

The Methods of Long-life Calculation for a Friction Couple “Rotor – Hybrid Bearing”

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ABSTRACT

Most of rotary machines with a rotation rate of 10^5 rpm use a fluid-film bearing (FFB) as a support of the rotor. Fluid-film bearing unlike rolling-element bearings (REB) are not limited in high speed. But at the point of “start-up” and “shutdown” the wear of the FFB is certain to happen because of the dry frictions at these points. One of the possible solutions of the problem is the use of combination of two bearings – a REB and a FFB in the hybrid bearing according to the principal of speed separation (PSEX) (fig.1a). Such configuration allows to reduce rotation speed of the REB to a fraction of the shaft speed [1]. A rotor shaft rotates in a REB during start-up and shutdown. A FFB switches on at the main operating mode. In a hybrid bearing at the moment of “start-up” and “shutdown” the FFB is affected not by the rotor torque, but by the friction torque of a REB, which is several orders of magnitude less. Thus, the damaging load decreases and the service life of the whole PSEX increases.

The method of resource calculation for cylindrical friction pairs is based on the solution of a number of interdisciplinary problems: contact Hertz theory [2], the theory of the wear of a tribonode [3], the hydrodynamic lubrication theory [4].

The mechanism of the operation of the hybrid bearing leads to the assumption about the proportionality of wear rate to the speed of the outer ring of the REB. The simultaneous solution of the equations of rotary motion and wear dynamics allows to get the dependency of the resource on various working parameters of the PSEX and to compare it when the FFB is set alone (fig.1b).

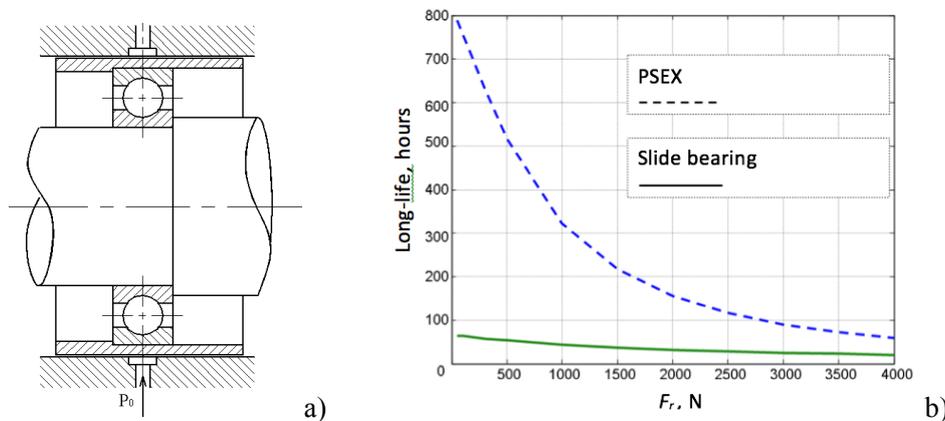


Fig. 1. Hybrid bearing with speed separation (a), long-life of the hybrid bearing (b)

The results show that the resource of the slide bearing increases significantly when it is used in combination with a rolling-element bearing compared to its single setting. Fig.1b shows that at different combinations of outer load the resource can become from 2 to 9 times longer.

REFERENCES

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