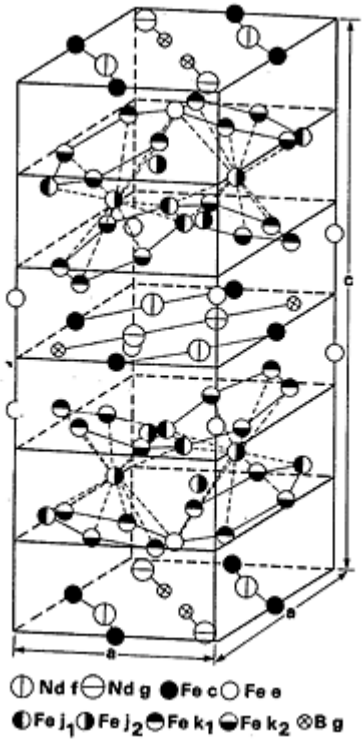
MQP™ Powder History

About MQP™ Isotropic Powders

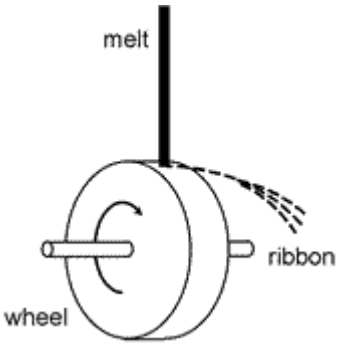
If you are unfamiliar with magnetic characteristics and need assistance with terminology or units of measure, a brief tutorial of the important properties available.

The superior permanent magnet properties of all are rare earth (RE)-iron (Fe)-boron (B) materials are derived from the strong magnetocrystalline anisotropy and high saturation magnetization of the intermetallic compound $RE_2Fe_{14}B_1$, a tetragonal crystal structure discovered and patented in the early 1980's. Due to the excellent magnetic properties achieved and its relative abundance, the most commonly used RE element is Neodymium (Nd), although other elements such as Praseodymium (Pr), Lanthanum (La) and Cerium (Ce) are sometimes also used.



MQP™ powders are based upon Magnequench's patented RE-Fe-B alloy compositions that are rapidly solidified from the molten state at extremely high cooling rates, on the order of 1,000,000 degrees per second. This rapid solidification results in a material which has an extremely fine (typically 30-50 nanometer) metallurgical grain structure. Because the consequent grain size is smaller than the critical size for a single magnetic domain, these materials are magnetically isotropic. Further, in contrast to the fine, anisotropic powders that are used to manufacture sintered RE-Fe-B magnets, MQP™ powder is relatively stable against oxidation-induced demagnetization. These characteristics make MQP™ powders ideally suited for the production of bonded permanent magnets.

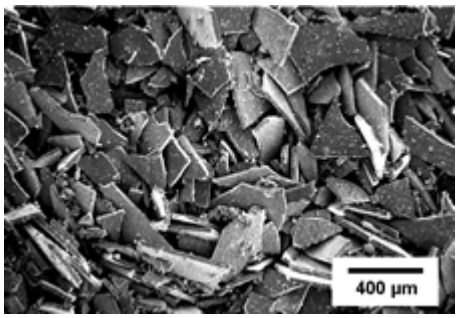
How is MQP™ powder produced?



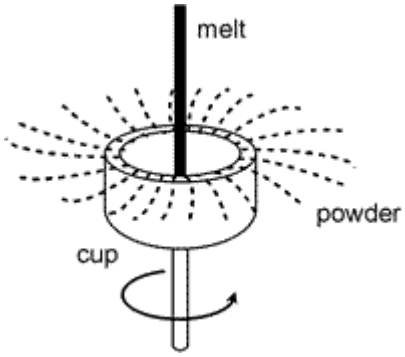
MQP™ powders are produced by a process known as melt spinning.

In the patented Magnequench melt spinning process known as Jet Casting, an ingot of RE-Fe-B alloy is first melted, then the molten metal is ejected under pressure from a nozzle onto the surface of a water cooled rotating metal wheel. The material solidifies into a thin metal ribbon which is approximately 35 µm thick and 1-3 mm wide. By carefully controlling process variables such as the metal flow rate and speed of the rotating wheel, the quench rate (and hence microstructure) can be controlled to achieve optimum magnetic properties.

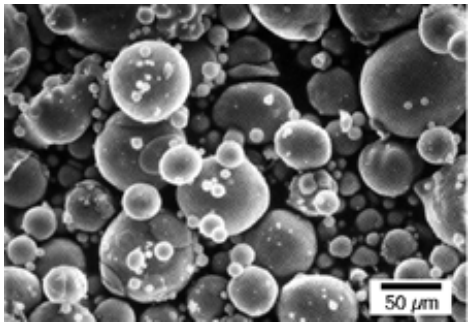
The ribbon is collected and then milled into a platelet- or flake-shaped metal powder, which is heat treated to obtain the desired magnetic properties.



Magnequench has recently commercialized an alternative rapid solidification process for producing its MQP-S fine, spherical RE-Fe-B powders. In this process, known as centrifugal or spinning cup atomization, molten metal is ejected from a nozzle onto the surface of a rapidly spinning cup.

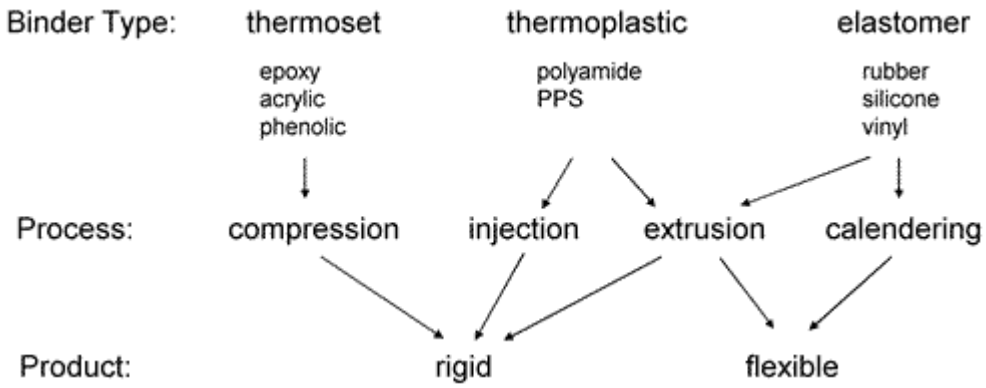


As it leaves the rim of the spinning cup, the molten metal forms droplets which then form into spheres and solidify in flight. The powder is collected and then heat treated to obtain the desired magnetic properties.



How is MQP™ powder used?

Magnequench's MQP™ powders are used in the production of bonded RE-Fe-B permanent magnets. Bonded magnets are composite materials produced by mixing magnetic powder with a binder (typically a polymeric material), then forming a shaped magnet part in which magnetic particles are interspersed within the bonding matrix. Many different types of binders and forming methods can be used, and this high degree of flexibility is one of the most important advantages of bonded magnets, offering significant opportunities for high volume, low cost manufacturing of magnetic parts or assemblies.



After the bonded magnet is formed, it is magnetized using equipment that generates an appropriate applied magnetic field needed to impart the permanent magnetic properties to the material. Because MQP™ powders are magnetically isotropic, there is tremendous flexibility in terms of the magnetization patterns and orientations that can be created; for example, multipole ring magnets are widely used in motor applications. By combining the advantages of both the flexibility in manufacturing and magnetization in their designs, application engineers

are often able to achieve improved efficiency and reduced costs by using bonded magnet solutions.

For design purposes, bonded magnet properties can be reasonably estimated using the MQP™ powder data, available in spreadsheet format for each product.

Why Magnequench MQP powders?

Our patented rapidly-solidified powders form the basis for the entire bonded isotropic RE-Fe-B magnet industry. We therefore have unequaled experience in producing high-quality, cost-effective products designed to meet your needs.

In order to provide greater value to our customers, we are strongly committed to continually reducing our manufacturing costs. We acquired Xinbao Special Metals to reduce material costs by producing alloys near the raw material source. We've invested heavily in next-generation melt spinning technology to achieve greater efficiency and improved product quality. And we built a new powder manufacturing plant in Tianjin, China. This plant improves our ability to serve the rapidly expanding market in Asia for bonded RE-Fe-B magnets by placing production close to the source of raw materials, by reducing delivery time to customers, and by improving inventory management. These steps further solidify Magnequench's position as the world's leading producer of isotropic RE-Fe-B powders, and as a valued global partner.