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The Influence of the Static Loading of the Bearing Subjected to Shock on the Damping Capacity of the Lubricant Film for a Radial Bearing with L/D=0.5 as a Function of Spindle Speed

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Abstract: *This paper presents experimental research on influence of the static load of the bearing subjected to the shock on the damping capacity of the lubricant film depending on the spindle speed. We focus on determination of the acceleration taken during the shock by the bearing-lubricant film-spindle system under different static and dynamic load conditions.*

Keywords: *acceleration of the bearing, damping capacity, radial sliding bearing.*

1 INTRODUCTION

The main objective of the experimental tests presented in this paper is to determine the acceleration taken during the shock by the bearing-lubricant film-spindle system under different static and dynamic load conditions, and to determine the influence of the static load of the bearing subjected to the shock on the damping capacity of the lubricant film depending on the spindle speed.

Due to the short time during which the dynamic loading takes place, the predominant phenomenon of realizing the lift of these bearings is the effect of expelling the lubricant from the interstitium. The effect of bringing the surfaces closer (squeeze) introduces effects similar to damping.

2. EXPERIMENTAL METHODOLOGY

In the framework of the experimental research, an additive mineral oil for bearings was used, type LA 32, STR 5152-89, viscosity class ISO VG 32 [2], [3].

The acceleration of the bearing at the time of application of the shock, in the 5 points P1-P5 on the bearing body, was determined with the help of the ADXL 190 WQC acceleration sensor, whose signal was acquired with the ADuC 812 acquisition board [4]. The output signal of the sensor is the electric voltage, at 250 mV corresponding to an acceleration of 9.8 m/s2, through the calibration established by the manufacturer [5].

The shaft of the radial bearing has the nominal diameter D=60 mm, the width L=30 mm, it is made of 18MoCr10, the bronze bearing in the composition, 88% Sn, 8%Sb, 4%Cu. Or carried out experimental research for spindle speeds of 370 and 600 rpm. In the case of the measurements, we considered the static loading of the bearing with the forces G1 =2250 N, respectively G2 =4500 N. The considered dynamic loading of the bearing is F=3332.5 N, which corresponds to a weight release height that models the dynamic stress H=40 cm.

Figure 3 shows the bushing bearing in experimental research having L/D=0,5 [1]

Fig. 1. The experimental stand with the ADXL 190 WQC acceleration sensor

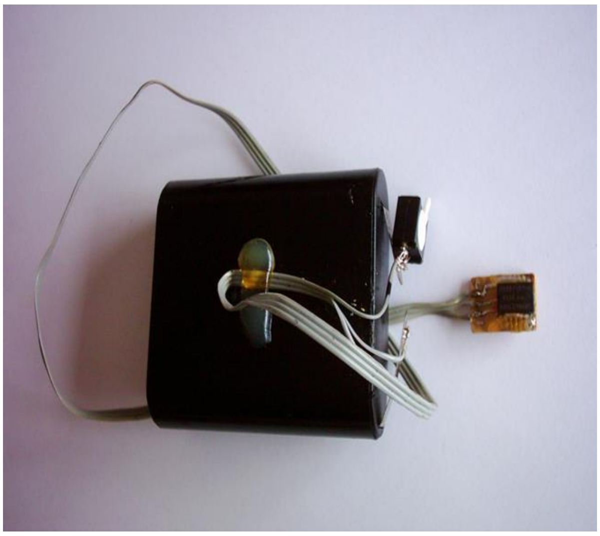

Fig. 2. ADXL acceleration sensor 190 WQC and power supply

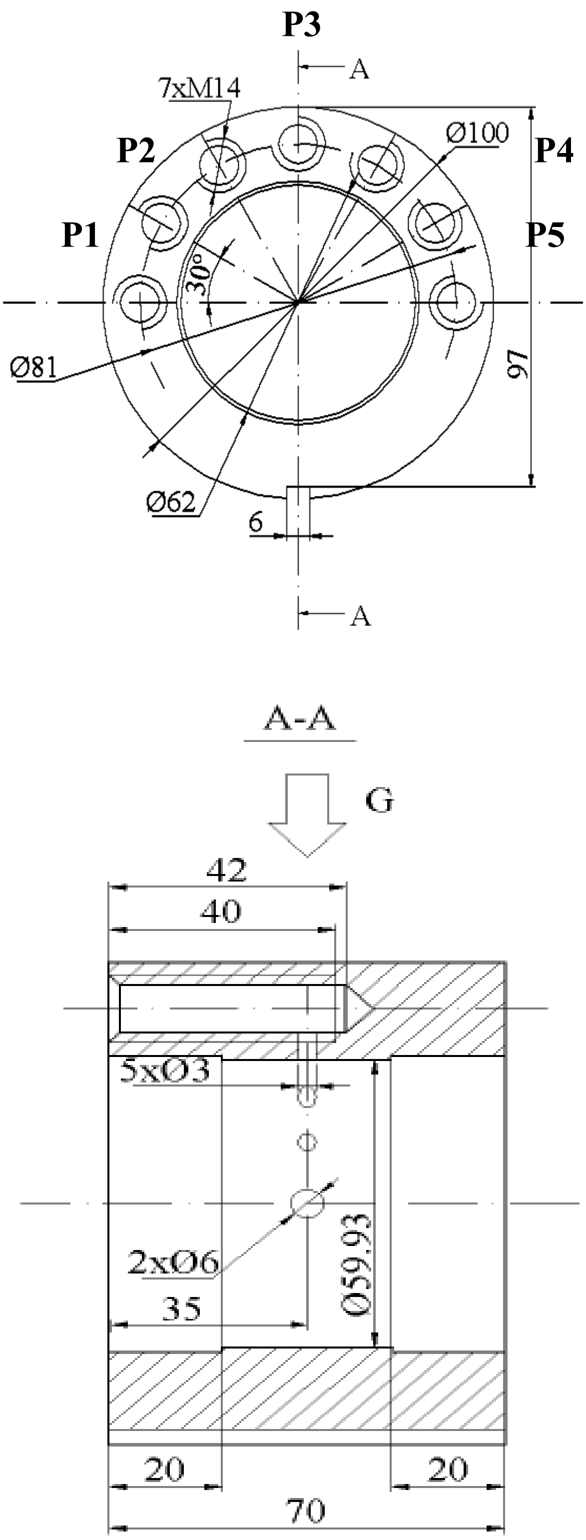

Fig.3. The bushing bearing of the study. hows the bushing bearing in experimental research having L/D=0,5 [1]

3. EXPERIMENTAL RESULTS

The experimental results presented in this paper include the determination of the acceleration taken during the shock, by the bearing-lubricant film-spindle system under the conditions of static loading with forces G1 and G2, at speeds of 370 rpm, **Figure 4** (next page)**,** respectively 600 tot/min in **Figure 5** (next pages) for each of the 5 positions P1-P5 on the periphery of the bearing, under the conditions of dynamic loading with force F=3332.5 N.

4. CONCLUSIONS

Due to the short time during which the dynamic loading takes place, it can be concluded that the predominant phenomenon of realizing the lift of these bearings is the effect of expelling the lubricant from the interstitium;

Through an "isothermal" approach, constant viscosity in the interstitium is considered, the hypothesis of the narrow bearing ("narrow bearing theory") is accepted. The approximation is acceptable for values $L<0.7\ D$ provided that the eccentricity is not very high ($\varepsilon< 0.9$);

Keeping the spindle speed constant, with the increase of the static load, from G1 to G2, the pressure curve curve moves in the direction of the pressure increase with the allure oriented towards the P1, P2 positions on the periphery of the bearing.

When the spindle speed increases, the displacement of the pressure filter in the direction of its increase, towards the positions P3, P4 on the periphery of the bearing, is observed.

For the same static and dynamic load, when the speed increases, the shock absorbed by the bearing - lubricant film - spindle system is greater; the damping of the initial shock in the two situations of the spindle speed is achieved after approximately 5 ms;

The shock amplitude is greater for the maximum position of the static pressure on the spindle circumference, thus, for speeds n=370 rpm and n=600 rpm, this maximum coincides with position P3 on the spindle circumference, the maximum shock amplitude, in all investigated situations it was recorded in the period 0.5-1 ms

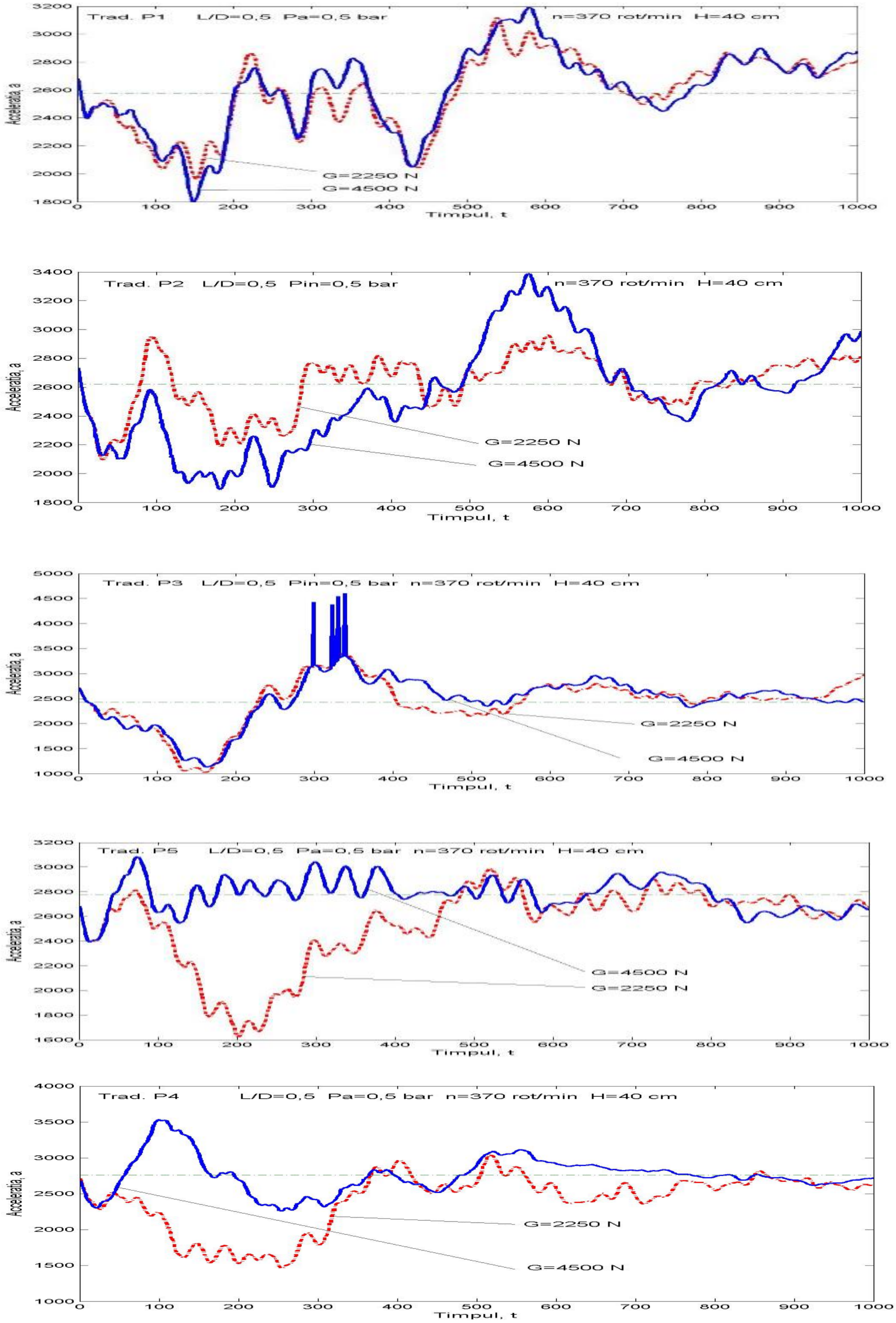

Fig. 4. Acceleration of the bearing on the moment of the shock corresponding to positions P1-P5 on the periphery of the bearing at n=370 rpm, p_a =0.5 bar depending on the static loads G1, G2

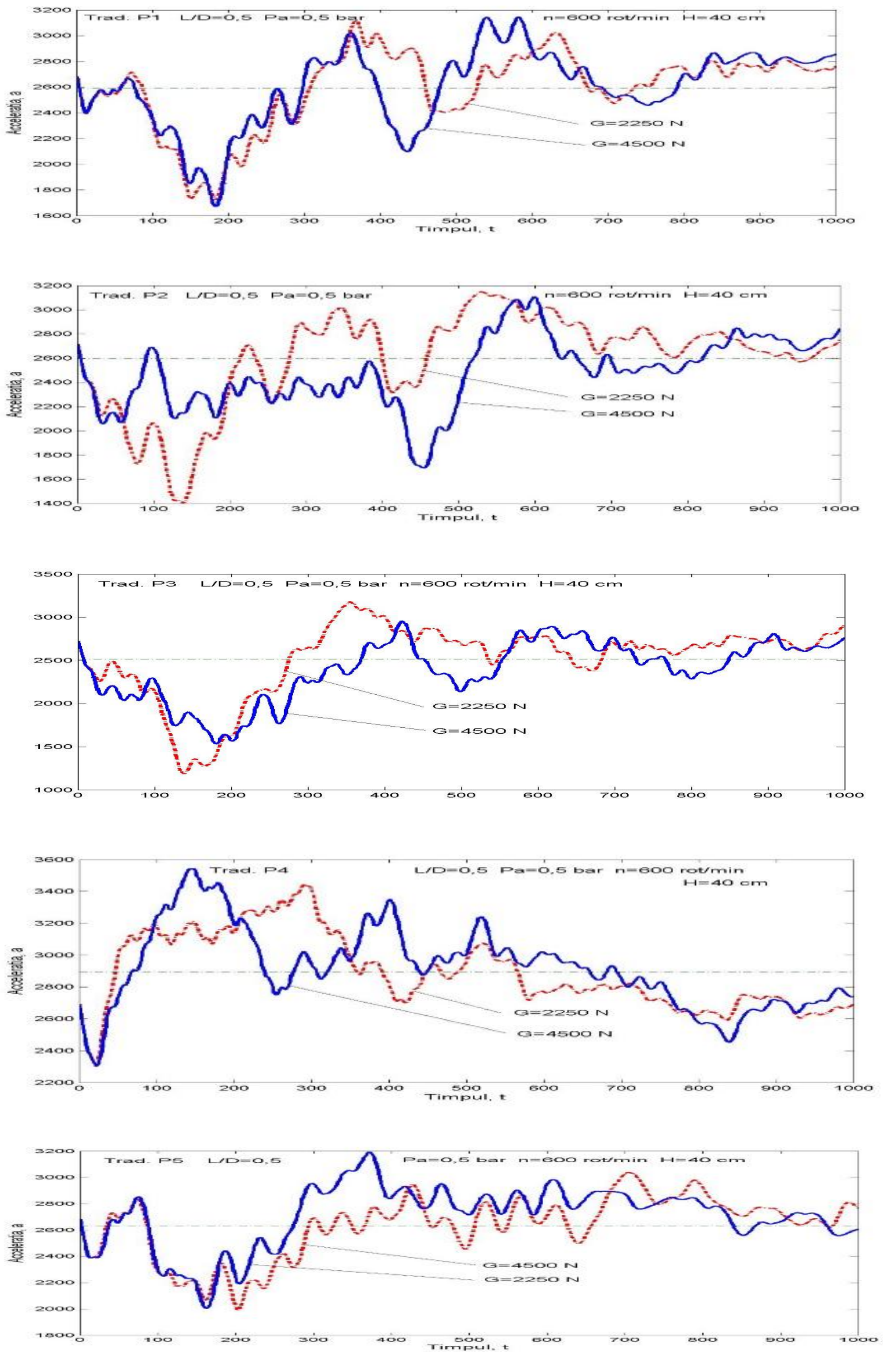

Fig. 5. Acceleration of the bearing on the moment of the shock corresponding to positions P1-P5 on the periphery of the bearing at n=600 rpm, p_a =0.5 bar depending on the static loads G1, G2

REFERENCES

[1] Alexandrescu, I. M. (2005), Studiul comportării lagărelor radiale cu ungere hidrodinamică în condiţiile funcţionării cu şocuri şi vibraţii. Teza de doctorat, Universitatea Tehnică Cluj-Napoca, 2005, Conducător științific: prof. dr. ing. Eugen PAY Dr. H.C.

[2] Alexandrescu, I.M., Cotețiu, R.I., Haragâș, S. (2019), Research on the load bearing force in narrow sliding radial bearings (L < 0,7 D) operating in shock conditions. Acta Technica Napocensis, Technical University of Cluj-Napoca, Series Applied Mathematics, Mechanics, and Engineering Vol. 62, Issue II, June, 2019 ISSN 1221-5872, pag. 299-308.

[3] Şugar, I.R., Chiver, O, 2020, Experimental Study on the Functioning of the Traction Batteries for Hybrid Vehicles, INGINERIA AUTOMOBILULUI, Issue: 55, pp. 23-26, Bucureşti, ISSN 1842 – 4074: WOS:000549564000007

[4] ***, National Instruments. Data Acquisition Product Guide, 2001

[5] ***, ADuC 812 MicroConverter. Analog Devices Inc., 2003

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