

Dynamics of a Liquid Droplet on a Granular Bed of Microstructured Particles: From Lens Formation to Marble Effect

A. Ananth Praveen Kumar,[†] Venkatanarayana Prasad Sandireddy,[†] Tamal Banerjee,[†]
and Dipankar Bandyopadhyay*,^{†,‡}

[†]Department of Chemical Engineering and [‡]Centre for Nanotechnology, Indian Institute of
Technology Guwahati, Guwahati, Assam 781309, India

Electronic Supplementary Information

*Author to whom correspondences should be addressed. Email: dipban@iitg.ernet.in

Description of Supplementary Videos

(A) Supplementary video 1

The video clip shows permeation of a water droplet on a bed of poppy grains. After the droplet was placed on the bed, the three-phase contact line of the droplet pinned to the micro-structures decorated on the poppy particles to form a lens. Consequently, the droplet deformation and the recoil together with the vertical component of the surface tension force at the three-phase contact line generated an upward pull, which was reflected in the marble formation – one by one poppy particles covered the droplet free-surface. The transition from the lens to liquid marble formation was followed by the drop permeation because the poppy particles on the droplet surface pushed the droplet inside the bed. Finally, as the drop permeated into the bed the loosely bound bed surface developed crater shaped morphology.

(B) Supplementary Video 2

The video clip shows trickling of water droplet on the bed of micro-porous sago particles. Water droplet instantaneously permeated through the bed. Sago particles soaked water from the droplet through the micro-pores and the bed swelled with time.

(C) Supplementary Video 3

Permeation of a water droplet on a crushed sago bed has been shown in this video. The micro-capillaries present on the surface of the crushed sago particles soaked water from the droplet while the drop permeated through the bed. The video clearly depicts that the lighter crushed-sago particles dislodged from the bed and float on the free-surface before the droplet permeates through the bed. Again, the bed swelled with time as the crushed sago particles soaked water from the droplet through the micro-pores.

(D) Supplementary Video 4

The video clip shows the permeation of a water droplet on the bed of heterogeneous crushed sago-poppy particles. After the drop was dispensed on the junction of the two different types of particles, the poppy particles climbed on the drop free-surface from one side whereas the crushed sago particles did the same from the other side led to a liquid marble comprising of both crushed sago and poppy particles before permeating through the bed.

(E) Supplementary Video 5

Permeation of a water droplet on a heterogeneous bed of crushed sago-mustard particles has been shown in this video. The droplet initially moved towards the crushed sago side, which helped in dislodging some of the mustard particles on which the droplet pinned the three-phase contact line. However, at the later stage, the crushed sago particles climbed up the droplet free-surface owing to their lesser weight as compared to the mustard particles, before the droplet permeated through the bed.