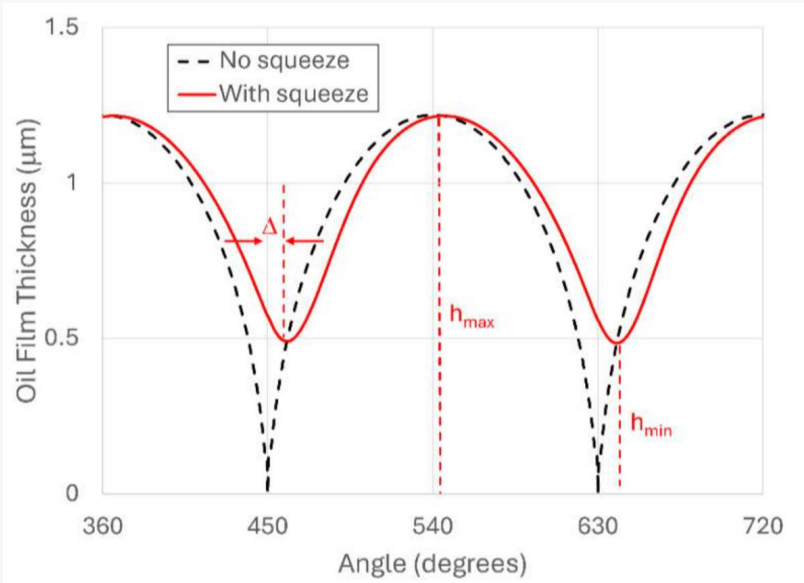
Predicting the cyclic oil film thickness variation in reciprocating hydrodynamic line contacts

GA, UNITED STATES, August 17, 2026 /EINPresswire.com/ -- Reciprocating contacts are commonly used machine elements. The simplest equations used by tribologists predict that the oil film thickness is zero at the reversal positions (where the relative sliding speed of the surfaces is zero). In fact, the oil film thickness is NOT zero, due to “squeeze” effects. Usually, numerical solutions of the Reynolds' equation are required to predict the actual minimum oil film thickness. In this paper, simple equations are proposed for both the minimum oil film thickness, and its position, which are in good agreement with experimental data. The equations were obtained by detailed analysis of many numerical solutions that were performed over a wide range of operating conditions. This work will be of great interest to tribologists interested in the lubrication of reciprocating contacts.



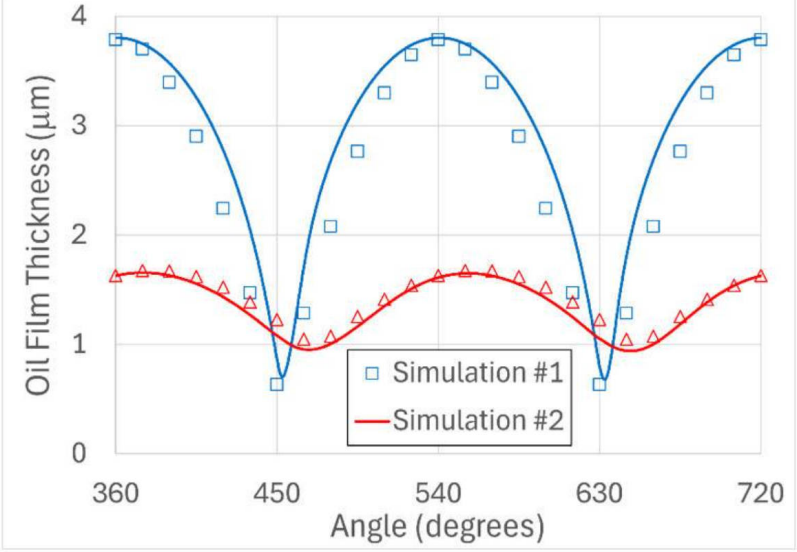
Calculated OFT versus angle. Operating conditions are given in the text. The simulation that includes “squeeze” effects is shown as the red full line, whereas the simulation that neglects such effects is shown as the black dotted line.

“The relevant research findings have been published in Tribology Advances by R.I. Taylor, under the title ‘Predicting the cyclic oil film thickness variation in reciprocating hydrodynamic line contacts’.”

Although the oil film thickness at the reversal points of reciprocating contacts is small, it is not zero, as predicted by the simplest models that tribologists use. The actual oil film thickness is required if mixed/boundary friction is to be estimated accurately. The proposed equations presented in the paper enable the oil film thickness variation throughout the reciprocating contact to be estimated relatively easily, from the operating conditions alone.

In addition, it has been noted by numerous researchers that the oil film thickness and friction, in

reciprocating tribology test machines is not symmetric, in the sense that different values are obtained when the contact moves to the left, compared to when it moves to the right. The research reported in the paper also explains this phenomenon and finds that the degree of asymmetry is directly related to the ratio of the amplitude (of the reciprocating contact) divided by the contact width.



Comparison of simple equation for OFT variation with angle (Eq. (28)) shown as blue squares and red triangles, with full numerical simulations, using Python code (blue and red lines).

The oil film thickness variation in a reciprocating contact can be estimated easily using equations for the maximum oil film thickness, the minimum oil film thickness, and the angular position at which the minimum occurs, as shown below.

Highlight 1: Figure 1 below shows how the oil film thickness varies with position in a reciprocating contact (key parameters are hmax, the maximum oil film thickness, hmin, the minimum oil film thickness, and D, the angular position (°) at which the minimum occurs).

Highlight 2: Figure 2 below shows a comparison of oil film thickness values obtained using simple equations (squares and triangles) with values estimated from full numerical solution of Reynold's equation (solid lines) for different operating conditions (full details given in the paper).

The ability to easily model the oil film thickness in reciprocating contacts should enable tribologists to improve their predictions for friction and wear in such contacts and so help in the design of longer lasting reciprocating contacts, whilst also minimizing friction.

The intention is to extend the work to elastohydrodynamic line and elliptical contacts in future work.

References

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