M.D. Stochitoiu, PhD Engineering, Associate Professor,
University of Petrosani, Romania

ASPECTS OF ASYNCHRONOUS MOTORS WITH HIGH ENERGETICALLY EFFICIENCY FOR AN EFFICIENT, ECONOMIC TRANSPORT SYSTEM USED IN THE LIGNITE OPENT PITS

Introduction The main objective of the energy sector in Romania, according to the energy and the environmental objectives set at the European level is to improve the efficiency in the electrical drives. The paper emphases some points of view for the improvement of electrical drives to the belt conveyors using the high efficiency motors and their advantages. An efficient, economic transport system is a key element in the viability of coal open pit in Romania.

The main advantages of using electrical energy (high efficiency, lack of residues, the possibility to transport it easily, the possibility to divide it on any scale, making accurate measurements, etc) have determined their operating in mining activity fields and at the same time are used to the belt conveyors drives.[1][2]

Electrical energy consumption is an important part on the lignite structure cost so it must achieve a detailed study about losses of energy and to establish a measurements plan. The following measurements and programme on short and average time are applied [3]: limitation of peak loading which is based on the direct relations between programmed mechanical torque to be used and the effective mechanical torque; electromagnetical monitoring to determ some levels for electrical measurements to be used; the adjustable electrical drives used in the open pit`s equipments through power electronics and adequated comand represent a method to diminuate the electrical energy consumption and the financial effort is not important because the actual motors are kept in function working with static converters;

Technological flow and new techniques, based on new materials and modern technologies, in order to assimilate asynchronous motors with high energetic parameters

The bucket wheel excavator is continuous flow complex machinery that excavates the coal using the buckets fitted on the wheel and in the same time conveys the material to the transportation facility. The working element – bucket wheel executes horizontal and vertical movements, the basic one being the rotation.

The asynchronous motors in schortcut or induction motors are frequently used in electrical drives for open pits machines. The motor `s power are from 100 to 630 kW and the open pits costumers are supplied from transformer stations about 2x6300kVA, 20/6 kV using different electrical cables. By adopting certain constructions and design methods, one can obtain motors with high energetic indexes. The energetic parameters of the asynchronous motor are defined by efficiency(η) and power factor (cosφ), which help calculating the loss of active power and the loss of reactive power.

Out of the losses generated in an asynchronous motor, the mechanical losses p_m are practically independent from the charging power, and only the losses from the wrappings and the ferromagnetic core remain variable according to the electrical and mechanical variations.[4][5]

The losses from the wrappings are practically dependent only on the charge and the quantity of the materials.

Considering the American Standard API 541, which introduces the L_{cc} indicator (the cost of the life cycle), which is the basis used to evaluate the correlation price-performances of the electrical motors. This indicator is the sum of the purchase price and the costs generated by the loss of power/life cycle. The analytical expression for the calculation of the L_{cc} indicator is the following:

$$L_{cc} = C + C_e \cdot N \cdot P_N \cdot \left(\frac{100}{\eta} - 1\right) \quad (1)$$

Where: C= the price of the motor; Ce= cost of active energy; N= number of functioning hours

P_N = the nominal power of the motor (kW); η = nominal efficiency (%)

For the asynchronous motors with contact rings, this measure can be applied for both rotor and static armatures. The limit is given only by the possibility to place spires, limited by the exterior diameter of the machine. The importance of the plate quality from which the ferromagnetic iron is made results, without referring to a certain asynchronous motor.

It is known that there are several types of plate with different magnetic properties and losses, but the more the plate is magnetically and the loss figures smaller, the higher is the price. Industry can purchase presently two types of indigenous plate: 2,3 W/kg, at 1T induction and a frequency of the sinusoidal variation in time of 50 Hz at the price of 5,5RON /kg and 1,4 W/kg at the price of 7 RON/kg, their magnetizing properties are similar.[6]

So, considering the cost, it appears that the solution is to solve the problem at low costs, by purchasing the plate which has more losses, but cheaper. But the factory doesn't only execute motors for sales, but also to be used by the beneficiaries.

Presently the asynchronous motors are executed with medium magnetic solicitations for the entire machine, at around 1,5 T and 50 Hz. But for 1,5 T the losses per mass unit in both cases are: plate 2,3 W/kg- p_{Fe} = 5,18 W/kg and plate 1,3 W/kg- p_{Fe} =2,93 W/kg. This means that for 1 kg of plate, the 1,3 W/kg plate has fewer losses than 2,3 W/kg one with formula. For a m_{Fe} mass of the core, on the T_D lifetime of the machine and the price for 1 kWh of N_E results a difference of the electromagnetic cost transformed into thermal energy:

$$\Delta C_U^{1} = \Delta p_{Fe} \cdot m_{Fe} \cdot T_D \cdot N_E \quad (2)$$

Formula is in favorer of the machine made of the more expensive plate. Rotor losses are less free because the rotor must be sized with consideration of additional restrictions related to the mechanical characteristics (starting torque maximum torque) and nominal slip. Both types of losses are expressed as the mass of iron (or copper) and a specific mass loss (W / kg). The difference is that if the copper winding (copper electrical) this value is unique and expresses the square of the current density for iron (electrical board) is possible assortment of options. The obtaining the big torques and small currents during the motor`s start up can be made only by reducing the efficiency because the pelicular effect implies a high rotor dispersion which determines a reducing for power factor [7].

Using electrical motors having reduced speed and a higher torque to the shaft the cinematic reductor is eliminated as well as the weakness due to maintenance costs and the low efficiency.

Conclusions

The quality of plate has upon the economic indexes of an electric motor, fact which leads to the necessity of the plate factories to increase the quality of plate for the electromagnetic cores of electric motors as much as possible. An important increase of motor efficiency (for bigger speed more 1000rot/min) can be obtained by the substantial reduction of the losses generated by the ventilators and this can be done by replacing the radial ventilators with axial ventilators with a 30% function efficiency increasement. In a modern open pit coal mine the technological, mechanical, electrical and economical elements of the production process are in a direct interdependency, the modernization of any of these components (mainly the electrical one) is necessary.In the scientific research evolution for the automation of the conveyor belts and its control, the challenge is the implementation of a rational mode of operation and the optimizing of the working parameters, for obtaining superior technical-economic indicators, especially the power saving.

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