Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

A comprehensive study of the lift generation in soft porous media under rapid compression QIANHONG WU, Villanova University, RUNGUN NATHAN, Penn State Berks, ROBERT CRAWFORD, Villanova University, VU CBMSS TEAM — Lift generation in soft porous media under rapid compaction is a new concept for porous media flow, which has broad applications in biological systems, squeeze damping, and soft lubrication, etc. Previous studies on this topic share a common feature of neglecting the lift contribution of the undeformed porous structures surrounding the compressed porous media, thus deviated from real applications. Herein we report a comprehensive experimental and theoretical approach to treat this shortcoming. A soft, polyester, fibrous, porous material with specified micro-structure, porosity and permeability was dynamically compressed by a loaded piston in a porous-walled cylinder-piston apparatus. Pore air was forced out radially either directly to the ambient ("unconfined" case) or to the surrounding undeformed porous media ("confined" case). Detailed pressure measurements indicate that the air lifting force underneath the piston was enhanced by 25% to 30% for the "confined" case as compared to the "unconfined" case. A consolidation theory was developed to characterize this process, which shows very good agreements with the experimental data. This study significantly improves our understanding of the dynamic response of soft porous media under rapid compression.

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Date submitted: 31 Jul 2013 Electronic form version 1.4