UTILIZING MAGNETIC MATERIALS IN TECHNICAL APPLICATIONS

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Abstract
This article discusses the use of magnetic materials in engineering and their main characteristics.

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Introduction

It is very difficult to imagine our daily life without technology. Therefore, the 21st century is the "age of technology", which poses a number of problems for humanity. Especially at a time when the field of materials science and instrumentation is developing, the human need for pure materials is growing. We can also see the development of technology in the field of railways, that is, we can take the example of magnetic railways on the example of strong states.

In the context of continuous improvement, identification and expansion of production, the success of the main workshops of metallurgical enterprises will depend on the efficient operation of railway transport, the timely delivery of raw materials to units, the transportation of semi-finished products between workshops and delivery. finished products to consumers.

When using magnetic materials, the magnetic flux increases dramatically. Low-voltage currents from the magnetic flux are used to convert high-voltage currents or electrical energy into mechanical energy, as well as to generate electrical energy in a similar way [1].

Materials that have the property of being magnetized by an external magnetic field are called magnetic materials. Examples of basic magnetic materials are various alloys based on nickel, cobalt and pure iron. Magnetic materials of technical importance include ferromagnetic materials and ferromagnetic chemical compounds (ferrites).

The magnetic properties of materials lie in the internal movement of electric charges, in which the charges are expressed as an elementary circulating current. Such rotating currents are created by the rotation of electrons around their own axis (electron backs) and their rotation in an orbit inside the atom. The phenomenon of a ferromagnet is associated with the formation of crystalline structures in the inner microscopic part of some materials, such structures are called magnetic domains. In this case, the electron spins are oriented in one direction parallel to each other [1-3].

A characteristic feature of a body in a ferromagnetic state is its spontaneous (spontaneous) magnetization under the action of an external magnetic field. Spins in some regions of

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ferromagnetic magnetic moments can have different directions. The total magnetic flux of such materials in the external environment is zero.

Soft Magnetic Materials

Magnetic materials are divided into soft and hard. Magnetic cores are made of soft magnetic materials. The initial value of the magnetic susceptibility of these materials must be large. In soft magnetic materials, the resistivity should be relatively large, and the coercive force (H_c<0,1 A/m) should be small. Examples of these materials are pure iron, alloys of iron with silicon, nickel and cobalt.

Electrolytic iron is obtained by electrolysis of commercially pure iron. The total amount of additives in such cast iron should not exceed 0.05%. By processing electrolytic iron, a powder with a particle size of 50-100 μm is obtained. Cores are made from this powder by pressurizing it. They are used in devices with a frequency of about 100-1000 gauss [2].

Carbonyl iron is obtained by chemical decomposition of pentacarbonyl [liquid $Fe_2(CO)_5$] at a temperature of 200-250°C. Carbonyl iron is in the form of a fine powder, from which high-frequency magnetic circuits are made. The small spherical particles drastically reduce the amount of sediment that forms in the core.

Carbon and oxygen are released from a pure iron compound burned in hydrogen at 1480°C for 30-40 minutes:

$$Fe_3C+2H_2 \rightarrow CH_4+3Fe; \quad FeO+H_2 \rightarrow H_2O+Fe.$$

This iron is particularly clean; in a weak magnetic field, the value of μ_p of this material is large. Monocrystalline iron has very high magnetizing properties.

Silicon electrical steel is composed of an alloy of iron and silicon. Sheets from it are called sheets of electrical steel. This steel is one of the main magnetic materials and is widely used in electrical machines and devices operating at industrial frequencies. The main purpose of adding silicon to the iron content is to increase the resistivity of the material and limit the current in it. The element silicon significantly increases the value of P, practically without changing the magnetic properties of iron [2-3].

Structural cast iron and steel tools, hardware and electrical equipment are widely used materials in mechanical engineering. According to their magnetic properties, they are divided into magnetic (gray cast iron, carbon and alloy steel) and non-magnetic types.

Gray cast iron contains 3.2 - 3.5% carbon, silicon, manganese, phosphorus and sulfur. The bending strength of this material is 200-450 MPa. The body, base and similar parts of electrical machines are made from it.

Usually castings are made of carbon steel containing 0.08 - 0.2% carbon. In this case, the casting is gradually softened at a temperature of 850 - 9000C. Steels alloyed with nickel, vanadium, chromium and molybdenum are used in special electrical machines, as well as in machines of light construction. The mechanical bending strength of these steels is in the range of 500 - 950 MPa.

Hard magnetic materials

According to the composition, conditions and methods of production, hard magnetic materials are divided into: 1) alloyed martensitic steels; 2) cast hard magnetic alloys; 3) powder magnet; 4) hard magnetic ferrites; 5) flexible alloys and magnetic tapes. When there is an air gap between the poles, some of the energy is associated with the area outside the volume of the magnetic material [3].

When metals such as tungsten or chromium are introduced into steel, a martensitic structural material is formed. This reduces the wear process of steel permanent magnets. Tungsten steel contains 0.6% C, 5-6% W, and chromium steel contains 1% C, 1%-3% Cr, and their properties are greatly improved compared to carbon steel. The magnetic properties of these materials are: H_c = 0.45-0.5 kA/m, B_r = 0.9-1.1 Wb/m^2, W_r = 0.9-12 kJ/m^3.

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