CALCINING OF GYPSUM

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GG Gebr. Pfeiffer AG supplies both directly heated MPS vertical roller mills and indirectly heated kettles for calcining gypsum. Due to the different calcining methods used and the respective atmospheres, the products differ, even if the same raw material is used. Hemihydrate produced via grinding-calcining has an initial setting time of 5 - 8 minutes, approximately, whereas hemihydrate produced in a kettle or via a combination of both processes reaches initial setting time within 12-20 minutes.

Introduction

The gypsum industry has been using Pfeiffer plant and equipment for many years. The equipment supplied by Gebr. Pfeiffer AG to customers all over the world ranges from individual machines, namely MPS vertical roller mills, ball mills, Moleculator mills, separators and gypsum kettles to the complete equipment for gypsum works.

The calcination process either takes place in the MPS vertical roller mill or the GK gypsum kettle (Fig. 1), or it starts in the mill and finishes in the kettle.

The GK gypsum kettle

The actual kettle, equipped with an inlet and outlet slide, stirring device, the hot gas supply via the bottom of the kettle, the hot gas pipe system and the equipment for separate removal of flue gases and water vapours represent the key components of the GK calcining facility.

The pre-crushed and, as the case may be, partly calcined gypsum, enters the kettle via the inlet slide and is heated indirectly by gases with a temperature of up to 750°C. The stirring device ensures a uniform calcining process. The exhaust gases and the water vapours forming in the kettle are removed separately.

The process is monitored by continuous temperature measurement. When the material has reached a temperature of 160°C, that is the temperature required for the complete conversion of dihydrate to hemihydrate, the

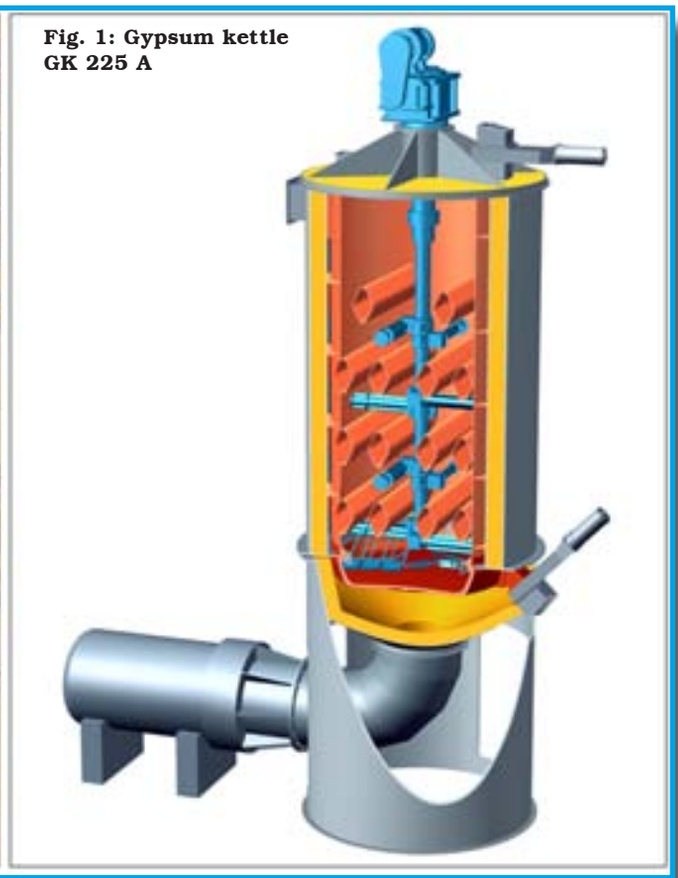

Fig. 1: Gypsum kettle GK 225 A

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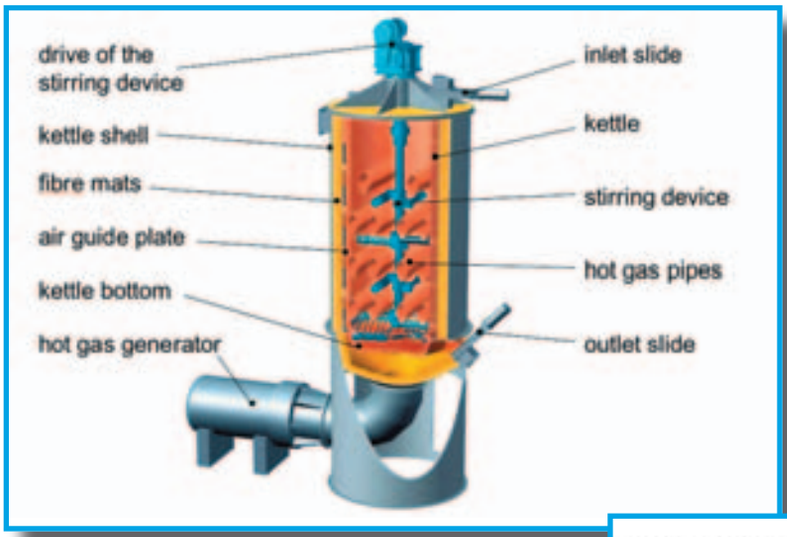
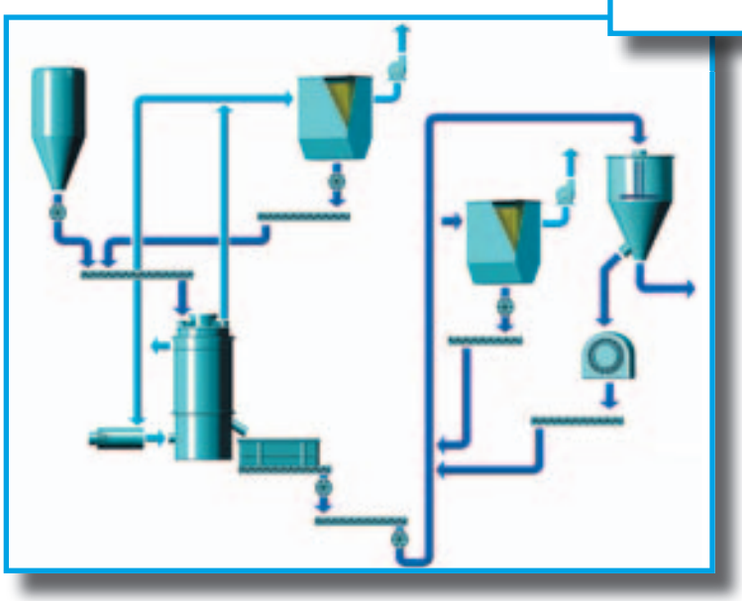


Fig. 2, above: Design of a gypsum kettle GK.

hot gas generator switches to low-fire, and the finished product passes through the open outlet slide and into the buffer silo before the next batch enters the kettle.

The time required for processing a batch, and hence the dwell time of the gypsum in the kettle, ranges from roughly one hour to three hours, depending on the purity and the degree of pre-calcination of the feed material.

Fig. 3, below: Single-staged calcining in the gypsum kettle.



The installation of an additional riser with a pneumatic fluidisation aid enables Pfeiffer's GK gypsum kettle to operate on a continuous basis. A calcining facility (Fig. 2) generally consists of

• equipment for metering and supplying the feed material

• a hot gas generator, which is supplied with a certain amount of flue gases from the kettle, which serve as dilution air

• a kettle

• a dedusting unit for the flue gases and water vapours combining downstream of the kettle

• a buffer silo and equipment for removing the finished product.

A cooler and/ or post-grinding unit may be required depending on the task on hand.

Depending on the size of the kettle and the moisture and crystal water contained in the feed material, Pfeiffer's standard GK gypsum kettles are capable of throughputs from 50 up to 300t per day (Fig. 3).

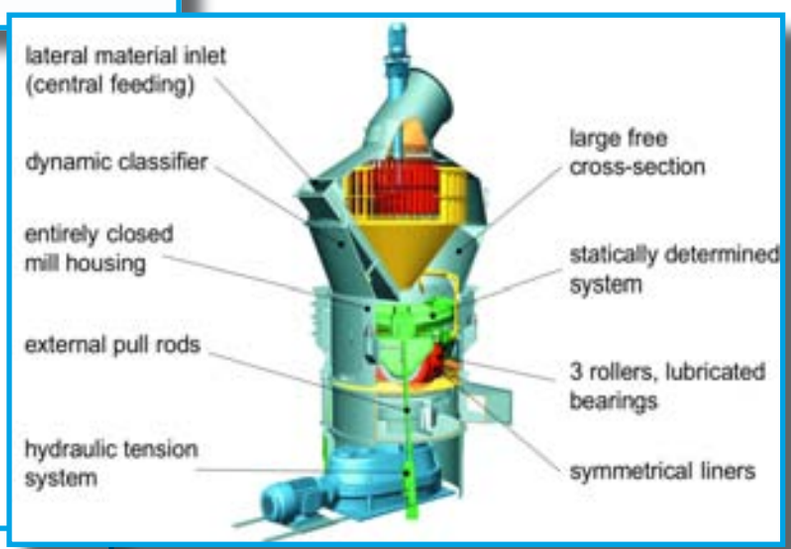


Fig. 4, above: Design of vertical roller mill MPS GC for the grinding and calcining of gypsum

MPS vertical roller mills

MPS vertical roller mills are widely used in grinding cement raw material, coal, cement clinker, granulated blast furnace slag, limestone, clay and gypsum [cf. 1]. The comminution is carried out between three rollers and a grinding table, while the drying and calcining process mainly takes place in a fluidised bed, through which the hot gas flows directly and which is located outside the grinding table. The fineness of the product is set via the high-efficiency classifier, which sits on top of the grinding zone.

Standard MPS vertical roller mills for grinding-drying and grinding-calcining gypsum are considerably smaller in size than the MPS mills used today in cement raw material or cement grinding (Fig. 4). This can be solely attributed to customers' requirements. At present, throughput rates average from 20 to 90t/h.

Process, product and energy consumption

During the few minutes of dwell time inside the MPS verti-

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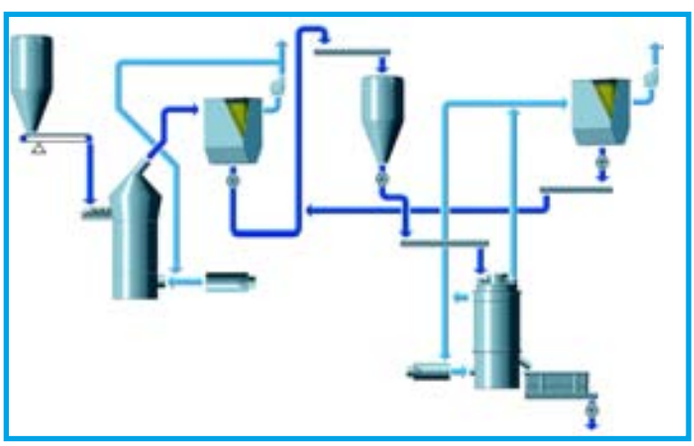
Fig. 5: GK 250 A, Rigips Austria, Puchberg, Austria

cal roller mill, the hot gases and the gypsum come into direct contact, which is not the case inside the gypsum kettle. In the gypsum kettle, the calcination process thus takes place in an atmosphere of an increased concentration of water vapour and during a long dwell time, whereas the reaction taking place inside the MPS vertical roller mill is distinguished by short dwell times and a significantly lower concentration of water vapours.

As a consequence of these basic differences, the hemihydrate begins to set after 5 to 8 minutes, even if the crystal water content is the same, which is considerably shorter than the initial setting time of gypsum that has been calcined in a kettle, i.e. 12 - 20 minutes.

The customer's requirements in terms of setting behaviour are, therefore, a major factor in deciding which procedure to use. In the MPS vertical roller mill, heat is transmitted to the gypsum directly from the hot gas in the fluidised bed. In the case of the kettle, however, the heat is introduced indirectly, via the bottom and the walls of the kettle and the pipes. This leads to exhaust gas temperatures of 200°C downstream of the kettle, the temperature being 160°C if the material is calcined while being ground, and a fuel consumption which is approximately 10 - 20% higher.

Fig. 6: Multi-stage calcining in MPS and gypsum kettle.



Multi-stage calcination

Prior to being fed into the kettle, natural gypsum has to be pre-crushed. Capable of simultaneously grinding and drying and eliminating some of the crystal water, MPS vertical roller mills are often used for this purpose. In the kettle, the material is calcined further to form hemihydrate. The fact that this entails less heat transformation enables smaller kettle sizes to be used. If partial calcination takes place, the mill product, and hence the kettle feed material, usually contains 10 to 15% of crystal water. The dwell time of the partly calcined gypsum in the kettle in a water vapour atmosphere is still significantly longer than when the whole calcination procedure takes place within the vertical roller mill. As a consequence, the product thus obtained does not differ significantly from kettle plaster produced without partial calcination in a mill.


Fig. 7: GK 300 A, Yamama Gypsum Factory for Yanbouh works, Saudi Arabia

The extra cost of gearing an MPS grinding plant to partial calcination is significantly lower than the cost saved as a result of the reduced heat transformation in the kettle. On the whole, while the quality of the product is similar, multi-stage calcination tends to be more cost-effective than carrying out the complete calcination procedure in the gypsum kettle.

Gebr. Pfeiffer AG is currently processing two orders for equipment of this kind (Fig. 5 and 7): an MPS 180 B with 2 GK 300 A kettles with a total throughput of 600t/d for a Saudi Arabian manufacturer and an MPS 112 B with a GK 250 A kettle for processing 170t/d ordered by an Austrian customer.

References

[1] Reichardt, Y., Schnabel, U.: MPS vertical roller mills for gypsum. Global Gypsum June 2004, pp. 30-33.