7th World Tribology Congress, WTC 2022
July 10-15, 2022, Lyon, France

Sliding bearings in the conditions of lubrication by contaminated water – results of experimental tests

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Water-lubricated journal bearings are nowadays frequently applied in industry. In many cases, simple open system without sealings is applied. Surrounding water is a lubricating liquid. Very often water consist of solid particles –debris and wear process of journal and bush could be very rapid. The conducted research work was focused on influence of sliding couple and bearing bush geometry on wear process. Results prove that sliding couple and geometry has important influence on wear process.

Keywords: green tribology, water lubrication, lubricant with particles, lubricant contamination

1. Introduction

Water-lubricated journal bearings are frequently applied in marine and hydropower industry due to their advantages over other bearing types. The simplicity is an important advantage. Usually friction losses are small. Water lubricated bearings are environmentally friendly, can operate even without sealings – in ship stern tube bearings or in pumps when lubrication by surrounding, often dirty water with debris takes place.
Experimental tests conducted recently were inspired by a real case when water pump bearings were badly damaged by rapid wear caused by hard, mineral debris contamination after tsunami in Japan. In the literature there is a number of scientific papers referring to this problem. Most of them are theoretical studies focused on hydrodynamic lubrication with lubricant which contains solid particles.

2. Methods

The main concept of the conducted research work was to test group of six different bearing bush materials (two polymers, two composites, rubber, PTFE + rubber). Some of them are accepted by classification societies for marine applications, some others are used in pumps of in water turbines. Each sliding couple was made in four different geometry versions (different shape and number of lubrication grooves).
After initial 10 hours long running-in with clean water as a lubricant the test with dirty water was conducted. Each test run takes 60 hours. Bearing specific pressure was 0.64 MPa. Bearings diameter was 65 mm and the shaft speed was 600 rev/min. In the test 10 liters of water was contaminated with 5 cm3 of river mud (fig.1). In fact one sliding couple test takes up to two weeks.

3. Results

Conducted tests for three different bush materials and five various geometries takes almost a year.
The results are very interesting. As it was predicted the grains are crumbled during operation (fig. 2) and in time wear process getting slower.
After tests measurements of journals and buses were conducted. The wear ratio was estimated.

Figure 1: Sand grains added to water

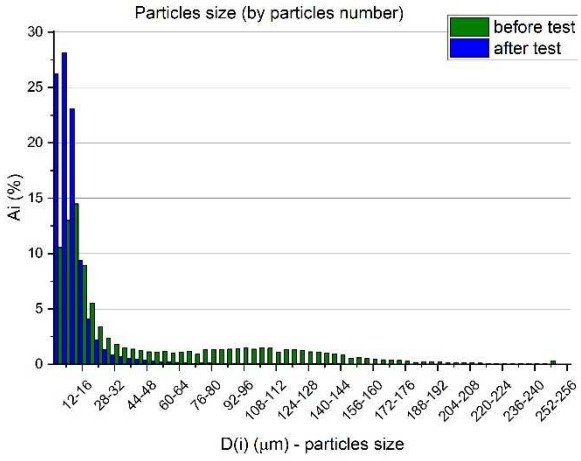

Figure 2: Grains size before and after tests

4. Discussion and conclusions

The journal wear analysis base on roughness profile measurements. During bush wear wall thickness was measured.
The two the most important conclusions are:

- Water flow has significant influence on sliding couple wear. In authors opinion higher flow helps to wash away debris from bearing,
- sharp edges of lubrication grooves makes difficult migration of particles in friction zone.