Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Fluid dynamics following flow shut-off in bottle filling SUMEET THETE, School of Chemical Engineering, Purdue University, SANTOSH APPATHURAI, HAIJING GAO, Chevron Corporation, OSMAN BASARAN, School of Chemical Engineering, Purdue University — Bottle filling is ubiquitous in industry. Examples include filling of bottles with shampoos and cleaners, engine oil and pharmaceuticals. In these examples, fluid flows out of a nozzle to fill bottles in an assembly line. Once the required volume of fluid has flowed out of the nozzle, the flow is shut off. However, an evolving fluid thread or string may remain suspended from the nozzle following flow shut-off and persist. This stringing phenomenon can be detrimental to a bottle filling operation because it can adversely affect line speed and filling accuracy by causing uncertainty in fill volume, product loss and undesirable marring of the bottles' exterior surfaces. The dynamics of stringing are studied numerically primarily by using the 1D, slender-jet approximation of the flow equations. A novel feature entails development and use of a new boundary condition downstream of the nozzle exit to expedite the computations. While the emphasis is on stringing of Newtonian fluids and use of 1D approximations, results will also be presented for situations where (a) the fluids are non-Newtonian and (b) the full set of equations are solved without invoking the 1D approximation. Phase diagrams will be presented that identify conditions for which stringing can be problematic.

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Date submitted: 12 Aug 2012 Electronic form version 1.4