Review: Wind turbine main-bearing lubrication - Part 2: Simulation based results for a double-row spherical roller main-bearing in a 1.5 MW wind turbine

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The manuscript illustrates the application of EHD concepts explained in Part 1 to a practical case of a spherical roller bearing in a main shaft of a wind turbine. Properties of a commercial grease for this application are used as input parameters and the calculation includes starvation effects variable contact load plus potential dynamic effects. The manuscript shows that the contacts experience mixed-lubrication regime in a large proportion of the running time.

The reviewer is favourable to the publication of the manuscript but requires some minor revisions or at least the answer of some questions.

Revisions:

1. Section 3.1: It is very interesting to see the source of the load and speed cases analysed in this study. The authors refer to the IEC design standards. Can the authors point out exactly which standard they use (number?).

2. Section 3.2: Perhaps the only missing aspect is to say that the considered properties of the grease are taken when the grease is fresh. It is well known that these properties change as the grease ages, but also the bleeding rate, so starvation will depend on the age of the grease somehow. The reviewer assumes that the authors did not consider re-greasing intervals in their model.

3. Section 3.2.1: What about cold starts or cold weather in Wind Turbines?

4. Section 4.2: For an EHL person Λ values are a good way to sense the mean lubrication conditions in a contact. However, for bearings the ISO standards use κ (defined in ISO 281). In the same standard an approximation between the two parameters is given $\kappa \approx \Lambda^{1.3}$, therefore it is possible to give order of magnitude of the results also in terms of κ. Notice that if this parameter is known, bearing life estimations are possible (also using ISO 281) and at least relative life values of different lubrication conditions can be obtained.

5. Section 4.2: Indeed the consideration of starvation in the present manuscript is somehow a bit disappointing. However, the reviewer understands that the modelling of starvation in greased lubricated bearings is not simple. Especially when the availability of grease in the contacts is unknown and also the aging status of the grease (bleeding rate). Besides all these in this application the bearings should (in general) be fully packed of grease, which means that there is also a “gravity” effect. The grease in the lowest part of the bearing might have to carry the weight of all other grease making the bleeding non-uniform.

6. Section 4.3: Grease thickener interactions, perhaps a more accurate calculation could be done with models: Nogi, (https://doi.org/10.1080/10402004.2020.1778147) and Morales-

Espejel (Tribology International 74 (2014) 7–19). Indeed, a worked grease will see reduced these benefits, but how much?

Section 4.3: Perhaps a more significant effects are stand-still periods and accelerations + decelerations. Sudden changes of speed. Stormy weather.

Section 5: The authors have written the following text “Rolling bearing fatigue life predictions are made under the assumption that fully EHL conditions hold throughout the bearing lifetime”. In the experience of this reviewer this is inaccurate. Actually the parameter κ takes into account the lubrication conditions as part of the factor a_{ISO} in the standard ISO 281. Modern bearing life models can model variable operating conditions within the life of a bearing, not only speed but also load. Besides this, new bearing life models are being developed to explicitly separate surface and subsurface failure modes, the authors can look for such references (the reviewer has seen this at least in some SKF publications).