

Grinding solutions from coarse to ultra-fine

When people call Glen Mills they typically know that they need to grind their product from size X to size Y, but they don't know how to go about it. That's where the experts at Glen Mills can help. We can match your application to one of 50+ grinding solutions either by calling on previous experience or by running new trials. Depending on the final fineness required we split up potential applications into one of four size ranges; each section shows only one of the many mills available in that range.

Coarse: Generally we regard anything bigger than 1mm to be coarse

Equipment: Hammer Mill, final fineness from 1" down to approx. 0.5mm



Medium: Glen Mills standard, 100-500 microns

Equipment: Ultra Centrifugal Mill, final fineness in the 50-750 micron range

Fine: Glen Mills standard, 10-50 microns

Equipment: Electric Mortar Grinder, final fineness in the 10-50 micron range



Ultra-fine: Glen Mills standard, ≤10 microns

Equipment: Jet Mill 1-10 microns, High Energy Ball Mill ≤1 microns



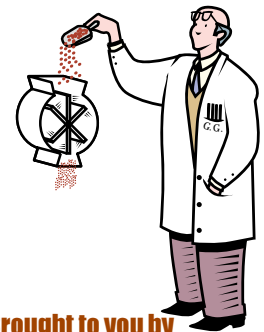
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Tech Tips 6 looks at the macro mini micro and nano-scale world of size reduction.



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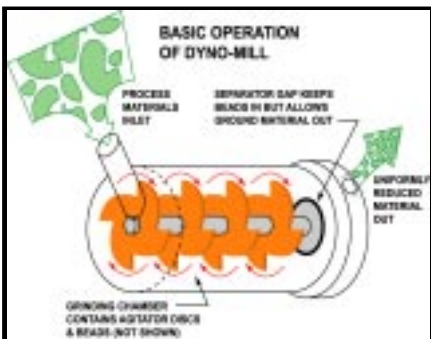
Options for grinding to nano-scale

Nano-scale technology is a very hot topic. Reaching nano-scale (less than 1 micron or 0.001mm) with conventional grinding equipment such as knife mills and hammer mills is not possible - the mechanical tolerances are too big to achieve the final fineness that we need. Presented here is information on two machines that have both proven successful in grinding disparate materials to the nano-scale region. The DYNOMILL and the PLANETARY BALL MILL are both high energy ball mills, but tackle the problem from different angles.

DYNO[®]-MILL

The DYNO[®]-MILL is a versatile horizontal bead mill that has found a home in thousands of labs and production facilities around the world. Applications range from paints and coatings to drug manufacturing and cell disruption for extracting proteins. Grinding to a mean size of 320nm has been reported in research papers related to the oral absorption of a specific anti-cancer drug (copies of this article are available upon request).

Operation of the DYNO[®]-MILL is always wet, that is, the material to be ground is held in suspension in any suitable liquid. A jacketed grinding chamber contains a series of agitators that are equally spaced along the length of a central shaft. (The jacket



on the grinding chamber is used to control the temperature of the material being processed.) The chamber is secured at one end and cantilevers out

over the shaft. The bearing end contains a separator gap which has clearance tolerances that can be set as tight as 20 microns. The chamber is filled to about 80% of its capacity with beads. Depending on the specific application beads made from glass, ceramic, metals, tungsten carbide and other materials are available. The process material is now introduced into the chamber. When the chamber is full of material and beads, the



machine is switched on and the agitator discs rotate forcing the beads to impact over and over with the process material with hurricane-like force. This action of having thousands of separate impacts

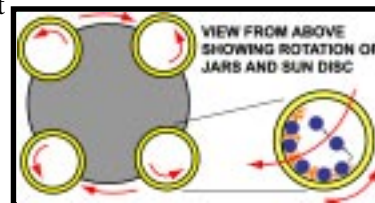
produces rapid and consistent size reduction. Batch and continuous processing can be handled in the same mill by changing the grinding chamber and the gap setting.

Shown above is the DYNO[®]-MILL MULTILAB. Grinding chambers available from 0.15l to 1.4l in steel, stainless steel and ceramic.

PLANETARY BALL MILL

The PM400 PLANETARY BALL MILL has been designed to process a variety of materials, both wet and dry in batches up to about 1 liter. Final fineness with dry grinding can reach the single digit micron range. When grinding wet, results below 500nm are possible.

We're often asked how this mill works and the easiest way to describe it's action is to think of a cup and saucer ride at the amusement park. Four stations, each of which can accept two small or one larger grinding jar rotate in the same direction. These are the cups (or planets). The disc on which they



are mounted (the sun disc) rotates in the opposite direction. This imparts tremendous energy to the balls and material inside the grinding jar. In a conventional ball mill the balls roll around the inside of the jar before gravity takes hold and throws the ball to the other side crushing whatever is below it. In the PLANETARY BALL MILL gravity is replaced by centrifugal forces which act to throw the balls across the grinding jar. Because the jars are constantly in motion in two directions, the centrifugal forces are constantly changing adding a random quality to the grinding not seen in any other mill. This randomness adds to the grinding intensity which results in very fine particles that can be reproduced with just the flick of a switch.

Dry grinding requires the grinding jars to be filled to no more than about 60% of the total volume of the jar. This filled volume is split about 50/50 between material and balls. When grinding wet, especially when grinding into the nano-scale region,



the jars are normally filled to ~70% of total volume with beads then the wet material is poured in to cover the beads in much the same way as it is done in the DYNO[®]-MILL.

Grinding jars and media are available in seven different materials and in sizes from 50ml to 500ml to cover just about any process requirements.

What's best for you?

Glen Mills makes both the DYNO[®]-MILL and the PLANETARY BALL MILL available for trials (as well as 50+ other machines), either in our lab in New Jersey or in your facility anywhere in North America. Run trials and prove which technology works best for you.

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