Journal of Lubrication Technology

Discussion

Isothermal Hydrodynamic Lubrication in Hydrostatic Extrusion of a Work-Hardening Material[1]

W. R. D. Wilson.[2] The author finds that at low speeds his model cannot simultaneously satisfy both the upstream and downstream pressure boundary conditions. This is assumed to be indicative of a critical speed below which hydrodynamic lubrication is impossible. It seems more likely that the inability to satisfy boundary conditions is due to an unwarranted assumption about the geometry of the lubricant film. In particular, it is assumed that the outlet edge of the workzone coincides with the transition between the conical and cylindrical die surfaces. In previous analyses (references [2, 3, and 4] in the brief) the edge of the workzone has been assumed to be a short distance upstream of the end of the conical surface. This results in a local reduction in film thickness with an accompanying almost steplike change in pressure. This pressure step permits matching the solution in the inlet and workzone to that in the outlet zone, satisfying both upstream and downstream pressure boundary conditions. Incorporation of this feature into the present analysis would probably eliminate the critical speed prediction.

The present analysis also attempts to relate the inlet "rounding" or "sinking-in" phenomenon to the build-up of pressure in the inlet zone. Recent work by White and Wilson [1] with solid lubricant coatings indicates that rounding is present well upstream of the area where pressure build-up occurs. Moreover, the degree of rounding depends on the billet material and die geometry but is independent of the lubricant used. This suggests that the rounding phenomenon is not related to the pressure build-up in the inlet zone but is a plasticity effect similar to the rounding observed in punching or shearing.

Additional Reference

1 White, D. R., and Wilson, W. R. D., "Solid Lubricant Entrainment in Hydrostatic Extrusion," A.S.L.E. Preprint No. 79-AM-3A-3 presented at the A.S.L.E. Annual Meeting, St. Louis, 1979 (to be published in *A.S.L.E. Transactions*).

Author's Closure

The author would like to thank Dr. Wilson for his comment on the brief. The model cited by him assumes that the end of the work zone to be a short distance upstream of the end of the conical surface of the die. This model satisfies all the boundary conditions at all speeds, thus eliminating the prediction of a critical speed.

A sharp drop in pressure at the end of the die associated with this model seems appropriate for a die with a short die land. However, when the die-land is not short, it is not clear how a sharp drop in pressure may occur at the transition between the work zone and the outlet zone. With the model used in the brief any sharp drop in pressure could occur only at the end of the die-land, i.e. where a geometrical discontinuity is.

The "sinking-in" phenomenon or "rounding" of the billet under different lubrication conditions has been reported by Dr. Wilson. He found the degree of rounding to be independent of the lubricants used. It may be possible that hydrodynamic lubrication conditions might not have reached in those tests. Rounding of the billet observed in hydrostatic extrusion (reference [6] of the brief) is more pronounced at high speed compared with that in low speed extrusion. The small amount of rounding predicted by the theory is, therefore, not in contradiction with this observation.

[1] By S. Thiruvarudchelvan, published in the July, 1979, issue of the JOURNAL OF LUBRICATION TECHNOLOGY, Vol. 101, p. 386.

[2] Department of Mechanical Engineering, University of Massachusetts, Amherst, Mass. 01003

Analysis of Misaligned Grooved Journal Bearings[1]

F. A. Martin.[2] Pinkus and Bupara are to be commended for their comprehensive analysis[1] of misaligned journal bearings. When covering such a wide field of bearing conditions (such as type of grooving, L/D ratio, slope of journal, line of slope relative to bearing datum, etc) one of the problems usually encountered is how to present the data.

The authors have been very ambitious in producing the performance plots for a single groove bearing (Figs 4 to 7). These give a vast amount of interesting information on load capacity, film thickness, friction, side leakage and moments. To enhance the value of these particular graphs it would be helpful if the authors could also show resulting load directions for the various shaft positions considered.

At this stage it may be of interest to mention a study carried out on misaligned sterntube bearings [A1] where the discusser not only considered straight shafts but also predicted the effect of a bowed shaft within the sterntube bearing of a 250000 dwt tanker. More relevant to the authors' work is a design chart produced in that same paper [A1] for the two axial groove misaligned bearing which has similar geometry to that in the authors' performance data, Table 2. As mentioned previously, data presentation can be a problem because of the number of variables to be considered. The authors in their Table 2 consider various misalignments for a bearing of L/D equal to 1. The

[1] By Oscar Pinkus and S. S. Bupara, published in the October 1979 issue of the JOURNAL OF LUBRICATION TECHNOLOGY, Vol. 101, pp, 503–509.

[2] Design Techniques Section R&DO, The Glacier Metal Co. Ltd., Wembley, Middlesex, UK.