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Clogging in a microfluidic hourglass ALVARO MARIN, MASSIMILIANO ROSSI, CHRISTIAN J. KÄHLER, Bundeswehr University Munich — One of the main disadvantages of microfluidic devices is their tendency to clog when a high density of particles or droplets is forced through them. The same problem is often encountered in classical granular flows in silos and hourglasses. It is well-known that hourglasses work optimally when the particle-to-neck ratio is within certain ratio without interruption (Zuriguel et al., Phys. Rev. E, 2003), while arching occurs for particle-to-neck ratios above $d/D \approx 2$. Microfluidic devices normally work in geometries in which $d/D > 10$, in which the arching probability is negligible. Clogging is nonetheless possible, but mainly due to the accumulation of particles at the walls (Wyss et al, Phys. Rev. E, 2006). On the other hand, clogging by arching in systems with $d/D \sim O(1)$ are expected to have radically different physics and statistics, due to collective behavior and hydrodynamic interactions. To study these regimes, we study microfluidic devices with a bottleneck of squared crossed section and side length D through which we force polystyrene particles with diameters from $d/D \approx 1$ to 0.25 at packing fractions ranging from 10% up to 50%. Our results show that clogging of such systems have more in common with granular flows in hourglasses than expected.

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