Grinding terminals

The installation of grinding plants for the milling of cement and blastfurnace slag has rapidly increased in recent decades. With this shift in investment, there has been greater demand for flexible and compact grinding systems, ideally near raw material sources and often in remote areas.

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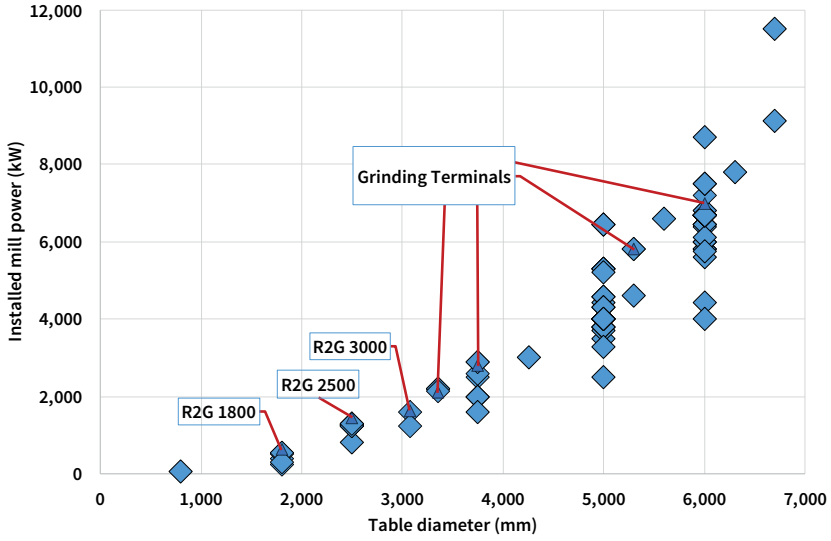
For decades vertical roller mills (VRMs) have been in use in the cement industry for the grinding of raw material and coal. Since the 1980s VRMs have also been used for the combined or separate grinding of clinker and additives. Over the last three decades, the number of cement and blastfurnace slag grinding installations has increased remarkably.

Gebr Pfeiffer's MPS mill has earned a decade-long reputation for the grinding of raw materials, clinker, solid fuels, gypsum and limestone. Due to the trend towards increasing capacities of individual grinding plants, the Germany-based grinding specialist developed the MVR mill in the early 2000s which has been operational in an industrial setting since 2006. Today, the MVR series is well established for large units with an installed drive power of nearly 12MW. It is also used in Gebr Pfeiffer's ready2grind modular, compact grinding plants. Currently, more than 120 MVR mills are in operation or in the order execution phase worldwide.

Figure 1: MVR duty series, indicating ready2grind plants and grinding terminals



Source: Gebr Pfeiffer

Grinding terminals

In the last few years investments in new clinker capacity have become rare, but capacity increases through standalone grinding plants have been rising. Countries such as India have a long tradition of split-grinding units with large capacities. However, over the last decade the type of investor in the cement industry has changed. As well as major players, regional and local players are also now investing in cement capacities. This change has driven the growth in the use of compact grinding units. This growth has been further supported by the local availability of raw materials and a need for low transportation costs, which require the establishment of grinding units in remote locations.

Independent of the size of the split-grinding unit, a wide range of different feed materials are used for the production of low-carbon cements. The versatility of the MVR mill enables the flexible grinding of materials such as clinker, limestone, granulated blastfurnace slag (GBS), pozzolana, fly ash and bottom ash with a wide range of properties. When moist materials are included in the feed mix, a heated rotary lock is installed. When dry and already quite fine materials are relevant, an additional feeding point is provided at the classifier housing.

The size range of MVR mills covers all capacity requirements. Ready2grind plants cater for small capacities of up to 90tph, depending on material composition and fineness. Complete grinding plants with largers capacities are served by the MVR mill duty series (in former times with MPS mills). The MVR 6000 C-6 is installed in many split-grinding units for grinding composite cements and slag. Worldwide reference projects span India, Africa, Latin-America, North America, Asia and western Europe.

With a short time to market and its modular, prefabricated concept, the project completion time for a ready2grind plant is fast. The pre-assembled construction of the modules with standard container dimensions makes these factors possible compared to conventional grinding terminals. Most of the steel construction for the grinding plant is integrated in the container structure. The need for building work is reduced to a minimum. Its modular design using containers and container dimensions not only means simpler, faster transportation, but also standardised on-site assembly procedures.

For grinding terminals or split-grinding units with bigger MVR mills the project scope is different due to client specific requirements and project specific customisation.

Independent of the unit's capacity the sourcing of raw materials is essential. Some plants need to import all materials and therefore, are often installed in

Figure 2: view of the grinding terminal in western Europe under construction

Figure 3: the MVR 5300 C-6 and silos during erection

seaport terminal locations. Other plants are located near limestone, pozzolana or clay deposits and need to import clinker, sulphate agents or other supplementary cementitious materials (SCMs). Therefore, logistics are an important pre-requisite to be considered.

Grinding terminal project, western Europe

Gebr Pfeiffer has equipped a 1Mta grinding terminal with an MVR 5300 C-6 in western Europe (see Figures 2-4).

Raw material storage capacity at the faciity is 200,000t. The outdoor GBS storage area can be seen on the right of Figure 4. The storage building for other materials (including clinker, limestone and sulphate agents) is situated behind the slag storage area. Clinker is delivered by vessels, unloaded and conveyed via belt conveyor to the storage hall.

For the storage of finished product, there are 10 x 2500t silos with separate loading bays below the silos for bulk trucks.

The plant is located next to a 12.5m deep water port, providing port access and allowing Panamax vessels to dock at the quay. This enables the grinding terminal to achieve both the import of raw materials from all over the world as well as the export of cement.

Figure 4: view of the grinding terminal in western Europe upon completion

Figure 5: inside a clinker and SCM storage hall at a ready2grind installation with a Gebr Pfeiffer MVR 2500 C-4

Meanwhile, Figure 5 shows the inside of a clinker and SCM storage hall at a ready2grind plant installation.

VRM performance

The performance of a VRM is defined by a required throughput at a required fineness paired with a low specific thermal and electric energy consumption. For cement grinding the required product quality is the most important target, together with the above-mentioned points.

Some areas in general need special attention: feed uniformity, metal detection and extraction and preventive maintenance, to name a few. Levers to pull for a well-performing VRM are operational parameters such as table speed, gas flow, working pressure and mechanical adjustments, such as the dam ring height and covering the nozzle ring. A smooth and stable mill operation with reduced or zero water spray is possible, hence grinding without external heat is dependent on feed moisture of the material.

Table 1 shows operating data from MVR mills installed in ready2grind plants or split-grinding units. The capacity of GGBS ground in an MVR 2500 C-4 is achieved with a utilisation of about 60 per cent because the equipment was chosen due to required capacity being lower than the possible maximum capacity with this mill size. The other data show a wide range of feed materials depending on the location of the grinding terminal.

For split-grinding units an additional challenge can also be varying raw material properties due to different sources. Therefore, focussing on adjusting the operational parameters to meet the finish product properties is a key consideration for grinding terminals when a new batch of, for example, clinker or blastfurnace slag is delivered.

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Outlook

Grinding terminals with an MVR mill installed in a ready2grind plant or as a split-grinding unit for bigger MVR sizes are well established. The MVR mill implemented in either split-grinding units or kiln lines provides a wide range of flexibility for grinding cementitious products with SCMs, enabling cement plants to reduce their carbon footprint.

Digital modules focussing on maintenance and enhancing operations support the performance of these grinding plants. The need for manual operators will not become obsolete, but fewer personnel will be needed in the future. Efficient grinding technology and additional features, such as digital modules, enable an overall innovative approach to reducing the carbon footprint of split-grinding plants situated near sources of SCMs. ■

Table 1: operational data of MVR mills installed in split-grinding units (terminals or ready2grind plant)

Mill size	Feed mix (addition up to 100% is sulphate agent)	Capacity (tph)	Fineness (cm^2/g)	Specific energy demand of mill (kWh/t)
MVR 1800 C-4	57% clinker, 38% pozzolan	30	3450	13.8
MVR 2500 C-4	80% clinker, 15% pozzolan	61	4500	15.9
MVR 2500 C-4	95% clinker	70	3500	17.2
MVR 2500 C-4	100% GBS	28	5300	25.3
MVR 3750 C-4	95% clinker	115	3830	18.7
MVR 6000 C-6	95% clinker	220	4000	19.1
MVR 6000 C-6	100% GBS	194	5400	27.0
MVR 6000 C-6	55% clinker, 30% limestone, 10% inert stone	351	4500	17.7
MVR 6000 C-6	45% clinker, 50% GBS	235	3800	25.1
MVR 6000 C-6	68% clinker, 27% flyash	285	3960	17.9