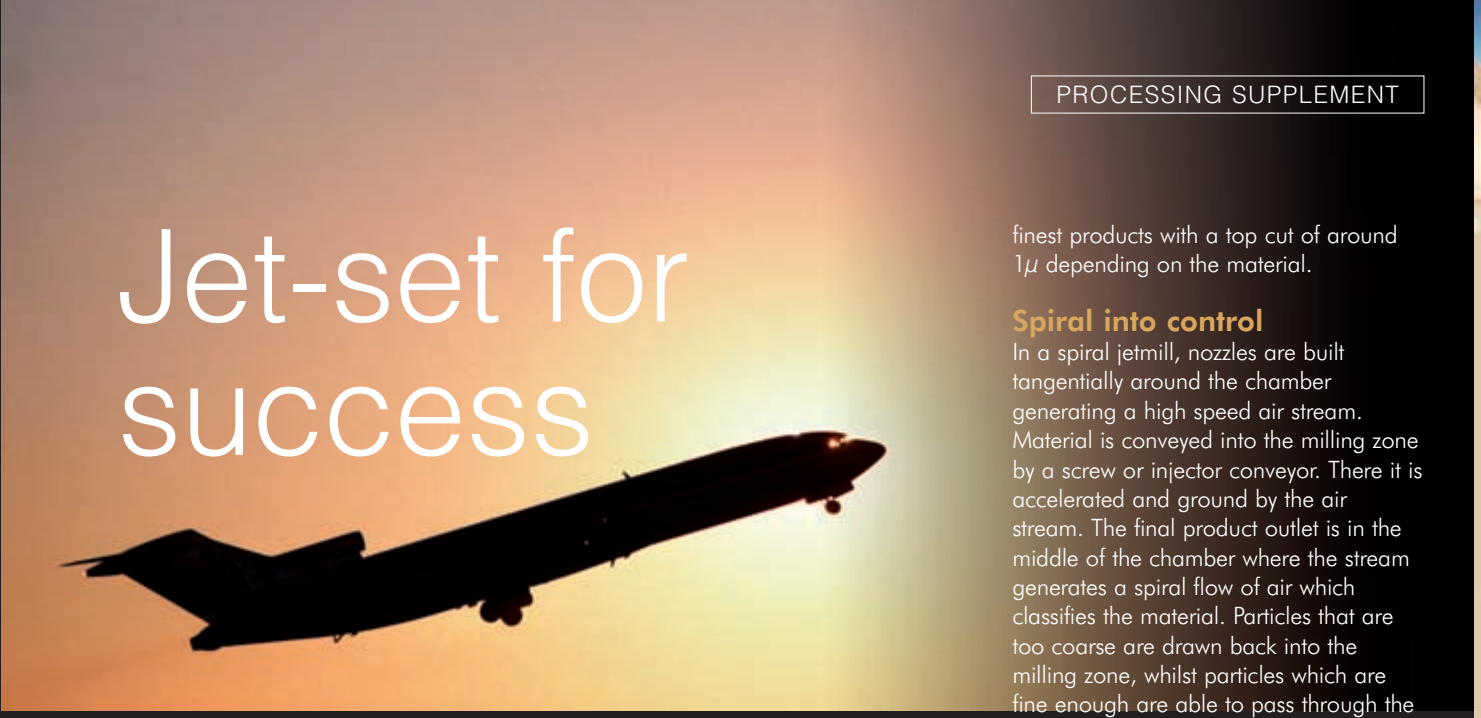
Jet-set for success



PMT Jetmill GmbH offer specialist jetmills for ultrafine grinding

INDUSTRIAL MINERALS have for a long time been used as mineral fillers and functional additives. However, as consumers demand higher quality products, product developers are put under increasing pressure to develop materials that perform better, and accordingly look increasingly to mineral fillers and functional additives to give the required results.

Where particles are ground down to form fillers, this need for enhanced qualities means that producers are not only looking for characteristics such as the fineness of the material, but are also looking at the behaviour of the material based on its functional properties, such as the retention of particle shape or form. As a result, the grinding method has a highly crucial influence on whether properties are enhanced or destroyed.

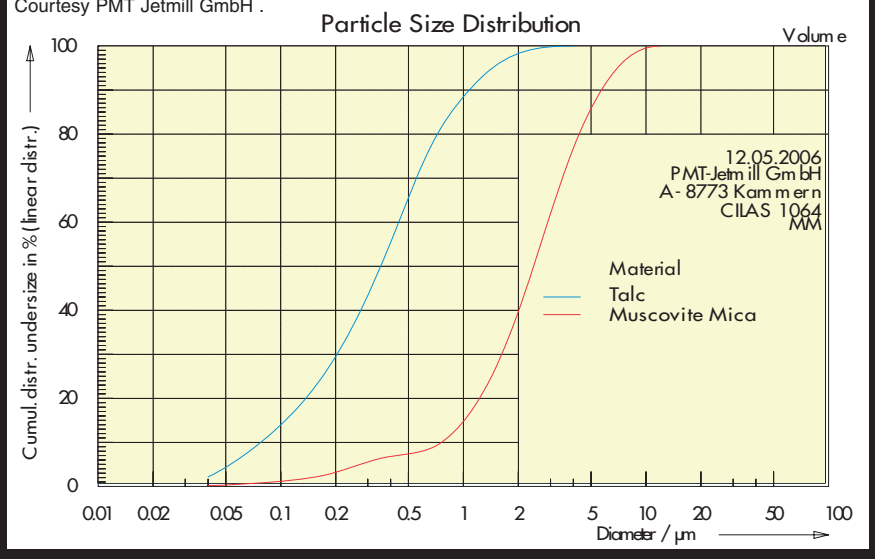
This is especially the case with lamellar or similar shaped minerals like talc, mica, graphite, and also wollastonite, where delamination, and with this the improvement or at least conservation of the aspect ratio, is one of the big targets for the micronizing step.

Shape retention

PMT Jetmill GmbH is one of the leading companies in the field of dry grinding and classifying of industrial minerals to the finest end, and has always put all its efforts into developing grinding technologies and classifying systems to reach the natural given limits in material grinding.

To meet the needs of industries where particle shape is important, PMT has developed its spiral type jetmilling mechanism, which is specifically designed to delaminate platy materials down to the finest products with a top cut of around 1μ depending on the material.

Figure 1: The rotary classifier allows products to be ground to tight particle size specifications. Here results of samples of muscovite mica and talc, tested by Cilas Lasergranulometer are shown. Courtesy PMT Jetmill GmbH .



Spiral into control

In a spiral jetmill, nozzles are built tangentially around the chamber generating a high speed air stream. Material is conveyed into the milling zone by a screw or injector conveyor. There it is accelerated and ground by the air stream. The final product outlet is in the middle of the chamber where the stream generates a spiral flow of air which classifies the material. Particles that are too coarse are drawn back into the milling zone, whilst particles which are fine enough are able to pass through the spiral stream and out of the chamber.

PMT's jetmill offers several improvements on this standard model, mainly in relation to the milling body, feed control, and integrated classifier rotor.

Milling body

The milling body is different to commonly used jet mills, which are designed to keep the space inside the mill as small as possible to prevent the product from escaping from the milling process. Conversely in the jetmill system the body has a wider space with a higher upper part, allowing a large amount of product into the milling area.

As a result, the product is present in oversupply, and so all of the energy in the air stream is directly transferred into grinding. Additionally, the product is fluidised which lifts as many particles as possible into the stream.

Feed control

The grinding conditions in the mill are also optimised by carefully controlling the feed. In this case, the input of amperage of the classifier rotor (*see below*) is the relevant measurement which controls the optimum product feeding rate.

Integrated classifier rotor

Regardless of the importance of the grinding mechanism for the functional properties, the classifier is the limiting factor when determining fineness. To reach products in the range of a few microns or even down to the submicron range by dry grinding methods, top speeds of 150m/s and above are required. This means achievable limits right down to real submicron products are only obtainable by improved classification systems.

The classifier rotor in the jetmill system is built into the mill with a centric or vertical axis. Directly combined with a

motor unit, the classifier has the advantage of maintenance-free and high-speed bearings. Together with the basic structure made from high strength aluminium alloy, the highest centrifugal speeds are possible up to 160m/s.

The rejecting effect of the rotor against coarse products means that the high filling rate needed in the mill can be reached. As a result, independent of the load, the fineness of the final product can be adjusted by the speed of the rotor.

This factor allows the optimum load to be adjusted creating significant increases in efficiency – a factor that is an important difference to conventional jetmills which normally control fineness by increasing or decreasing the load in the mill.

Improved results

With this system it was possible to combine the advantages of retaining the shape of platy minerals with the advantage of having good particle size control. Additionally it could be observed that with suitable minerals (soft, laminar ones) the specific energy consumption (kWh/t final product) was much better compared to the opposed type jetmills, which reduce particle size by accelerating two streams of particles into each other.

This was mainly due to a reduced path for the coarse rejects as the classifier was installed right in centre of the grinding zone.

Seeing results

As can be seen when looking at micrographs, talc samples processed with the PMT Jetmill retain the platy structure even when reduced to high fineness with a top cut of 5μ.

A tight particle size distribution is also possible, as exemplified in Figure 1 which also illustrates the possibilities in terms of fineness, indicating the actual limits in dry fine grinding of these minerals. Results from the accompanying sedigraph for the talc showed a d50 of about 0.2μ and a top cut of around 1μ.

When tested, the advantages of the Spiral Jetmill can clearly be seen. Figure 2 shows several comparison tests in plastic applications using different grinding systems. Here, the maintenance of particle shape has allowed higher notch resistance in plastics compared to other, less advanced methods of grinding.

These benefits are one of the main reasons behind the continued development of the existing PMT Spiral Jetmill with internal classification as a means of achieving finer products in the most economic way.

Another feature of the machine includes the possibility to remove hard, but grindable impurities, like quartz from the system thus improving the quality of the final product. In Figure 3, a comparison of a final talc sample and the reject sample shows significant enrichment of quartz and dolomite in the reject compared to the clean final product sample.

In this particular case the overall quartz content of the talc could be reduced from about 1.7% down to < 0.5% by rejecting approximately 8% of the total material.

Gaining ground

All of these observations, deliberations, and tests have lead to the development of PMT's grinding and classifying systems. With ongoing research and development, the company is aiming towards the development of grinding down to the real submicron range with the finest dry processed industrial minerals.

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Figure 2: Comparative plastic application tests using mica and different grinding mechanisms. Courtesy PMT Jetmill GmbH

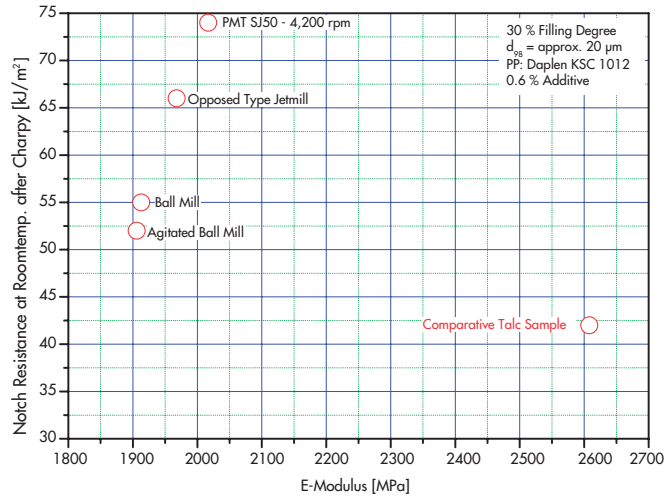

Figure 3: Comparision of a final talc sample (A) and the reject product (B). Courtesy PMT Jetmill GmbH