Fine Grinding and Classifying

Process Technology for Rare Earth Alloys
Solutions for Processing Rare Earth Alloys
Fine Grinding and Classifying with a narrow particle size distribution

Magnetic materials are used in numerous applications as functional materials, e.g. in the field of communication technology, in regulation and control processes, in drives, in measuring technology etc.

Neodymium-iron-boron-magnets (Nd-Fe-B) are so-called rare earth magnets, which are characterized by their high energy density. This makes them particularly interesting for application areas in which strong magnetic fields but small volumes and low weights are required. For instance, in sensor technology the high energy density of Nd-Fe-B magnets allow for miniaturization or a reduction of the component size in motor construction which therefore reduces volume and weight. Another example is their use in wind power plants in which rare earth magnets are used for permanent excitation of the generators.
In the manufacturing process the material powder is ground before being pressed and sintered. Its grinding is an essential step as the particle size is of significant importance for the quality and properties of the magnets which are subsequently manufactured from the powder. Ideally the particle size distribution should be narrow and contain an extremely low ultra-fine fraction (< 2 µm) and only a small amount of coarse particles (> 8 µm).

Using jet mills and classifiers made by NETZSCH you can reliably process sensitive Nd-Fe-B-compounds or other alloys under inert gas conditions and obtain a product with a narrow particle size distribution and a defined upper particle size limit.
Dry Fine Grinding

**CON JET® High-Density Bed Jet Mill**
- The combination of a spiral jet mill with a dynamic gas classifier enables you to achieve a final product with a steep particle size distribution free of under- and oversized particles and also guarantees reproducible product quality.
- The setting of the fineness depends only on the rotational speed of the gas classifier and is independent of the product load. This allows the feeding of larger amounts of product to markedly increase the efficiency and economy of the mill.
- A minimal amount of product is not needed to run the grinding process. That means each batch is completely ground under equal conditions.
- The compact design of the NETZSCH CON JET® provides very good access for easy, fast cleaning to remove components that cannot be ground.
- As a result of the rotating product bed, the high energy density can increase the degree of efficiency by up to 40% compared to conventional gas jet mills.

**CGS Fluidized Bed Jet Mill**
- Innovative gas jet mill suitable for grinding even the hardest products down to a size of \( d_{97} \), 2 \( \mu \)m to 120 \( \mu \)m (depending on density) with a steep particle size distribution.
- The product is accelerated in a free gas jet and size reduction is carried out by the impact of particle against particle. Grinding is entirely autogeneous and no contamination of your product occurs.
- The integrated dynamic air classifier can be infinitely adjusted to your desired fineness, which guarantees reproducible product quality.
- A flap at the bottom of the grinding chamber makes the discharge of the product bed (components that cannot be ground) quick and easy.
- Contamination of the fine product with coarse particles is excluded.
Classifying – Dedusting of fine Powder

CFS/HD-S High-efficiency Fine Classifier

- The CFS/HD-S High-efficiency Gas Classifier, equipped with the patented ConvVor® classifier wheel, is suitable for an extremely fine classification (d97 1 µm to 120 µm) with a closely defined sharpness of cut providing you with a high and consistent product quality.
- Removing of fine dust (< 1 µm) to further optimize product properties.
- Effective separation results can easily be achieved with just one classifier wheel.
- The specially designed housing means a significant improvement in throughput.
- Accessibility and cleaning of the machine are made easy by the hinged housing door and the removable guide vane basket.

Compact Laboratory Plants

- Smaller sizes of the NETZSCH Jet Mills and Fine Classifiers are available as a complete, compact skid-mounted plant in gas-tight execution for operation under inert gas.
- PU lining prevents product build-up
- Rinsing connections for Argon / N₂
- Aspiration of product components which are difficult to grind such as ductile neodymium or α-iron can easily be carried out
- Central connection points for aspiration
- Automatic passivation of the plant
Results

The ideal particle size before pressing and sintering of rare earth magnets ranges between 2 µm and 8 µm. Particles of these sizes can be well orientated by conventional magnetic fields and contribute to obtaining a high residual magnetism of the magnets which are made from them.

The measurements of the particle size distribution of the Nd-Fe-B powder made on NETZSCH mills and classifiers, and the magnetic properties of the sintered magnets subsequently manufactured from it, deliver convincing results. After classifying, the fines fraction < 1.65 µm was around 0.75 %. At 2.4, the $d_{90}/d_{10}$ value was half that of conventionally produced powder.

Comparison of particle size distribution of Nd-Fe-B powder after grinding and after additional classifying.
Particle size distribution of Nd-Fe-B powder after grinding and classifying in comparison to conventionally produced product.

Demagnetization curve of a Nd-Fe-B magnet manufactured from a classified fine powder.

**NETZSCH offers you comprehensive service**

- Grinding- and classifying tests under inert conditions with your original material are possible in our test lab.
- With a cooperation partner magnet samples can be prepared from the material samples obtained in grinding tests. This is done according to parameters defined by you.
- We are pleased to invite you to be present in our lab in order to ensure that tests are carried out according to your specification.
The NETZSCH Group is a mid-sized, family-owned German company engaging in the manufacture of machinery and instrumentation with worldwide production, sales, and service branches. The three Business Units – Analyzing & Testing, Grinding & Dispersing and Pumps & Systems – provide tailored solutions for highest-level needs. Over 3,400 employees at 210 sales and production centers in 35 countries across the globe guarantee that expert service is never far from our customers.