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Catch and release of bubbles in a soft granular medium CHRISTOPHER MACMINN, University of Oxford, JIAN GUAN, University of North Carolina, OMID DOROSTKAR, University of Oxford and ETH Zurich, SUNGYON LEE, University of Minnesota — A liquid-saturated packing of soft particles can behave like a complex fluid or like a porous solid, depending on the confining stress. In the fluid-like state, a gas bubble can rise through the packing due to buoyancy with a rise velocity that decreases as the solid fraction increases. In the solid-like state, gas bubbles cannot rise unless their buoyancy overcomes the failure stress of the packing or the capillary entry pressure of the pore space. Here, we use laboratory experiments, discrete-element simulations, and theoretical modelling to study these two states and the transition between them. Specifically, we study the rise velocity of bubbles as a function of bubble size and solid fraction in order to identify the solid fraction at which bubbles are immobilised. We also study the poromechanics of changing the solid fraction by compressing the packing with a fluid-permeable piston. We combine these ingredients to show that active manipulation of the solid fraction can therefore be used for the on-demand catch and release of gas bubbles.

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