POWRÓT

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THE INFLUENCE OF GREASES' PROPERTIES ON POROUS BEARINGS WORK

WPŁYW WŁAŚCIWOŚCI SMARÓW PLASTYCZNYCH NA PRACĘ ŁOŻYSK POROWATYCH

Keywords:

porous bearings, grease, self-lubricated bearings.

Key-words:

Summary:

The results of stand investigations of porous bearings are presented in this article. Four different greases – based on mineral and on synthetic oils were used as lubricants. The influence of chemical constitution on working parameters of bearings is presented. Over hundred hours of stand investigations were done. Working temperature and resistance to motion were measured during stand investigations.

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INTRODUCTION

Porous self-lubricating bearings are used in installations, where conventional lubricating is ineffective (for example in low temperature, in vacuum, in chemical active entertainment), risky (f.e. in installations for food, pulp and paper, textile industries) or unprofitable.

The seizure of porous bearings is caused by loss of self-lubricating properties. It results from too high bush's wear as well as lubricant's losses. Properly selection of lubricant is very important in order to obtain maximum durability with good parameters of work. Nowadays users apply porous bearings saturated mostly by oils. Greases are used more rarely, which seems not to have any justification. Also Polish Norms, and foreign normative documents qualify only oils as lubricants to saturating the porous bushes. The results of research of greases as lubricant for porous bearings working in self-lubricating regime are presented in this article.

RESEARCH METHODS

The estimation of influence of greases' properties on work of porous bushes was an aim of done stand investigations. The propriety of use this kind of lubricants in porous bearings was indirectly investigated.

The investigated greases mentioned below:

BM 2 – mineral grease,
BS 2 – synthetic grease, } "base greases" – these greases did not contain any additives but base oil and thickener

H 2 – mineral grease,
H 3 – mineral grease. } commercial greases

Mineral grease BM 2 is based on the mineral oil base (1114) and synthetic BS 2 is based on the synthetic oil base (HC-4). Greases H2 and H3 are based on the mineral oils, but producer does not specify them These grease contain EP additives based on MoS_2.

In these investigations we used sintered bushes with below properties:

chemical constitution	97,5% Fe + 2,5% Cu,
dimensions	∅25×∅35×20 mm,
open porosity	21,5%
density	6,15 g/cm^3.

In order to research base properties of investigated lubricants like dropping point and penetration were evaluated. It helped to estimate the high limit working temperature without fear for destruction of greases and evaluate their rheologic parameters.

The saturation of bushes was done in vacuum drier using following parameters: temperature 140°C, time of saturation 120 minutes, negative pressure – 0,08 MPa.

During stand investigations porous bushes worked with steel shafts with hardness about 65 HRC. The bearing slackness was applied about $z \approx 0{,}050\ldots0{,}060$ mm. The investigation was performed at load p ≈ 1,08 MPa, rotational speed n = 1000 rpm (v ≈ 1,31 m/s) during 107 hours, but in 8…12 hours intervals. There were investigated twenty two bearings, six saturated by BM 2, five by BS 2, six by H2 and five by H3. Investigations were accomplished on stand, which was presented in.

RESULTS

Base properties of investigated greases are shown in fig. 3.

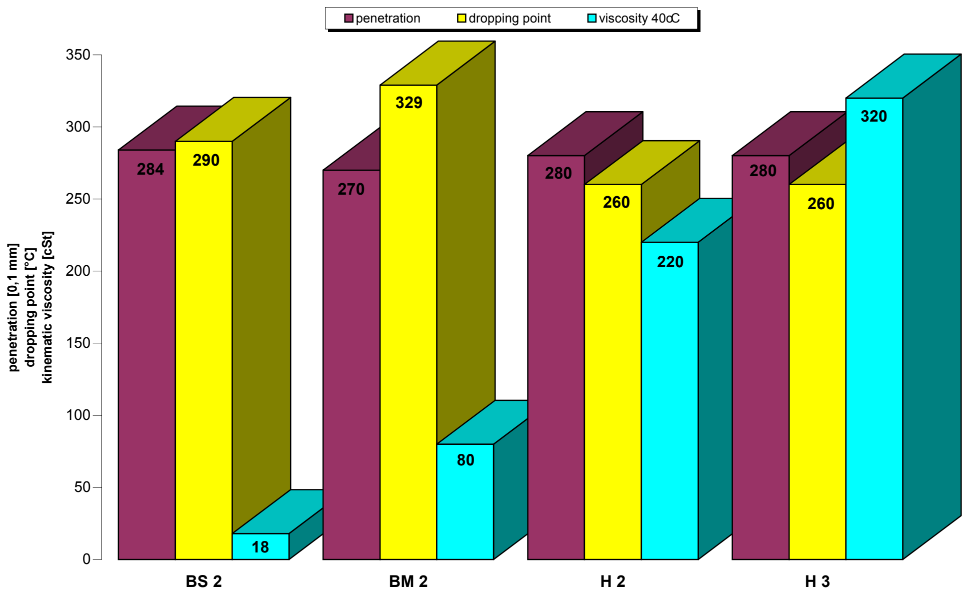

Fig.1. Penetration, dropping point and kinematic viscosity of base oil (at 40°C) values obtained for investigated greases.

Rys. 1. Wartości penetracji, temperatury kroplenia i lepkości kinematycznej oleju bazowego (w 40°C) uzyskane dla badanych smarów

Obtained results of penetration classify all greases in "2" class according NLGI. High dropping point temperature let to use porous bushes in high temperature without fears about destruction of greases.

Selection of greases for investigations allowed estimating an influence of chemical constitution of lubricants on working parameters of bearings. Basic properties like penetration and dropping point values are similar for all greases, but they are based on different base oils.

The kinematic viscosity of base oils of greases, which value was given by producer, is different for all greases. It shows differences in structure of investigated greases.

The stand research results of investigated bushes are given in fig. 2, 3, 4 and 5. They show changes of work parameters of bearings (coefficient of friction and working temperature), saturated by greases BM 2, BS 2 (fig. 2 and 3) and saturated by H2 and H3 (fig 4 and 5), in time function during 107 hours.

The figures show changing of mean values of measured work parameters with standard deviation (mean value ± 1SD). Trend lines were added also.

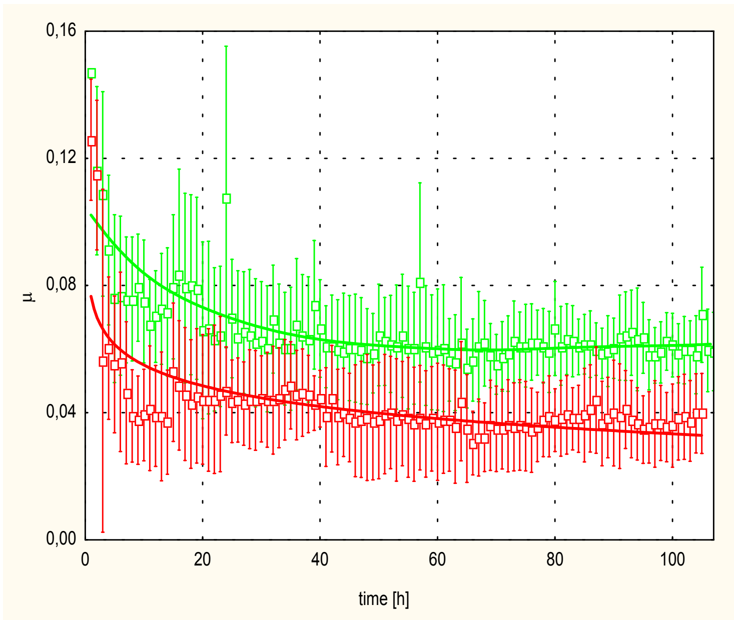

Fig.2. Changing of mean value of friction coefficient μ for bushes saturated BM 2 --- and BS2 ---.

Rys. 2. Przebieg średniej wartości współczynnika tarcia μ dla tulei nasyconych saturated BM 2 --- i BS2 ---.

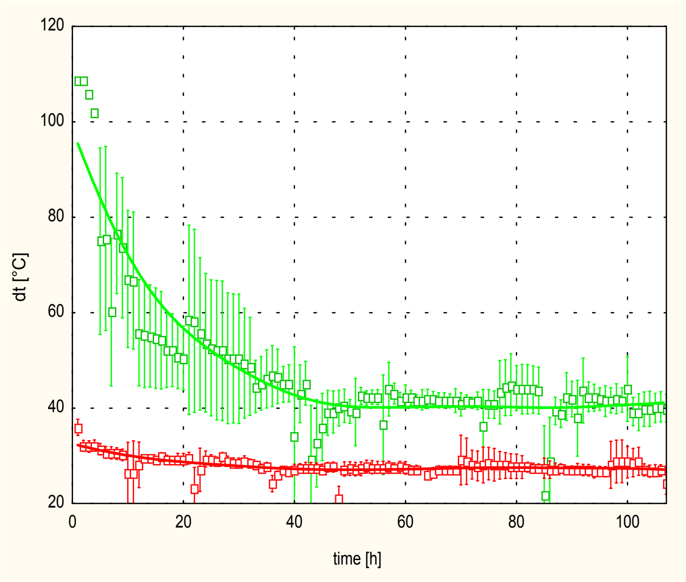

Fig.3. Changing of mean value of temperature-rise *dt* for bushes saturated BM 2 --- and BS2 ---.

Rys. 3. Przebieg średniej wartości współczynnika tarcia *dt* dla tulei nasyconych saturated BM 2 --- i BS2 ---.

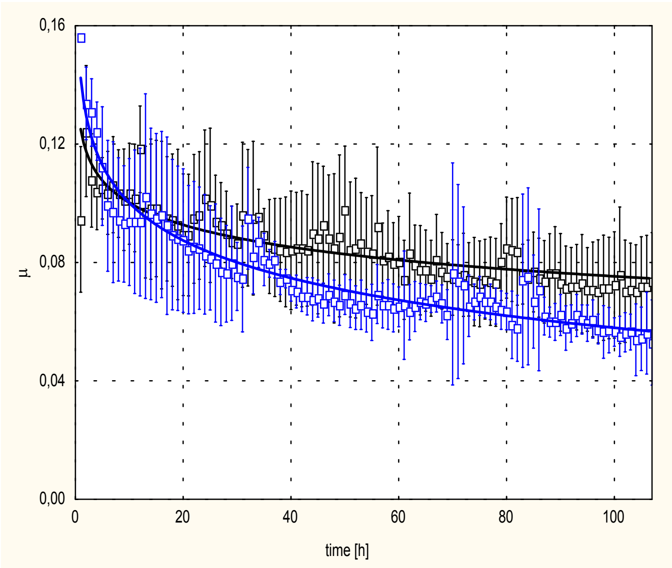

Fig.4. Changing of mean value of friction coefficient μ for bushes saturated H2 --- and H3 ---.

Rys. 4. Przebieg średniej wartości współczynnika tarcia μ dla tulei nasyconych saturated H2 --- i H3 ---.

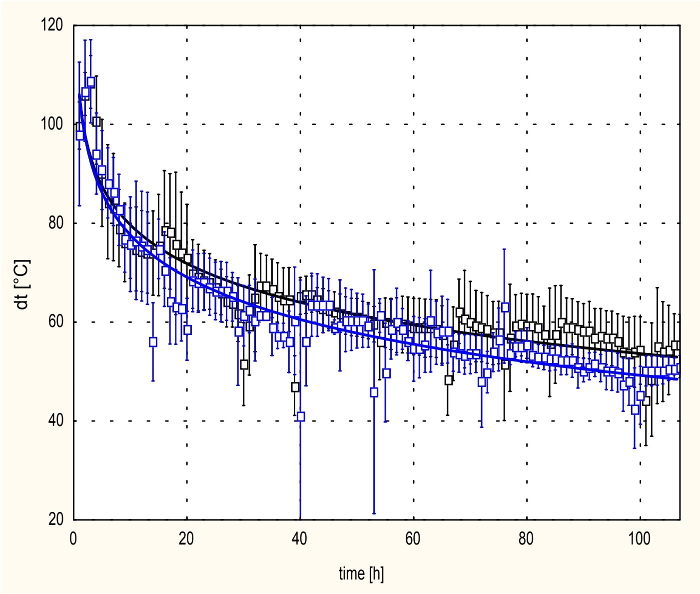

Fig.5. Changing of mean value of temperature-rise *dt* for bushes saturated H2 --- and H3 ---.

Rys. 5. Przebieg średniej wartości współczynnika tarcia *dt* dla tulei nasyconych saturated H2 --- i H3 ---.

The value of friction coefficient μ were evaluated according following evaluation (1):

$$\mu = \frac{2 \cdot M_T}{P \cdot d}, \qquad (1)$$

where: M_T – moment of friction [Nm],
P – load [N],
d – inside diameter of bush [m].

The temperature-rise *dt* in fig. 3 and 5 were determined as difference of working temperature t_w and ambient temperature.

There was a big resistance to motion, which caused a quick increase of temperature in first stage of work for all bearing. Increased temperature was conductive to intensive release of lubricant from pores of bushes, what allowed to decrease of resistance to motion. The first wearing-in stage caused stabilisation of resistance to motion values and working temperature. Wearing-in takes about 40 hours for bearings saturated BM2 and BS2 (fig. 2, 3), but bearings saturated with BS2 characterised more stability of coefficient of friction and working temperature curves than bearings saturated BM 2. During all work we observed (fig. 2, 3) that grease BM2 causes higher μ value, and higher *dt* than BS2. It was about $\mu \approx 0,04$, $dt \approx 25…30°C$ for BS2 and $\mu \approx 0,06$, $dt \approx 40…45°C$ for BM2 during stable work (40…107h).

For bushes with H2 and H3 we observed decrease of μ value during all test. Probably wearing-in stage has not ended for these bearings during 107 hours of investigations. Operating characteristics for these bushes were very similar (fig. 4 and 5). Differences of μ and *dt* values were not big. Finally it was about $\mu \approx 0,07$, $dt \approx 55°C$ for H 3 and $\mu \approx 0,06$, $dt \approx 50°C$ for H 2.

DISCUSSION

Basing on done stand investigations of self-lubricating bearing and laboratory investigations of lubricants we can see the influence of chemical composition on operating characteristics. At given parameters of work ($p \approx 1,08$ MPa, $n = 1000$ rpm) bushes saturated by synthetic greases were characterised by lower resistance to motion and lower working temperature. Bushes saturated by synthetic greases occurred quicker wearing-in than bushes with mineral greases, what caused more profitable lubricating conditions.

Application of commercial greases, with special additives, like H2 and H3 have not good effect on operating characteristic of investigated bearings. Probably good lubricity of these greases slowed wearing-in process, what in given work parameters and during 107 hours caused worse work parameters.

For better understanding the influence of properties used greases on operating work of porous bearings further and longer investigations should be performed although use greases as lubricant to porous bearings seems well founded. The proper selection of greases, their properties probably improves operating characteristic of porous bearings and lets to increase their future application as self-lubricating bearings.

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PN-88/C-04133 Przetwory naftowe. Pomiar penetracji smarów plastycznych i petrolatum penetrometrem ze stożkiem.

Recenzent:
Marian GRĄDKOWSKI

Streszczenie

W artykule przedstawiono wyniki badań stanowiskowych łożysk porowatych. Cztery różne smary – na bazie olejów mineralnych i syntetycznych zostały użyte jako środki smarowe. Przedstawiono wpływ składu chemicznego na parametry pracy łożysk. Wykonano ponad 100 godzin badań stanowiskowych. W trakcie badań mierzono temperaturę pracy łożysk i opory ruchu łożysk.