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Self-similar rupture of thin free films of power law fluids SUMEET THETE, CHRISTOPHER ANTHONY, OSMAN BASARAN, School of Chemical Engineering, Purdue University, West Lafayette, IN 47906, PANKAJ DOSHI, Chemical Engineering and Process Development, National Chemical Laboratory, Pune, India — Rupture of a thin sheet (free film) of a power law fluid under the competing influences of destabilizing van der Waals pressure (vdWP) and stabilizing surface tension pressure (STP) is analyzed. In such a fluid, viscosity is not constant but decreases with the deformation rate raised to the $n-1$ power where $0 < n \leq 1$ is the power law exponent ($n = 1$ for a Newtonian fluid). It is shown that when $1 > n > 6/7$, film rupture occurs under a balance between vdWP, inertial stress (IS), and viscous stress (VS), and the film thickness decreases as $\tau^{n/3}$ and the lateral length scale as $\tau^{1-n/2}$ where τ is time remaining to rupture. When $n < 6/7$, the dominant balance changes so that VS becomes negligible and the film ruptures under the competition between vdWP, IS, and STP. In this new regime, film thickness and lateral length vary as $\tau^{2/7}$ and $\tau^{4/7}$.

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