Contribution ID: **511** Type: **Oral 20 Minutes**

From Red Cells to Soft Porous Lubrication

Thursday, 17 May 2018 11:23 (15 minutes)

In this paper, we report a novel experimental study to examine the lubrication theory for highly compressible porous media (*Feng & Weinbaum, JFM, 422, 282, 2000*), which was applied to the frictionless motion of red cells over the endothelial surface layer (ESL). The experimental setup consists of a running conveyer belt covered with a soft porous sheet, and an upper planar board, i.e. planing surface. The pore pressure generation was captured when the planing surface glides over the porous sheet. If the lateral leakage was eliminated, we found that the overall pore pressure's contribution to the total lift, f_{air}≈80%, and the friction coefficient $= 0.0981$, when $U = 5$ m/s, $L = 0.381$ m, $= h_2/h_0 = 1$ and $k = h_2/h_1 = 3$, where U is the relative velocity of the conveyor belt; L is the length of the planing surface; h_0, h_1 and h_2 are the undeformed, leading edge and trailing edge porous layer thickness, respectively. f_{air} increases with the increase in U, and L, while decreases with the increase in k. decreases with the increase in f_{air}. If later pressure leakage exists, the pore pressure generation is reduced by nearly 90%. All the experimental results agreed well with the theoretical predictions. The study presented herein lays the foundation for applying soft porous media for new type of bearing with significantly reduced friction.

References

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Session Classification: Parallel 10-B

Track Classification: MS 4.17: Transport through Soft Porous Media