Trends in Coarse and Fine Grinding and Separation Technology.

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The amount of solid material world-wide which has to be reduced in size, screened and sifted is estimated at about 5 billion tonnes. Only a fraction of that applies to the food industry. The machines are remarkable, not for their strength, but rather for being small and fine, and have almost invariably been awarded the high-tech seal. In spite of this, their specific energy consumption is actually low. Just how low it is becomes clear from the fact that a reduction of 1% in energy consumption would increase the efficiency of a mill by nearly 100%. At the same time, the mills have become more reliable and user-friendly, and can often be taken apart and cleaned rapidly.

Of course, this also applies to laboratory mill. By simply changing their attachments, all-purpose mills with direct drive can be operated as turbo mills, pinned disk mills, hammer pulverisers or crown gear mills. With an output of about 1 KW, the rotor peripheral speed is infinitely variable over a wide range. With the use of a dosing conveyor trough, the material is uniformly fed into the mortar. In order to resist to friction and corrosion, as well as being easier to clean, all parts which come into contact with the product are made from stainless steel.

With a rotor diameter of 124 mm, small batches used in a laboratory of a production line can be broken down at rates of between 3 and 180 kg/h. Minimal product losses make the mill perfect, for example if valuable pharmaceutical or pesticide additives have to be broken up. Depending on the material for grinding, the amount involved, the mill attachments and the rotor peripheral speeds, fineness levels of below 10 µm can be obtained.

General-purpose mills also include impact crusher mills for the fine grinding and pulverising of materials of up to 3 on the Mohs hardness scale for powder particle fineness levels of d 87 = 10 to 400 µm. It is a feature of modern mills that the mill housing can be swung open. The mill cover, complete with directly driven overhead sifter, guide wheel and liner, can be swung back completely through 180 from the mill underbody.

Because of the low noise produced, and so as not to wear down the bearing on one side with radial stress of a drive belt, the grinding discs are directly driven. In order to improve handling, and so as to be able to change the product more easily and in less time, the grinding disc is locked to a shaft hub with just one simple screw nut.

With a new rotor, the pulverising of various materials reaches the micron level, which was previously possible only with an airstream mill. In extremely fast air vortexes and with simultaneous air or water-cooling, various materials and special chemicals can clearly be reduced in size to below 10 µm. Laboratory experiments have demonstrated an extremely high reduction effect with simultaneous avoidance of undersize particles. The mill can be opened quickly for cleaning. This is of particular interest if the material for grinding is changed frequently.

Until now, pulverising in an air vortex has been restricted to high-speed rotor mills for soft to medium-hard materials. New building materials, such as ceramics or zircon oxide, as well as special steel alloys, make the high-speed rotor suitable for new applications: drying of organic and inorganic pigments; agglomerate-free drying of mineral suspensions, possibly with simultaneous surface treatment (coating).

Working materials of up to 9 on the Mohs hardness scale can be pulverised down to less than 1 µm with the moving-bed jet pulveriser, free from contamination. A special jet design - a ring jet which is fitted in its centre with a return feed for material from the moving bed - increases the overall performance of the pulveriser without using any additional energy.

Modular systems are constantly extending the area of application for machinery and keeping costs down. This also applies to mills. In a fine grinder, the machine housing can be fitted with various attachments. As a result of the array of mill attachments with different screen inserts, various friction elements, as well various friction trays or friction elements, as well as various pin fittings, there is hardly any limit on possible uses. The common denominators of these fine mills are the grinding material feed into the centre of the mortar, the particle acceleration provided by each rotor, the particle acceleration provided by each rotor, and the impact of the particles with a contact surface.

Cylinder mills enjoy great popularity, thanks to their problem-free operation and their range of uses. A compact, dust-proof rolling mill with a welded machine housing is characterised by its particularly smooth with corrugated or flat rollers of various diameters and lengths. Apart from the rollers, the parts which come into contact with the material are made from stainless steel. Because the drive mechanism can be swung out, the rollers can be removed for replacement or maintenance work.

The material for grinding is fed uniformly to the rollers via a vibratory duct. The fineness of the product is selected as a result of the shape of the roller surface, the indefinitely variable slit in the roller, the speed and the differential speed between the rollers. Further more, the mortar can be inerted especially for highly flammable products. Relatively small amounts of inert gas are required for this purpose.

In contrast to mills, the jaw crusher is more of a reduction machine for coarse material. Specially made for sample preparation of medium-hand, brittle and tough materials, jaw crusher meet EC safety regulations. The features of the devices are a high throughput, a reduction ratio of 50:1 and high degree of fineness.

Infinitely variable crush settings with indicator scale, swing-out funnel, removable crusher arm and brake motor are additional features. Unlike preset crusher arm and brake motor are additional features. Unlike preset crush settings, the width setting on these crushers is infinitely variable and therefore optimally matches the crushing effort required with the material to be crushed. In addition, zero point adjustment for abrasion compensation is also available.

Reduce before you recycle

Cutting mills are undoubtedly among those benefiting from the law on re-circulation economy. With outputs of more than 100 KW, they are real powerful. Rotor diameters of 800 to 1000 mm digest chunks of plastic of more than 50 Kg without complaining, and still get through more than 3 tonnes an hour. The rotor design and the cutting geometry have also been developed further. Specifically, there is an enclosed rotor fitted with variable blades. Here, too, the energy consumption is reduced, and the increased amount of current consumed is only minimal.

A blade-free reduction machine is available in the form of the impact crusher. The machine had been developed for the reduction of valuable material which has been highly contaminated with metal and mineral impurities. This includes agricultural sheeting, lightweight fractions from automatic shredders, and DSD packaging materials.

In these applications, the high costs of wear and tear and frequent mechanical breakdowns caused by foreign objects getting inside create problems which have not been satisfactorily solved until now. The rotor of the impact crusher is fitted with suspended, oscillating grinder attachments. These economical attachments are relatively hardy, and can be rapidly replaced. Large-scale foreign bodies are automatically filtered out of the product flow, without interrupting the operation. With the addition of water, the impact crusher becomes an effective washer. One important side effect: paper is extensively unravelled and can be subsequently removed in the friction washer.

Even problem items can be broken down

Screening machines have always been essential in the manufacture of granular and pulverised mass-produced and quality goods. There are some notable new developments in fine screening, especially with grain sizes of less than 100 µm.

With a screen diameter of 1,600 mm, there are companies extending their range of vibration screening machines. There is also a new large version in single - and double- decker configurations for safety and controlled screenings, as well as for simple fraction of practically all pourable waste products - even in the pharmaceuticals sector. For controlled screenings with mesh widths of 2 mm, out-puts of more than 50 m^3 per hour can be attained, depending on the product. In addition to the low space requirement and an easier switch-over to changing products, the basic outlay should be less than 3% of previous machines. Cleaning with a ball beater should remove of the heaviest items. The vibratory screening machine is driven by two counter-rotating unbalanced motors.

By fitting ultrasonic cleaning, hub screening machines are intended to separate heavier products of between 25 and 100 um in size without any problem. With its low frequency and a high amplitude of 15 to 50 mm, far higher outputs should be achieved than with conventional machines. Screen frames which can be fitted in the form of cassettes can easily be changed in single- and double-decker versions. A built-in screen cleaning control device can a drive frequency regulator are further parameters available for the optimal solution of existing screening problems.

A vibratory and oscillating screening machine with diameters of up to 1,200 mm has been specially developed for wet screenings of between 30 µm and 30 mm in 2 to 4 fractionations. High -acceleration, three-dimensional screen movements enable even moist screenings to be removed. Balls and rings under the screens ensure free passage. A vibratory motor takes over the drive, and stainless steel is used throughout.

With a newly developed airstream precision screen, size distributions can be reproduced precisely in the finely ground and pulverized areas. All operational parameters are included and any desired size can be obtained.

Finest quality thanks to innovative technology

Sifting is competing with screening. It is true that, in the fine sector, sifting has a higher throughput than screening, but it also produces outsize material in both fine and coarse materials. In screening, on the other hand, there can be no outsize material, because, as oversize particles, they cannot pass through the screen mesh. This is sufficient justification for screening to remain an indispensable basic operation.

For the pulverization of toners (dust precipitation at 5µm) or the production of the finest filler material, a wind sift has been developed with only one wheel, which obtains sharply separated sifting in the d^{87} = 3-30 µm area. Fitness levels can therefore now be reached in production which were previously possible only in the laboratory. This is possible as long as the material to the sifted is intensively rinsed by the separated air in the static light shovelling area. The actual separation takes place as normal in the sifter wheel. The screw-shaped design of the housing optimises the product flow within the device. Large quantities of coarse material can thus pass through the exit funnel without hindrance. As a result of the clean product being guided by the sifter operating as a single device, any mixing of the sifted coarse material and the material waiting to be sifted can be excluded.

Cyclone sifters for optimal solid material separation

It is well known that dust particles can be precipitated from the outgoing air with cyclones, but also that solid materials can be separated in liquid or gas streams. Because of its method of construction, the cyclone sifter can be operated both off-line and on-line mode, even with large-volume production. As a result of optimising the flow control and the dispersal of agglomerated, the separation has been improved to such extent that, using powered paint as an example, the coarse yield in the 10 µm area could be improved by more than 15%. The most outstanding features of the cyclone sifter include a separation spectrum which extends from 5 µm to several hundred µm. Maintenance and cleaning are simple. Volume flows of more than 10,000 m^3 per hour, and throughputs of 100 kg per hour are easily attainable.

For years, 10t µm represented a threshold beyond which any further separation of grain sizes was difficult, if not impossible. Demands on products, however, made it more and more necessary to be able to make further separations. Meanwhile, there has been a breakthrough, and now even products in the sub-micron area can be separated with the appropriate adjustment.

The main feature of wind sifter, which easily achieves products with grain sizes of 10 µm and less, is a flow-and technical process-optimised rotor. Thanks to minimal pressure losses, the specific energy consumption is also reduced. The rotor can be removed quickly, so that the sifter is freely accessible and can thus be easily cleaned. Additional options are offered by the secondary air circulation which can be adapted for individual applications. With the new kind of wind sifters, the user can manufacture products with excel, especially as regards separation effect and freedom of spray particles. Typical areas of application for the wind sifter include the production of powered paints, thin-film powders and pigments. With volume flows of several thousand m^3 per hour, throughputs of several hundred kg per hour can be achieved.