A New Rheometer for Particle Suspensions

The "capillarytron" lets researchers access mechanical properties of very dense suspensions.

By **Marric Stephens**

Walk along a beach after high tide and you might notice that every step momentarily creates a dry patch of sand. This effect is due to a peculiar phenomenon called dilatancy, where, under shear, the grains in waterlogged sand are forced apart from one another, opening channels through which the water can drain away. This property can lead to some interesting effects, but it can also make it difficult to study a dense suspension's rheology. Now Bruno Etcheverry and colleagues at the French National Center for Scientific Research (CNRS) have devised a rheometer that overcomes that difficulty [**1**].

In a conventional rheometer, a suspension is confined between two parallel, counterrotating plates. Under this fixed-volume condition the suspension cannot dilate, and large stresses can develop between the grains. This property makes some of the suspension's flow properties difficult to access experimentally.

The rheometer developed by Etcheverry and colleagues circumvents this problem by connecting the sample to a variable-height fluid reservoir using a liquid-permeable lower plate. This modification allows the suspension to dilate. By setting the reservoir's height, the researchers can control the strength of the capillary force at the edge of the sample such that it balances the shear-induced dilation stress. This allows them to probe previously inaccessible properties of the suspension—in particular, its friction coefficient, which characterizes the force required to make the suspension flow.

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The researchers used their "capillarytron" to study suspensions of silica particles and cornstarch, providing experimental confirmation of a recent rheological model. They say that their method of controlling stress could be used to study fragile systems such as living-cell suspensions or to obtain insights that could lead to fluids with custom rheological properties.

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REFERENCES

1. B. Etcheverry *et al.*, "Capillary-stress controlled rheometer reveals the dual rheology of shear-thickening suspensions," **Phys. Rev. X 13, 011024 (2023).**