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Regimes of fluid-driven grain transport in a confined channel

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The flow of grains through confined and constricted geometries occurs in an array of industrial and natural settings. As such, various flow configurations have been extensively studied in dry and wet systems, for instance silo, Couette, avalanche and Poiseuille. Here we present experiments in which fluid-driven, non-buoyant grains, filling a horizontal channel confined from both the sides and above, are found to exhibit a variety of behaviours depending on the imposed flow rate and the size of the channel. For example, at low imposed flow rates the fluid stress from the injected fluid was not sufficient to mobilise the frictional grains and flow akin to Darcy's Law was observed. Above a critical threshold however, grains began to flow at the top of the channel with Gaussian velocity profiles that were self-similar with respect to flow rate, in contrast to the exponential decay seen in bedload transport. These Gaussians became faster with increased flow rate, also penetrating further into the packing. Beyond this regime at high flow rates, grains through the entire depth of the channel were mobilised and the self-similarity ceased, with velocity profiles becoming gradually more symmetric, towards those more typical of Poiseuille flow.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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