Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Experimental investigation of Rayleigh Taylor instability in elastic-plastic materials AARON ALAN HALEY, ARINDAM BANERJEE, Missouri S&T — The interface of an elastic-plastic plate accelerated by a fluid of lower density is Rayleigh Taylor (RT) unstable, the growth being mitigated by the mechanical strength of the plate. The instability is observed when metal plates are accelerated by high explosives, in explosive welding, and in volcanic island formation due to the strength of the inner crust. In contrast to the classical case involving Newtonian fluids, RT instability in accelerated solids is not well understood. The difficulties for constructing a theory for the linear growth phase in solids is essentially due to the character of elastic-plastic constitutive properties which has a nonlinear dependence on the magnitude of the rate of deformation. Experimental investigation of the phenomena is difficult due to the exceedingly small time scales (in high energy density experiments) and large measurement uncertainties of material properties. We performed experiments on our Two-Wheel facility to study the linear stage of the incompressible RT instability in elastic-plastic materials (yogurt) whose properties were well characterized. Rotation of the wheels imparted a constant centrifugal acceleration on the material interface that was cut with a small sinusoidal ripple. The controlled initial conditions and precise acceleration amplitudes are levied to investigate transition from elastic to plastic deformation and allow accurate and detailed measurements of flow properties.

Arindam Banerjee
Missouri S&T

Date submitted: 05 Aug 2010 Electronic form version 1.4