

1.2.11. METHODS OF ELECTRIC CONTROL FRICTION PAIRS: MODERN ACHIEVEMENTS AND DEVELOPMENT PROSPECTS

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Electrical methods of non-destructive testing and diagnostics contain following advantages: universality (possibility of the decision of various problems of tribology, problems of the control and forecasting of separate elements and friction knots as a system); there is no inertia in relation to friction process; simplicity of realization (special converters are not required, the electronic diagnostic device is connected directly to surfaces of rubbing details); simplicity of formation of signals from the measuring information. Methods are effectively used for the decision of set of monitoring problems and different tests, like: diagnosing of contact surface and friction mode, an estimation of the actual area of contact surface, estimate a characteristics of materials and lubricant environments, wearing process, probe of processes of repair restoration of friction knots. The major achievement of last years on the field of not destroying control contains the theory of electroparametrical diagnosing methods of ball bearings, which was developed by a science school of the Orel state technical university (the founder – S.F. Korndorf). The developed methods and means allow to solve effectively set of the problems connected with an estimation of a technical condition of ball bearings.

Lubricant condition allows to judge about technical condition of friction zone in friction knot at use of electric methods. The lubricant condition is estimated by statistical parameters of electric value of contact surface (electric resistance, electric conductivity, electric capacity, voltage). As others diagnostic sign named probability of occurrence of micro contacts has received application. Probability of occurrence of micro contacts describes by parameter named “normalized integrated time of destruction of a lubricant layer”. The event consisting at simultaneously ball contact to both rings of ball bearing called micro contact. Using methods with given diagnostic sign have advantages: good noise immunity, high sensitivity, a low threshold of sensitivity. On application of this parameter are based a method of search of local defects of work surfaces of ball bearing, a method of diagnosing of bearing knots taking into considering macro geometry of rings paths and a method of complex diagnosing.

Various means are developed for realization of these methods. Considering appointment and requirements for electronic diagnostic means divided into groups: laboratory means for solving complex probes and tests; means for express-diagnostics and tests in the industrial conditions; the diagnostic means for functional testing intended for the control and monitoring objects while they are in service for the purpose of prevention of their emergency refusals.

The analysis of signals of the measuring information and its interpretation are carried out taking into account the developed base of mathematical models. The base of models considers the basic conditions of frictional interaction of solids (the friction scheme, parameters of micro geometry, the lubricant characteristics, external conditions: loading, speed of relative moving of details, etc.). Difference of the developed models from known consists in description of electric processes in friction zones. Mathematical models are adapted on any inclusion of the analytical blocks. This approach allow to connect parameters of friction zone with electric parameters.

Directions of development of electric methods of non-destructive testing and tribology: use of complex diagnostic parameters and diagnostic methods; a computerization of control devices and method; perfection of algorithms of information processing; working out of a tribological methods, providing an estimation of functioning of a lubricant and "the third body" separately; application of theoretical positions of methods for the control of restoration processes, just as for degradation processes; expansion of a scope of use of methods for new objects (plain bearings, friction zones with a boundary friction, friction pairs "the tool – the detail", etc.).

Basis for complex diagnostic are probes of set of known electro physical principles and parameters at the decision of typical problems in friction zones. Frictional contact is modeled as the system where the electric parameter is target parameter. It provides to analyze efficiency for each parameter. The received information defines experimental directions at use complex parameters or groups of them. The purpose of the given actions is directed to increase efficiency and reliability on the field of tribological problems. An example of complex diagnostic is use of joint correlation measurements between electric parameters and parameters with another physical nature (vibration and blow parameters, acoustic emission, the moment of a friction, etc.). The correlation analysis raises information volume and noise immunity at an estimation of defects micro- and macro geometry of working surfaces of details.

Solving problems of an estimation condition of lubricant in a friction zone and "the third body" you are working in different fields of knowledge, such as: mechanics (tribology and tribological dynamics); a friction, wear, lubricant; non-destructive testing; electric measurements in physical experiment; chemistry and its specific areas, etc. The urgency of basic researches on the given problem is connected by that any of the listed areas has no theoretical complex description for processes in a friction zone. Many theoretical positions based on classical representations about friction zone where the lubricant was represented by structure with the elementary mathematical description and rubbing surfaces were homogeneous solids are not suitable. The specified features have led to following consequences: limited reliability of models of the frictional contact, essential toe-outs of theoretical and experimental results, insufficient introduction of results of basic researches in industrial areas, great volume of unresolved problems in area of reliability, durability and a residual or potential resource of tribological system. Trial results of the given direction have shown possibility of use of electric methods for creation of methodical base of experimental researches of a lubricant layer ability, viscosity (and viscosity and temperature), antifrictional, adhesive, physical and chemical, regenerative and others properties of lubricants.

Improvement of algorithms of gathering and information processing, improvement of models of electric-physical processes in a friction zone have allowed to expand the list of control. In 2008 the first industrial sample of diagnosing system of large-sized bearings on sheet-rolling camp is started. The science school which concern authors of this article, already has experience of introduction of scientific and technical results to industry. The introduction of scientific and technical result on such high level (it means largest in Russia metallurgical enterprise) is reached for the first time. It can be considered as an official recognition of efficiency and reliability of electric diagnostic methods of friction zone.