WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 8, Aug., 2022

SIMULATION OF AN ASYNCHRONOUS ELECTRIC MOTOR USING THE ANSYS MAXWELL RMXPRT PROGRAM

Xolliyev Jovohir
Lecturer at Bukhara Institute of Natural Resources Management

Amrullayev Behzod
Student of Bukhara Institute of Natural Resources Management

Annotation
B The article discusses the design and simulation of an induction motor using the Ansys Maxwell program. The results of a study in the field of modeling and design of electrical machines using the Ansys Maxwell RMxprt software module are presented. The advantages of using the Ansys Maxwell RMxprt software module for the design of electrical machines are revealed and the results of the analysis of their performance are obtained. The results of the performance calculation are shown in data tables and in the form of graphical characteristics.

Keywords: induction motor, stator, rotor Ansys Maxwell RMxprt, performance, net power, power factor.

Introduction

Asynchronous electric motors (AM) are used in almost all industries due to their simple design and ease of operation. Asynchronous electric motors consume about 65% of the electrical energy generated by the country's power plants [1].

The issues of design and simulation of asynchronous electric motors remain very acute, since the performance requirements of modern electric motors have increased significantly. Computer-aided design systems are often used to solve such problems, however, most of the models created in them are not interactive. In this regard, the use of the latest software products, in particular, the Ansys Maxwell RMxprt software module [2], is of considerable interest. Users only need to enter the initial data: the type of windings and the connection scheme, the properties of the stator and rotor materials, geometric parameters, data on power supply, load, fan, etc. At the same time, all Maxwell tools for parameterization and optimization calculation are available. Thus, this software tool allows you to significantly speed up the process of developing an electric machine with a standard configuration.

The Ansys package includes three software products with which you can implement the simulation of the electric drive system of various types of electric machines:

RMxprt, Maxwell 2D/3D and Simplorer. Moreover, the same model is launched in conjunction RMxprt – Simplorer, Maxwell 2D/3D – Simplorer simultaneously [3]. RMxprt supports the following types of electrical machines: three-phase IM, single-phase IM, three-phase synchronous motors (SM) and generators, variable frequency SM and generators, permanent magnet DC motors, etc. [four].

The RMxprt program allows you to perform engineering calculations of electrical machines based on circuit theory. The developer can create a configuration in RMxprt, convert the model into a Maxwell task, where he can already make all the required changes. This will be much faster than designing a model from scratch.

As an example, consider the construction of a 4A80A4UZ engine model. To do this, enter in the control window (Project Manager) the passport data of the 4A80A4UZ engine: P2nom = 1.1 kW; Ul=380 V; 2p=4, geometric dimensions of its active parts: Dv=131 mm; D=84 mm; l1=78 mm; Da=83.5 mm; Dv=22 mm, stator slot parameters: slot shape – semi-open trapezoidal; Z1=36; b1=4.4 mm; b2=6.1 mm; h=12.1 mm; m=2.5 mm; e=0.5 mm, rotor slot parameters: slot shape - half-open pear-shaped; Z2=28; b1=4.5 mm; b2=1.5 mm; hp=16.4 mm; m=1.0 mm; e=0.5 mm, stator winding parameters: Sp=60; n=1; d=0.67 mm; winding type - single-layer concentric.

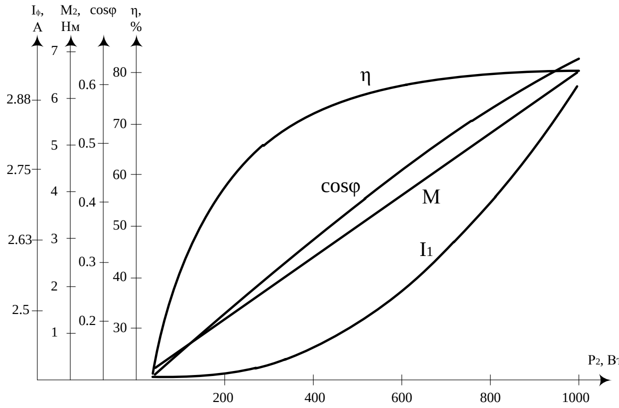
Before running a software analysis of a motor, it is necessary to enter its general parameters, such as power, voltage, operating temperature, number of poles, rated speed, power loss.

After that, validation (Validate) and calculation of the project (Analyze All) are performed. The calculation results in RMxprt are presented in the form of data (Table 1) and as a set of characteristics (Fig. 2). All results can be viewed by selecting the Solution Data command from the RMxprt toolbar, characteristics through the Curve command.

Table 1 Performance data obtained using the RMxprt program

P_2, Вт	$I_ф$, A	η, %	cosφ	M_2, Н·м
0	2,38	0	0,08	0
270	2,39	64,5	0,25	1,73
400	2,43	72	0,33	2,57
540	2,45	76,4	0,42	3,49
640	2,56	78,3	0,47	4,15
700	2,6	79,1	0,51	4,54
900	2,78	80,5	0,61	5,88

Stator current versus motor power ($I1=f(P2)$), efficiency versus motor power ($\eta=f(P2)$), power factor versus motor power ($\cos\varphi=f(P2)$) and torque versus power motor ($M2=f(P2)$).



Operating characteristics of the 4A80A4UZ asynchronous electric motor obtained using the RMxprt module

As shown by the performance results of the 4A80A4UZ asynchronous motor using the RMxprt module, the useful power reaches the value P2=0.9 kW at □=80.5%, cos□=0.61, I1=2.78 A, M2=5.88 Nm .

Experimental studies have been carried out to compare the accuracy of induction motor performance results obtained using the RMxprt program.

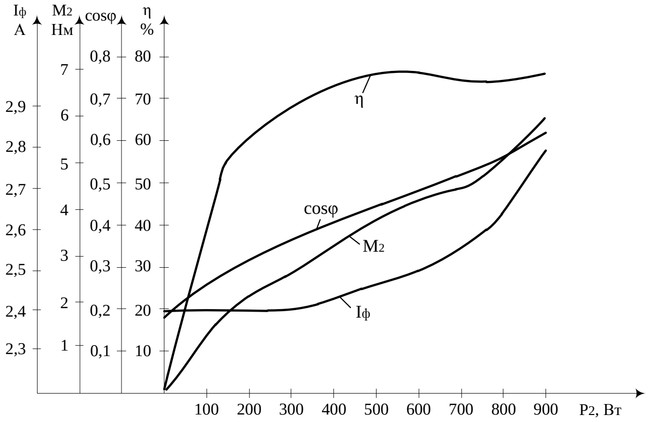
Experimental data for building the performance characteristics of an asynchronous motor are given in table. 2.

Table 2 Experimental performance data

P_2, Вт	$I_ф$, A	η, %	cosφ	M_2, Н·м
0	2,4	0	0,18	0
270	2,4	56,25	0,29	1,74
400,5	2,4	66,75	0,36	2,60
537,5	2,45	74,65	0,43	3,50
637,5	2,5	75,89	0,49	4,17
701,2	2,6	73,05	0,54	4,60
900	2,8	75,00	0,62	5,94

experimental data on the operating characteristics of the electric motor are presented in the form of graphically expressed dependences of the useful moment (torque on the shaft) M2, efficiency. η, phase current I and power factor cosφ for various values of useful power P2 when operating at rated voltage and frequency.

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 3, Issue 8, Aug., 2022



Performance characteristics of an induction motor

As shown by the results of the experiment given with an asynchronous electric motor, the useful power reaches the value P2=0.9 kW at ☐=75%, cos☐=0.62, I1=2.8 A, M2=5.94 Nm.

When comparing the results obtained using the RMxprt program and the experiment with a useful power P2 = 0.9 kW, the efficiency error 0.72%, power factor 6.8%, phase current 1.6%, shaft torque 1% respectively. This means that experimental studies were carried out on analog measuring instruments, which have errors.

An analysis of the main parameters of a three-phase asynchronous electric motor with a squirrel-cage rotor of general industrial design allows us to notice that two different calculation methods give almost identical results with the same initial data when solving the problem of improving the energy efficiency of an electric machine, the calculation using the RMxprt module is most preferable, since it is simpler .

References

1. Deshmukh K.S., Bansal K., Killedar A.. Modeling and Simulation of Three Phase Induction Machine Using Written Pole Technology Journal of Electrical and Electronics Engineering, Ver. IV (Jan. – Feb. 2017). P. 23-29.
2. Кириченко А., Полянский П., Иванов Г.. Моделирование асинхронного электродвигателя с использованием программного модуля Ansys Maxwell RMxprt. Commission of Motorization and Energetics in Agriculture – 2016. Vol.18. No.2. C. 49-55.
3. Ansys Maxwell 3D V.15 - Electromagnetic and Electromechanical Analysis: user's guide/ Ansys Inc. – Pittsburgh, 2012. – 1006 p.
4. Amrullayev Behzod https://cyberleninka.ru/article/n/reaktiv-quvvat-kompensatsiyasi-uchun-mikrokontrollerni-boshqarish-tizimini-ishlab-chiqish-usullari/viewer

5. Amrullayev Behzod http://openaccessjournals.eu/index.php/ijdias/article/view/958/911
6. Amrullayev Behzod http://www.conferencezone.org/index.php/cz/article/view/86
7. Amrullayev Behzod https://conferencepublication.com/index.php/aoc/article/view/1691