THE DIFFERENCES - RARE EARTH AND CERAMIC MAGNETS

Rare-earth magnets and ceramic magnets are both types of permanent magnet; they are both composed of materials which, once given a magnetic charge, will retain their magnetism unless they become damaged. Not all permanent magnets are the same, however. Rare-earth and ceramic magnets differ in their strength and resilience because they are made from different metal alloys.

Ceramic Magnets

For years all magnets were natural magnets such as lodestone, a naturally magnetic iron ore. In 1952 magnets were made out of ceramic for the first time. By making magnets out of ceramic, engineers were able to make magnets into any shape they wanted. By making the ceramic magnets out of carefully created mixtures, more powerful magnet fields than were possible in nature could be generated. Ceramic magnets were less expensive and more powerful and quickly became popular. Ceramic magnets are also called hard ceramic magnets or ferric magnets. They are made from strontium or barium ferrite.

Rare Earth Magnets

There are two types of rare-earth magnets: samarium cobalt (SmCo) and neodymium-iron-boron (NdFeB). SmCo and NdFeB magnets are called “rare earth” because they are made from the rare earth, or lanthanide series, of the periodic table of elements. SmCo magnets were developed in the 1970s and were the first of the rare-earth magnets to be produced. NdFeB magnets became available to buy in 1984.

Strength of Ceramic versus Rare Earth magnets

The strength of the magnetic field produced by a magnet is quantified with BHmax, or maximum energy product, which is measured in MegaGauss Oersted (MGOe). The higher the BHmax, the more powerful the magnet. Ceramic magnets have a BHmax of 3.5, SmCo have a BHmax of 26 and NdFeB are the most powerful of the rare-earth magnets with a BHmax of 40.

Resistance to Thermal Stress of Ceramic versus Rare Earth Magnets

Magnets can begin to lose strength when they are heated beyond a certain temperature, known as Tmax, and should not be operated beyond this temperature. They will, however, regain their strength when cooled below Tmax. Ceramic magnets have a Tmax of 300 degrees Celsius, as do SmCo magnets, and NdFeB magnets have a Tmax of 150 degrees Celsius. If a magnet is heated too far beyond Tmax, it will eventually become demagnetized at a temperature known as Tcurie. When a magnet is heated beyond Tcurie, it will not recover once cooled. Ceramic magnets have a Tcurie value of 460 degrees Celsius, SmCo have a Tcurie of 750, and NdFeB have a Tcurie of 310 degrees.

Durability of Ceramic versus Rare Earth Magnets

Along with their resistance to thermal stress, magnets also vary in their resistance to other stresses. NdFeB magnets are brittle and difficult to machine. They also corrode easily. SmCo magnets are slightly less brittle and are also difficult to machine, but have a high resistance to corrosion. SmCo magnets are also the most expensive type of magnet. Ceramic magnets are less costly than both SmCo and NdFeB magnets and have good resistance to demagnetization and corrosion.

Benefits of Each

Ceramic and neodymium magnets each have different benefits. Ceramic magnets are easy to magnetize. They are very resistant to corrosion and generally do not need extra coatings for corrosion protection. They are resistant to demagnetization by outside fields. They are stronger than natural magnets, though many other types of magnet are stronger than them. They are relatively inexpensive. Neodymium magnets are the most powerful of all permanent magnets. A neodymium magnet can lift more than any other type of magnet of the same size. They are extremely resistant to demagnetization by external magnetic fields.

Drawbacks of Each

Ceramic and neodymium magnets have different drawbacks as well. Ceramic magnets are extremely brittle and easily broken. They cannot be used in machinery that experiences a lot of stress or flexing. They become demagnetized if they are exposed to high temperatures (above 480 degrees Fahrenheit.) They have only a moderate magnetic strength, making them unsuitable for applications requiring powerful magnetic fields. Neodymium magnets are relatively more expensive than ceramic magnets. They rust very easily, and extra steps must be taken to protect them from corrosion. Neodymium magnets are also very brittle and will crack under stress. They lose their magnetism if exposed to temperatures above 175 to 480 degrees Fahrenheit (depending on the exact alloy used).