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Experimental evaluation of effect on Cassie-Baxter equation of surface roughness with application to soil water repellency

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Manifestation of soil water repellency depends both on the surface chemistry and the physical structure of the particles making up the soil. In materials science the effect of physical structure on water repellency is often explained by the Cassie-Baxter equation. Recently, a few attempts have been made to explain water repellency of soil using the Cassie-Baxter equation for hexagonally-arrayed spheres on a flat plane. Experimental verification of this conceptual model using glass beads as model soil particles has been left somewhat incomplete, as the experimentally measured contact angles do not match well those expected from theory. This might be caused by a failure to generate a perfect arrangement of particles.

Therefore, we have aimed to obtain highly precise arrangements of glass beads as model soil particles using 3D printing technology. Our aim is to generate particle frames of precise hexagonal arrangement with particles at differing separations, and to measure the water contact angles upon the particle arrays optically using a goniometer.
In this contribution, we report our preliminary results in which we explore the applicability of the Cassie-Baxter equation to such regular arrays as both separation distance and surface roughness is varied.

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