

Date: April 4

Time: 11:00 AM

Location: Ames 234

Speaker: Dr. J. H. Duncan
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Title: "The Effects of Surfactants on Weak Spilling Breakers"

Abstract

The effects of surfactants on weak spilling breakers were studied experimentally in a wave tank that is 14.8 m long, 1.2 m wide and 1.0 m deep. The breakers were created from mechanically generated dispersively focused wave packets. The profile histories of the wave crests during breaking were measured with a photographic technique that employs a laser light sheet, fluorescent dye and a high-speed digital camera. The breakers were generated in clean water and water with various concentrations of three soluble surfactants (sodium dodecyl sulfate, Triton X-100 and hemicyanine dye). The mechanical properties of the free surface, including the surface pressure isotherm and the equilibrium surface viscosity and elasticity, were measured with a device centered on an in-situ Langmuir trough. In clean water, as these waves approach breaking, a bulge forms on the forward face of the wave at the crest and capillary waves appear upstream of the leading edge (called the toe) of the bulge. PIV measurements show that the transition to turbulence in this case is initiated by flow separation in the water under the toe. The entire breaking process occurs without overturning of the water surface or air entrainment. In the presence of surfactants, a variety of changes occur in the breaking process and these changes depend strongly on the type and concentration of the surfactant used. In some cases, a small jet forms that originates from the water surface just above the toe and impacts with the front face of the wave thus entrapping a packet of air.