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Effect of Temperature on Electric Current, Magnets and Electromagnet

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Abstract

The approach of this research paper is to find out the effect of the temperature on the strength of electricity, magnetism and the electromagnet. Magnets, electromagnets and electricity we are using in our day to day life. And every time these things are dealing with the temperature. This experiment we have conducted to find out that with increase in temperature or with decrease in temperature, will the properties of material (Magnet, Electromagnet and Electricity) will increases or decreases. Or there is chances that their properties value will be constant. To find this, we have used strong magnet made of neodymium, electricity and set of strong electromagnet. Also for cooling the magnet refrigerator and a heating component is used. A wire is used of known resistance. There was lot of change in properties of all these materials after the experimentation.

Keywords: Electricity; Electromagnet; Magnet; Temperature; Resistance

Introduction

What should be the nature of magnet on increasing the temperature or decreasing the temperature? What's about the property of electromagnet on increasing or decreasing the temperature? This experiment leads the result of all the effect of temperature on magnet, electricity and the electromagnet. After this you easily can tell about relation b/w the electric, magnetic and electromagnetic variation with the temperature. You will able to describe about the magnetic dipoles, and how magnetic dipoles varies with the variation of temperature in different cases.

Material

The following material are used in this experiment

- Strong neodymium magnet n50 grade. Dimension 50*20*10mm
- Refrigerator for cooling the magnet
- Electricity and some electric component to heat up the magnet
- A set of electromagnet (having resistance of 700 ohm)
- Dry ice for cooling electromagnet
- Gloves and glasses for safety purposes
- Electricity measuring tool
- Gauss meter for measuring the power of magnet and also of electromagnet
- Boiled water (one tub)

Properties of used material

Neodymium magnet: Neodymium magnets are the strongest magnets available; they have a high power to volume and weight ratio and subsequently also have a relatively low cost per unit of strength (Maximum Energy Product, MGOe).

Their extremely high resistance to being demagnetised is a further benefit, meaning they can be used in the most demanding applications and exposed to substantial external magnetic fields.

Their drawback is that they are susceptible to corrosion if their coating is damaged and regular grades have lower maximum operating temperatures than other permanent magnets, typically up to 80ºC.

By slightly altering the amounts of the various elements used to create a neodymium magnet individual characteristics can be changed and improved. For grades with high maximum operating temperatures small amounts of iron (Fe) are replaced with cobalt (Co), which results in increased performance at elevated temperatures but a reduction in intrinsic coercivity. If small portions of neodymium (Nd) are replaced with dysprosium (Dy), the intrinsic coercivity is improved, but the maximum energy product (BHmax) decreases.

Dry Ice: Dry ice is the common name for the solid form of carbon dioxide. Originally the term dry ice was a trademark for the solid carbon dioxide produced by Prest Air Devices (1925), but now it refers to any solid carbon dioxide. Carbon dioxide is a natural component of air. Dry ice is safe to use for smoke machines and lab experiments, providing care is taken to avoid frostbite.

Electromagnet: An electromagnet works on the principle that an electric current not only allows electrons to flow in a circuit, but also generates a small magnetic field. When a wire carrying electricity is coiled, the magnetic field becomes even stronger. Iron or steel objects surrounded by this coiled electric wire also become magnetized. This combination of electronic energy, coiled wiring and conductive metal object forms the basis of the device.

It may be easier to think of an electromagnet as an electron magnet, not an electric magnet. What is relevant is the free flow of electrons in a circuit and their effects on the wire carrying them. It's possible to demonstrate the basic principles using a supply of bare copper wiring, a D-size chemical battery, and an iron or steel nail.

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Method

For magnetic strength and field calculation, take two magnets and joint them (be careful). After joining two magnets now put them in cooled temperature. When magnet is being cooled at a temperature of less than zero, the local magnetic moments tries to align, to produce the strongest possible magnetic force in a magnet. This magnet character will be for some fraction of time. When the magnet will come at the room temperature. After this it again gets its same properties.

As temperature increases, a magnet becomes weaker as more local magnetic moments spin away from the shared alignment; a nonmagnetic field is being created with this elevated temperature. Now take the magnet and put it into boil water. The strength of magnet was reused by 50 %. At 100 degree Celsius when magnet is putted for 15-25 minutes. In the meantime the heater is connected to the boiled water to maintain its temperature. It loses its magnetic property and behavior. It is being varied with the magnet to magnet. For normal ferrate magnet, they losses their properties above 200 degree Celsius. But the magnets that I used they losses their properties near 100 degree Celsius.

For electromagnet, after making a set of electromagnet the electricity from battery passed. Now we measure the strength of it. The strength was 10000 gauss or 1 tesla. At room temperature it's having 1T power, on decreasing the temperature continuously it also decreases the strength of electromagnet. On decreasing the temperature 24 to 0 degree Celsius it decrease the strength about half. After this putting the dry ice on the electromagnet. The temperature of dry ice was near -60 degree Celsius. It decreases the strength of electromagnet dramatically, and the value that is measured was near 3000 gauss.

After cooling, start heating the coil. With increase in temperature the electromagnet value increases continuously, but this increase is very less compare to as its power decrease. From room temperature the heating value of electromagnet coil increased to 100 degree Celsius. The strength of the electromagnet increase by 3000. And the value that is measured was 13000 gauss. On further increasing the temperature the electromagnet stars increasing its strength slowly.

To measure the effect of temperature on electric current I took one meter wire of resistance .02 ohm. The thickness of the wire was 1mm. I connected the wire to the battery and measure its resistance. On decreasing the temperature in refrigerator, its resistance was decreasing. After cooling it to zero degree Celsius the resistance value reached to .014. After this putting the wire in dry ice its resistance again decrease. After this stars heating the wire and measured its resistance. The resistance of the wire was increasing with increase in temperature. At 100 degree Celsius it was having the value of resistance around 0.029 [1-4].

There is common relation b/w the resistance and the strength.

V=I*R

P=V*I

P= I*I*R

So as resistance increases the power is also increases on heating, as resistance decreases the power is also decreases.

Result

For the magnets magnetic strength slightly increases on cooling. But when we are heating it completely losses its magnetic field. On cooling the magnets the magnetic dipoles are coming closely and the density is increased and cause of that factor magnetic strength is increasing. And when the temperature of the magnet is increased, the magnetic domains are getting apart and because of which the magnetic strength decreases.

For electricity when we are putting wire into high temperature or increasing the temperature the resistance of used wire is increases and because of this the electric field strength increases. It will decrease the drift velocity because as the temperature increases, the atomic vibrations will increase, which will cause more collisions of the electrons with the crystal lattice. Hence the drift velocity will decrease. The resistance of the wire will increases with heating it. When we are decreasing the temperature the strength of electric field also decreased, decreasing the temperature just increase its drift velocity. Because of atomic vibration is decreased. And the resistance of the wire decreased. If further we will continue to decreasing the temperature of the wire there will be condition where it will reaches to superconductivity. Even at superconductivity the resistance of the wire can't be zero.

For electromagnet, the warmer the electromagnet was the stronger it became. At room temperature it's having the average result and at putting dry ice it having the least value. When we are putting electromagnet in the cold place the resistance of the electromagnet decreases and because of decreasing of resistance the flow of the voltage decreases and because of that the power that system is using also decreases. And hence this leads decrease in the strength of electromagnet [5-7].

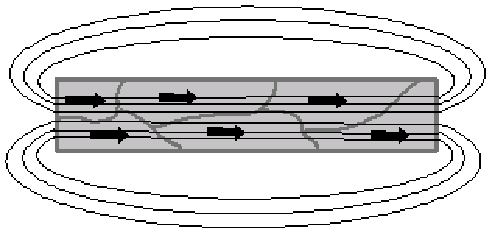

Figure 1: Magnetic domains of a magnet, when it is attracted by some material or when current is flow through it.

Figure 1 describes about magnetic domains of a magnet [8,9], when it is attracted by some material or when current is flow through it. Figure 2 describes about magnetic domains of a magnet, when it is not attracted by any of the material. In normal case magnetic domains are like this only.

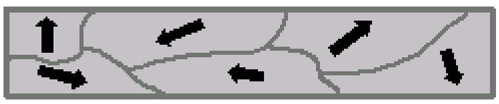

Figure 2: Magnetic domains of a magnet, when it is not attracted by any of the material. In normal case magnetic domains are like this only.

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Graph

Figure 3 describes about effect of temperature on magnet when temperature decreses from room temperature. Figure 4 describes about effect of temperature on magnet when temperature increses from room temperature.

Figure 5 describes about effect of temperature on current when temperature decreses from room temperature. Figure 6 describes about effect of temperature on current when temperature increses from room temperature.

Figure 7 shows the effect of temperature on electromagnet when temperature decreases from room temperature. Figure 8 shows the effect of temperature on electromagnet when temperature increases from room temperature.

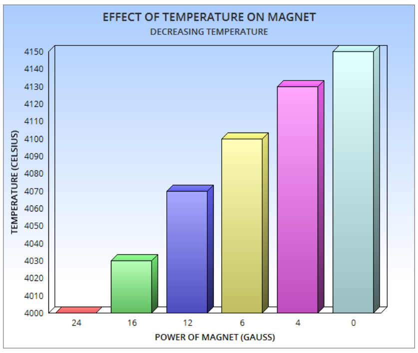

Figure 3: Effect of temperature on magnet when temperature decreses from room temperature.

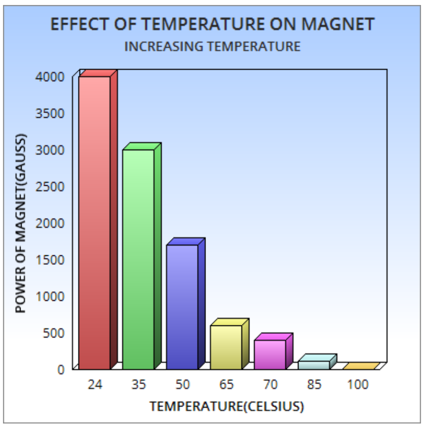

Figure 4: Effect of temperature on magnet when temperature increses from room temperature.

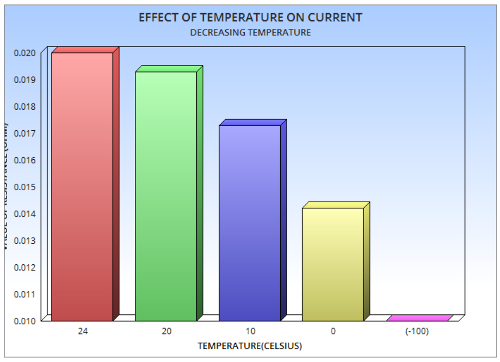

Figure 5: Effect of temperature on current when temperature decreases from room temperature.

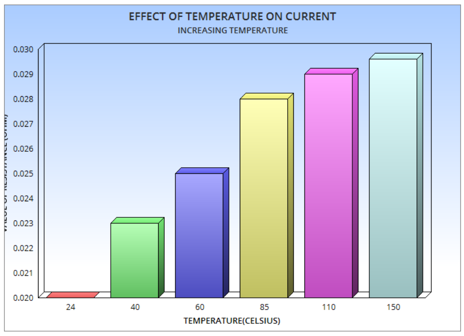

Figure 6: Effect of temperature on current when temperature increases from room temperature.

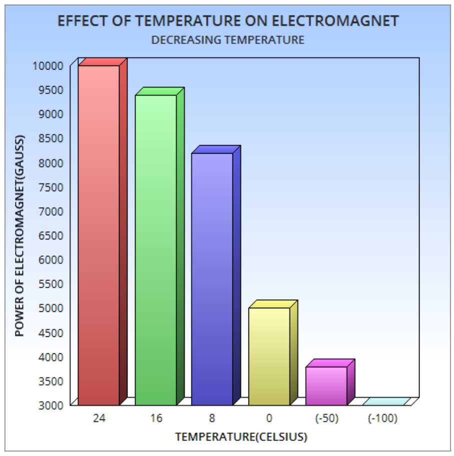

Figure 7: Effect of temperature on electromagnet when temperature decreases from room temperature.

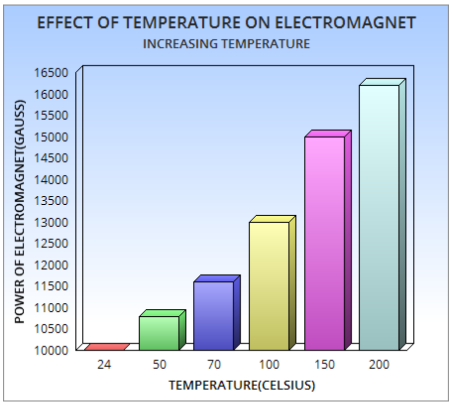

Figure 8: Effect of temperature on electromagnet when temperature increases from room temperature.

Discussion

In magnets with increase in temperature the very tightly bonded atom starts splitting, and a time comes when they are completely free to move and thus magnetic field is finished because most of them gets excited. On cooling atom get contract and thus their magnetic field increases by some factor. There are some different kind of magnet whose power slightly decreases on increasing the temperature. On electricity in a wire when we decreases the temperature the resistance of wire decreases. If further we are decreeing the temperature there will be a state of superconductivity. Where resistance will be zero.

References

1. Coates E (2016) How temperature changes resistance.
2. Wikipedia (2016) Electricity.
3. Wikipedia (2016) Magnetism.
4. Wikipedia (2016) Electromagnet.
5. Wikipedia (2016) Magnet.
6. Science B (2016) How the strength of a magnet varies with temperature.
7. Appel E, Geisler G, Kiene W, Nissen P (1980) Temperature-compensated electromagnetic flowmeter. US4236410 A.
8. Stamberger A (1960) Electromagnets, particularly for electromagnetic regulators. US2932775 A.
9. Jepson JW (1916) Electromagnet. US1202392 A.