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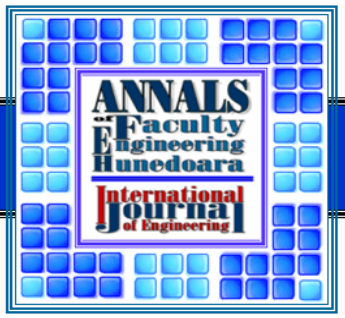

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APPLICATION OF DIFFERENT TECHNICAL PLASTICS IN MECHANICAL ENGINEERING – SLIDING BEARINGS

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ABSTRACT: In recent decades the manufacturing of sliding surfaces made of technical plastics was developed rapidly. These new materials fulfill the economical and technical requirements of customers such as: lack of lubricant, lifetime, construction of the bearing and of course, its price. The selection of materials applying nowadays became much greater than in the previous time concerning the basic materials and their mixtures (composites). Polymer-composites for special applications are developed by leader firms.
KEYWORDS: Sliding surface, compound, plastic, sliding bearing

❖ INTRODUCTION

In case of great load in the interest of abrasion resistance and restrain the scoring metal sliding bearings have to be lubricated. In the interest of reduction of maintenance of bearings emerged the application of materials of service-free bearings.

On the other hand service-free bearing materials have to be used in case of quite low or high work temperature, moreover high level purity requirements the lubrication would be impossible. Special bearing materials having no adhesivity with the surface shaft can be used. These materials are technical plastics and their composites. In the interest of reduction of abrasion and friction the metal and plastic composites mainly contain reinforcing materials. Lubricating oil can be stored in plastic composites.

In up-to-date plants self-lubricating bearings are applied. Some examples: agglomerate bronze filled up with oil, self-lubricating metal-polymer, oil-free solid polymer sliding material. Application of technical plastics is especially advantageous in case of mixed friction state.

Plastics have other additional advantages:

- ☐ good corrosion resistance,
- ☐ chemical resistivity,
- ☐ good damping capacity,
- ☐ good electric insulating capacity,
- ☐ can be lubricated with water and other liquids,
- ☐ small mass,
- ☐ great loading capacity on low sliding capacity,
- ☐ low noise level.

In comparison them with metal bearings their greatest disadvantages are the heat insulating capacity and the great heat expansion [1,3].

❖ BEARING ELEMENTS MADE FROM ORDINARY PLASTICS

Fabric-filled phenolics, polyamide (PA), polyurethane (PUR), polyformaldehyde (POM), polyethylene glycol terephthalate (PET) as bearings are applied for a long time. In general their embedability are quite good and the level of danger of scoring is low. Their forming are mainly easy, they have good corrosion resistance and advantageous gliding characteristics.

In spite of these facts their application possibilities are limited because of heat insulating capacity and the great heat expansion.

Polyamides are often applied as bearing materials. These plastics can be applied as bearing materials without any additives or with less than 6 % molybdenum disulphide (MoS_2) or graphite additive. Additives in polyamide bearings improve the gliding characteristics and abrasion resistance of polyamides. For this reason polyamides can be applied as self-lubricating sliding bearings.

❖ BEARING ELEMENTS MADE FROM POLYETHERETHERKETONE (PEEK) [1]

Polyetheretherketone (PEEK) is more and more often applied to manufacturing of bearings exposed high load and their accessory parts (bearing cage, axle brass). Many different mixtures of this

high power polymer are known. Some of their characteristics strongly differ from each other for example the abrasion resistance. In Europe the Victrex Europe Co. (Hofheim, Germany) sells this polymer on brand-mark Victrex PEEK. The Lehmann & Voss Co. manufactures different mixtures from polyetheretherketone. A new PEEK mixture was developed by this company recently. Its name: Luvocom 1105/XCF/30.

The partly crystalline material (PEEK) is significantly heat-resistant and thermoplastic technical plastic. Its melting point is on 343°C, glass temperature 143°C, it can be applied up to 260°C.

The PEEK is base material of many plastic mixtures (compound). Added to plastic-matrix reinforcing materials (carbon filament, glass-fiber, ceramic, metal) different type of bearing materials can be obtained fulfilled the requirements of special application. Beside of reinforcing materials polytetrafluoroethylene (PTFE) or graphite can be added to the mixture [2,5].

The PEEK bearing material named VITREX 450FC30 has high mechanical strength, its abrasion resistance is better than the average level and it resists environmental effects. It's allowed (Lpv) value is significantly better than values of ordinary plastics (Fig. 1-2).

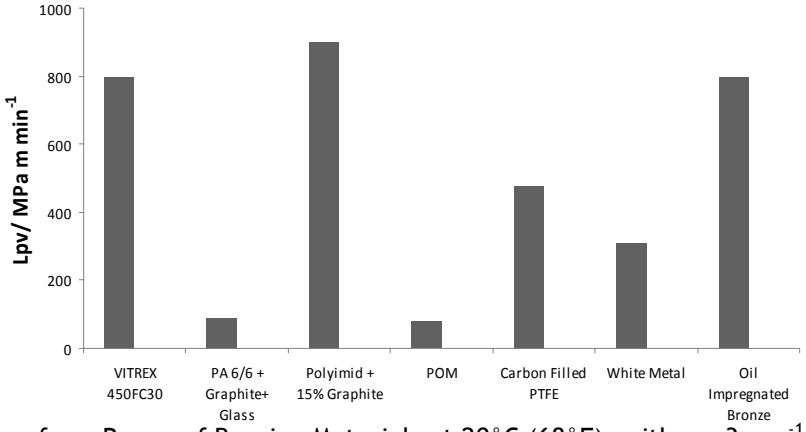

Figure 1 [5]. Lpv for a Range of Bearing Materials at 20°C (68°F), with v = 3 m s^{-1} (600 ft min^{-1})

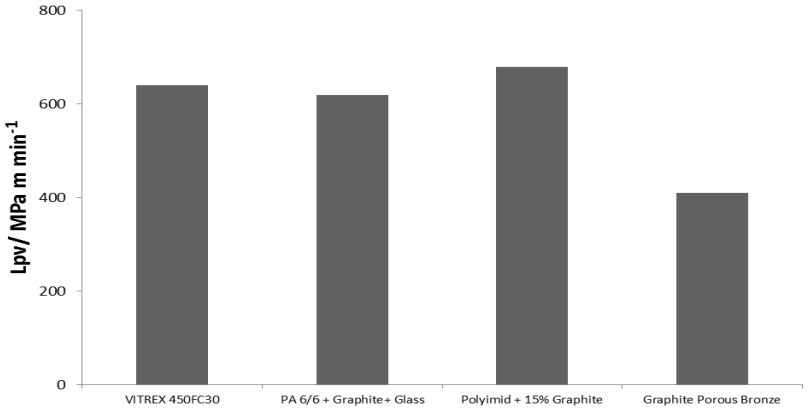

Figure 2 [5]. Lpv for a Range of Bearing Materials at 200°C (390°F), with v = 3 m s^{-1} (600 ft min^{-1})

❖ BEARING ELEMENTS WITH TEFLON-FIBER

Among SKF products the sliding bearings with Teflon cord have great dynamical loading capacity and the direction of their bearing power can be variable (Fig. 3). This bearing material is developed for great bearing power, vibration and corrosion.

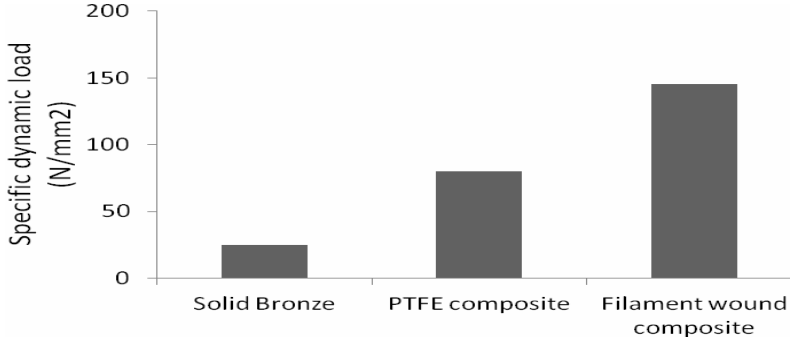

Figure 3 [6]. Load carrying capacity. Comparison of the permissible specific dynamic loads for different SKF sliding materials (sliding speed less than 0,01 m/s)

The sliding surface consists of fiberglass combined with acetone-formaldehyde resin, polyethersulfone (PES) and Teflon fiber (PFTE). The fibers are rolled in more rows. Due to special

sliding characteristics PFTE and PES enable very small coefficient of friction without lubrication and maintenance [6].

❖ BEARING ELEMENTS MADE FROM PLASTIC-METAL COMPOSITE

These bearing elements unify mechanical strength of metal and the low frictional coefficient of Teflon basis self-lubricating sliding surface. The central part made from porous bronze guarantees the strong connection and contributes to heat conduction. Teflon coating can be strengthened by glass-fiber or polymer fiber. One of possible structure is demonstrated by section of bearing of GGB Bearing Technology DP20™ (Fig. 4) [1,3,4,8].

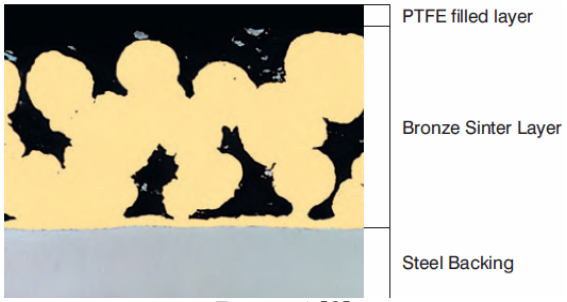

Figure 4 [8]

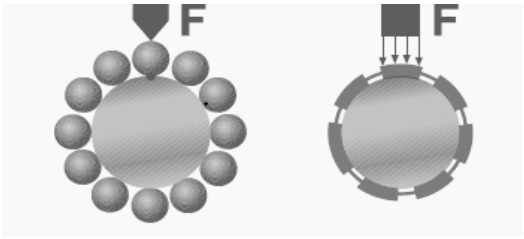

Figure 5 [7]

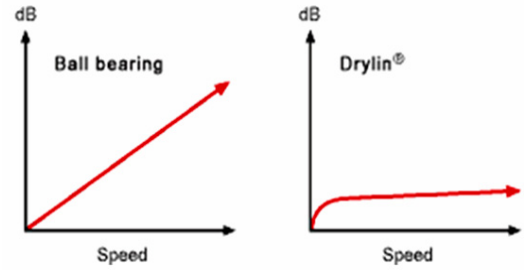

Figure 6 [7]

❖ LINEAR SLIDING BEARINGS

Linear sliding bearings move on gliding elements differently from circulating ball system. In this way the contact surface is much bigger and as a result the contact pressure significantly lowers (Fig 5).

High abrasion resistance polymers were developed by The Ltd. igus® to „DryLin R" linear series fulfilled special demands of linear sliding bearings. The linear sliding bearing systems were constructed to dry continuous operation. During their operation there is no oil or grease pollution. Linear sliding bearings can be applied in environment of sand and other pollution.

Contrary to circulating ball systems there is no problem for „DryLin R" linear sliding bearings the extremely short-stroke displacements. Application of plastic bearing sleeves decreases the operation noise (Fig.6) [7].

❖ CONCLUSIONS

Summing up of the above mentioned: it can be seen that technical plastics play more and more important role in application of sliding surfaces. This trend can be realized on the basis of wide range of offering and developmental results of manufacturers: new polymer mixtures, metal-plastic pairing and additives to fulfil special technical requirements.

Due to these facts in these fields the application of technical plastics has risen rapidly. Taking into consideration the continuous modification of demands and increasing technical requirements can be seen clearly for the future: the application of plastic sliding surfaces will be more and wider in order to replace metal products.

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