

MAGNETISM AND MATTER

PERMANENT MAGNETS AND ELECTROMAGNETS

Difference Between Permanent Magnet and Electromagnet

Difference between Permanent Magnet and Electromagnet is magnetic field and strength. In Electromagnet, the magnetic field is created by a wire-wound coil but the magnetic field of Permanent (Bar) Magnet cannot be changed. The strength of Permanent Magnet depends on the material used for its creation, on the other hand, the strength of Electromagnet varies according to the flow of electric current into it. Three types of Permanent (Bar) Magnets are Ceramic Magnet, Flexible magnets, Neodymium iron boron magnet, and Samarium cobalt magnet. Each has its own applications and types. Let's see the more differences between the Permanent Magnet and Electromagnet

Permanent Magnet

These types of magnets can retain their magnetism and magnetic properties for a longer time. Strongly magnetized hard materials make up permanent magnets. A perfect example of a permanent magnet is the Bar Magnet. This magnet widely explains the behavior of magnets. Actually, we call permanent magnets as Bar Magnets also.

Electromagnet

When a battery is connected to a solenoid (a coil of wire is wound around a nail), the apparatus behaves like a magnet. This is due to the magnetic field produced by the current flowing through the coil. The nail retains its magnetism until there is a current flowing through the coil, but once there is no current, the nail loses its magnetism.

You can produce electromagnets when you wound a coil of wire across an iron core. Let us now look at the differences between a permanent magnet and electromagnet

Difference between Permanent Magnet and Electromagnet

PERMANENT (BAR) MAGNET	ELECTROMAGNET
They are permanently magnetized.	These are temporarily magnetized.
These are usually made of hard materials.	They are usually made of soft materials
The strength of the magnetic field line is constant i.e. it cannot be varied.	The strength of the magnetic field lines can be varied according to our need.
The poles of a Permanent magnet cannot be changed.	The poles of an electromagnet can be altered
Example of a permanent magnet is a Bar Magnet	Example of a temporary magnet is solenoid wound across a nail and connected to a battery

Similarities between Permanent Magnets and Electromagnets Both the magnets possess imaginary magnetic field lines. The magnets have north and south-pole whose behavior depends on the Geographic north-pole and south-pole of the earth. Both the magnets exhibit the properties of magnetism.

Advantages of Electromagnets over Permanent Magnets You can get electromagnets at cheaper rates than the permanent magnets. This is because the cost of materials used in the electromagnet is lesser. You can alter the magnetic strength of an Electromagnet according to your need. This is not possible in case of a permanent magnet.

Disadvantages of Electromagnets

- Electromagnets require a large number of copper couplings. This makes them unfit for use in small spaces. They also require a lot of maintenance. The short-circuit may damage the electromagnet.
- Electromagnets require a continuous supply of current. This may, at some point in time, affect the magnets and its field due to various factors like ohmic heating, Inductive voltage spikes, core losses, the coupling of coils, etc.

Disadvantages of Permanent Magnets

- You can produce the magnetic field of a permanent magnet only below a certain temperature. Therefore, you cannot use this type of magnets for hot-device applications.
- These permanent magnets tend to corrode with time. The strength of the maximum magnetic field is, thus, reduced. You cannot vary the poles of the permanent magnet.

Types of Permanent Magnets

In this section, we will discuss the various types of permanent magnet. They are:

- Ceramic Magnet: These magnets are the most inexpensive permanent magnets. We use them in food processing industries, resonance imaging etc.
- Flexible Magnets: The door seals used in the refrigerator are flexible magnets. You can develop these through a combination of rubber polymers, plastic, and magnetic powders.
- Neodymium Iron Boron Magnet (NdFeB): It a type of rare earth magnet. You can oxidize it very easily. It is a very expensive material. We commonly use it in jewelry making, bookbinding etc.
- Samarium Cobalt (SmCo) Magnet: This is a type of rare earth magnet. It is resistant to temperature and oxidation. They have a higher magnetic strength. You can use them in high-end motors, turbomachinery etc.

Application of Electromagnets

Transformers use electromagnets most commonly. The coils in the transformer produce varying magnetic fields when you supply the current. This induces a voltage. We use transformers primarily used to regulate the alternate voltages in the electric power system. You can achieve the desired voltage as and when required. We can do this by changing the amount of current. You can also use electromagnets in magnetic locks, relays, magnetic levitation, electric bells, loudspeakers etc.

Q: Which among the following consists of soft iron?

- A) Permanent Magnet
- B) Electromagnet
- C) Temporary Magnet
- D) All

Ans: B) The soft iron inside the coil makes the magnetic field stronger as it itself becomes a magnet when the current starts to flow. Soft iron is suitable because it loses its magnetism as soon as the current stops flowing