中国化学工程学报 2003 11 (5): 542-549 ISSN: 1004-616x CN: 44-1063/R

RESEARCH PAPERS

液丝破裂过程的VOF模拟

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收稿日期 修回日期 网络版发布日期 接受日期

摘要 Study on pinching liquid filament in literature was reviewed. The breakup of liquid filaments under surface tension is governed by incompressible, two-dimensional (2-D), Navier-Stokes Equations. Surface tension was expressed via a CSF (continuous surface force)

model that ensures robustness and accuracy. A new surface reconstruction scheme, alternative phase integration (API) scheme was proposed to solve the kinematic equation,and
was compared with other three referential schemes. A general-purpose computer program has
been developed for simulating transient, 2-D, incompressible fluid flows with free surface of complex topology. The transient behavior of breaking Newtonian liquid filaments under surface tension was simulated successfully using the developed program.The initial wave growth predicted using API-VOF (volume of fluid) scheme was in good agreement with Rayleigh's linear theory and one-dimensional (1-D) long-wave theory. Both long wave theory and two-dimensional (2-D) APIVOF model on fine meshes show that as time goes on, these waves pinch off large droplets separated by smaller satellite ones that decrease in size with decreasing wavelength. Self-similar structure during the breakup was found using 1-D and 2-D models, and three breakups were predicted for a typical case. The criterion of filament breaking predicted by the 2-D model is that the wavelength is longer than the circumference of a filament. The predicted sizes of main and satellite droplets were compared with published experimental measurements.

关键词

Navier-Stokes equation control volume volume of fluid free surface liquid-filament breaking

分类号

DOI:

Numerical Study of Pinching Liquid Filament Using VOF Method

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Received Revised Online Accepted

Abstract Study on pinching liquid filament in literature was reviewed. The breakup of liquid filaments under surface tension is governed by incompressible, two-dimensional (2-D), Navier-Stokes Equations. Surface tension was expressed via a CSF (continuous surface force) model that ensures robustness and accuracy. A new surface reconstruction scheme, alternative phase integration (API) scheme was proposed to solve the kinematic equation,and was compared with other three referential schemes. A general-purpose computer program has been developed for simulating transient, 2-D, incompressible fluid flows with free surface of complex topology. The transient behavior of breaking Newtonian liquid filaments under surface tension was simulated successfully using the developed program.The initial wave growth predicted using API-VOF (volume of fluid) scheme was in good agreement with Rayleigh's linear theory and one-dimensional (1-D) long-wave theory. Both long wave theory and two-dimensional (2-D) APIVOF model on fine meshes show that as time goes on, these waves pinch off large droplets separated by smaller satellite ones that decrease in size with decreasing wavelength. Self-similar structure during the breakup was found using 1-D and 2-D models, and three breakups were predicted for a typical case. The criterion of filament breaking predicted by the 2-D model is that the wavelength is longer than the circumference of a filament. The predicted sizes of main and satellite droplets were compared with published experimental measurements.

Key words Navier-Stokes equation; control volume; volume of fluid; free surface; liquid-filament breaking

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