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Instability of Newtonian and Viscoelastic Submerged Jets BAVAND KESHAVARZ, GARETH MCKINLEY, MIT, MIT, DEPT. OF MECH. ENG. TEAM — We study the behavior of high speed submerged liquid jets using a novel experimental setup equipped with strobe imaging flow visualization. Visualizations for Newtonian liquids at high Reynolds numbers (Re $\sim$ 150) show that for large wave-numbers a varicose mode dominate and the nonlinear growth of instability leads to the appearance of axisymmetric bags that roll up and encapsulate the central jet. At lower wave-numbers the varicose mode initially starts to grow close to the nozzle but is overwhelmed by the sinuous mode as the jet moves downstream. Due to the difference in the wave speeds for these two different modes of instability, the varicose waves slowly pile up into continuously growing sinuous waves leading to some unique concertina or chevron like morphologies. Tests with different viscoelastic model solutions show that by increasing the fluid elasticity the disturbance growth of both modes can be substantially inhibited due to streamline tension. These observations are the first experimental validation of theoretical predictions obtained from an elastic Rayleigh equation [1].

[1] J. M. Rallison and E. J. Hinch, "Instability of a high-speed submerged elastic jet," J. Fluid Mech., vol. 288, pp. 311-324, 1995.

Bavand Keshavarz
MIT

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