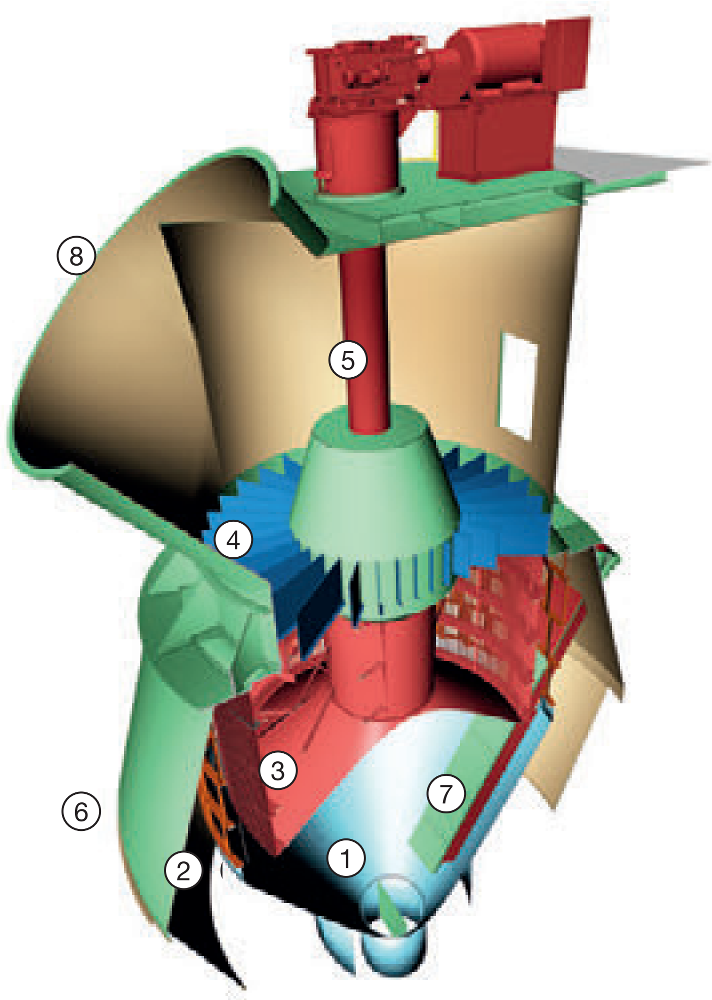


Design:

① Grit return
② Guide vanes
③ Rotor with classifier blades
④ Vortex rectifier
⑤ Rotor shaft
⑥ Housing
⑦ Material feed chute
⑧ Product discharge

LOESCHE Dynamic Classifier (LDC)

Extensive calculations using Computational Fluid Dynamics (CFD) and studies using true-to-scale models have resulted in a further optimisation of the LOESCHE Dynamic Classifier.

The new LDC Series (Loesche Dynamic Classifier) has the patented vortex rectifier ④ above the bladed rotor and the adapted housing ⑥. The geometry is characterised by greater efficiency with lower flow resistance and thus a reduced energy demand. The swirl-free gas flow from the classifier outlet ⑧ with optimised dust distribution gives rise to a fundamentally more uniform dust distribution to the filter. Improved accessibility in the classifier upper housing enables the wear protection to be serviced more easily and replaced in the case of abrasive products.

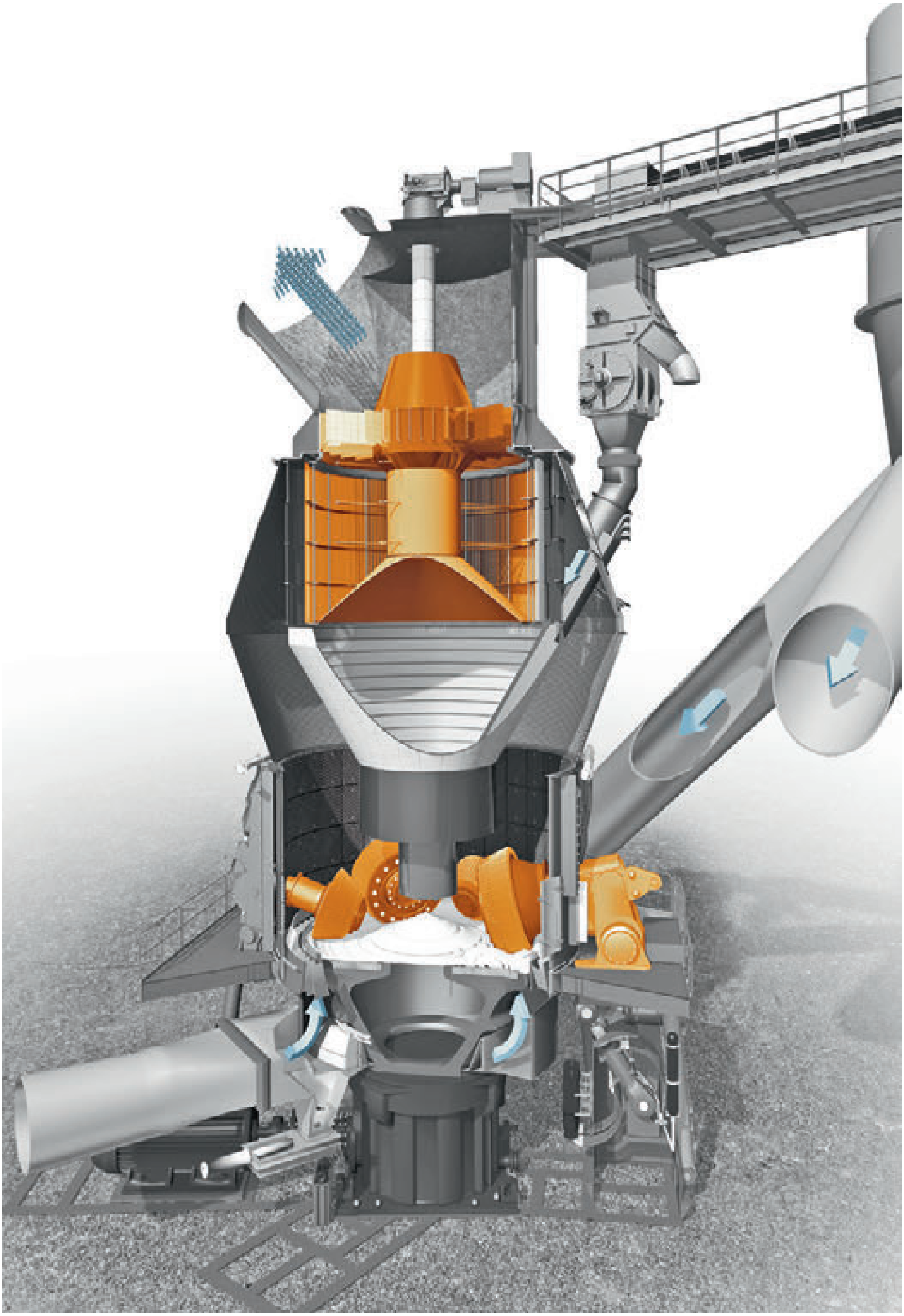
The classifier can separate particles sizes down to 1 µm and generate residues of 1% R 10 µm.
A wide range of particle size distributions can be produced using the available process influencing parameters. The separation efficiency can be adjusted as required.

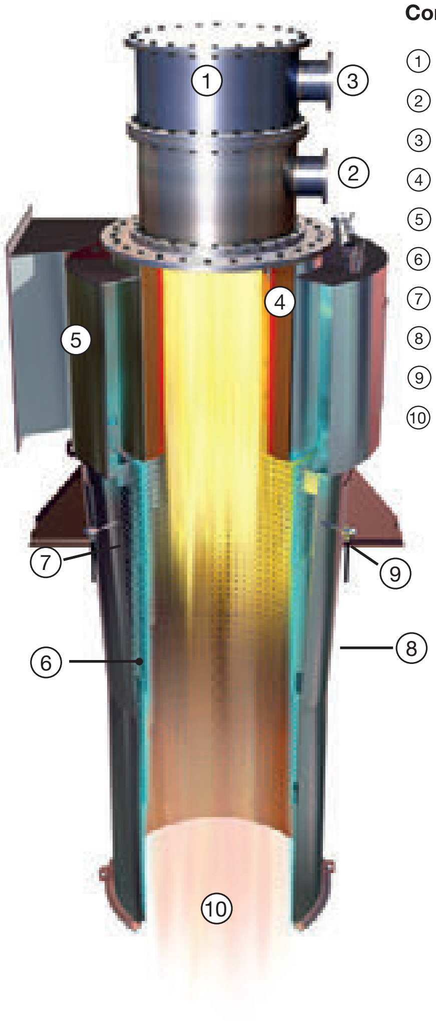
The gas/solids flow rises from the mill in the area between the classifier outer wall and an internal static guide cone ②. It is then redirected into the annular gap between the static guide vanes that concentrically surround the rotating bladed rotor ③.

As it rotates the rotor accelerates the supplied gas/solids mixture tangentially.
The centrifugal force generated in the process rejects oversized particles.
The rotor speed in conjunction with the gas flow and flow direction allows desired particle cut sizes to be set within wide limits.

A unique feature of this classifier type is the continuous reclassifying of the particle flows rejected by the rotor. When these move outwards under centrifugal force in the annular gap they are presented again to the gas flow and are directed upwards and inwards.

Agglomerated particles are effectively dispersed and do not drop as apparently oversized material with the grit return ① onto the grinding table.





Construction

1. Burner
2. Fuel
3. Combustion air
4. Burner muffle
5. Spiral housing
6. Perforated jacket
7. Annular gap
8. Protective casing
9. Temperature control
10. Hot gas outlet

LOMA combustion unit type LF 25 with a natural gas burner in the central grinding plant for granulated blast furnace slag, Dunkerque, France, 2005

Loesche Hot Gas Generator

The perforated jacket combustion system developed by Loesche in the mid 1960's consists of a steel combustion chamber of heat resistant steel with burner muffle, and is well known in the market under the name LOMA Hot Gas Generator. The LOMA Hot Gas Generator has been used worldwide for decades in many different types of thermal processes in order to optimise these processes.

- The combustion chamber consists of heat resistant steels – no refractory brickwork is necessary
- When starting up the hot gas generator heat losses are minimised since it is not necessary to heat up refractory brickwork. A start at full load is therefore possible.
- Very good thermal shock resistance and rapid load changes with only a short delay
- High cooling rate of the combustion chamber prevents thermal overloading of following units. An EMERGENCY chimney stack is not necessary in EMERGENCY-OFF SITUATIONS and when starting and stopping.
- Accessible within a short time for inspection
- Low wear
- Short installation times, low weight, small space requirement. Can be installed in existing plants. Complete preassembly is carried out – also for larger LOMA combustion units.

LOMA Hot Gas Generator units are constantly being developed and conform to current technical standards. More than 600 hot gas generators (of this type) have been commissioned for a heat flow of between 100 kW and 64,000 kW.

Loesche Hot Gas Generators are used where hot gases are required for direct drying, e.g. in the cement, power station, steel, industrial minerals, ore, wood, cattle food, agri-food and chemical industries.

Mode of operation

The process gas stream which enters the spiral housing (5) cools both the protective jacket housing (8) and the perforated jacket (6) as a result of the flow pattern. The process gas enters the interior of the combustion chamber through the annular gap (7) and holes in the perforated jacket, and mixes there with the hot flue gases from combustion. At the same time the flame and hot flue gases are kept away from the perforated jacket.

Heating media

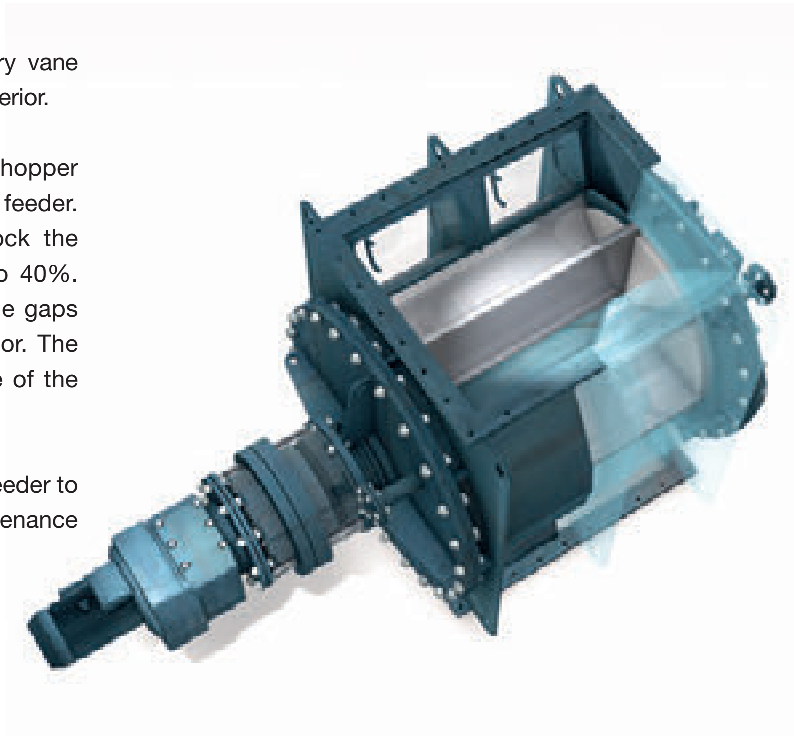
- Natural gas, bio gas, coke gas, blast furnace gas and other low calorific value gases
- Light and heavy oils, wood and lignite dust

Loesche rotary vane feeder

Feeding of Loesche CS mills is carried out via a rotary vane feeder in order to prevent false air ingress into the mill interior.

Material is fed continuously from above via the inlet hopper into every vane pocket of the slowly rotating vane feeder. In order to reduce wear from the abrasive feed stock the peripheral speed is low and the filling level limited to 40%. Adjustable sealing strips on the rotor prevent any large gaps between the wearing plate of the housing and the rotor. The material is discharged downwards into the feed chute of the mill.

Hot gas can be passed through the inside of the rotary feeder to prevent material caking. It is easy to dismantle for maintenance purposes.



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.

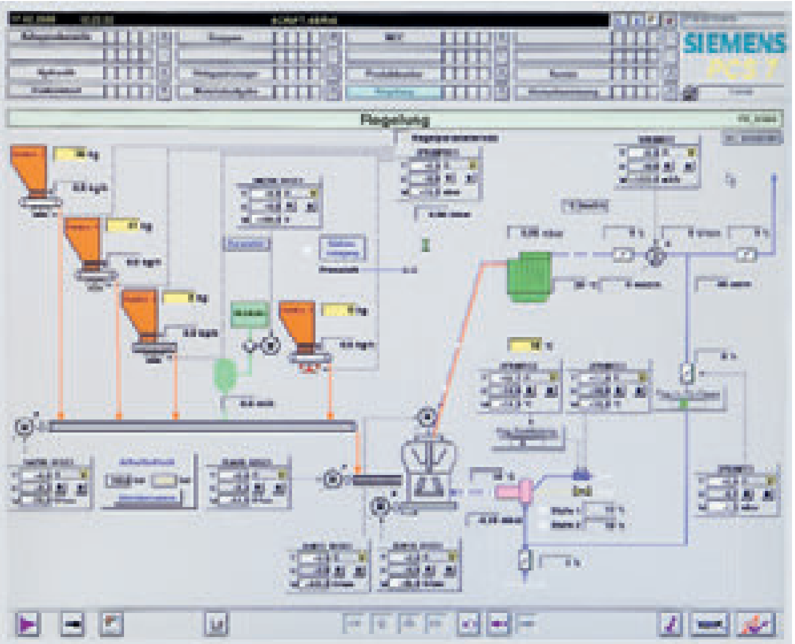
Technological development through practical laboratory grinding tests

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.

Fully-automatic operation with PLC



LM 3.6 laboratory mill

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 (Cfix, volatile matter, ash content)

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.