International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol. 4, Issue 6, June – 2020, Pages: 83-86

Surface Losses in Electrical Machines

Axmedov Abdurauf and Murodlaev Izadla
Faculty of Electro mechanics and Radio electronics
Jizzakh polytechnic institute
Jizzakh city, Uzbekistan
Uchqun8822@gmail.com

Abstract *- In this article, the reasons for the formation of surface waste in asynchronous machines have been studied.*

Keywords: Efficiency, DC machine, magnetic losses, power.

Introduction

Surface losses occur due to induction ripples in the air gap. Efficiency depends on the load. Surface losses occur in the surface layer of prongs or poles due to field pulsations in the air gap. The frequency of induction ripples is determined by the number of teeth and the rotation frequency $f_z n_z$/ 60, where z is the number of teeth on the stator if surface losses in the rotor are determined, or the number of slots on the rotor if surface losses in the stator are determined.

Surface losses occur in all machines that have a toothed surface on one or both sides of the air gap. These losses occur in stations and rotors of asynchronous machines and on the surface of the pole tips of synchronous and DC machines. Surface losses occur due to induction ripples in the air gap.

Surface losses, as shown by the calculation, are very small. Surface losses in rotor steel are most dangerous in large machines and are most reliably reduced by mixing its pole shoes. But in recent years, large synchronous motors are more often made with massive poles, that is, from solid iron. In these cases, good results are obtained by fluting the surface of the rotor. The fluted surface dramatically increases the active resistance of eddy current circuits from higher harmonics, which, as is known, are closed along the surface of the rotor. In addition, the cooling surface area of the rotor is noticeably increased.

Surface losses with stratified iron are usually insignificant. The surface losses of the rotor caused by the higher harmonic fields of the stator are calculated taking into account the frequency, the number of poles and the pole division of the higher harmonic fields. Total surface losses $P_{of\ surfactant}$ W, is obtained by multiplying $p_{surfactant}$ by the area of the entire surface of the stator or rotor under consideration - the heads of teeth or pole tips.

The correction factor Kh. The coordinate system for the calculation of surface losses. The total surface losses of the machine are proportional to the surface area of the stator bore. Keep in mind that induction at $_0$does not have the same values simultaneously everywhere. For a sinusoidal field, the average square value is equal to half the square of the amplitude value.

Let's consider the surface losses in the rotor steel at idle of an asynchronous motor with closed slots on the rotor. The element on the surface of the rotor turns out to be either under the tooth or under the slot (slot) of the stator. Ripples of the tooth flow at two different positions of the rotor relative to the stator (a, b. under certain conditions, surface losses pass into other types of losses, in particular, ripple losses in the teeth. This occurs when the width of the tooth heads in one part of the machine is approximately equal to or less than the opening of the slots in the other part, as in asynchronous machines. In this case, the surface losses are partly missing and instead of them there are pulsation losses.

Surface losses are not affected by the length of the steel in the axial direction. Dependence of the equilibrium criterion P_a from the contact criterion To $_o$ for l-type solid reactions. In non-externally heated reactors, the same surface heat loss per unit of output is required in the model and in kind. Therefore, you need to control the heat loss in the model.

The use of thin sheets of steel significantly reduces surface losses in the case when the rotor surface is not processed after its charge. In the case of additional processing, the losses must be calculated in the same way as for massive rotors. Calculating surface losses, and the numerical value of the coefficient k_0 can be taken from the table below. The main types of additional losses in steel are pulsation and surface losses.

There are three main types of losses: a) surface losses associated with heat transfer through a high vacuum by radiation (very high quality thermal insulators have not yet been developed, which are practically suitable for use in the temperature range from 4 to 77 K); b) losses due to the thermal conductivity of supports; C) losses related to the thermal conductivity of electrical connections.

As the grooves on the rotor are enclosed, so that surface losses in the stator is equal to zero.

It can be seen that the highest specific surface losses have traction engines NB-414, NB-418 and ED-104A. Secondly, these field harmonics cause additional magnetic losses on the surface (surface losses) and in the body of the teeth (ripple losses) of the stator and rotor. Rotation of the rotor teeth relative to the stator teeth causes ripples of magnetic flux in the teeth, and therefore the corresponding part of the loss is called ripple losses. Magnetic losses in the rotor core under normal operating conditions are usually very small and are not taken into account separately. As can be seen from the above values, the use of sheet steel instead of massive significantly reduces surface losses. The k0 values for well-insulated steel sheets are approximately proportional to their thickness. The calculation of kQ is associated with great mathematical difficulties, and therefore it is necessary to apply the above values, established experimentally.

The influence of the arrangement of teeth on the distribution of magnetic flux. a-axis of the rotor tooth coincides with the axis of the stator tooth. b-axis of the rotor tooth coincides with the axis of the stator groove. The main types of additional losses in steel are: a) ripple losses and b) surface losses.

Thus, losses of the third type can be attributed to mechanical losses in the surface molecular layer (surface losses), and they are always proportional to the number of broken bonds, and not to the rate of crack growth. In this regard, methods of controlled destruction do not determine the free surface energy of a solid in its pure form, but a value that includes mechanical losses of the third type.

The cross section of the T - shaped pole tail (a) and the rotor rim groove (b). pole Tails made of steel sheets of greater thickness have greater strength, but at the same time, surface power losses in the pole tips increase.

If the mouthop is made entirely forged, then the volume losses from pulsations in the teeth of the mouthop do not take place, and there are only surface losses.

If the rotor is made entirely forged, then the volume losses from pulsations in the teeth of the rotator do not take place, but there are only surface losses. Thus, the presence of teeth on the stator determines the occurrence of surface losses in the rotor, and, conversely, the rotor teeth cause surface losses on the stator. Surface losses occur in all machines that have a toothed surface on one or both sides of the air gap. These losses occur in the stators and rotors of asynchronous machines and on the surface of the pole tips of synchronous machines and DC machines.

Thus, the presence of teeth on the stator determines the occurrence of surface losses in the rotor, and, conversely, the rotor teeth cause surface losses on the stator. Surface losses occur in all machines that have a toothed surface on one or both sides of the air gap.

Limits of variation of the tooth division tz depending on the pole division t for synchronous machines. When the number of slots decreases, the volume of current in the slot and the temperature drop in the insulation increase, additional losses in copper, as well as ripple and surface losses increase. In addition, with the increase in the size of the coil, its manufacture and placement in the grooves become more complicated. When developing a series, in order to unify the winding wires and the number of dies used, we strive to choose the same slots for machines with different numbers of poles.

Higher harmonic grooves penetrating into the opposite part of the machine and spreading further along the surface of the boring, cause surface losses. V - yoke, V n - on hysteresis V on the friction of the rotor on the air, VL is the sum of the losses in the rotor Vm - mechanical, Vo is the surface losses in the steel, Vp - pulsation, Vs - in the frontal part winding, Vv - coil, exhaust air in the ventilation channel, Vw - from eddy currents, Vw - in the winding, USH - plus active steel due to poor quality insulation sheets VWG - additional steel due grata, Vz - in prong.

Strain relaxation losses (losses of the first kind), which are small for brittle bodies, are ignored. Surface losses are independent, and dynamic lossesкие потери depend on the crack growth rate.

Surface losses in the pole tips are caused by the gear structure of the armature.

The amount of surface losses of the rotor depends on the opening of the stator slots and, conversely, the amount of surface losses of the stator depends on the opening of the rotor slots; with open slots, the losses are greatest, with closed ones are absent. Large surface losses occur in the massive rotors of synchronous turbo generators and machines with massive poles.

The leaves of the poles. The poles of electric machines are permeated by a stream having a constant direction, and therefore there are no losses to magnetization and eddy currents in them. However, surface losses in the pole tips do not allow them to be made massive, and the poles are assembled from stamped sheets. Only the main poles of generators and electric motors of automotive electrical equipment are massive. Recently, massive poles have become common in synchronous machines, where they play the role of a starting or calming winding.

Usually, higher-order tooth harmonics (at P1) are neglected, since they are relatively poorly expressed. It can be assumed that the surface losses are proportional to the ripple frequency in the power of 1 5 and the square of the average value of the induction in the gap.

Usually toothed harmonics of the highest order (at n) are neglected, since they are expressed relatively weakly. It can be assumed that the surface losses are proportional to the ripple frequency in the power of 1 5 and the square of the average value of the induction in the gap. The analysis shows that the surface losses depend on the frequency in the power of 1 5 and the square of the average value of the induction in the gap.

When loading the machine, additional losses also occur due to distortion of the magnetic field distribution under the influence of the transverse armature reaction. Due to the uneven distribution of magnetic induction in the gap, surface losses increase. In the presence of a compensation winding, this part of the magnetic losses is practically absent. Another part of the additional losses is associated with the formation of eddy currents in the armature winding rods due to changes in the scattering flux. The short-circuit current of the switched sections also causes losses in the conductors. One of the means of reducing this part of the loss is the use of winding rods assembled from small-section conductors.

It is dangerous to continue generalizing by including cobalt, niobium, molybdenum, and tungsten because of the complexity of inter-element interactions. This is a very good anti-oxidation resistance, in which the surface loss (on one side of the sample) does not exceed 0 025 mm. Fixing the core of the pole with rivets (a and rod (b. Poles to reduce losses are recruited from sheets with a thickness of 1 - 2 mm. With large thicknesses, sheet stamping becomes more difficult and surface losses increase, with smaller thicknesses, labor costs increase due to an increase in the number of sheets, and the coefficient of filling the core with steel decreases.

When loading the machine, additional losses also occur due to distortion of the magnetic field distribution under the influence of the transverse armature reaction. Due to the uneven distribution of magnetic induction in the gap, surface losses increase. In the presence of a compensation winding, this part of the magnetic losses is practically absent. Another part of the additional losses is associated with the formation of eddy currents in the armature winding rods due to changes in the scattering flux. The short-circuit current of the switched sections also causes losses in the conductors. One of the means of reducing this part of the loss is the use of winding rods assembled from small-section conductors.

References

[1] P. Arumugam, T. Hamiti, and C. Gerada. "Analytical modeling of a vertically distributed winding configuration for Fault Tolerant Permanent Magnet Machines to suppress inter-turn short circuit current limiting". in Electric Machines & Drives Conference (IEMDC), 2011 IEEE International. 2011.

[2] S. Zhigang, "Analytical prediction of the short-circuit current in fault-tolerant permanent-magnet machines," IEEE Trans. Component Parts, vol. 55, pp. 4210-4217, 2008.

[3] T.J. Juha Pyrhonen, Valeria Hrabovcova, "Design of rotating electrical machines," John Wiley & Sons, United Kingdom: Chichester, 2008, pp. 230–250.

[4] J.D. Ede, Z.Q. Zhu, D. Howe, "Optimal split ratio for high-speed permanent magnet brushless DC motors," Electrical Machines and Systems, 2001. ICEMS 2001. Proceedings of the Fifth International Conference on, vol.2, no., pp.909-912 vol.2, Aug 2001.

[5] D. Evans, Z. Azar, L.J. Wu, Z.Q. Zhu, "Comparison of optimal design and performance of PM machines having non-overlapping windings and different rotor topologies," Power Electronics, Machines and Drives (PEMD 2010), 5th IET International Conference on, vol., no., pp.1-7, 19-21 April 2010.