

Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Breakup of threads and rupture of films: Singularity-free solutions in the framework of a unified approach YULII SHIKHMURZAEV, University of Birmingham — As is known, the standard approach of fluid mechanics applied to the thread breakup problem leads to a singular, and hence unphysical, solution whereas the film rupture problem appears to have no solution at all, unless one “augments” the continuum model with intermolecular forces. The present work gives a regular description of both flows as particular cases of the same physical phenomenon. As can be shown by analyzing the standard model, the developing instability of a thread or an external disturbance of a film lead to the creation of a fresh free-surface area. The rate of this process tends to infinity as the thickness of the thread/film goes down and, as it becomes comparable with the inverse surface tension relaxation time, one can no longer treat the surface tension as a material constant; it becomes a variable whose dynamics and distribution along the interface are coupled with the flow. Thus, both problems appear to be particular cases of the fluid motion with forming/disappearing interfaces and can be described using an earlier developed theory of such flows that has first been applied to the moving contact-line problem of dynamic wetting.

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Date submitted: 04 Aug 2005

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