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Lubrication theory for a random fibrous medium[1] PARISA MIRBOD, YIANNIS ANDREOPOULOS, SHELDON WEINBAUM, The City College of City University of New York, New York, NY 10031, USA — In the classical theory for a slipper bearing one examines the relative motion of an inclined planar surface and a horizontal planar surface. The solution for the pressure distribution and lift force are independent of which boundary is moving and there is an optimum tilt $k = h1/h2 = 2.2$ for maximum lift. This symmetry is lost if the intervening space is filled with a soft porous fibrous material. In this paper the generalized Reynolds equation derived in Feng and Weinbaum (2000) J. Fluid Mech. 422:281 is extended to treat a random fiber matrix satisfying the widely used Carman-Kozeny equation. We show that the solutions are strikingly different depending on whether a) the inclined upper boundary moves or b) the upper boundary is stationary and the horizontal lower boundary moves beneath it. The behavior depends critically on the value of the dimensionless fiber interaction layer thickness $\alpha = H/\sqrt{K_p}$. In a) the pressure and lift force increase as α^2 and asymptotically approach a limiting behavior for large values of α since the fluid is pushed forward by the tilt of the upper boundary. In b) the pressure and lift force decay as α^{-2} since the fiber interaction layer thickness decreases and the amount of fluid dragged though the fluid gap decreases as α increases and vanishes for $\alpha >> 1$.

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