



## Vorticity Generation in a 10 cm Spilling Wave

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The evolution of the streamwise velocity and transverse vorticity during the spilling process is shown above for a 10 cm viscous wave. The Reynolds and Weber numbers are  $Re = 99\,000$  and  $We = 1361$  based on the wavelength, gravitational acceleration, and the viscosity and surface tension of pure water. The simulation is initialized with a small-amplitude linear wave and is forced by a periodic surface pressure. The phase of the surface pressure lags the primary wave resulting in wave growth. The wave grows for about 4 s or 16 periods ( $T = 0.249$  s), increasing in energy by a factor of 200, and begins to spill. In the sequence, the wave is being

followed at the linear phase speed. The simulated wave is traveling faster than a linear wave.

In the velocity plots, the white and black contours correspond to  $U = 0$  and  $U = c_p$ , respectively. In the first two images, a bulge forms and begins to move forward of the crest. The fluid above the  $U = c_p$  contour is moving upstream of the crest and represents the spilling portion of the wave. Although the surface vorticity within the capillary waves is large, significant net generation of vorticity occurs after the spilling is initiated. The vorticity is generated at the leading edge of the spill. The resulting sheet of vorticity is unstable. The vorticity rolls up creating new surface features.

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