

THE ENVIRONMENT MATHCAD IS USING FOR TECHNICAL CALCULATIONS

To solve problem of study the characteristics of magnetic material it is necessary to use mathematical apparatus and modelling. Increasing the coercive force will allow you to obtain higher operating points at which the specific energy of the magnet is highest. Larger operating points allow more energy to be generated from permanent magnet operation. Accordingly, if you know the maximums of the working range of these materials, it is possible to achieve a reduction in the dimensions of the magnetic material itself in the design of the equipment or appliance. This will save on materials and make their production more ergonomically advantageous and cheaper. In turn, reducing the size will lead to the development of industries such as nanotechnology, robotics and microprocessor technology. In addition, the reduction of re-magnetization losses can be achieved by calculating the operating points of the magnet, analyzing the residual induction and coercive force. It is also possible to develop methods for extending the life of magnetic materials and storing residual induction without re-magnetization.

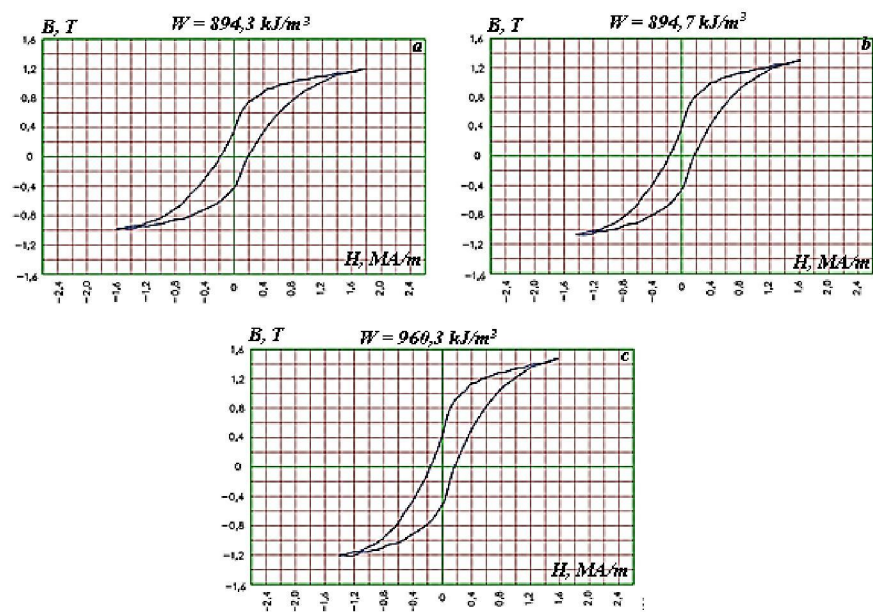
Purpose of the study. To calculate the re-magnetization energy for the permanent magnets consisted of $\text{Nd}_{15,2}\text{Fe}_{74,99}\text{B}_{6,6}\text{C}_{0,51}\text{Cu}_{1,57}\text{Ti}_{1,38}$, obtained under different conditions, by the method of integration along the contour of the maximum hysteresis loop.

composition, which were obtained under different conditions, were investigated (see Table 1).

Table 1. Conditions for obtaining permanent magnets consisted of $\text{Nd}_{15,2}\text{Fe}_{74,99}\text{B}_{6,6}\text{C}_{0,51}\text{Cu}_{1,57}\text{Ti}_{1,38}$

Example No.	Chemical composition of permanent magnet	Initial pressure, P, MPa	Sintering / annealing temperature, K.
1	$\text{Nd}_{15,2}\text{Fe}_{74,99}\text{B}_{6,6}\text{C}_{0,51}\text{Cu}_{1,57}\text{Ti}_{1,38}$	0,5	1323 / 813
2		3	
3		9,5	

To determine the re-magnetization energy, it is necessary to find the hysteresis loop area by integrating along the loop path. The magnetisation energy of the examples was calculated as the hysteresis loop area (see Pic. 1).



a – 0,5 MPa; b – 3 MPa; c – 9,5 MPa

Picture 1 – Hysteresis loops for samples consisted of $\text{Nd}_{15,2}\text{Fe}_{74,99}\text{B}_{6,6}\text{C}_{0,51}\text{Cu}_{1,57}\text{Ti}_{1,38}$ caused under different conditions

To accomplish this task, splines were obtained and the area of the figures was calculated by numerical methods. Given that the samples under study were in the shape of a cylinder $h = 5 \text{ mm}$ and $d = 9 \text{ mm}$ ($S = 3,18 \cdot 10^{-7} \text{ m}^2$), it is possible to find the real re-magnetization energy for each sample. The results of the calculations are presented in Table. 2.

Table 2. The value of the specific and real energy of the re-magnetization of the samples

Example No.	1	2	3
Numerical Methods			
$W_{\text{num}}, \text{ kJ/m}^3$	894,3	894,7	960,3
$W, \text{ J}$	0,2844	0,2845	0,3054

Example No.	1	2	3
By points			
$W_{\text{итт}}, \text{kJ/m}^3$	784,5	792,6	869,7
W, J	0,2495	0,2521	0,2766

Thus, calculations and simulations have shown that the use of matkad environment gives more accurate results.