Loesche Mills for industrial minerals

LOESCHE

THE GRINDING EXPERT

Loesche Technology – always one step ahead

Over more than 100 years Loesche has built up a wealth of experience in the grinding of coal, cement raw material, clinker, slag, ores and various industrial minerals such as:

- Limestone
- Dolomite
- Marble
- Chalk
- Quick lime
- Barite
- Betonite
- Colemanite
- Phosphate rock
- Anhydrite
- Talc
- Manganese oxide
- Magnesite, etc.

These are ground in Loesche Mills by a wide range of industries:

- Steel industry
- Fertilizer industry
- Chemicals industry
- Feedstuffs industry
- Paper industry
- Glass industry
- Plastics industry
- Paint industry
- Building materials industry
- Power plant industry
- Food industry
- Road construction and
- Crude-oil extraction

Since 1934 Loesche Mills have also been used worldwide for mineral base materials. To date, we have sold some 200 industrial mineral mills, for example for:

- Limestone
  LM 9 to LM 23, quantity: 63
- Anhydrite
  LM 16 to LM 17, quantity: 2
- Quick lime
  LM 12 to LM 16, quantity: 17
- Phosphate rock
  LM 9 to LM 21, quantity: 35
- Betonite
  LM 12 to LM 16, quantity: 9
- Barite
  LM 14 to LM 16, quantity: 4
- Colemanite
  LM 13 to LM 23, quantity: 2

Loesche Mill LM 15.200, Slavno, Poland, 2006

Industry mainly requires such mineral materials at rates of between 5 t/h and 80 t/h. The main flow range lies between 5 t/h and 25 t/h at finenesses of 1% R 25 µm to 1% R 300 µm. Loesche has developed a special series of industrial mineral mills for these specific needs.

The smallest mills in this series – LM 12.200 and LM 15.200 – are delivered to the customer complete or semi-complete.

Thanks to its stocking of components with long lead times and the ability to effect complete or semi-complete shipment of mills, Loesche is not only able to offer customers short delivery periods but also to significantly reduce assembly at the construction site.

Completed planning documents are available for all the mills.

This innovative Loesche industrial mineral mill stands out for its:

- Simplified and robust mill construction
- Fast assembly of mill and classifier thanks to preassembled components
- Complete preassembly of smaller mills
- Maintenance friendly thanks to ease of access and use of high quality materials
- Fast reaction to fluctuations in material qualities
- High flexibility for switching to other product quality requirements
- Grinding and drying in one machine
- Low investment costs
- Low operating costs
- Short delivery periods

Loesche Mill LM 19.2, Bigadic, Turkey, 2003

Customer benefit and satisfaction

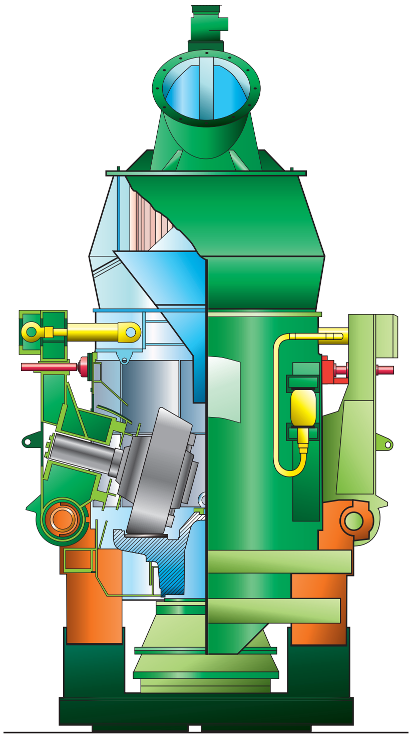
Quality and reliability from the outset are the internationally recognized advantages of Loesche grinding plants. Ever since 1928, when the first Loesche mill came onto the market, the grinding principle of the vertical roller grinding mill with driven grinding track and spring-loaded rollers travelling on the track has proven to be particularly energy- and resource-conserving These advantages of the Loesche mill are becoming increasingly more important in the face of increasing plant sizes and commitment to more economical use of resources, such as primary energy, water consumption, etc.

From sales through to aftersales service, from punctual project planning through to the handover of plants, Loesche is a competent partner to their customers. Our maxim is: “Every Loesche grinding plant is a reference plant!”

The cornerstones of our competence include:

- Customised plant concepts from planning through to commissioning, based on our own knowledge and experience, tailored to customer requirements
- Individual problem solutions with optimised process technology
- Customer service: plant optimisation and advice on technical further developments
- Long-term commitment to supply spare parts
- Certification to EN ISO 9001: 2008.

Loesche Mill: Principle of operation, design and functioning



Principle of operation

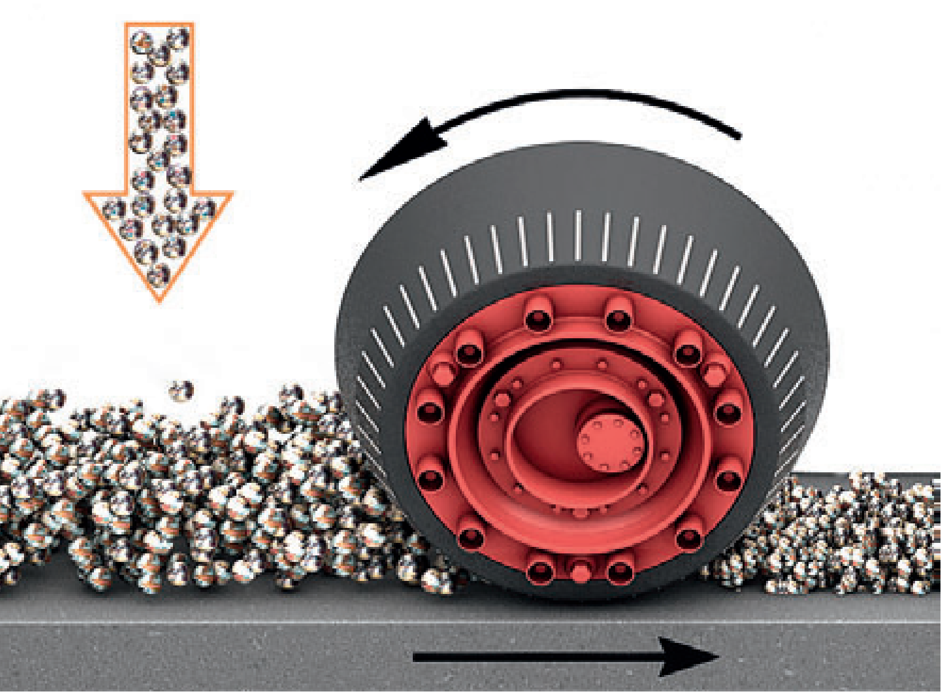
The grinding material is comminuted in the Loesche roller grinding mill between the rotating horizontal grinding track and the stationary grinding rollers.

Grinding is effected primarily by compression. A certain amount of shear force increases the quantity of fine particles in the grinding material. This effect is created by tapered rollers, whose axes are angled at 15° with respect to the horizontal grinding track. Comparative studies conducted in the 1930s show that this achieves optimum comminution combined with minimized wear.

Hot gases are supplied to the combined drying and grinding process to evaporate material moisture. In the classifier above the grinding chamber the finished material is separated from the grit, which can drop back onto the grinding table to be comminuted again.

Design

The mill housing with the rocker arm bearings is mounted on a foundation frame. The gas ring duct with inlet is separated from the load-carrying parts. This avoids thermal expansion stresses.



The mill gearbox with its integrated thrust bearing to absorb the grinding forces is located in the lower section of the mill. The drive flange supports and drives the grinding table.

The louvre ring – a gas diffusion ring – surrounds the grinding table. Two tapered rollers with tyres are fixed in rocker arms whose shafts are guided in bearings.

The mill body with assembly and inspection opening surrounds the grinding table and the grinding rollers. The hydraulic spring assembly cylinders are hinged on the rocker arms. On the oil side, the cylinders are each coupled with a hydraulic accumulator which acts as a pneumatic spring. The working pressure for the grinding forces is generated in a pump unit.

The bar caged with bar rotor and variable-speed drive is mounted on the mill.

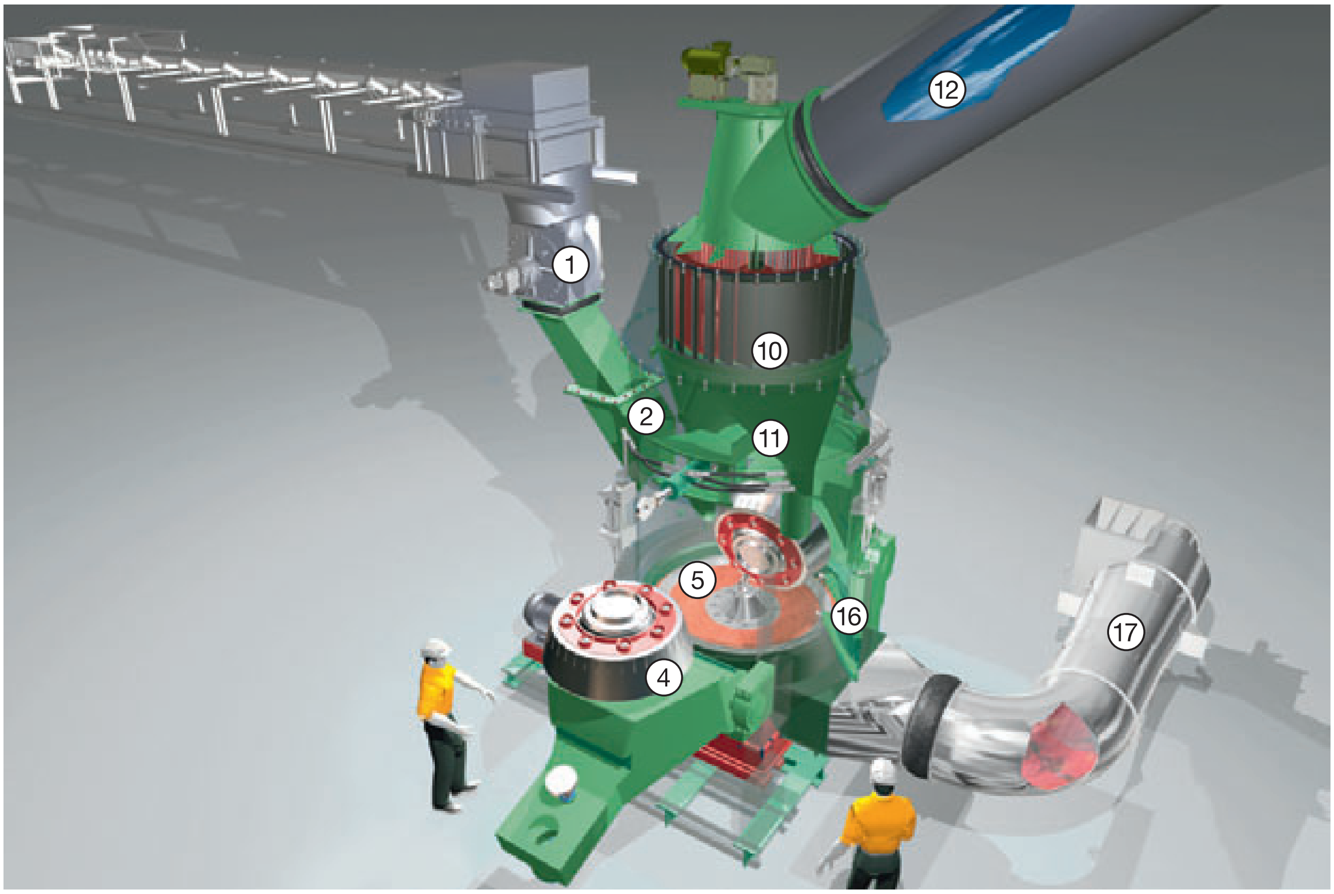
The hydraulic swinging-out device for the roller simplifies and speeds up maintenance.

Loesche technology is characterised by the following features:

- Each roller is held by a locally secured rocker arm.
- The rocker arm and roller assembly are precision-mounted in roller bearings integrated into the mill stand
- A device for raising the rollers serves as a starting aid for the mill during startup with the grinding track filled. It is an integral part of the hydropneumatic spring assembly.
- The two opposing rollers are connected to a common hydraulic unit.
- A virtually parallel grinding gap is maintained for the entire service life between the grinding rollers and the grinding plates of the grinding table.

The DIN EN ISO 9001 quality management system permits the delivery of mills complete or in easy-to-transport components with fast and precise assembly on site.

LM 15.200 ready for transport



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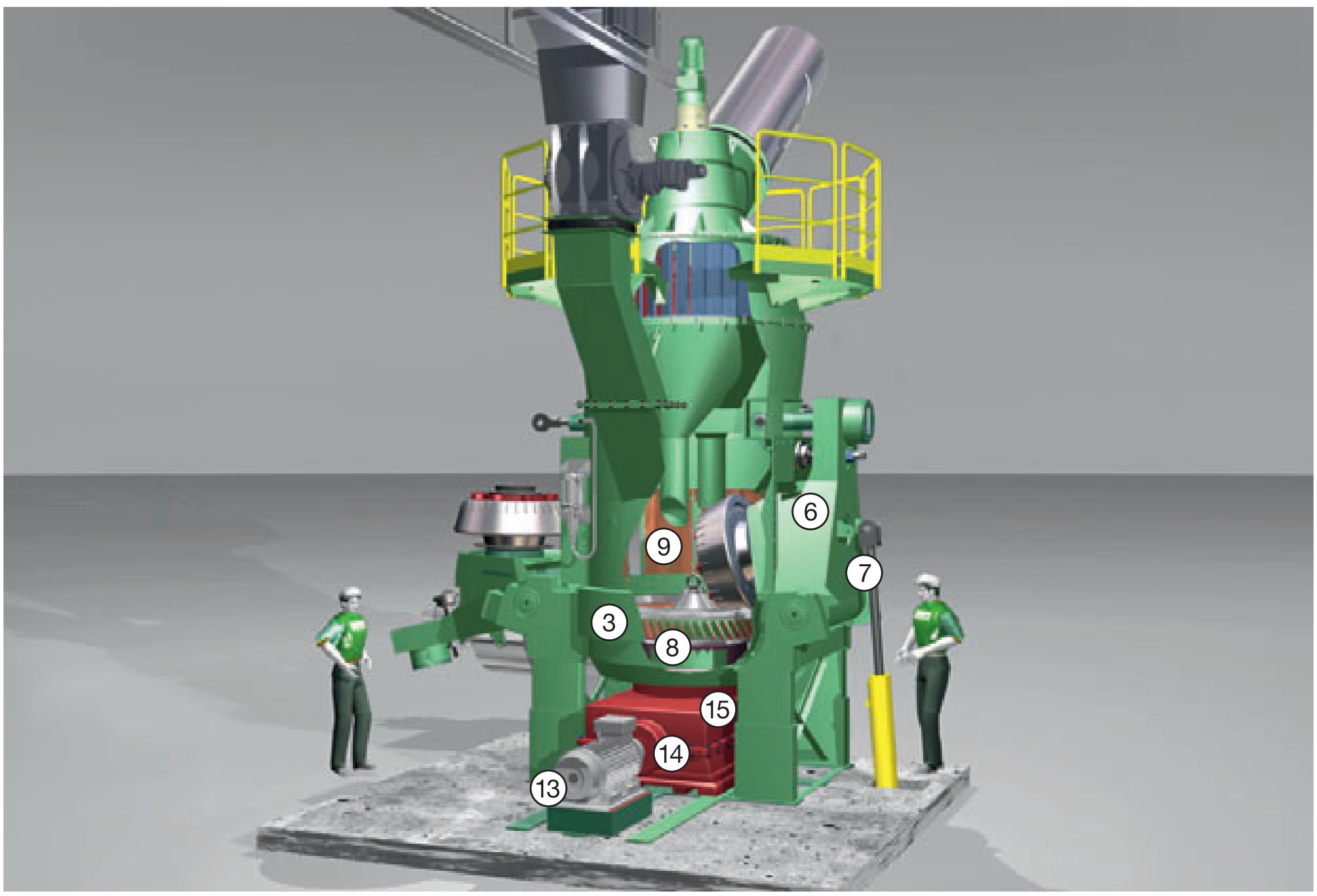

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How the mill functions

The feed material is supplied to the mill via a rotary gate ① and drops through the chute ② onto the centre of the table ③. Ferritic foreign bodies are magnetically extracted from the feed material ahead of the gate ① and removed via a diverter gate. A metal detector, operating in a similar way, separates non-magnetisable metal parts. On the grinding track, the grinding material migrates under the effect of centrifugal force to the edge of the table and so passes under the hydropneumatically sprung grinding rollers ④. In the gap between the rollers and the grinding track the trapped grinding material is comminuted in the material bed. The rollers ④ follow the contour of the material bed ⑤. In this way the functional unit of rocker arm ⑥, spring rod and piston of the spring assembly cylinder is deflected. The piston forces the hydraulic oil from the cylinder into gas-filled bladder accumulators. Nitrogen-filled rubber bladders are compressed in the accumulators and act as a pneumatic spring. The pneumatic spring can be set to be harder or softer by selecting the gas pressure in proportion to the hydraulic operating pressure, depending on the crushing behaviour of the grinding material.

The material rolled over by the grinding rollers is conveyed outwards and over the table edge under the effect of centrifugal force by the rotation of the table. In the area of the louvre ring ⑧, which encloses the grinding table ③, the upward-moving gas flow ⑨ intercepts the mixture of ground and not yet fully comminuted material and carries it to the classifier ⑩.

Depending on its settings, the classifier ⑩ rejects the oversized material which drops into the internal grit return cone ⑪ and then back onto the grinding table ③ for re-grinding. The finished material is conveyed out of the classifier and exits the Loesche mill in the gas flow ⑫.

Foreign bodies and small amounts of oversized material drop as rejects through the louvre ring ⑧ into the ring duct ⑯.

Scrapers connected to the grinding table convey foreign bodies into the reject funnel.

Once the rolled grinding material leaves the table for the area above the louvre ring, the water contained in the feed material evaporates spontaneously on intimate contact with the hot gas flow. Thus, the desired dust/gas mixture outlet temperature of some 80° to 110 °C is already reached in the grinding chamber. In most cases, the required hot gases are provided by Loesche hot gas generators ⑰.

The mill is driven by an electric motor ⑬ via a flexible coupling ⑭ and the mill gearbox via a vertical output flange ⑮ . A segmental thrust bearing at the top of the gearbox absorbs the grinding forces.

Before the mill motor is started, the grinding rollers ④ are lifted hydraulically from the grinding track. The mill can then be started not only empty, but also filled, at low starting torque. An adjustable buffer prevents the grinding parts from coming into metal contact when the mill is empty or loaded.

A so-called “auxiliary drive” for starting a filled mill at low revolutions is not necessary!

Servicing

Worn grinding parts, roller tyres and grinding track segments can be easily and quickly replaced. The rollers are retracted from the grinding table into a vertical position with a swinging-out cylinder. Complete rollers, tyres and grinding plates are thus made accessible for lifting gear.

During grinding, metal parts generally wear out to such a uniform extent over the entire service life that mill throughput decreases only when the grinding parts are completely worn.

Dimensioning – model series – dimensions – drives

Dimensioning parameters

The following standard parameters are decisive in the sizing of Loesche mills:

- GRINDING PRESSURE
  This lies between the minimum value for solid fuels and the maximum value for cement clinker/ granulated slag.

- MATERIAL MOISTURE
  The Loesche mill can process material with up to 25% moisture.

- PRODUCT FINENESS
  The end product fineness lies between 1% R 25 µm and 1% R 300 µm depending on the feed composition.

- DRIVE POWER
  The specific energy consumption during the grinding test is decisive for gearbox and motor power.

Model series

- The mill sizes are identified according to the outer effective diameter of the grinding track in decimetres [dm].

Dimensions

- In the following table (page 11), the table diameter and the number of rollers are shown on the y-axis. The x-axis shows the product rates the mills are capable of. The width of the fields indicates the performance factor (dependent on the aforementioned parameters).

- Dimensions H, A and D indicate the installation height of the mill with classifier, the footprint diameter and the total space requirement allowing for a servicing area (grinding parts replacement) respectively.

Drives

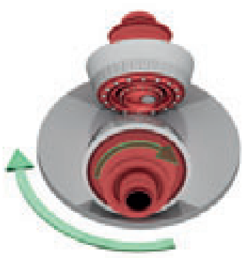
An electric motor is used as the drive. It drives a gearbox with bevel and spur gears via a torsionally elastic coupling. The input shaft is horizontal, the output shaft operates vertically upwards. The drive is enclosed at the top by a horizontal output flange. The gearbox contains a segmental thrust bearing which absorbs the grinding forces in the top of the housing. Loesche mill gearboxes are developed in cooperation between Loesche GmbH and leading gearbox manufacturers. The field service conditions under which the gearboxes must operate are matched to each other. Decades of field experience with Loesche mills determine the design of the (mill) gearboxes and their peripherals under all climatic conditions.

A lubrication unit ensures that the gear teeth, the shaft bearings and the segmental thrust bearing are supplied with sufficient oil. Filter and cooling systems condition the oil. Electrical and hydraulic monitoring instruments incorporated into the customer's measuring and control system ensure safe operation. The modular construction principle of gearboxes allows further power increases to reflect the latest state-of-the technology without the need to develop a new construction concept.

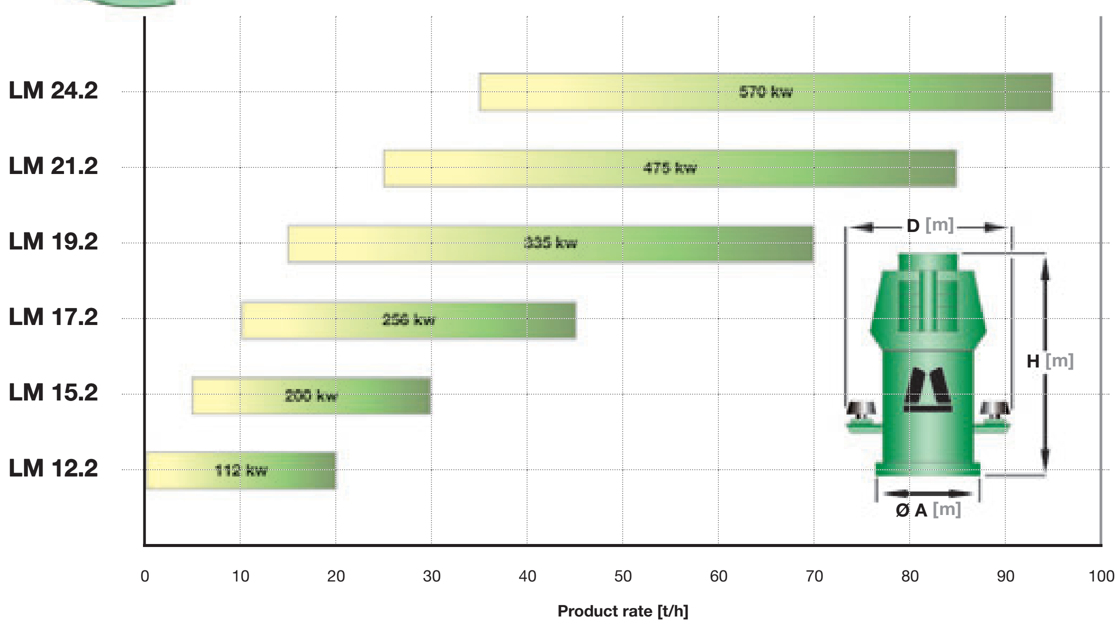
Loesche mills do not require a motor with increased starting torque. Because the rollers are hydraulically raised, the breakout torque of the filled mill amounts to only 40% of the full-load torque. A "standard motor" can easily deliver this starting torque.

The installed motor power is related to the mill's energy requirement and is determined in the technical centre during the grinding test. The closest matching commercially available motor is selected and recommended to the customer.

Gearboxes ready for shipment



Product rate [t/h] as a function of the LM size



	H [m]*	A [m x m]*	D [m]*
LM 24.2	10.0	4.0 x 3.0	8.0
LM 21.2	9.3	3.7 x 2.7	7.1
LM 19.2	8.6	3.4 x 2.5	6.6
LM 17.2	6.1	3.0 x 2.3	6.0
LM 15.2	6.6	2.6 x 2.0	5.2
LM 12.2	5.5	2.2 x 1.8	5.0

Fineness
fine ◄──► coarse

hard ◄──► easy
Grindability

*Note: all the dimensions are indicative values and may not be taken as binding for the basis of any planning

Grinding material analyses

The characteristics of the material in question must be known for determining the size of the mill and classifier. The material properties are analysed in the Loesche technical centre. Ideally, the customer sends a representative sample as used at his plant to the technical centre. The samples are chemically analysed and their moisture measured. At least 1.5 t feed material is prepared from the raw material provided. If the provided grain size is too coarse for the Loesche laboratory mill, the Loesche laboratory crusher attains the required feed material grain size as an intermediate step before grinding. Then, the raw material is ground to final fineness, dried and classified in continuous operation in the Loesche technical centre grinding plant.

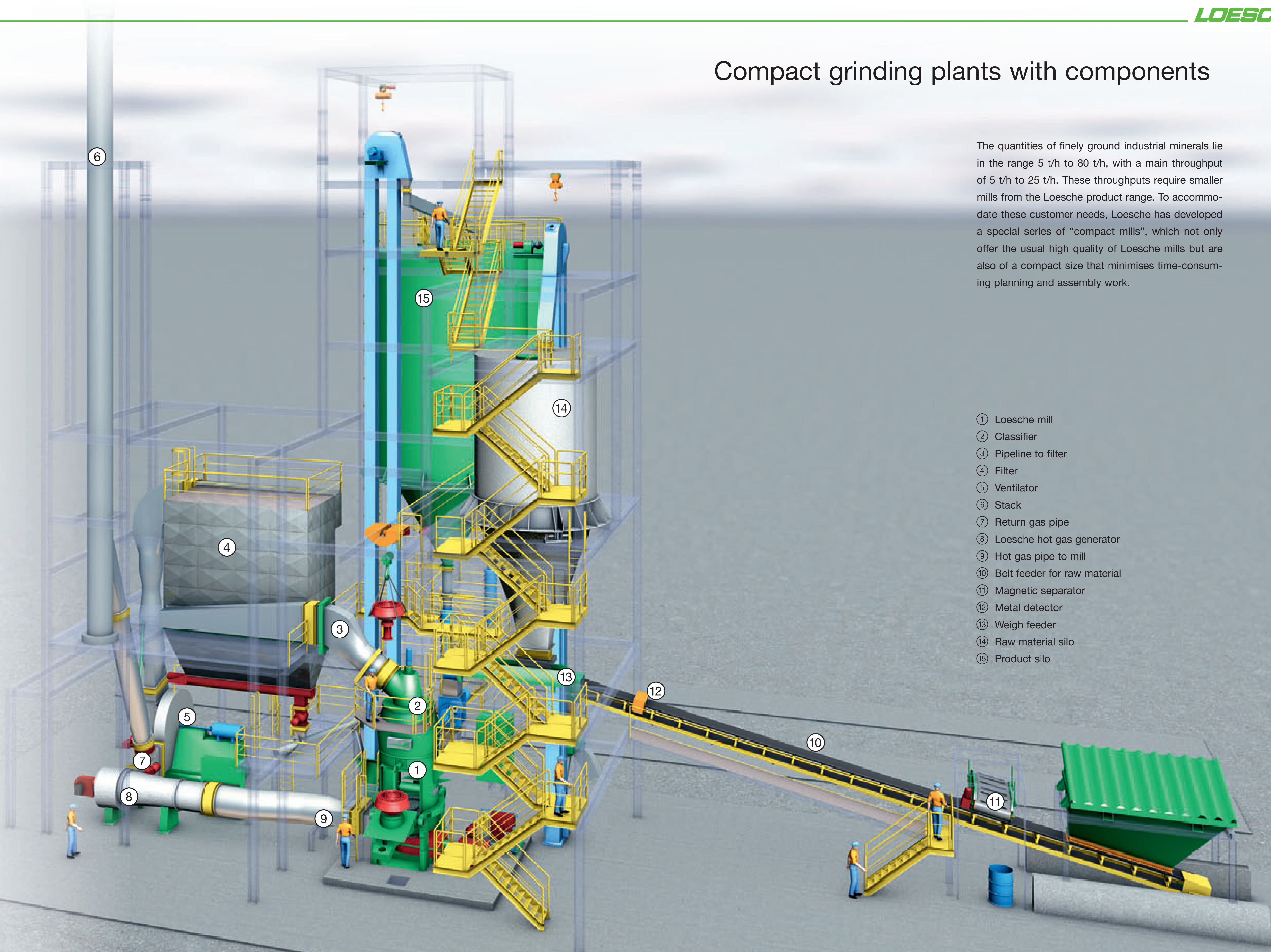
The test grinding produces the following representative results:

- Loesche grindability factor "MF";
- Loesche fineness factor "FF";
- Moisture factor "WF" for water content > 8 %;
- Specific energy consumption "e" [kWh/t];
- Wear factor "V_P".

These parameters and standard diagrams are fed into the Loesche dimensioning software to determine the appropriate Loesche Mill.

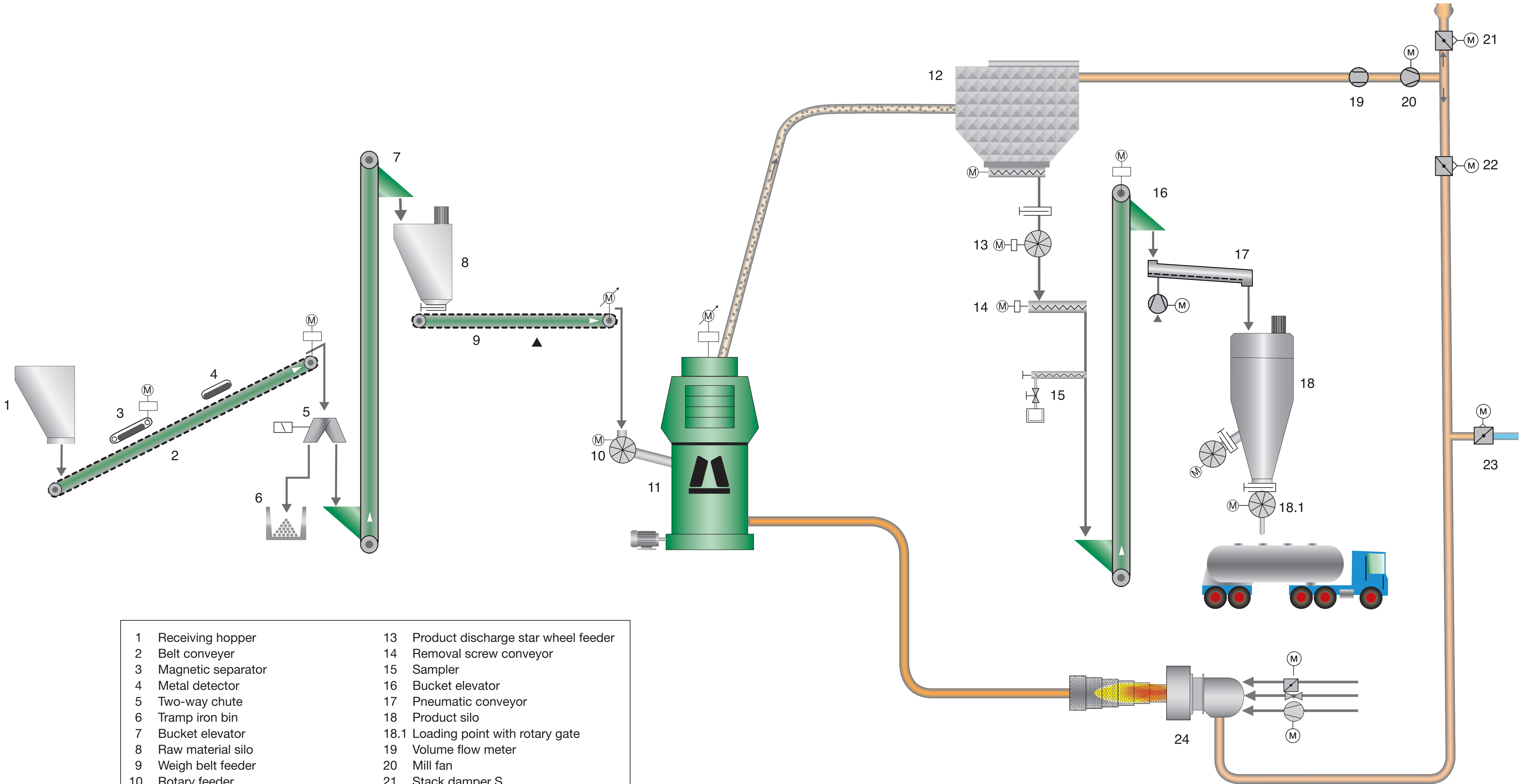
Independently of this standardized procedure, other variables, such as extremely high grinding material moisture or very pronounced differences in the grindability factors of individual raw material components, are incorporated into the dimensioning of the mill, the classifier and also the mill fan.

Compact grinding plants with components



The quantities of finely ground industrial minerals lie in the range 5 t/h to 80 t/h, with a main throughput of 5 t/h to 25 t/h. These throughputs require smaller mills from the Loesche product range. To accommodate these customer needs, Loesche has developed a special series of “compact mills”, which not only offer the usual high quality of Loesche mills but are also of a compact size that minimises time-consuming planning and assembly work.

1. Loesche mill
2. Classifier
3. Pipeline to filter
4. Filter
5. Ventilator
6. Stack
7. Return gas pipe
8. Loesche hot gas generator
9. Hot gas pipe to mill
10. Belt feeder for raw material
11. Magnetic separator
12. Metal detector
13. Weigh feeder
14. Raw material silo
15. Product silo



- 1 Receiving hopper
- 2 Belt conveyer
- 3 Magnetic separator
- 4 Metal detector
- 5 Two-way chute
- 6 Tramp iron bin
- 7 Bucket elevator
- 8 Raw material silo
- 9 Weigh belt feeder
- 10 Rotary feeder
- 11 Loesche mill
- 12 Product filter with discharge screw conveyor
- 13 Product discharge star wheel feeder
- 14 Removal screw conveyor
- 15 Sampler
- 16 Bucket elevator
- 17 Pneumatic conveyor
- 18 Product silo
- 18.1 Loading point with rotary gate
- 19 Volume flow meter
- 20 Mill fan
- 21 Stack damper S
- 22 Recirculation damper R
- 23 Fresh air damper Z
- 24 Loesche hot gas generator

LSKS Dynamic Loesche classifier

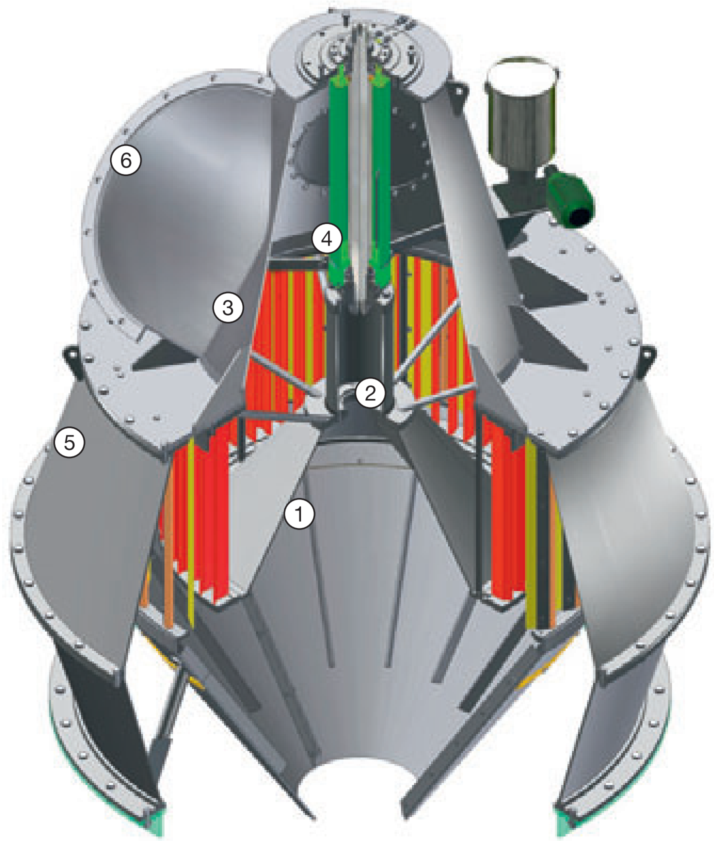
The Loesche LSKS-type classifier delivers highly selective separation. It produces grain distributions of both narrow and wide bandwidths. These differing demands on grain structure can be satisfied by varying the process-technology setting parameters and the appropriate built-in classifier components. The raw meal fineness lies as a rule between 1% R 25 µm and 1% R 300 µm.

The gas/particle flow rising from the mill is directed via a static guide vane assembly ② to the classifying chamber. The gas/solids mixture flows, depending on the flap position, specifically into the space between the guide vane assembly ② and the concentrically running rotor with blades ③.

As it turns, the rotor ④ accelerates the supplied gas/solid-matter mixture tangentially. The centrifugal force generated in the process rejects oversized grain.

The rotor speed and the gas flow with its flow direction determine the desired separation diameter. This can be adjusted within wide limits.

A unique feature of this classifier type is the continuous reclassifying of the particle flow rejected by the rotor. The gas flow blasts them upwards/inwards again as they fly outwards under the centrifugal force in the annular gap. This dissolves agglomerated particles so that they follow the product flow as individual grains rather than dropping onto the grinding table with the grit as oversized grains.



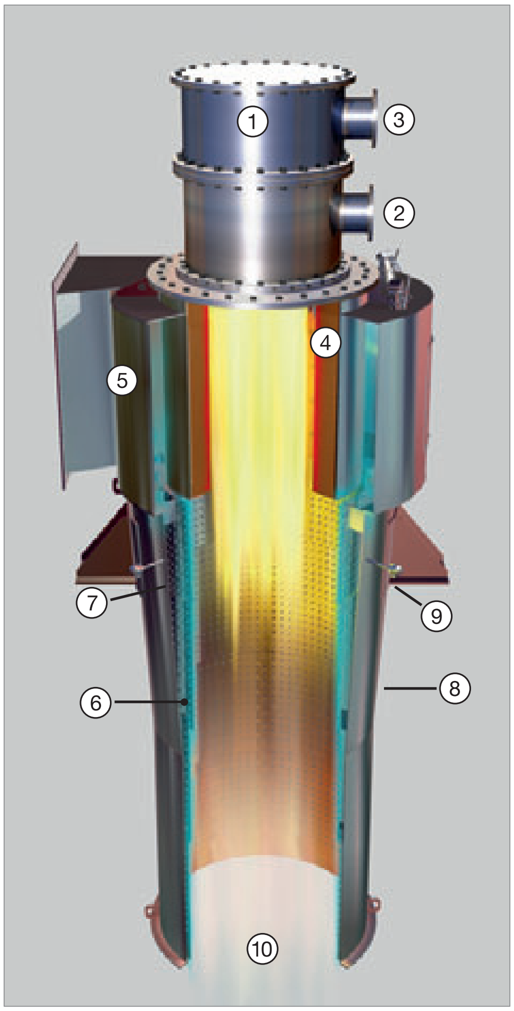
Structure

① Grit return
② Guide vane
③ Rotor with classifier blades
④ Rotor shaft
⑤ Housing
⑥ Product discharge

Loesche hot gas generator

Structure

① Burner
② Fuel
③ Combustion air
④ Burner muffle
⑤ Spiral housing
⑥ Perforated sheath
⑦ Annular gas
⑧ Protective sheath
⑨ Temperature monitor
⑩ Hot gas outlet



In the mid 1960s Loesche developed perforated sheath heating – a heat-resistant steel combustion chamber with a burner muffle. It is marketed under the name LOMA heater. For decades the LOMA heater has been used worldwide to optimize a very wide range of thermal processes.

Design and properties

- The combustion chamber is made of heat-resistant steels, making refractory lining unnecessary
- There are minimal heat losses as no refractory lining needs to be heated when the gas heater is fired up, hence it can be started under full load
- Very good temperature shock resistance and prompt adaption of performance to fast load changes
- Fast combustion chamber cooling speed prevents thermal overloading of downstream assemblies, no emergency stack required in emergency-off situations and start-up/shut-down
- Quick access for inspections
- Low wear
- Short installation times, low weight, small space requirements, installable in existing systems, complete preassembly even for larger LOMA heaters

Loesche gas heaters are used wherever hot gases are required for direct drying, for example in the cement, utility, steel, stone and earth, ore, wood, animal-feed, and chemical industries.

Mode of action

The process gas flow entering via the spiral housing ⑤ cools both the protective sheath ⑧ and also the perforated sheath ⑥. The process gas flows through the annular gap ⑦ and holes in the perforated sheath into the interior space of the combustion chamber, where it mixes with the hot flue gases from the burner. This also keeps the flames and the hot flue gases away from the perforated sheath.

Heating media

- natural gas, biogas, coke gas, blast-furnace gas, and other lean gases
- light and heavy oils, wood dust, and pulverised lignite

LOMA heaters undergo constant further development and so conform to the latest technical standards. Up to 2009, more than 600 of these gas heaters for heat flows of 100 kW to 64,000 kW have been supplied to industrial plants.

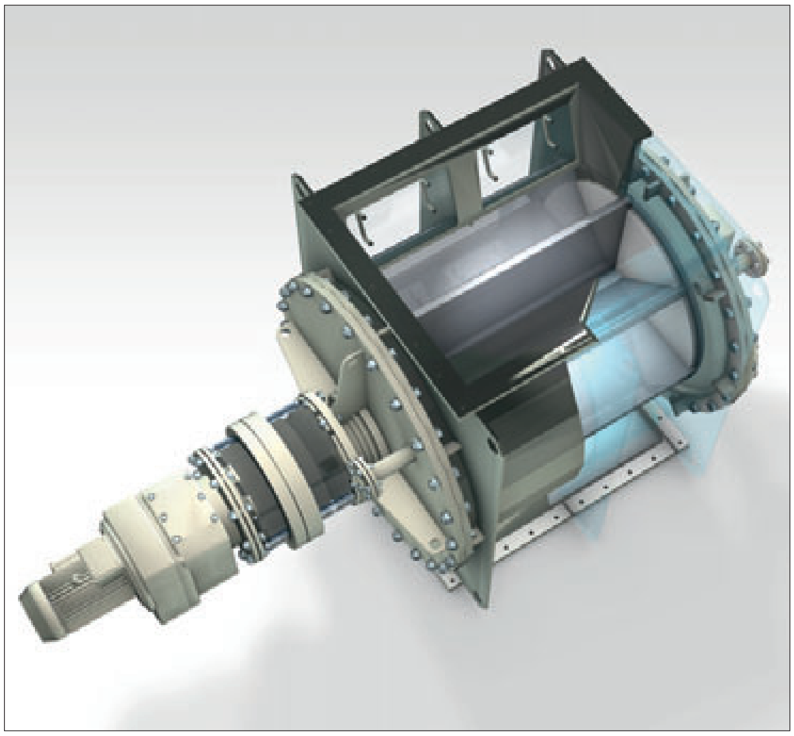
Type LF10 LOMA heater with a natural gas burner, 2008

Loesche rotary gate

The Loesche mill is filled via a star feeder, which prevents air leakage into the grinding chamber.

The grinding material flows continuously from the top via the inlet hopper into the pockets of the slowly rotating star wheel. Wear caused by the abrasive feed material is minimized by the low circumferential speed. The filling level is limited to max. 40 %. Adjustable sealing strips on the star wheel prevent any large gaps between the wearing plate of the housing. The grinding material is discharged into the mill's feed chute.

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



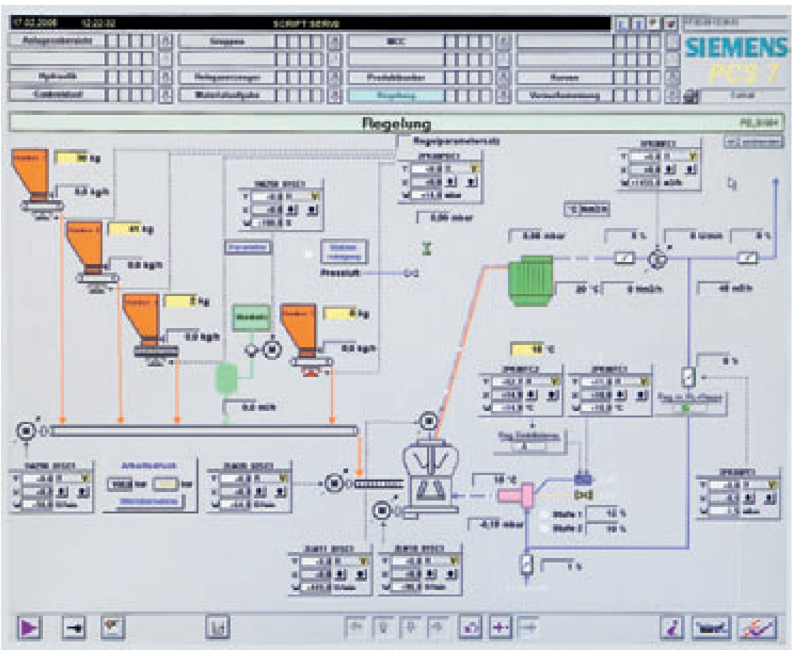
The Loesche technical centre – centre for grinding material analyses, research and development

Standard grinding tests for mill configuration

Loesche has many years of experience in the configuration of grinding plants. The most important precondition for correctly configured grinding plants is accurate knowledge of the properties of the grinding material involved.

The most important variables of a grinding material are the Loesche grindability factor and the specific power consumption based on a defined fineness. Depending on the geological origin of the grinding material, what appear to be the same materials can have very different properties.

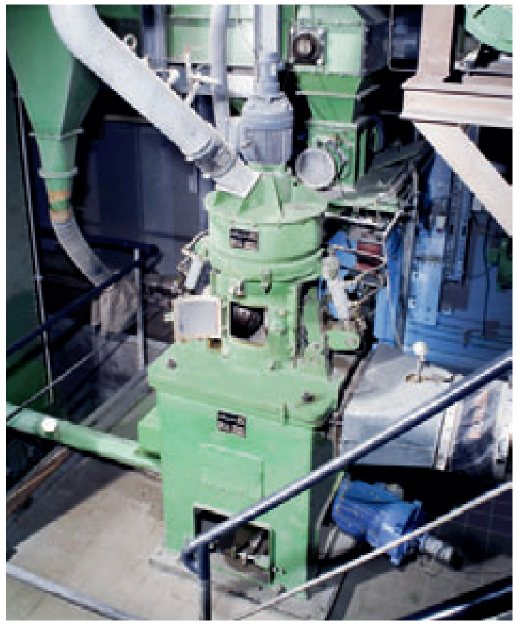
Fully automated operation with PLC



Analysis options

- 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)

The Loesche technical centre has three well equipped LM 3.6 laboratory grinding plants for the efficient conduction of standard grinding tests.



LM 3.6 laboratory mill

Technology development through realistic laboratory grinding tests

One of the first steps for introducing new technologies is laboratory testing under realistic conditions.

During our research and development projects, we:

- examine new grinding stock for future market segments;
- determine optimum mill settings for special products;
- optimize plant components and circuits;
- test new wear materials and concepts.

Our test mill systems are configured so that they can simulate different operating modes and plant circuits under test conditions.

Loesche – worldwide presence

Loesche is an owner-managed, export-oriented company founded in Berlin in 1906 and today is a global player with subsidiaries, representative offices and agencies around the world.

Our engineers continuously develop new ideas and customize concepts for mill technologies and preparation processes for the benefit of our customers. Their expertise has been acquired from decades of experience and our global information management system.

This ensures that the cutting-edge knowledge and developments are immediately available for use in new projects.

Our subsidiaries and representative offices play a central role for our customers in the analysis, execution and solving of project-specific tasks and challenges.

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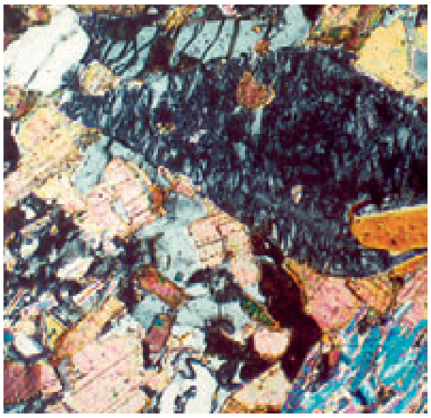
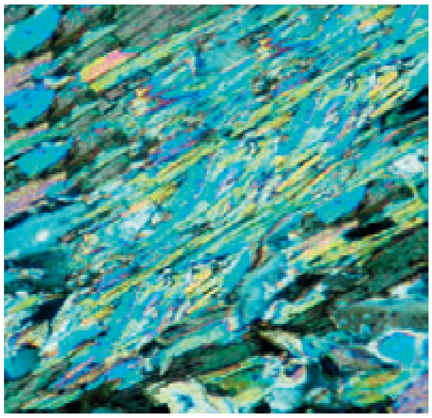
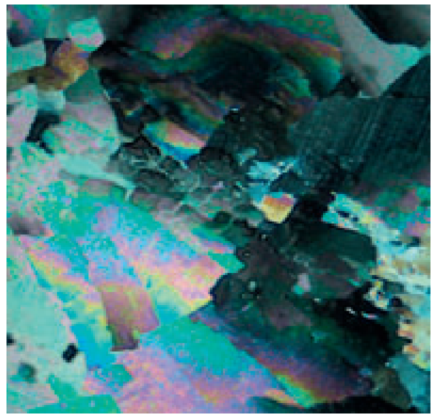
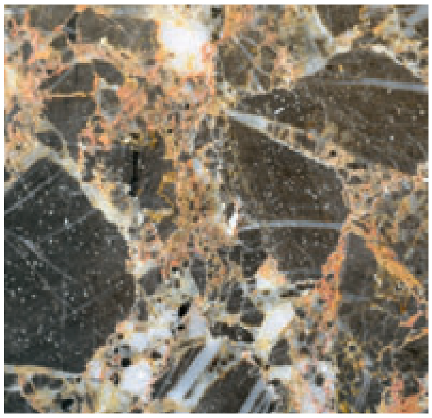
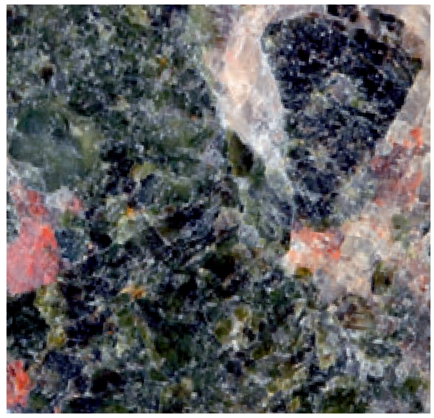

Kaolinite and feldspar 0.5 mm

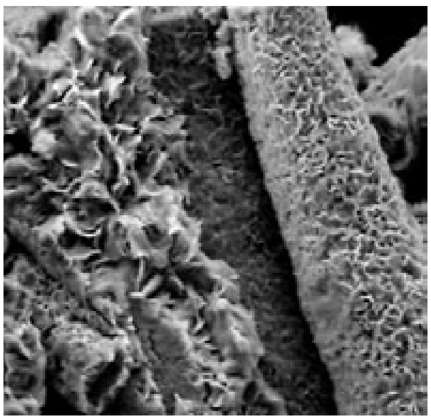

Sediments and turmaline 0.5 mm

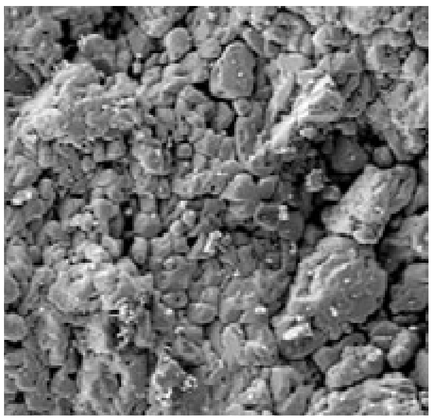

Limestone 0.5 mm

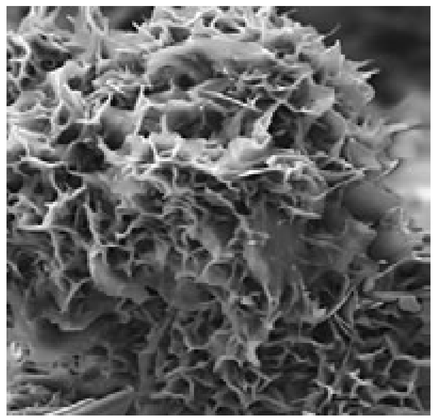

Colemanite, Turkey

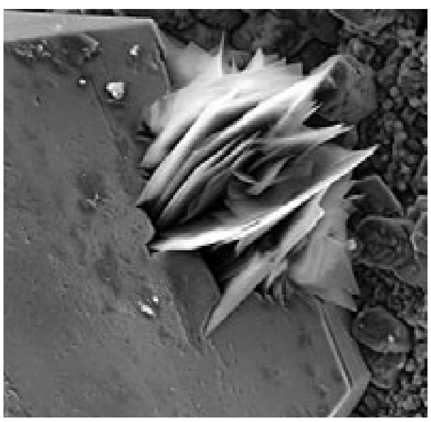

Marble, Italy

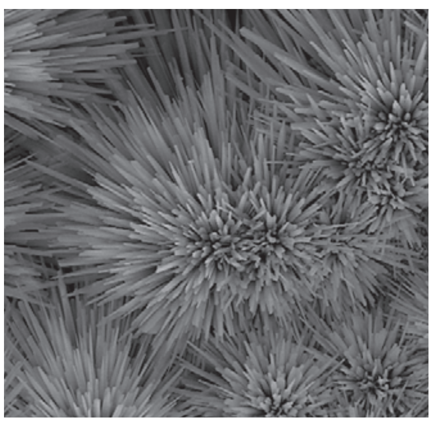

Phosphate ore, South Africa

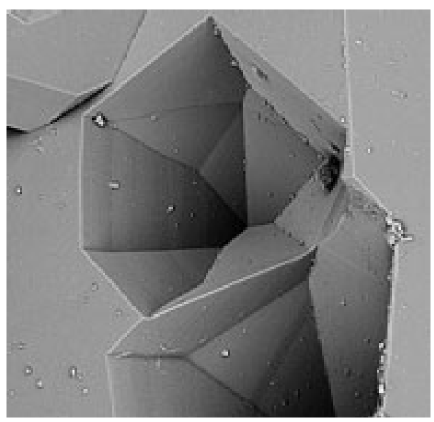

Bentonite, Libya 10 µm


Baryte, Germany 20 µm


Clay minerals 30 µm


Dolomite, Germany 20 µm


Calcite, Austria 50 µm


Quartz, Brazil 20 µm

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

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