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On the Pressure Distribution in a Porous Media under a Spherical Loading Surface[1] QIUYUN WANG, ZENGHAO ZHU, Villanova University, RUNGUN NATHAN, Penn State Berks, QIANHONG WU, Villanova University
— The phenomenon of pressure generation and relaxation inside a porous media is widely observed in biological systems. Herein, we report a biomimetic study to examine the pressure distribution inside a soft porous layer when a spherical loaded surface suddenly impacts on it. A novel experimental setup was developed that includes a fully instrumented spherical piston and a soft fibrous porous layer underneath. Extensive experimental study was performed with different porous materials, different loadings and different sized loading surfaces. The pore pressure generation and the motion of the loading surface were recorded. A novel theoretical model was developed to characterize the pressure field during the process. Excellent agreement was observed between the experimental results and the theoretically predictions. It shows that the pressure generation is governed by the Brinkman parameter, $\alpha = h/K_p^{0.5}$, where h is the porous layer thickness, and K_p is the undeformed permeability. The study improves our understanding of the dynamic response of soft porous media under rapid compression. It has board impact on the study of transient load bearing in biological systems and industry applications.

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