Bubble entrainment by a sphere falling through a horizontal soap foam

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ABSTRACT

When a solid particle impinges on a soap film it first deforms the film into a catenoid-like shape. As the particle moves through the film, a point is reached at which the film becomes unstable, in a manner familiar to anyone who has formed a soap film catenoid between two rings and pulled them apart. However, in this case the film may not rupture. Instead, the film reforms (”heals”) and a small bubble attaches to the particle as it is ejected. This process is fundamental in the use of foams to suppress explosions. We model the quasi-static motion of a spherical particle through a stable horizontal soap film using the Surface Evolver [1] and show how the contact angle at which the soap film meets the particle, as well as the size of the particle itself, influence the size of the bubble that is created [2]. This gives a measure of the energy dissipated by the soap film.

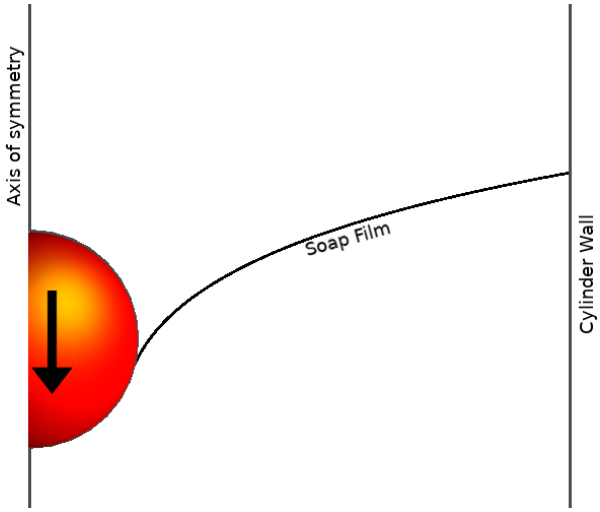

Figure 1: A sphere falls through a soap film. A bubble may be trapped as the film leaves the top of the sphere, provided the contact angle where they meet is sufficiently small.

[1] K. Brakke. The Surface Evolver, Exp. Math. 1:141-152, 1992.

[2] S.J. Cox and I.T. Davies (2020) Bubble entrainment by a sphere falling through a horizontal soap foam. arxiv:2001.04125