

EXPERIMENTAL CHARACTERIZATION OF THE TRIBOLOGICAL AND ACOUSTIC PERFORMANCE OF DIFFERENT STERN TUBE BEARING MATERIALS

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ABSTRACT

Underwater radiated noise (URN) emitted by ships poses a significant threat to marine mammals due to their reliance on hearing for vital activities. Within the ship's structure, the stern tube bearing stands as an important component at the interface between the vessel and the marine environment, constituting an important element of the shafting system, supporting the propeller. The present study focuses on experimental characterization of different stern-tube bearing materials with regard to their tribological and acoustic performance. Three materials, in particular, COMPAC elastomeric polymer, rubber polymer, and white metal (Babbitt), were evaluated under water and oil lubricated conditions using a flat-on-disk setup.

Three different material types have been cross-evaluated. In particular specimens of 20x20 mm have been generated of COMPAC elastomeric polymer material, rubber polymer material, and white metal. All specimens had a total thickness of 8 mm; all acting materials were supported by a stainless-steel backing. Different thickness values (shape factors) of the acting material, either COMPAC or rubber have been investigated. The COMPAC and rubber specimens have been investigated for operation under water-lubricated conditions, whereas the white-metal specimens have been investigated under oil lubricated conditions, in particular under SAE-10 and SAE-30 lubricating oils. The research involved surface characterization, stiffness coefficient measurement, and tribological and acoustic performance assessment under different combinations of load and rotational speed.

Phase A: Surface Characterization

Surface topography of specimens was measured using a *Bruker Contour GT-KO* optical profilometer. Parameters such as average roughness, skewness and kurtosis were measured.

Phase B: Stiffness Coefficient Measurement

The stiffness coefficient of materials was measured using a *Bruker UMT-3SYS* Tribometer. Different vertical offsets have been applied, recording the corresponding vertical load.

Phase C: Performance Assessment

Performance under water/oil lubricated conditions was assessed using a flat-on-disk setup on the *Bruker UMT-3SYS* Tribometer. Measurements included vertical force, friction force and

friction coefficient. Corresponding sound pressure signals were recorded synchronously at a sampling rate of 8kHz using a PCB 130D21 microphone, located above the rotating disc, inside a custom-made insulated box. FFT and one-third octave band analyses were applied to the sound signal for frequencies up to 4kHz.

The results have demonstrated significant differences in friction characteristics and acoustic performance of the specimens for the studied combinations of load and rotational speed. The water-lubricated rubber and COMPAC specimens exhibited higher values of friction coefficient in comparison to the oil lubricated specimens, at combinations of low values of rotational speed and high loads, attributed to the low viscosity of the water as lubricant. The water lubricated COMPAC and the high oil viscosity white metal specimens demonstrated better acoustic behavior, above 1500 Hz at low and medium values of rotational speed. The rubber specimens exhibited higher friction coefficient and sound pressure levels across all combinations of RPM and load, especially at frequencies above 1000 Hz. For all specimens, sound pressure levels showed an increasing trend with rotational speed, while the observed differences between various specimens were less pronounced at higher values of rotational speed.

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