Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

An Experimental Study of Soft Lubrication QIANHONG WU, THOMAS GACKA, Villanova University, RUNGUN NATHAN, Penn State Berks, LI-ZHU WU, The Chinese Academy of Sciences, CBMSS TEAM[1] — Lift generation in soft porous media, as a planing surface glides over it, is a new topic in porous media flow with superior potential for lubrication and squeeze damping. This paper presents the first experimental study of this phenomenon. The experimental setup consists of a running conveyer belt covered with a soft porous sheet, and a stationary instrumented inclined planar upper board. Twelve pressure transducers mounted on the upper board captured the pore pressure generation, while a load cell was used to capture the total lifting force, arising from both the pore pressure and the compression of the solid fibers. One finds that the pore pressure distribution is consistent with theoretical predictions (Feng and Weinbaum, JFM, 2000; Wu et al., MSSE, 2006, 2011), and depends on the running belt velocity, U, the mechanical properties of the porous material, and the compression ratios of the porous layer. For a typical trial (h_2/h_1=5,h_2/h_0=1, U=3.8 m/s, where h_2, h_1, and h_0 are the leading edge, trailing edge, and undeformed porous layer thicknesses, respectively), 68% of the lifting force was generated by the pore pressure. It conclusively demonstrates the validity of using soft porous materials for super lubrication. applications.

[1]Villanova Cellular Biomechanics and Sports Science Laboratory

Qianhong Wu
Villanova University

Date submitted: 31 Jul 2012 Electronic form version 1.4