# Applications of
# GEBR. PFEIFFER technology in the lime industry

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**Summary**

Limestone ($CaCO_3$), quicklime (CaO), and hydrated lime ($Ca(OH)_2$) are used in various fineness degrees, among others, in the building materials industry, metallurgy, agriculture and forestry, chemical industry, in flue gas desulphurization plants as well as water treatment plants, and as fillers for the most various products.

For decades, GEBR. PFEIFFER AG has supplied clients worldwide with machines and plants which grind, separate, dry and hydrate an extensive range of lime products for these various areas of application. GEBR. PFEIFFER AG's range of products includes, as core equipment for these processes, MPS vertical roller mills and SLV or SUV/SUT separators for feed rates of up to 100 t/h, TRT dryers for up to 200 t/h, KLV lime hydrators for up to 60 t/h as well as ball mills with a drive power of up to 1000 kW (**Fig.1**). Used in the cement industry, MPS vertical roller mills are capable of achieving throughput rates of 800 t/h.

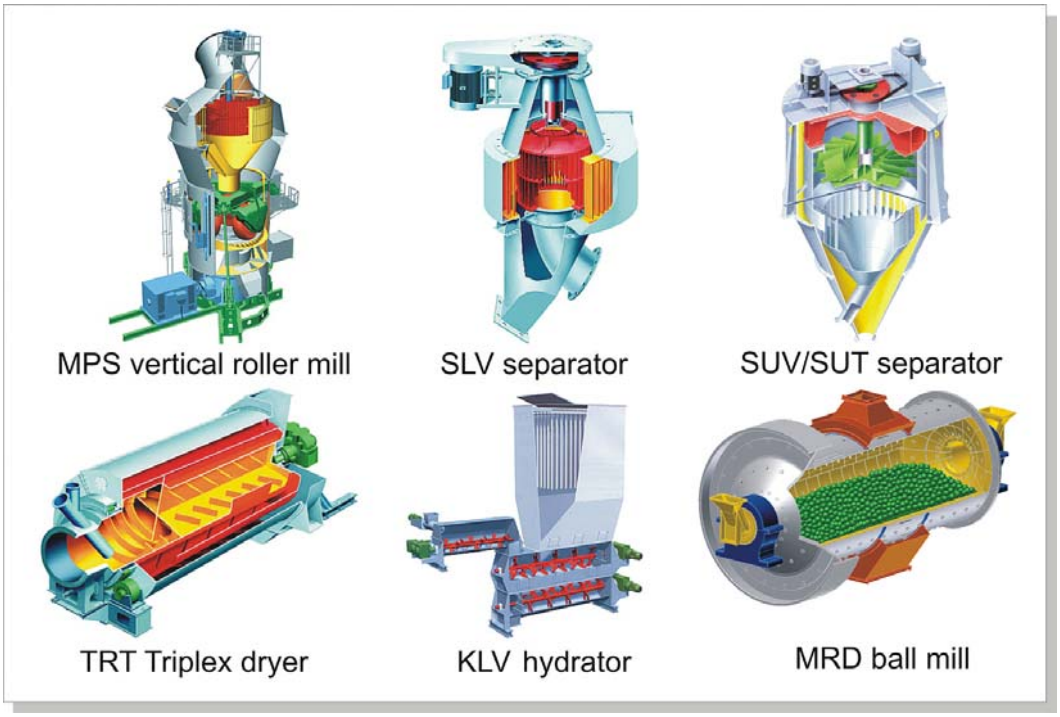


**Figure 1: Pfeiffer machines in the lime industry**

**MPS Vertical roller mills**

The MPS vertical roller mills used for grinding limestone and quicklime are basically designed the same as the MPS mills that have been used successfully since the 1960s for grinding cement raw material and coal (**Fig. 2**): Most characteristically, the statically determi-

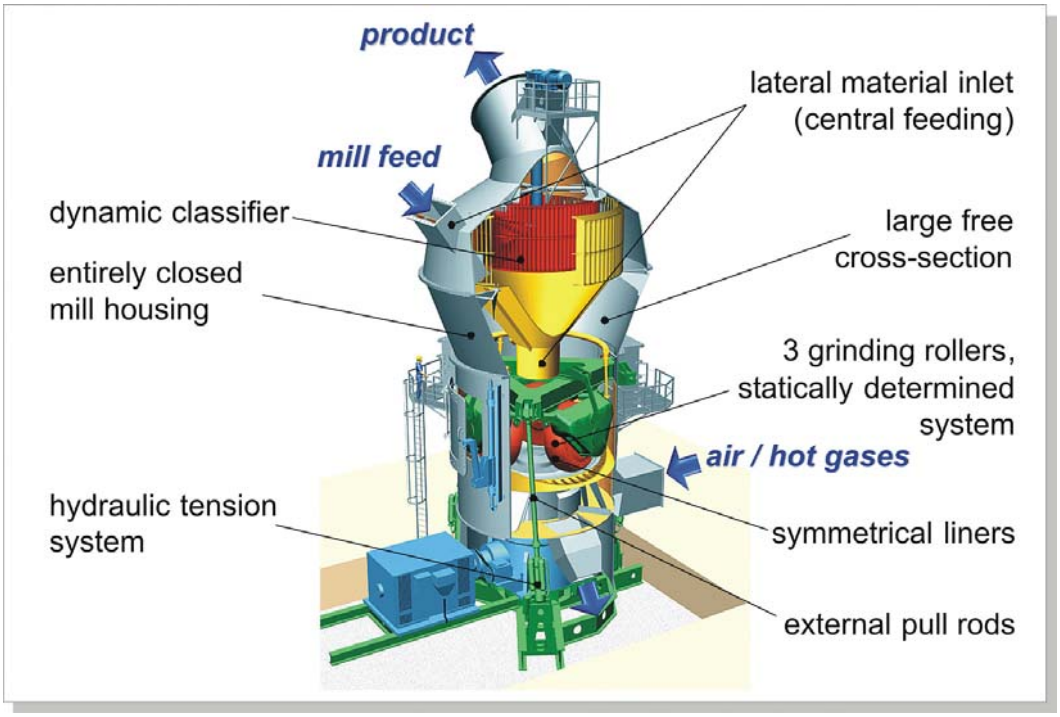


**Figure 2: Pfeiffer MPS vertical roller mill**

nate 3-roller system is pressed via the pressure frame, external pull rods, and hydraulic system onto the grinding bed. For start-up operation and maintenance purposes, the grinding rollers may be lifted by means of tension cylinders. Comminution is carried out by a combined pressure and shear load on the grinding bed between the grinding rollers and grinding plate which is driven by a motor and gear. Air or hot gases, respectively, are directed into the mill area through the nozzle ring which is located between the grinding plate and mill housing. This causes a fluidized bed to form which together with the rotating grinding plate ensures a permanent material feed to the rollers. When using hot gases, the material is dried simultaneously while being ground. The ground material is transported together with the gases up to the high efficiency classifier of the type SLS. The grains that have the finished product size envisaged pass through the separating rotor while the coarser grains are rejected and returned as classifier grits into the grinding area. The product fineness envisaged is set by adjusting the speed of the separating rotor. The fresh material feed is located in the separating area in a way to ensure a proper mixing of fresh material and classifier grits and a central feed onto the grinding plate. With quicklime and limestone

grinding, rotary locks are normally used as infeed devices ensuring an airtight seal at the same time.

An MPS 250 B vertical roller mill grinding quicklime to a fineness of 2 % residue on the 0.09-mm screen has been running in Poland since 2001. (**Fig. 3**). The mill was guaranteed to produce 50 t/h and now achieves a throughput of 55 t/h.

***Lhoist Bukowa, Poland – MPS 250 B***

| | | |
|---|---|---|
| ***material:*** | ***quicklime*** | |
| in operation since | 2001 | |
| product rate: | 55 | t/h |
| power consumption: | 18,4 | kWh/t |
| (mill, separator + fan) | | |
| fineness : | 1,9 | % R on 90 µm |

**Figure 3: Pfeiffer MPS 250 B vertical roller mill for quicklime grinding, Poland**

A plant using an MPS vertical roller mill for grinding quicklime or limestone comprises the following components (**Fig. 4**):

- material handling and metering
- MPS vertical roller mill with high efficiency classifier
- process gas ducting
- dust collection system and take-away equipment for finished product

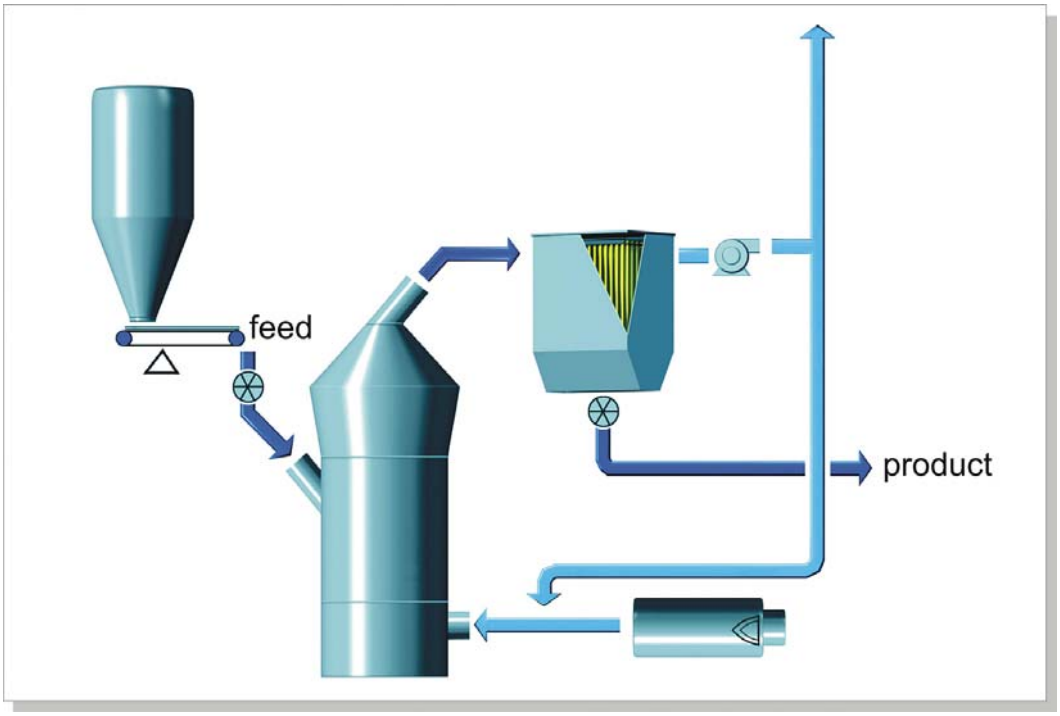


**Figure 4: Flow sheet for MPS mills**

Unlike quicklime, limestone with a feed moisture exceeding 2% must be dried while being ground in the MPS mill. For this purpose hot gases are used from a hot gas generator arranged upstream. For discharging the classifier grits, MPS mills for limestone grinding are today commonly equipped with a special screw conveyor (**Fig. 5**). Hence apart from the fine filler, e.g. with a fineness of less than 0.09 mm, it is also possible to produce a dry product within a fineness range of 0.1 mm to 1 mm. Such product is often diversified into narrow fractions by subsequent separation and screening.

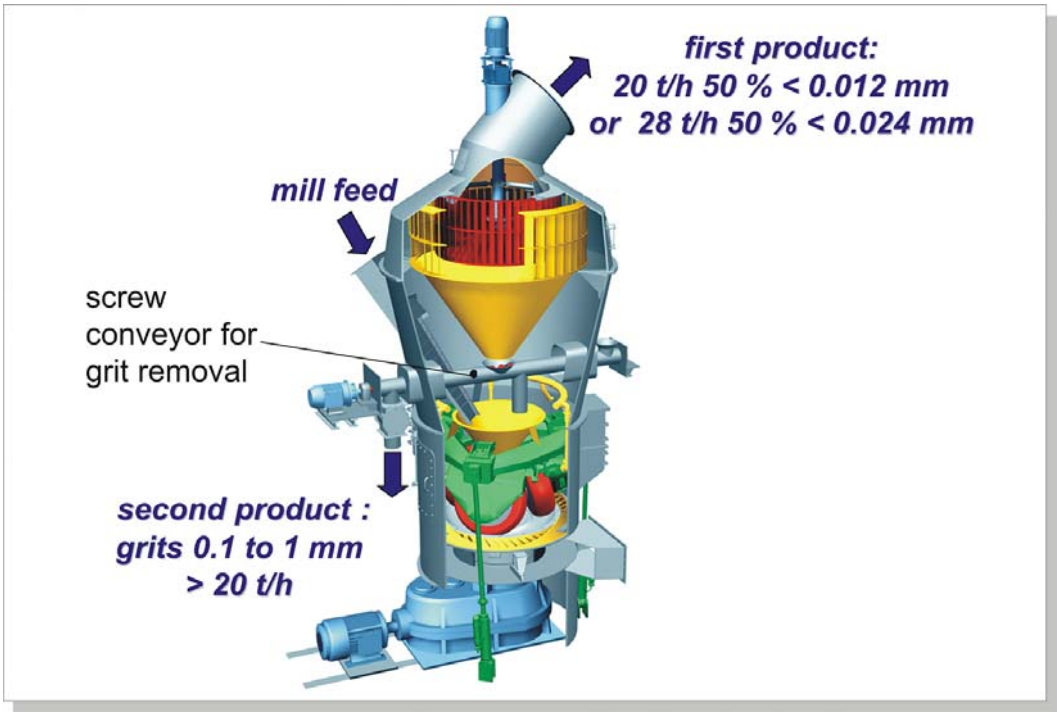


**Figure 5: Pfeiffer MPS vertical roller mill with removal of grits**

The product finenesses obtained with an MPS vertical roller mill range from 20 µm for very fine grinding via 90 µm for fine grinding in the filler and fine white lime sector up to 1 mm for the coarse classifier grit fraction **[1]**.

Due to the generally low wear, consistent product qualities are obtained over the entire service period of the mill which is in many cases one of the decisive advantages over different grinding systems like for example hammer mills or impact mills.

Thanks to the reduced dwell time of the material in the MPS mill which is as little as 1 to 3 minutes, it is very easy to change products in such a plant without getting any significant transfer products. The change-over is effected by adapting the classifier speed, throughput rate, and hot gas supply. Quite obviously this is - apart from the lower energy consumption and easier solution of combined grinding and drying – another essential advantage over ball mill plants.

Specific power consumption of mills and plants may partly differ considerably depending on the characteristics of the materials to be ground even if the product finenesses are similar. For new projects it is possible to determine the material characteristics by means of grinding tests carried out under near field conditions on semi-industrial pilot plants available at the Pfeiffer test station. The results plus our long standing experience in the rating and designing of plants are the solid ground for the technical and economical success of a new grinding plant **[2]**.

The throughput rates required today in the lime industry and amounting to a maximum 100 t/h are considerably lower than the rates to be found in the cement industries all over the world that call for a minimum 400 t/h of cement raw material. Hence the existing model ranges of MPS vertical roller mills have sufficient reserve capacities for the requirements of the lime industry.

Depending on the customer’s request, the scope of supply of GEBR. PFEIFFER AG may cover the mechanical equipment of the entire grinding plant including grit discharge and screening like for example the grinding plant in Czatkowice/Poland (**Fig. 6, [3]**) or just the mill with gearbox or anything in between.

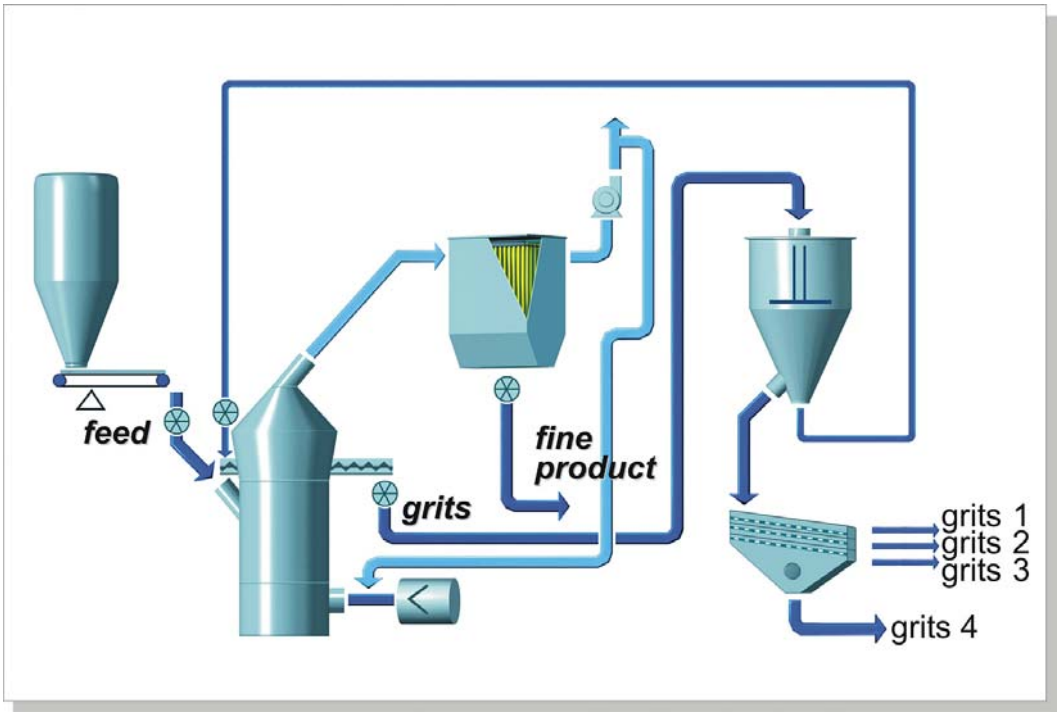


**Figure 6: Flow sheet of a limestone grinding plant with grit preparation**

**KLV and KLE Lime hydrators**

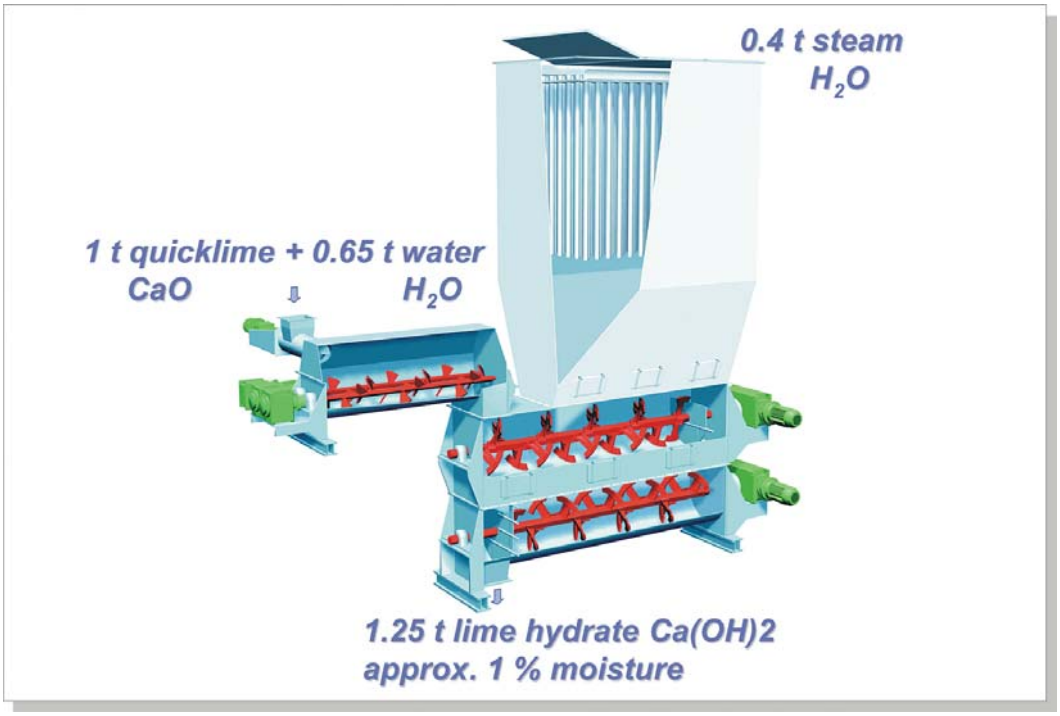


**Figure 7: Pfeiffer KLV three-stage hydrator**

In lime hydrators quicklime Ca0 reacts with water to form lime hydrate $Ca(OH)_2$ **(Fig. 7)**. The product achieved has a moisture of about 1 %. The hydrating process is a strong exothermic reaction. To stabilize the process thermally more water is added than the chemical reaction actually requires. This water is evaporated by the reaction heat. The overall process runs

thermally stable due to the water quantity added being regulated as a function of the temperatures measured in the lime hydrator.

The arising water vapour is nowadays usually dedusted by means of a bag filter mounted on top of the hydrator or partially in wet scrubbers.
Equipped with a mixer in which the main reaction takes place and 2 hydrating chambers for maturing, KLV three-stage lime hydrators are used for a capacity range of 5 t/h to 60 t/h of hydrate and KLE single-stage lime hydrators for capacities below 5 t/h of hydrate. A typical field of application for the small capacities are flue gas desulphurization plants **[4]** installed at coal power stations or waste-to-energy plants. The profitability of these small plants is based on the favourable transport costs of unslaked quicklime. The bulk density of quicklime is about double that of lime hydrate, i.e. 1 kg/l of quicklime as against 0.5 kg/l of lime hydrate.

**SLV and SUV/SUT Separators**

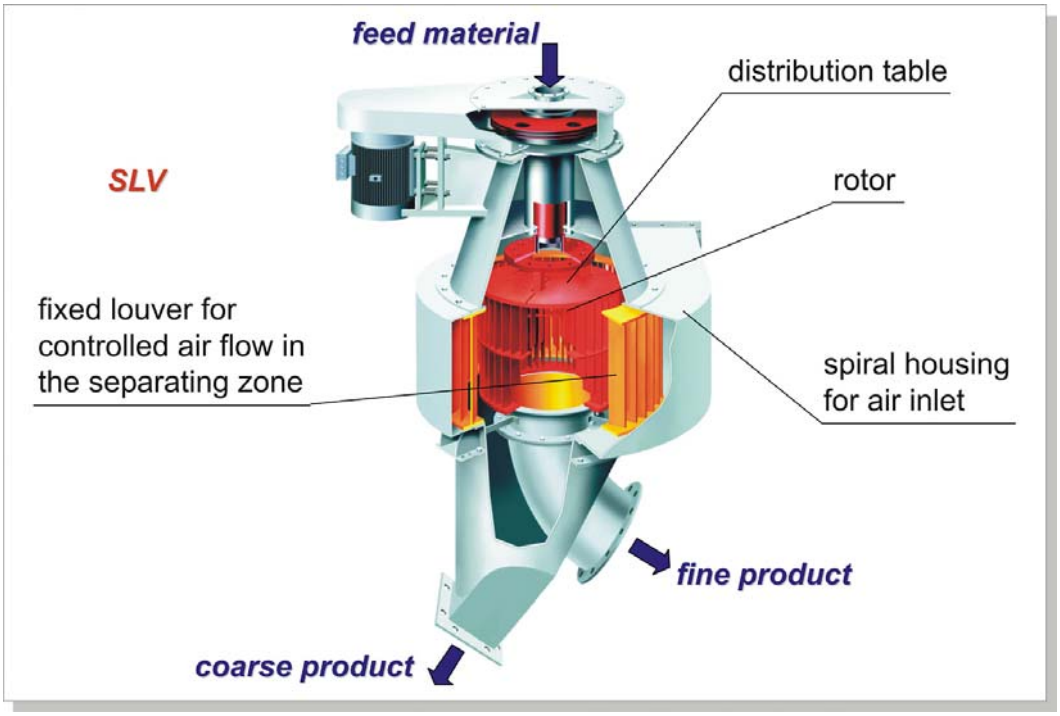


**Figure 8: Pfeiffer SLV high-efficiency separator**

With typical feed rates of 2 to 100 t/h, SLV high-efficiency separators are used for the production of fine products between 10 and 100 micrometers (**Fig. 8, [5]**). Fed from above, centrally through the hollow shaft and the distribution table, the material gets into the separating zone between the rotor and the static louver plates through which the separating air enters. The fine product carried along in the separating air passes through the rotor and is separated from the air in an external dust collection unit. The coarse material leaves the separating zone with the force of gravity and is discharged from the system by means of a rotary lock. The fineness is set by adjusting the speed of the rotor.

**Fig. 9** shows 2 such separators and **Fig. 10** the Tromp curve of a limestone meal obtained from an SLV 800 (rotor diameter 800).

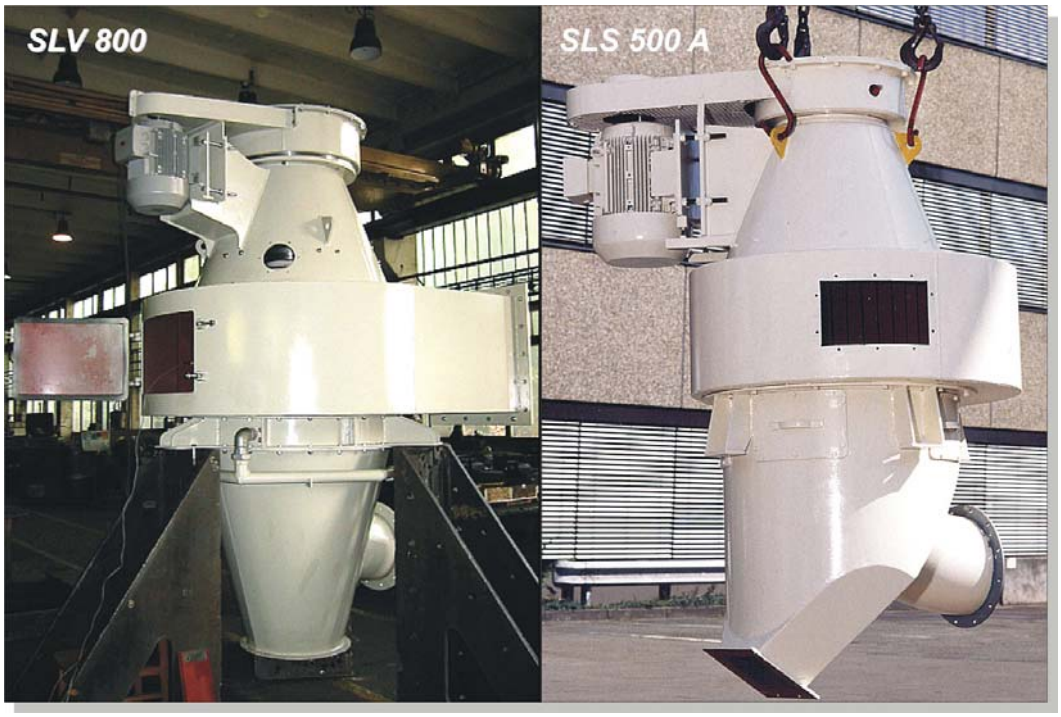


**Figure 9: Pfeiffer SLV 500 and SLV 800 separators**

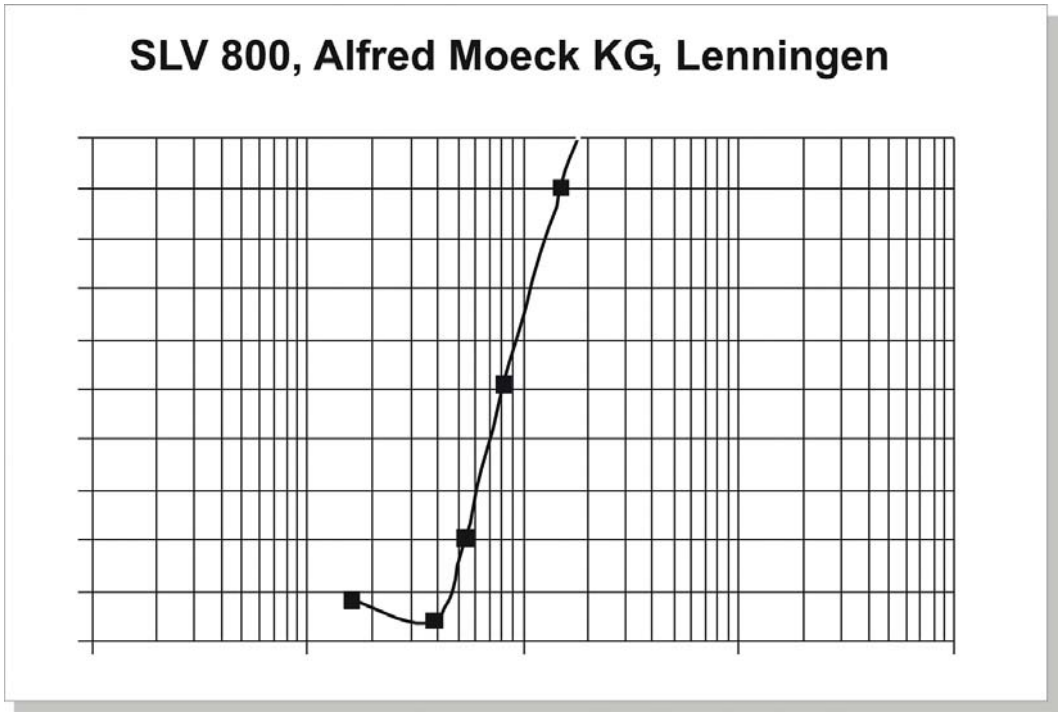


**Figure 10: Tromp curve of SLV 800**

Distribution table air separators are still used in the fineness range of about 90 micrometers and more (**Fig. 11**). Although these separators are bigger in height than high-efficiency classifiers, they do have the advantage that the fan and the dust collector are already integrated. Gebr. Pfeiffer AG supplies two types of distribution table air separators, the SUV type where the speed of the counter-vane system is adjustable and the SUT type, a simpler

model with a fixed speed. Here, the fineness is set by changing the number and shape of the counter-vanes. A typical field of application of distribution table air separators is dedusting of, for example, sands in the mortar sector.

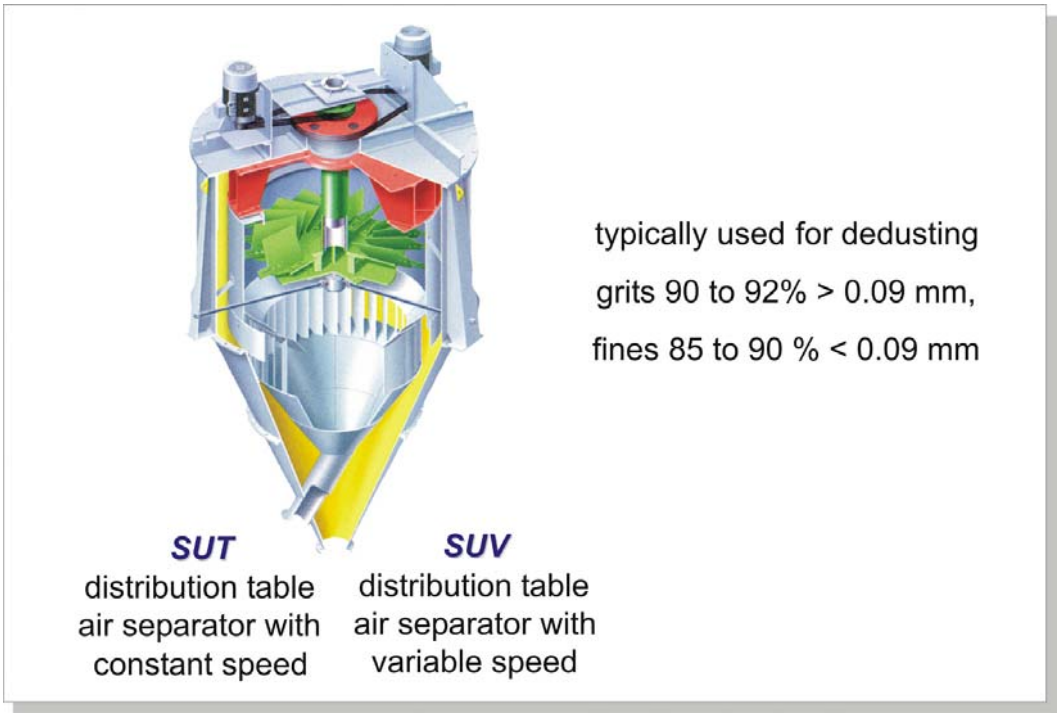


**Figure 11: Pfeiffer SUV and SUT distribution table air separator**

**Ball mills**

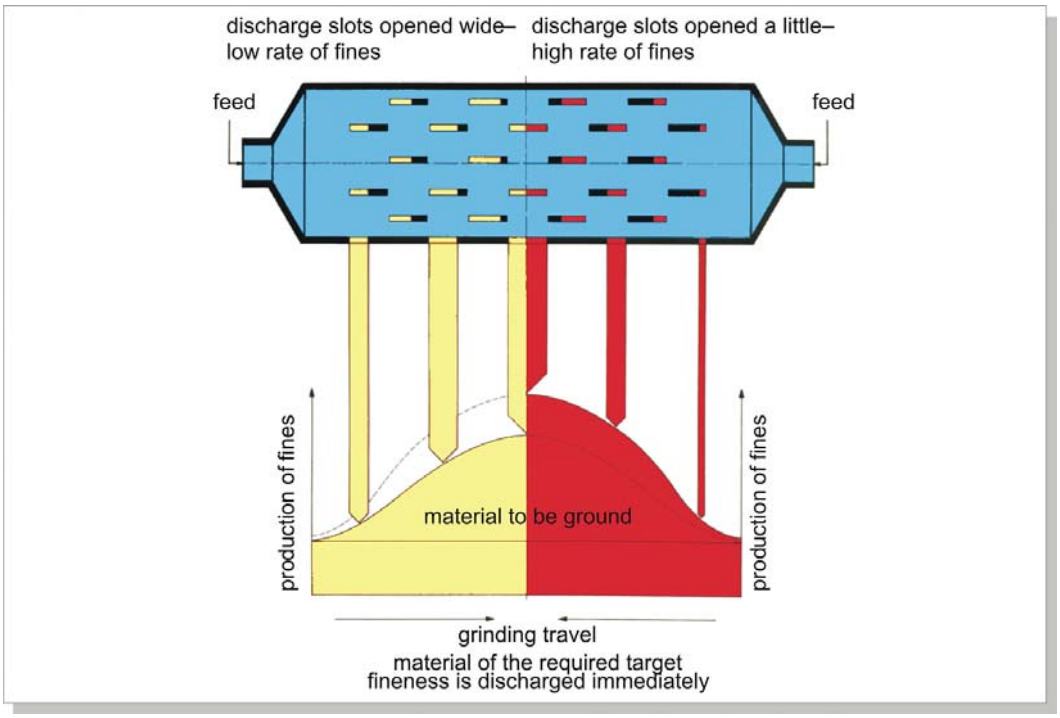


**Figure 12: Pfeiffer MRD ball mill**

Gebr. Pfeiffer AG supplies ball mills up to 1000 kW for special applications in the field of dry grinding (**Fig. 12, [5]**). These ball mills are mainly designed to allow the material to be fed into the mill at both its ends and the product to be discharged through adjustable slots in the

drum. Thanks to this principle, the dwell time in the mill can be adapted individually to the material with the result that the dwell time is particularly short which counteracts the effects of overgrinding and clogging. This is of considerable importance, for instance when it comes to grinding lime hydrate.

**Hydrating plants**

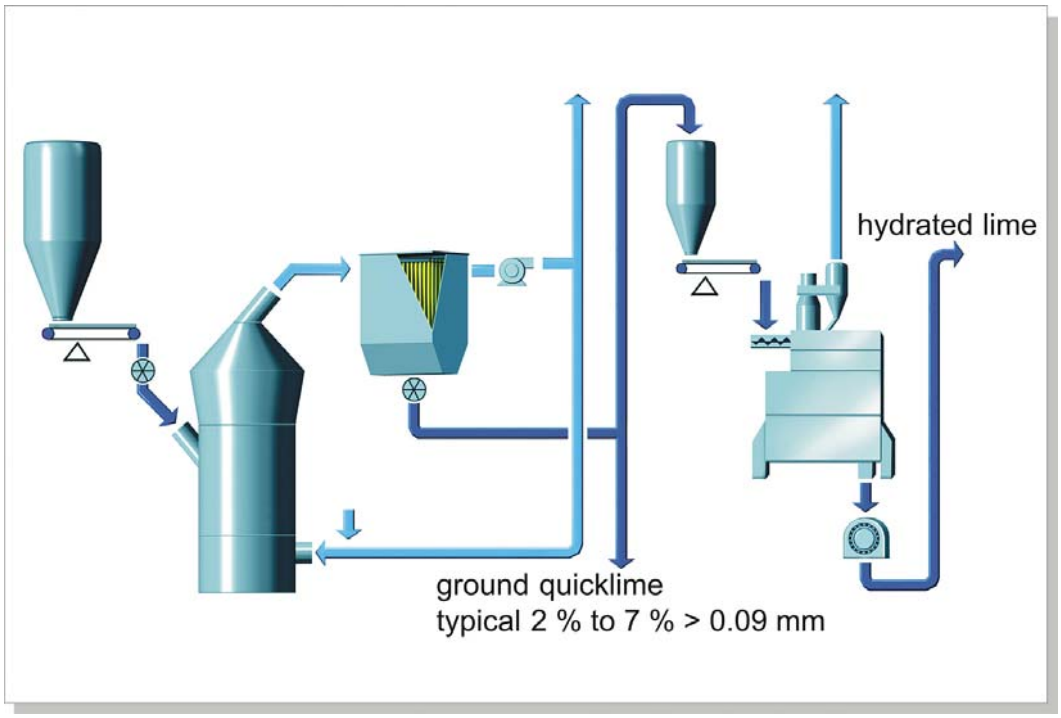


**Figure 13: Flow sheet of a plant producing quicklime powder and hydrate**

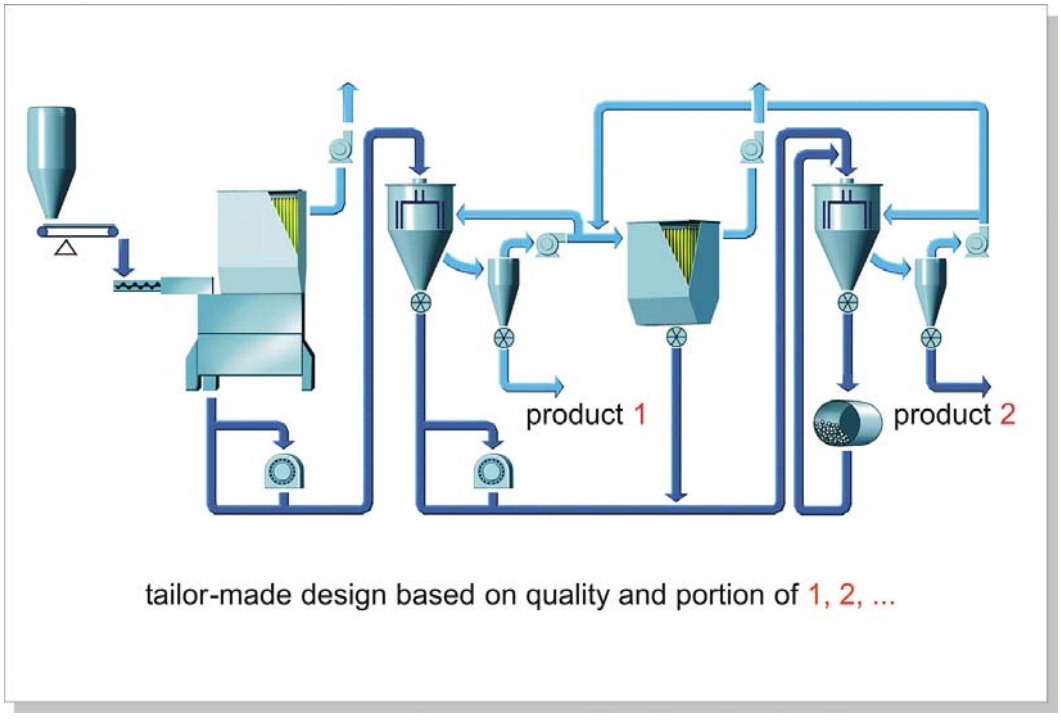


**Figure 14: Flow sheet of a plant producing two hydrate products**

In the case of hydrating plants there are 2 basic concepts which are dependent on the finished products required **(Fig. 13)**. If apart from producing hydrate, a project is also aimed at grinding quicklime to a typical fineness of about 95 % minus 0.09 mm, this speaks in favour of grinding the quicklime in an MPS vertical roller mill and subsequently hydrating part of the pulverized quicklime to form hydrate in a KLV lime hydrator. Such a concept has been applied in Austria where the plant installed is designed for a capacity of 8 t/h of hydrate.

If different qualities of hydrate are to be produced, (**Fig. 14**), the first step is to hydrate the quicklime the feed size of which must not exceed 20 mm. The fine product sorted out in the subsequent first separating stage normally has a high $Ca(OH)_2$ content and is frequently used for high-quality applications. The impurities contained in the quicklime are mainly to be found in the fine product of the second separator operating in closed circuit with a ball mill. The product from this separating stage has a lower $Ca(OH)_2$ content and is frequently sold to the building industry. The usual fineness degrees of the two products range between 90 and 99 % passing 0.09 mm.


**Figure 15: Pfeiffer 30-t/h hydrating plant, Cementos Progreso, Guatemala**

A plant designed according to this concept and producing a total of 30 t/h of hydrate has been running in Guatemala for a couple of years (**Fig. 15**). At this very works another hydrating plant featuring core equipment from GEBR. PFEIFFER AG was built and commissioned successfully in co-operation with Maerz Ofenbau. This plant is producing 30 t/h of hydrate, too.

**TRT Triplex dryers**

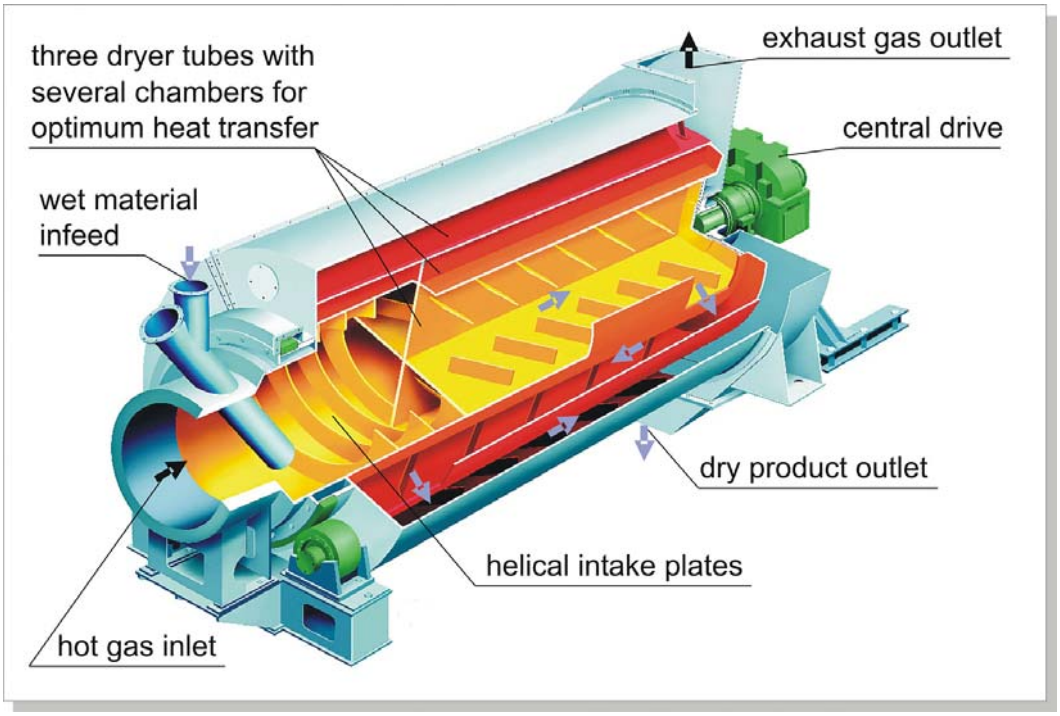


**Figure 16: Pfeiffer TRT Triplex dryer**

TRT Triplex three-tube dryers (**Fig. 16, [6]**) are used for the drying of chalk, limestone sand and limestone gravel in the lime industry. The usual throughput rates range between 20 and 50 t/h and may be as high as 200 t/h.

**Figure 17: Pfeiffer TRT 2000 dryer, Switzerland**

The main benefits the three-tube concept (**Fig. 17**) with the 3 drying sections inserted one into another offers over other drum dryers are the smaller size, a good heat transfer to the

material to be dried and the lower heat loss through the comparably small outer shell. The Pfeiffer TRT Triplex drum dryer has a very high level of reliability thanks to its great flexibility with regard to changes and variations in the material to be dried.

**Bibliography**

[1] Reichardt, Y.: Grinding of limestone and quicklime on MPS vertical roller mills, CWB (2005) No. 3, pp. 1-4

[2] Reichardt, Y. : Grinding, classifying, drying - as used in sophisticated pilot-scale trials for capital plant projects, ZKG International 54 (2001) No. 1, pp. 38-43

[3] Kotowski, C., Schnabel, U., Reichardt, Y.: Simultaneous production of limestone meal and grains minus 1.2 mm with an MPS roller mill, ZKG International 56 (2003) No. 6, pp. 73-75

[4] Blier,L., Sauer, H., Bennewart, W. .: Construction and operation of a hydrated lime plant for flue gas desulphurization of the Siersdorf power station, ZKG International 45 (1992) No. 6, pp. 285-288

[5] Schmelzer, G., Reichardt, Y. : Increased capacity in a dry grinding circuit at Wolfach barite mine, Mineral processing (2003) No. 4, pp. 37-44

[6] Reichardt, Y., Lode, D., Schnabel, U.: 40 years of the TRT Triplex dryer - processing of various mineral raw materials, Mineral processing (2003) No. 2, pp. 18-21

**Captions**

Fig. 1: Pfeiffer machines in the lime industry

Fig. 2: Pfeiffer MPS vertical roller mill

Fig. 3: Pfeiffer MPS 140 B vertical roller mill for quicklime grinding, Saudi Arabia

Fig. 4: Flow sheet of a quicklime grinding plant with MPS vertical roller mill

Fig. 5: Pfeiffer MPS vertical roller mill with removal of grits

Fig. 6: Flow sheet of a limestone grinding plant with grit preparation

Fig. 7: Pfeiffer KLV three-stage hydrator

Fig. 8: Pfeiffer SLV high-efficiency separator

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