

Big performance in small machines

Batch and continuous laboratory wet grinding systems

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Laboratory machines, designed for mixing, dispersing, kneading and wet grinding as well as de-aeration are well established as a part of wet grinding technology equipment. Their applications range from the development of new products or processing small batches of high-tech materials to quality control or assurance and process optimization. It is important, therefore, that these machines are easy to handle and offer a high degree of flexibility. In addition, little cleaning effort and low product loss at an exact reproducibility must be guaranteed.

Wet grinding aggregates as well as mixing, dispersing and kneading machines of different sizes are used in industry for the production of colors and paints, pigments, dyes, pharmaceutical and cosmetic products, minerals, ceramics and many additional applications. NETZSCH-Feinmahltechnik GmbH manufactures agitator bead mills with a grinding chamber volume from 0.3 to 10,000 liters. The 10,000 liter machines are used for processing ores and achieve suspension throughputs of 100 – 200 t/h. However, before such a large-scale production system can be installed, different development steps must be taken to assure accurate scale up results. Here, laboratory machines play an important role. The different laboratory wet grinding systems of NETZSCH-Feinmahltechnik GmbH are presented in this report. Classification occurs in dispersing and wet grinding processes that are used to prepare the materials. First discontinuous grinding systems are described then continuous processes are discussed.

Discontinuous wet grinding systems

Laboratory Batch Mill PE 075

If easy dispersing tasks are necessary or if the grinding behavior of a product shall be tested, the easy to handle laboratory batch mill PE 075 is the suitable grinding system. The volume of the coolable grinding tank is 0.75 l, which can be filled in a product batch of 0.15 – 0.3 l with approx. 0.25 l grinding media. Easy to exchange agitating tools such as the proven eccentric disk agitator, the system moliNEx and the attrition system are available. The grinding media is kinetically activated by the rotating agitators and grinds the caught particles by shearing and impact forces. Both, the agitator tools and the grinding tank can be designed in different materials such as zirconium oxide, aluminum oxide, Cr-Ni-steel or tungsten carbide. The speed adjustment is infinitely



variable via speed gear.

Laboratory Basket Mill *LABTOPMILL*[™]

The laboratory basket mill *LABTOPMILL*[™] achieves a product fineness in the range of $< 5 \mu\text{m}$. The biggest advantage of this machine is its ability to be easily cleaned and handled. Typical batch sizes of 1 – 12 liters can be processed without a pump or pipe lines. The products can be processed roughly without product loss and the change of product can occur within a few minutes. This laboratory basket mill has a unique grinding system with a rotating grinding basket filled with grinding media that dips into a tank filled with product. The movement of the product is caused by the radial acceleration of the rotating basket. The product is sucked via the upper and under slotted face surfaces into the grinding zone and is radially carried out via the circumferential slotted pipe.



The movement of the grinding media is caused by the rotation of the grinding basket.

A stator in the basket decelerates the grinding media and produces the differential speed necessary for the grinding. An ideal circulation operation is formed by the intensive product rotation where the product is finely ground by the repeated flow through the basket. The grinding basket can be replaced by a toothed disk to pre-disperse the product. The primary fields of application for the laboratory basket mill *LABTOPMILL*[™] vary from paints and printing inks to the field cosmetics and biotechnology.

The results can be scaled up to the production machine, type TopMill.

Continuous wet grinding systems

Laboratory circulation mill *MINIZETA*

Specially developed for principle tests for R&D, the *MINIZETA* is a versatile laboratory circulation mill that is easy to handle and that achieves excellent reproducible results and particle sizes down to the nano range. The swiveling grinding tank of the *MINIZETA* allows both simple filling and emptying of the grinding media as well as the easy cleaning. With this machine, which is designed with an integrated circulation tank, small product batches of approx. 0.25 – 0.5 l can be processed with grinding media from 0.5 mm in diameter. The grinding media is kept in the mill by a separation gap of 0.2 – 0.3 mm. A static gap



ring at the housing end and a dynamic gap ring at the agitator shaft end form the separation gap. A lip seal guarantees the sealing of the agitator shaft between product and atmosphere side. The constructional design of the *MINIZETA* allows a circulation operation without a product pump because the rotor of the mill works similarly to a pump. The agitator shaft is electrically or pneumatically driven when used in possible explosion areas. The speed is infinitely adjustable. The slogan “plug and grind” gets a completely new meaning because of its extremely easy installation.

Laboratory circulation mills *MINICER* & *MINIPUR*

If optimal reproducible grinding results and fineness down to the nano range are requested for small product batches, and the grinding procedure has to occur in metal-free conditions, the newly developed laboratory agitator bead mills *MINICER* and *MINIPUR* offer the ideal solution. The *MINICER*, with a grinding chamber design of zirconium oxide, is designed for processing solvent-based products. Likewise, the *MINIPUR* in polyurethane design is used for processing water-based products. Both machines are designed for the grinding of small batches in the range of 0.25 – 0.5 l. The products are continuously processed in circulation operation between the integrated circulation tank, in case of the *MINIPUR* in coolable design, and the laboratory mill. Both laboratory machines are equipped with a double acting mechanical seal and an adjustable hose pump. A swiveling grinding chamber simplifies the filling and emptying and makes this machine very easy to clean.



The *MINICER* and *MINIPUR* have a peg agitator, however, contrary to the *MINIZETA*, both machines work with the highly-efficient rotor slotted pipe centrifugal system. This enables the use of small grinding media of 0.3 – 2 mm in diameter. The ceramic coolable grinding tank also allows a discontinuous operation whereby the product inlet and outlet can be closed with a blind plug.

Possible applications for the *MINICER* and *MINIPUR* are metal free grinding of life science products, ceramics, ink jet, organic and inorganic pigments, electro ceramics or high-tech products such as color filter and polishing agents for electronic parts (CMP slurries) applications.

Multi-functional machine *LABSTAR*

The *LABSTAR* is the universally applicable laboratory mill, that enables precise grinding especially for difficult research and development tasks in industry and science. It is irrelevant if this laboratory mill is used for development of new products, quality assurance or process optimization as it is easy to handle and offers a high degree of flexibility regarding the available grinding chamber materials of both grinding systems.

The *LABSTAR* designed in protection class IP or Ex has an electrical drive of 3 kW which is infinitely adjustable via frequency inverter. Depending on the grinding system, the grinding chamber volume is between 0.6 – 0.75 l. Product batches of 1.5 – 5 l can be processed. The laboratory mill can be operated with the well-known

TriNEX[®] grinding system - the disk grinding system with pre-classifying disk - and ZETA[™] – the peg grinding system with rotor slotted pipe centrifugal separation system. Depending on the application, it can be designed in steel, ceramic materials such as aluminum oxide, zirconium oxide as well as silicon nitride and silicon carbide or

polyurethane. Because of this versatility the *LABSTAR* can process virtually any material according to application and operation of the machine e.g. circulation, passages or multi passage. When using 0.1 mm sized grinding media a product fineness of less than 100 nm (x_{50}) can be achieved. These grinding results are exactly reproducible to production machines. Further advantages include the easy evaluation and documentation of the test results with the specially developed LabDat[®] software and the swiveling grinding tank which enables a comfortable product change and easy cleaning.

Dispersing or wet grinding of pharmaceutical products places high demands on the material, surface condition and process control. The pharma *LABSTAR* meets these complex requirements completely. This machine is constructed as a clearance free and sterile complete module in CMP design of stainless steel AISI 304. All product-wetted parts are AISI 316 L with R_a 0.5 μ m. In addition, two different grinding systems are available for the pharma *LABSTAR*. During the grinding process all process related data is collected and presented on the integrated color display. The complex control of the different process steps e.g. sterilization procedure or grinding process guarantee highest reproducibility and operating safety.



Summary

The extensive laboratory mill program of NETZSCH-Feinmahltechnik GmbH offers the right solution for all dispersing and wet grinding tasks e.g. production of small quantities, formulation development, principle tests, quality assurance etc. Because of the compact construction and the resulting geometrical dimensions the laboratory machines, they can be designed in different materials. Therefore, polymers like polyethylene and polyurethane as well as wear resistant high-tech ceramics like aluminum oxide, zirconium oxide, silicon nitride and silicon carbide are all available materials for iron free processing. Tungsten carbide, stainless steel and highly wear resistant steels complete the possible material designs. The application spectrum whether solvent or water based is unlimited due to the variety of material.

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