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Conclusions drawn from bearing life equations

Fig. 1 shows an example of the influence of contamination on bearing life in general terms. A "real life example" best illustrates the various aspects of bearing life calculations. It shows the significance of operating loads, bearing selection and contamination on bearing life.

The pump considered here is a single stage, centrifugal type. Fig. 2 shows the performance curves and Fig. 3 radial load on the inboard bearing as a function of flow.

Since the pump is of single volute design, load is highly dependent on flow. The radial force is induced by an unbalanced pressure distribution in the pump volute. Knowing impeller weight, shaft dimensions, operating temperature, bearing type and lubricant properties, the expected bearing fatigue life can be calculated. The results are shown in Fig. 4. Both ball and spherical roller bearings are represented.

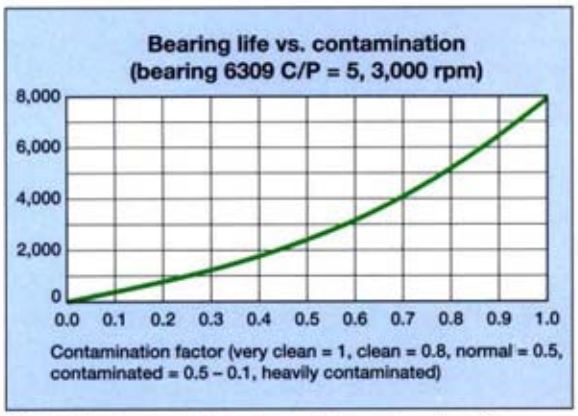

Fig. 1. Influence of contamination on bearing life.

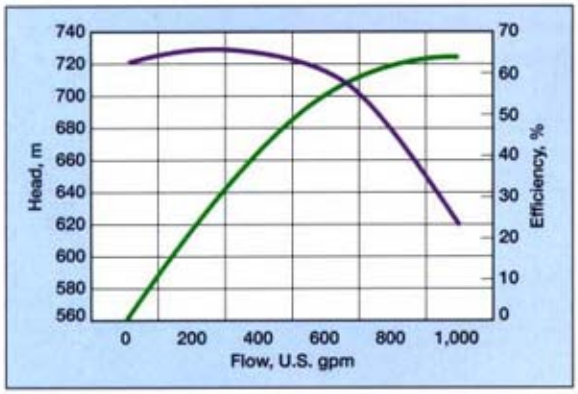

Fig. 2. Performance curves.

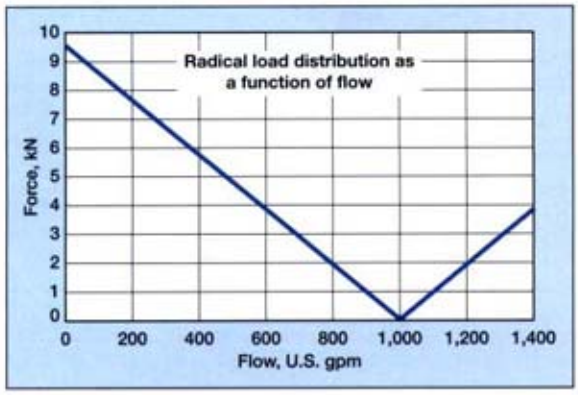

Fig. 3. Radial load.

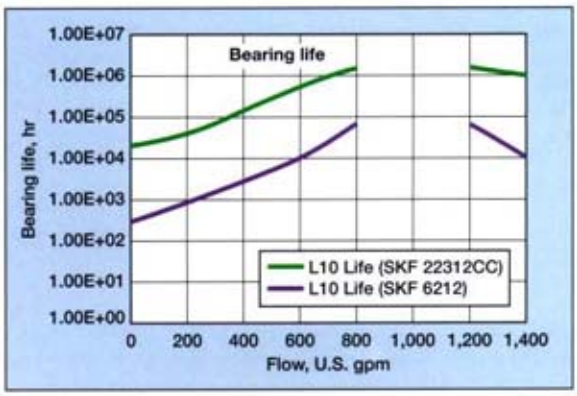

Fig. 4. Bearing life comparison.

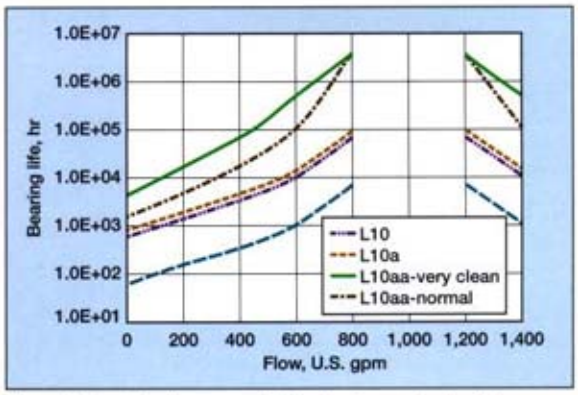

Fig. 5. Bearing lives and effects of contamination.

Bearing life could be increased significantly with spherical roller bearings. Fig. 5 shows bearing lives as calculated by simple, adjusted and the new life equations. Also, the effect of contamination is shown. The benefits of clean lubricants are clearly evident.

A significant improvement in bearing life can be achieved by paying more attention to bearing selection and ensuring lubrication system cleanliness.

In some cases, almost infinite life can be achieved provided the appropriate bearings are selected, operating conditions are known and the utmost lubricant cleanliness is assured.

The influence of contamination on bearing life is a function of many parameters. Nevertheless the following major factors have been identified:

- Wear is proportional to the amount of contaminants.
- Particles larger than the oil film thickness are the most significant.
- Particles with hardness greater than or equal to bearing material hardness will result in significant bearing wear.
- Extreme cleanliness pays off, giving 15 to 35 times longer life compared to expected or calculated lives.
- Water can decrease bearing life and a concentration of water of 0.01% is enough to decrease bearing life to half its original value; however, the effect of water on bearing life is not well understood.

ACKNOWLEDGMENT

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