Capillary Instability for Drop Breakup in a High Speed Wind

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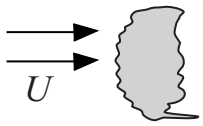
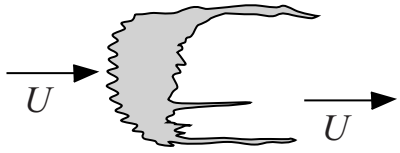
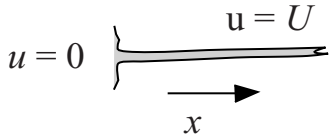
The first event is a Rayleigh-Taylor instability.



There can be a cascade of these. At the same time there is stripping.

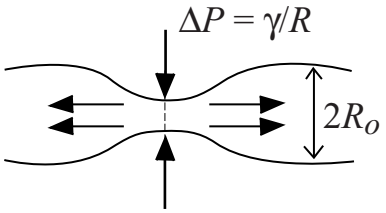


Filaments of liquid are dragged out of the parent drop. The filament is stretched; it has extensional stress, $\mu = \partial u/\partial x$, μ is viscosity.



A filament that does not stretch undergoes capillary instability. It necks down squeezing out liquid. The capillary pressure is γ/R, where γ is surface tension and R is the throat radius. The smaller it gets, the bigger is ΔP. So its headed for capillary collapse. All waves with wavelengths less than the circumference of the jet $2\pi R_o$ do this *(a)*. If the flow is extensional, the neckdown is suppressed and the thread gets very thin. After it stops stretching it breaks into drops. You pull out these threads and they get very thin (R_o is small) before undergoing capillary collapse *(b)*. Very small drops are generated this way.

(a) Neckdown



(b) Extensional flow suppresses neckdown