Stability and drainage of foam bounded by porous media

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ABSTRACT

The drainage and collapse of foam atop porous media is a problem of interest in mining engineering, wherein foam is used as a dust suppressant atop porous media such as coal dust and rocks. We perform experiments to study the drainage and collapse of a commercial surfactant-and-nozzle system (Kirei Kirei®) atop porous media with capillary suction pressures that differ by an order of magnitude (floral foam, construction brick). Different slopes/angles of a permeable wall bounding the foam are studied: 45°, 60°, 75°, 90° (vertical). For the high-suction porous medium (floral foam), increasing the angle of incline results in increased foam lifetime. The effect is, however, not uniform, with lifetime increases being larger at the inclined wall and becoming largest at the corner of the bounding porous medium. This is due to increased 'wetting' at corners by porous medium capillarity during the initial stages of the experiment. Meanwhile, for the low-suction porous medium (brick), no 2D effect is present (thereby implying that rough and inclined surfaces in a mine would have an impact on foam dust suppressant lifetime only if the industrial-site porous medium is more like floral foam than a brick). After fitting the results to two different 'death' models [1], it is found that the model of Weibull fits best in the bulk and overall but the model of Gompertz fits best only for a couple of points within approximately 5 mm of the corner. This might imply that the corner indeed sucks a large amount of liquid initially and sees rapid change initially, while the bulk sees changes over longer (not immediate) time scales.

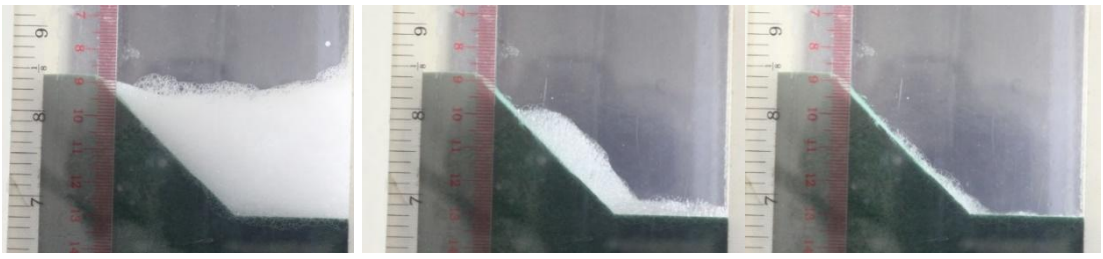

Figure 1: Raw photographs of foam collapse atop floral foam with one wall inclined at 45°.

[1] B. Haffner, J. Lalieu, P. Richmond, S. Hutzler. Can soap films be used as models for mortality studies? Physica A. 508:461–470, 2018.