MAKING A CASE FOR NON-METALLIC PUMP BEARINGS

This article will discuss some of the issues associated with vertical pump bearings in general, and non-metallic bearings specifically. Non-metallic bearings may not be the best answer in every case but have been an excellent choice for a great many applications worldwide. In general, these will be product lubricated bearings thus precluding additional contaminants (oils, greases) infiltrating the pumped fluid.

Non-metallic materials include rubbers, synthetic rubbers (elastomers), plastics, graphite based materials, ceramics and lignum vitae.

Design

When selecting bearings for a given application, there are many design issues to be considered involving aspects from both bearing and pump design. Bearings in a vertical pump are a necessary machine component forming the basic support structure for the power transmission system from the driver to the impeller(s). This system must be designed and selected with all the pertinent mechanical aspects considered to ensure that the overall performance will be satisfactory for the pump operating life. If the pump design and operating conditions are not carefully explored, the bearings being the weak link in the chain will indicate distress well before other components in the pump are affected. This is true whether the issue belongs specifically to the bearings or the pump.

Bearing Considerations

The typical length of non-metallic bearings conforms to L/D ratios ranging from 1 to 1.5. Bearing stiffness values for the general range of pump shaft sizes will be equivalent to metallic bearings from a shaft and column dynamics standpoint.

Loading of vertical pump bearings is difficult to analyze in general. It will normally be fairly light establishing bearing stability as a significant issue. While typical pump speeds are not high enough to develop serious observable instability effects, such activity may have detrimental outcomes on the life of a bearing.

Grooves in the bearing will tend to develop centering forces and small side loads may result from the stack up of tolerances during the assembly stage. For this situation, minor assembly offsets may be a good thing, resulting in improved operating stability.

Bearing clearances must be adequate to allow free running of the bearings but not so large as to compromise the important shaft support mechanism provided by the bearing. Typical running clearances will be 0.0015 mm/mm (0.00006 in./in.) of shaft diameter with a minimum of 0.08 mm (0.0031 in.). In the case of non-metallic materials, consideration must be made for fluid absorption and thermal expansion. These allowances, although less for Thordon than for most other materials, must be considered and may be minimized by reducing wall thickness to minimum values. In any case, the operational dynamics of the pump will be dependant on establishing correct running clearances between the shaft and bearing.

Standard pump sleeve materials such as 400 or 300 series stainless steels will function well with Thordon. For salt or brackish water applications, better corrosion resistance will be experienced with the 300 series or duplex type stainless steels. If significant abrasives are present in the pump fluid, enhanced life of the bearing system will be achieved with hardened sleeves. In such case, superior performance has been achieved with Thordon GM2401 material mated with nickel chrome boron (NiCrB) coated shaft sleeves.

In general, grooves should be provided to allow adequate flow through the bearing and to allow easy passage of any abrasive particulate debris. Some smaller bearings (under 50 mm or 2 in. shaft dia.) operating in clean fluids may work well without grooves. In either case, the recommended supply of clean water must flow through the bearing to ensure adequate lubrication and cooling.

Pump Issues

Bearing spacing is the province of the pump designer, but is often an issue for pump re-builders if bearings of different materials are contemplated. The preferred design approach is to provide a shaft/bearing system stiffness having the first bending critical of the shafting above the operating speed by a margin of 10 to

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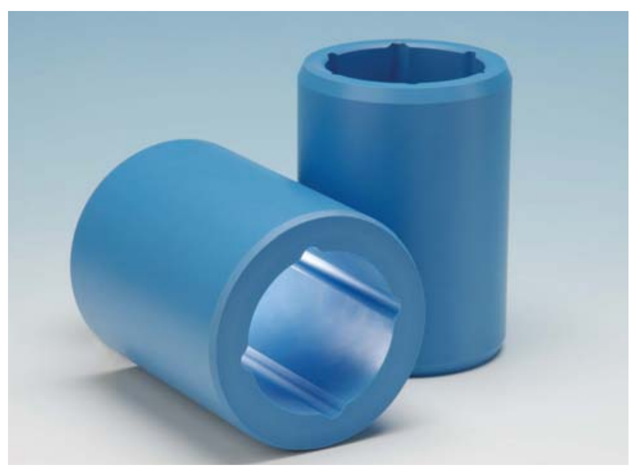

ThorPlas® pump bearings offer a broader chemical compatibility and higher operating temperatures than other Thordon grades

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Elastomeric Thordon SXL pump bearings offer excellent load distribution, low coefficient of friction and dry start-up capability

20% (stiff shaft design). However, for small shafting using more flexible bearings such as rubber, it has been well accepted to design based on the operating speed falling between the first and second bending critical speed (flexible shaft design).

The above shafting criticals must be determined using the stiffness values for the actual bearings and support system in use. The stiffness of a Thordon bearing will be large enough in comparison with typical shaft bending stiffness to be considered equivalent to a metal bearing for establishing spacing requirements. Use of a less stiff rubber material may require closer spacing of the bearings or a change in philosophy to the flexible shaft design.

Most of the installed vertical pumps worldwide do not have any lateral structural support below the pump mounting floor. This means that the casing holding the bearings, which are supporting the shafting, is itself quite flexible and subject to the possibility of resonance in the operating speed range. If this issue is not carefully investigated in the design of the machine, the bearings may suffer odd wear patterns which may not be easily interpreted.

Many vertical pumps are located in sumps without proper attention to approach velocities, or clearance guidelines provided in the literature for bottom, back wall, sidewall, or neighboring pumps. This may result in cavitation and/or separation producing excessive turbulence in operation. In addition, if minimum submergence recommendations by pump manufacturers are contravened, vortexing may be generated allowing air to be entrained in the suction flow with associated undesired machine vibrations.

Many pumps are operated across the performance curve without appropriate consideration for the best efficiency point. If a pump is highly throttled, or allowed to run out well beyond best efficiency point, excessive vibration can again result with possible overheating and damage of product lubricated bearings.

It is common practice to dynamically balance impellers of vertical pumps to ensure smooth operation without vibration. However, if an impeller core shifts in the casting process, it will not only result in mechanical unbalance, but hydraulic unbalance as well. No amount of dynamic balancing can correct for the latter condition which may lead to excessive vibration and shorter bearing life.

Advantages of Non-Metallic Bearings

There are several advantages offered by non-metallic bearings such as impact capability, low friction, self-lubricating qualities, edge loading capability. Most non-metallics, Thordon included, offer significant electrical resistance. As a consequence stray currents will not be a factor in bearing erosion, and a connection point is not provided for galvanic activity.

The significant advantages of using non-metallic pump bearings will ensure many years of excellent service life provided the various design issues imposed upon the pump and system are carefully investigated and considered in the pump design or re-build stage prior to putting the machine into service.

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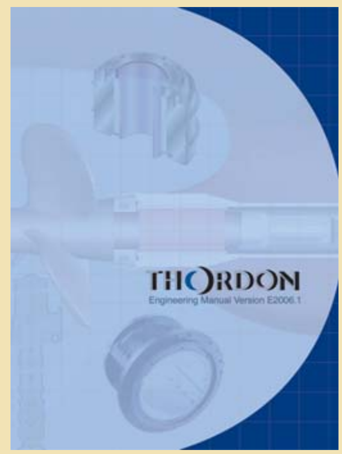

***New* Thordon Engineering Manual Version E2006.1**

Thordon Bearings has released its new Engineering Manual Version E2006.1 covering all Thordon elastomeric grades: XL, SXL, HPSXL, COMPAC and Composite/GM2401 (ThorPlas® will be covered in a separate Engineering Manual). This new version includes an update of technical information based on the most recent test data, and presents new material including technical updates, addition of HPSXL and COMPAC, chemical resistance chart as well as an expanded problems and causes section.

If you do not have your copy, please contact your local Thordon distributor or visit our website to order or download it: www.thordonbearings.com