Hybrid Rolling Element Bearings: a New Answer Facing the Problem of Debris Entrapment

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In the aeronautical domain, due to high speeds and weight-saving, hybrid rolling element bearings (REBs) are foreseen to replace classical REBs. They offer indeed many advantages including a lower density. The higher hardness appears also as a preponderant feature to warranty integrity in contaminated lubrication.

**Context/Objectives**

From all-steel ... ... to hybrid REBs

“Faster, Higher, Stronger”

Recurrent problem: debris contamination with destructive behavior

The type of contaminants found in lubricated mechanisms can be very diversified (debris, pollution particles) and from different sources (external or internal).

**Twin-disc machine**

Tests with the twin-disc machine and the contamination test bench: Controlled level of contamination (nature, size, quantities)

**Numerical tool**

Considering a contaminated lubricant suppose to take into account both the lubricant behavior and the particles dynamics.

Firstly by analyzing streamlines and secondly by determining the theoretical particle trajectories.

**Results**

Using numerical simulations

As particles are dispersed in the lubricant, they can approach the contact region from different positions, named release positions (RP).

The release positions normal to the rolling direction (RP) and across the confinement (RP) influence the entrapment probability.

The closer to the contact center line and the nearer from the walls the particles are released, the more likely they will be entrapped.

Using experiments

Assumption: each particle is responsible for a single dent → quantitative and qualitative comparison of entrapment phenomena.

Tests with different couples of materials → discs made of silicon nitride withstand indentation by ductile particles (Mgo steel).

Mixing both experimental and numerical works

Larger particles are more likely to be entrapped, in accordance with, due here to a larger entrainment width.

**Conclusions**

Key parameters governing particle entrapment were found:

- Dependence of particle entrapment with
- Release position
- Particle size and mass
- Changing contacting materials has a minor influence on particle entrapment phenomena
- Silicon nitride discs are able to withstand indentation by ductile particles

**References**


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