# An Overview of Neodymium Magnets over Normal Magnets for the Generation of Energy

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***Abstract*—** Neodymium (NdFeB) magnets have become most popular magnets in recent years and replaced. More advantages over the other types of magnet in many applications in modern products that require strong permanent magnets, such as motors in cordless tools, hard disk drives and magnetic fasteners. Neodymium magnets can be used to invent a new method of energy generation by using the magnetic field of magnet and convert the magnetic energy into kinetic energy without using any kind of fuel and overcoming the energy generation problem such as building a magnetic turbine. The main objective of the study was to study about the advantage of using NdFeB magnets over normal magnets, nature of different type of neodymium magnets and how it can be used to convert magnetic energy into kinetic energy.

***Keywords****- Energy generation, Magnetic energy, Magnetic turbine, Neodymium (NdFeB) magnet, Permanent magnet***.**

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## I. Introduction

Certain materials found in nature exhibit a tendency to attract or repeal each other. These materials, called magnets, are also called ferromagnetic because they include the element iron as one of their constituting elements. Magnets always have two poles north & south. Like poles always repel each other. However, unlike poles attract each other. A Magnetic field is defined as a physical field established between two poles. Its intensity and direction determine the forces of attraction or repulsion existing between the two magnets.

A neodymium magnet (also known as NdFeB, NIB or Neo magnet), the most widely used type of rare-earth magnet, is a permanent magnet made from an alloy of neodymium, iron and boron to form the $Nd_2Fe_{14}B$ tetragonal crystalline structure. Neodymium magnets are metal, and they are colored silver, like most other metals.

Developed in 1982 by General Motors and Sumitomo Special Metals, neodymium magnets are the strongest type of permanent magnet commercially available. They have replaced other types of magnet in the many applications in modern products that require strong permanent magnets, such as motors in cordless tools, hard disk drives and magnetic fasteners. Rare Earth magnets (also known as Neodymium magnets) are 5 to 7 times stronger than Ferrite Magnets and offer the greatest value for money

## II. Grades

Figure 1 Neodymium Magnet

Neodymium magnets are graded according to their maximum energy product, which relates to the magnetic flux output per unit volume. Higher values indicate stronger magnets and range from N35 up to N52. Letters following the grade indicate maximum operating temperatures (often the Curie temperature), which range from M (up to 100 degrees Celsius) to EH (200 degrees Celsius).

Neodymium magnets are metal, and they are colored silver, like most other metals. Hematite is not a metal, although it has some metal atoms in it. It is instead a mineral, formed primarily of iron oxide, specifically, the Fe2O3 oxide, which is common iron rust. Usually there are other elements mixed with it. Hematite magnets vary in color from red to gray to black.

*A. Grades of Neodymium magnets:*

1. N35-N52
2. 33M-48M
3. 30H-45H
4. 30SH-42SH
5. 30UH-35UH
6. 28EH-35EH

## III. PROPERTIES

Some important properties used to compare permanent magnets are: remanence (Br), which measures the strength of the magnetic field; coercivity (Hci), the material's resistance to becoming demagnetized; energy product (BHmax), the density of magnetic energy; and Curie temperature (TC), the temperature at which the material loses its magnetism. Neodymium magnets have higher remanence, much higher coercivity and energy product, but often lower Curie temperature than other types. Neodymium is alloyed with terbium and dysprosium in order to preserve its magnetic properties at high temperatures.[12] The table below compares the magnetic performance of neodymium magnets with other types of permanent magnets.

TABLE1. PROPERTIES OF NDFEB MAGNETS

| Property | Neodymium | Sm-Co |
|---|---|---|
| Remanence (T) | 1–1.3 | 0.82–1.16 |
| Coercivity (MA/m) | 0.875–1.99 | 0.493–1.59 |
| Relative permeability | 1.05 | 1.05 |
| Temperature coefficient of remanence (%/K) | −0.12 | −0.03 |
| Temperature coefficient of coercivity (%/K) | −0.55..–0.65 | −0.15... –0.30 |
| Curie temperature (°C) | 320 | 800 |
| Density (g/cm3) | 7.3–7.5 | 8.2–8.4 |
| CTE, magnetizing direction (1/K) | 5.2×10−6 | 5.2×10−6 |
| CTE, normal to magnetizing direction (1/K) | −0.8×10−6 | 11×10−6 |
| Flexural strength (N/mm2) | 250 | 150 |
| Compressive strength (N/mm2) | 1100 | 800 |
| Tensile strength (N/mm2) | 75 | 35 |
| Vickers hardness (HV) | 550–650 | 500–650 |
| Electrical resistivity (Ω·cm) | (110170)×10−6 | 86×10−6 |

## IV. DIFFERENCE BETWEEN HEMATITE & NEODYMIUM MAGMETS

While magnets are made out of a wide variety of materials, they all generate magnetic force fields that are capable of affecting other magnets and certain metals at a distance. This is because of the way the atoms inside the magnets all line up in the same orientation. Out of all the different types of magnets, none are more different than neodymium and hematite magnets. Hematite magnets are amongst the weakest magnets, and are suited to little more than making toys.

Another great difference between neodymium magnets and hematite magnets is in the way that the two materials respond to magnetic fields. Neodymium is a ferromagnetic material, meaning that it is a material that responds to magnets like iron does. It is attracted to magnets, and it forms magnetic fields itself very easily, and even spontaneously, by easily lining up its atoms so that they all spin the same way. Hematite is very nearly anti-ferromagnetic; it is only attracted to a magnet when heated up.

Neodymium magnets are metal, and they are colored silver, like most other metals. Hematite(red to gray to black) is not a metal, although it has some metal atoms in it. It is instead a mineral, formed primarily of iron oxide, specifically, the Fe2O3 oxide, which is common iron rust. They differ in formation too. Neodymium is an element, and was formed by the same processes that formed all of the other elements of the Earth. Hematite is often formed on the surface of the Earth after iron-bearing minerals are exposed to the air and rain. It is sometimes formed in seas and lakes as well. It is a secondary product derived from the weathering of other naturally occurring minerals.

## V. ADVANTAGE OF NEODYMIUM OVER NORMAL MAGNETS.

This is the most powerful permanent magnet humans have discovered so, per unit of size, NdFeB magnets provide the strongest magnetic field available without the use of an electro-magnet. Of course, if size is no object, a huge ferrite magnet will have more magnetic strength than a small NdFeB magnet.

Designers of linear actuators and motors have gotten a whole lot better at designing with the NdFeB magnets so they can accomplish the same thing with a smaller magnet. The neodymium magnet is extremely strong, with magnetic strengths between N24 and N55, with N55 being the strongest manufactured. Neodymium magnets are generally more powerful than normal magnets. However, neodymium magnets cost more due to the more expensive materials needed to manufacture them: they require a mixture of iron, neodymium and boron and are magnetized via exposure to a powerful magnetic field. Normal and neodymium magnets each have different benefits. Normal magnets are easy to magnetize. They are very resistant to corrosion and generally

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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. 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.

TABLE2. COMPARISON OF DIFFERENT MAGNETS

| Types | Max. energy product Bhmax (MGOe) | Residual Flux Density Br(G) | Coercive Force Hc(Koe) | Working temp. ˚C |
|---|---|---|---|---|
| Ceramic 5 | 3.4 | 3950 | 2400 | 400 |
| Sintered Alnico 5 | 3.9 | 10900 | 620 | 540 |
| Cast Alnico 8 | 5.3 | 8200 | 1650 | 540 |
| Samarium Cobalt 20 (1,5) | 20 | 9000 | 8000 | 260 |
| Samarium Cobalt 28 (2,17) | 28 | 10500 | 9500 | 350 |
| Neodymium N45 | 45 | 13500 | 10800 | 80 |
| Neodymium 33UH | 33 | 11500 | 10700 | 180 |

## VI. MAGNETIC ENERGY TO KINETIC ENERGY

### *A. Arrangements of Magnets*

For the conversion of Magnetic energy into kinetic energy we required some special agreements of magnets , and the arrangements are as follows:

1. One fixed in position and the other free to move like this.
2. Here magnets have a strong attraction to each other because of their opposite poles.
3. Movement of the approaching magnet is along the red line.
4. The force between the fixed magnets and the rotor magnets can be high, producing considerable rotational power to the axle on which the rotor discs are attached.

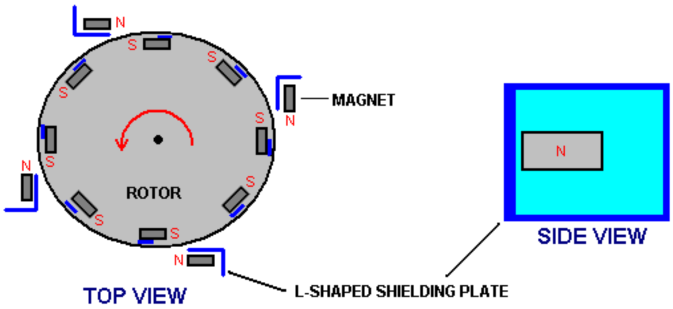


Figure 2 Arrangement of magnets on Rotor disc for perpetual motion

It is not easy to arrange permanent magnets in a pattern which can provide a continuous force in a single direction, as there tends to be a point where the forces of attraction and repulsion balance and produce a position in which the rotor settles down and sticks.

There are various ways to avoid this happening. It is possible to modify the magnetic field by diverting it through a soft iron component. A commercially available material called “mu-metal” is particularly good as magnetic shield material.

## VII. NEW APPLICATIONS

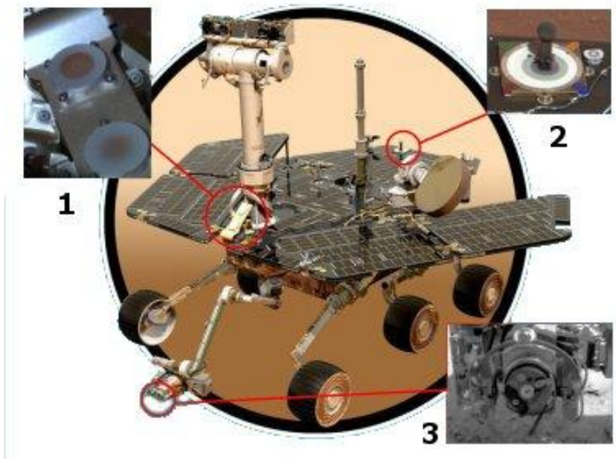


Figure 3 collecting space dust on mars

The NASA Jet Propulsion Lab uses neodymium magnets in each of the mars Exploration Rovers. The magnets are used to collect space dust for examination during mission. In addition, the greater strength of neodymium magnets has inspired new applications in areas where magnets were not used before, such as magnetic jewellery clasps, children's magnetic building sets (and other neodymium magnet toys) and as part of the closing mechanism of modern sport parachute equipment. They also are the main metal in the formerly popular desk-toy magnets, "Bucky balls", though some retailers have chosen not to sell them due to child-safety concerns.

The strength and magnetic field homogeneity on neodymium magnets has also opened new applications in the medical field with the introduction of open magnetic resonance imaging (MRI) scanners used to image the body in radiology departments as an alternative to superconducting magnets that use a coil of superconducting wire to produce the magnetic field.

Neodymium magnets are used as a surgically placed anti-reflux system which is a band of magnets surgically implanted around the lower oesophageal sphincter to treat gastroesophageal reflux disease (GERD).

### A. Other Applications

Figure 4 Neodymium used in hard discs

1) Head actuators for computer hard disks
2) Magnetic resonance imaging (MRI)
3) Magnetic guitar pickups
4) Mechanical e-cigarette firing switches
5) Locks for doors
6) Loudspeakers and headphones
7) Magnetic bearings and couplings
8) Bench top NMR spectrometers
9) Electric motors

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