Valentin MÜLLER

"Aurel Vlaicu" University of Arad
B-dul Revolutiei Nr. 77, 310130
Arad, Romania
mullervalentin@yahoo.com

THE OPERATING CHARACTERISTICS OF THE ASYNCHRONOUS MOTOR AT THE ROTORICAL PARAMETERS VARIATION IN COMPARISON WITH THE FREQUENCY

Abstract:

In this paper are analyzed the operating characteristics at the rotorical parameters variation in comparison with the charge and in that conditions when rotorical parameters $\left(R_2^{'}, X_2^{'}\right)$ *are constant.*

Keywords:
asynchronous motor, characteristics.

1. INTRODUCTION

The equations for the asynchronous motor with cage rotor in permanent regime of working, are [1], [2]:

$$\begin{cases} \underline{U}_1 = \underline{Z}_1 \underline{I}_1 - \underline{U}_{e1} \\ O = -\underline{Z}_2^{'} \underline{I}_2^{'} + \underline{U}_{e1} \\ \underline{I}_{01} = \underline{I}_1 + \underline{I}_2^{'} \\ \underline{U}_{e1} = -\underline{Z}_{1m} \underline{I}_{01} \end{cases} \tag{1}$$

where:

$\underline{Z}_1 = R_1 + jX_1$ - statorical winding impedance;

$\underline{Z}_{1m} = R_{1m} + jX_{1m}$ - magnetizing impedance;

$\underline{Z}_2^{'} = C_R \dfrac{R_2^{'}}{s} + jC_x X_2^{'}$ - rotorical impedance in comparison with rotorical frequency.

$$C_r = \frac{\left[R_2^{'} R_{1m}\left(\frac{f_2}{50}\right) + X_2^{'} X_{1m}\left(\frac{f_2}{50}\right)\right]^2 \left[R_2^{'} + R_{1m}\left(\frac{f_2}{50}\right)\right] + \left[R_2^{'} X_{1m}\left(\frac{f_2}{50}\right) + X_2^{'} R_{1m}\left(\frac{f_2}{50}\right)\right]^2 \left[X_2^{'}\left(\frac{f_2}{50}\right) + X_{1m}\left(\frac{f_2}{50}\right)\right]}{R_2^{'}\left\{\left[R_2^{'} + R_{1m}\left(\frac{f_2}{50}\right)\right]^2 + \left[X_2^{'}\left(\frac{f_2}{50}\right) + X_{1m}\left(\frac{f_2}{50}\right)\right]^2\right\}} \tag{2}$$

$$C_x = \frac{\left[R_2^{'} X_{1m}\left(\frac{f_2}{50}\right) + X_2^{'} R_{1m}\left(\frac{f_2}{50}\right)\right]^2 \left[R_2^{'} + R_{1m}\left(\frac{f_2}{50}\right)\right] - \left[R_2^{'} R_{1m}\left(\frac{f_2}{50}\right) - X_2^{'} X_{1m}\left(\frac{f_2}{50}\right)\right]^2 \left[X_2^{'}\left(\frac{f_2}{50}\right) + X_{1m}\left(\frac{f_2}{50}\right)\right]}{X_2^{'}\left(\frac{f_2}{50}\right)\left\{\left[R_2^{'} + R_{1m}\left(\frac{f_2}{50}\right)\right]^2 + \left[X_2^{'}\left(\frac{f_2}{50}\right) + X_{1m}\left(\frac{f_2}{50}\right)\right]^2\right\}} \tag{3}$$

Knowing the electrical parameters:

$\mathrm{R}_1, \mathrm{R}_2^{'}, \mathrm{R}_{1m}, X_1, \mathrm{X}_2^{'}$ and X_{1m} at a nominal frequency (f=50 Hz) and the supply, we can find-out the current in the stator winding and in the rotor winding.

$$\underline{I}_1^{'} = \frac{C_2 \underline{U}_1}{\underline{Z}_1 + C_1 \underline{Z}_2^{'}}; \qquad \underline{I}_2^{'} = -\frac{\underline{Z}_2^{'} \underline{U}_1}{\underline{Z}_1 + C_1 \underline{Z}_2^{'}} \tag{4}$$

where:

$$\underline{C}_1 = 1 + \frac{\underline{Z}_1}{\underline{Z}_{1m}}; \qquad \underline{C}_1 = 1 + \frac{\underline{Z}_1}{\underline{Z}_{1m}} \tag{5}$$

Equivalent impedance of the motor is:

$$\underline{Z}_e = \underline{Z}_1 + \frac{\underline{Z}_{1m}\underline{Z}_2^{'}}{\underline{Z}_{1m} + \underline{Z}_2^{'}} \tag{6}$$

from where we can determine the power factor:

$$\cos\varphi_1 = \frac{R_e(\underline{Z}_e)}{|\underline{Z}_e|} \tag{7}$$

The electromagnetic torque and the efficiency of the machine will be determined with the relations:

$$M = \frac{pm_1}{\omega_1} \cdot \frac{R_2^{'}}{s} I_2^{'\,2} \tag{8}$$

$$\eta = \frac{M \frac{2\pi f_1}{p}(1-s)}{3U_1 I_1 \cos\varphi_1} \tag{9}$$

Using the relations (4), (5), (8) and (9) we can sketch the operating characteristics of the asynchronous motor in camporison with the charge, taken into account the rotorical parameters variation in camporison with the rotorical frequency f_2.

2. PRACTICAL PARAGRAPH

We consider a triphases asynchronous motor, with a nominal power P_N=4 KW at 1500 rot/min, supplies by a nominal voltage U_1=220 V.
In figure 1 it is shown the working characteristics: I_1=f(s); $I_2^{'}$=f(s); $\cos\varphi_1$=f(s); M=f(s).

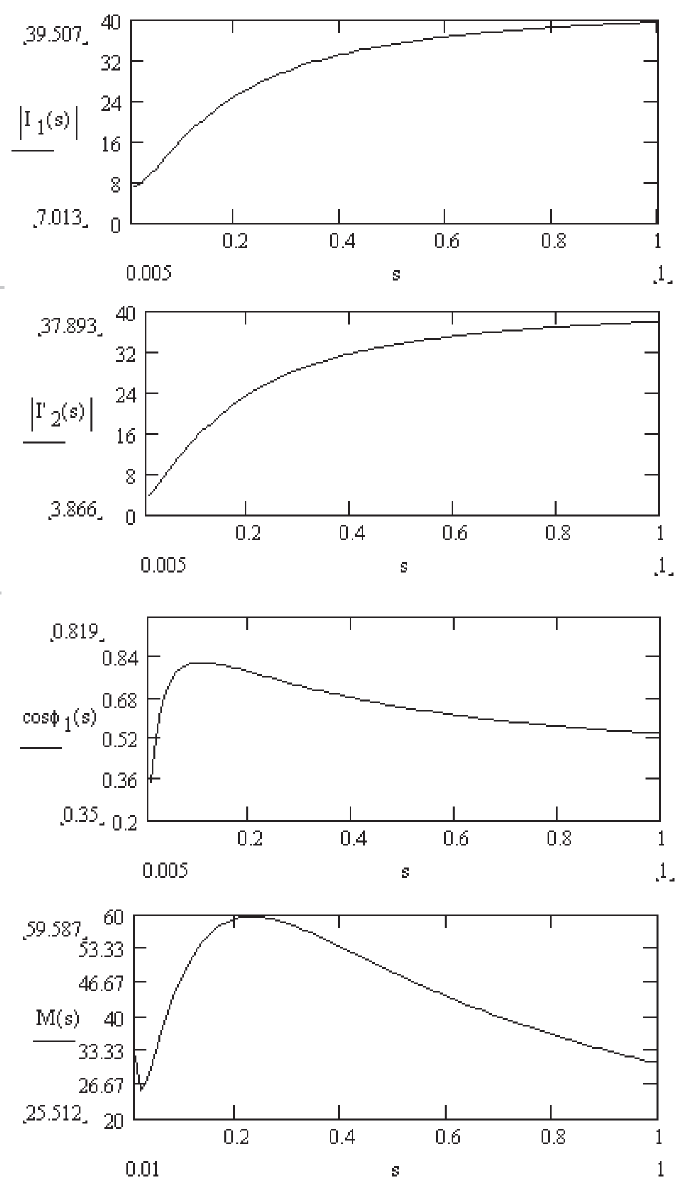

Fig.1. The working characteristics to the rotorical parameters modification in comparison with the frequency.

3. CONCLUSIONS

From mechanical characteristic M=f(s), at discharge regime (s=0), appear an increase of the electromagnetic torque due to the increase of the dispersion reactance of the rotor coefficient C_x.

REFERENCES

[1]. Dordea, T. *Maşini electrice.* Editura ASAB, 2002.
[2]. Biriescu, M. *Maşini electrice rotative*. Editura de Vest, 1997.