Serbian Tribology Society

University of Belgrade,
Faculty of Mechanical Engineering

10th International Conference on Tribology

BALKANTRIB '20

PROCEEDINGS

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Tribology of Machine Elements

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LOAD CAPACITY FOR SELF-LUBRICATING SLIDING BEARINGS

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Self-lubricating sliding bearings are widely used in numerous industrial applications, primarily regarding their specific lubrication mechanism. This lubrication mechanism is the main advantage compared with classical sliding bearings because their production is not complex and makes lower prices. According to the bearing material and type of exploitation, self-lubricating sliding bearings could operate with oil (grease) in their material structure or even without any amount of lubricant. This paper is dealing with the load capacity of the bearing, as probably the most important parameter in the aim to make a proper bearing choice for a particular application and corresponding operating conditions.

Keywords: *sliding bearing, self-lubricating, load capacity, operating speed, experimental investigations.*

1. INTRODUCTION

Most machine and equipment manufacturers are trying to reduce friction loss and make the simplest as possible lubrication in aim to settle production costs preserving most machine performances during their working life. According to significant investigations, more than 50 % of bearing failures are lubrication related (Fig. 1) which makes huge annual loss due to downtime and repairs to equipment damaged by poor lubrication [1].

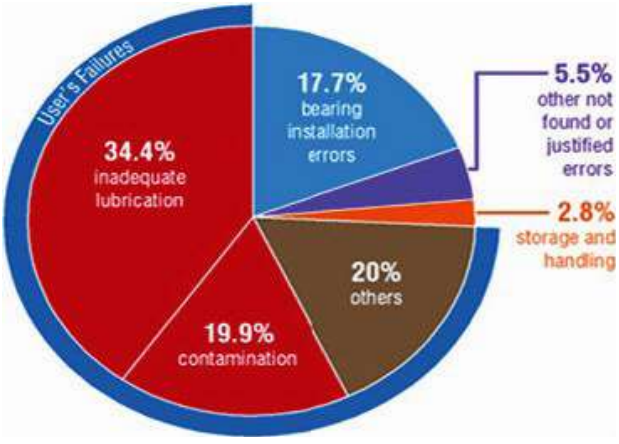

Figure 1. Types of lubricated related bearing failures

There are well-known groups of self-lubricating sliding bearings based on lubrication type, which determines their load capacity such as all other performances relevant for different applications:

- Sliding bearings that work without using any amount of oil or grease. These bearings are made of special plastics, graphite, or some ceramics materials.
- Sliding bearings that contain a lubricant, either in special storage or in their material structure. The best known in this group are porous metal bearings made by the sintering process and they are the product of powder metallurgy [2].

2. BEARING PERFORMANCES

The mechanism of self-lubrication in porous metal bearings makes the lubrication process better, but the coefficient of friction still takes values in a wide interval. That can be understood if we know that bearing life works in regimes from boundary to hydrodynamics lubrication. Lubrication quality and kind of regime are been defined due to all parameters which have an impact on friction. Besides bearing temperature, quality, and quantity of oil supply, a significant impact has doubtless a coefficient of friction value under particular load capacity and sliding velocity. Those important

bearing performances for different self-lubricating bearing groups were determined by experiments, where overview is presented in Figure 2 [3].

	Solid bronze	Sintered bronze	Wrapped bronze	PTFE composite	POM composite
Temperature range, °C	–40 .. +250	–10 .. +90	–40 .. +150	–200 .. +250	–40 .. +110
Friction coefficient, μ	0,08 .. 0,15	0,05 .. 0,10	0,08 .. 0,15	0,03 .. 0,25	0,02 .. 0,20
Permissible load, N/mm²					
– dynamic	25	10	40	80 (v ≤ 0,02)	120 (v ≤ 0,02)
– static	45	20	120	250	250
Permissible sliding velocity, m/s	0,5	0,25 .. 5	1,0	2,0 (p ≤ 1,0)	2,5 (p ≤ 1,0)
Shaft tolerance	e7 – e8	f7 – f8	e7 – f8	f7 – h8	h7 – h8
Housing tolerance	H7	H7	H7	H7	H7
Shaft roughness R_a, μm	0 .. 1,0	0,2 .. 0,8	0,4 .. 0,8	0 .. 0,4	0 .. 0,8
Shaft hardness, HB	165 – 400	200 – 300	150 – 400	300 – 600	150 – 600

Figure 2. Bearing materials performances overview

Possible the most important performance of sliding bearing, which defines its load capacity is "*pv*-characteristics", (operating range) determined by experiments. It is a crucial parameter in the aim to make a proper choice of sliding bearing for the particular application. This characteristic shows operating ranges for sliding bearing, which means limits of bearing load *p* in correlation with operating sliding speed *v*, as shown in Figure 3, for PTFE composite material [3].

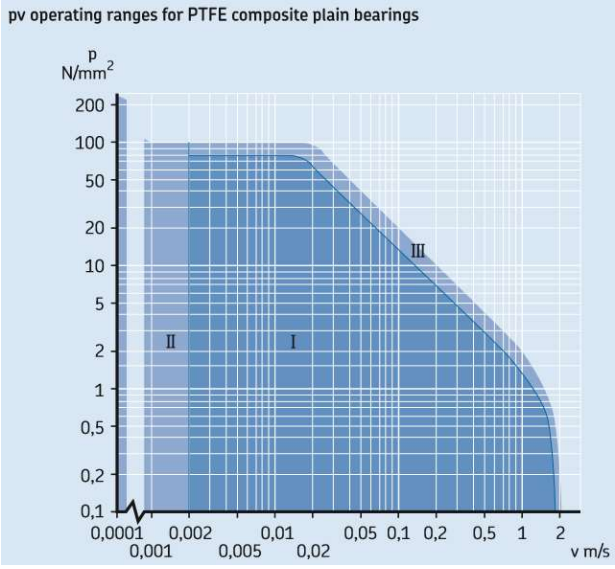

Figure 3. Bearing *pv*-operating range for PTFE

Investigation of porous metal bearings including their load capacity under corresponding sliding speed are been conducted at Belgrade University in Machine Design Lab., Mechanical Engineering Faculty. Those experiments were made on special test rigs USL5-30 with DAQ equipment in aim to simulate real working conditions subjected to explore main parameters trend, as temperature and coefficient of friction values during the sliding bearing exploitation [4]. Observing those results for porous metal bearings leads us to use new polymer-based and composite materials for particular applications. Regarding their advantages, plastic bearings are a good solution for many applications in machinery that require a clean and oil-free operation, corrosion resistance, high damping characteristics for vibrations, ability to reliably work under static or dynamic loads in dry conditions [5].

3. CONCLUSIONS

With this paper, the authors attended to give just a preview of load capacity investigation and several self-lubricating sliding bearing performances with practical implications. This study could represent an introduction in further researches of plastic bearings subjected to make simpler machine maintenance and better energy efficiency. Great expansion and clear explained advantages of polymer and plastic bearings application in several branches of industry, encourage us not only in the investigation of new polymer materials but also for new qualitative bearing behaviour analysis in dry, maintenance-free and conditions under different lubricants during exploitation life.

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