33rd Scottish Fluid Mechanics Meeting
Dewatering of fibrous porous media

Tom Eaves
School of Science and Engineering, University of Dundee
Fulton Building, DD1 4HN

28th May 2020

Abstract

This talk will provide an overview of a model for the compaction and dewatering of wood-fibre pulp during the paper-making process. Traditional two-phase models of particulate porous media based upon plastic yielding of the particle network structure[1] prove insufficient to capture the dynamics of networks of highly deformable, irregularly shaped wood-fibres. I will show how the traditional model was experimentally calibrated and extended to incorporate viscous effects during the fibre-network compaction[2]. The resulting poro-visco-plastic model can successfully reproduce experimental dewatering tests of wood-fibre pulp[2], in addition to predicting the behaviour of a standardised low-concentration industry test[3], and industrial dewatering screw presses[4]. When turning our attention to more rapid industrial dewatering processes, we see the emergence of an elastic behaviour of the wood-fibre network. The talk will conclude with a brief description of how we may extend our model to a poro-visco-plastic-*elastic* model which captures the rapid dewatering dynamics of fibrous porous media.

References

[1] e.g. K. A. Landman, C. Sirakoff, and L. R. White, “Dewatering of flocculated suspensions by pressure filtration,” Phys. Fluids A, Vol. 3, 1991, pp. 1495–1509.

[2] D. R. Hewitt, D. T. Paterson, N. J. Balmforth, and D. M. Martinez, “Dewatering of fibre suspensions by pressure filtration,” Phys. Fluids, Vol. 28, 2016, pp. 063304.

[3] D. Paterson, T. S. Eaves, D. R. Hewitt, N. J. Balmforth, and D. M. Martinez, “Flow-driven compaction of a fibrous porous medium,” Phys. Rev. Fluids, Vol. 4, 2019, pp. 074306.

[4] T. S. Eaves, D. T. Paterson, D. R. Hewitt, N. J. Balmforth, and D. M. Martinez, “Dewatering saturated, networked suspensions with a screw press,” J. Eng Math., Vol. 120, 2020, pp. 1-28.