Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Effect of Viscosity on Liquid Curtain Stability[1] ALIREZA MOHAMMAD KARIM, WIESLAW SUSZYNSKI, LORRAINE FRANCIS, University of Minnesota, Twin Cities, MARCIO CARVALHO, PUC Rio, DOW CHEMICAL COMPANY COLLABORATION, PUC RIO COLLABORATION, UNIVERSITY OF MINNESOTA, TWIN CITIES COLLABORATION — The effect of viscosity on the stability of Newtonian liquid curtains was explored by high-speed visualization. Glycerol/water solutions with viscosity ranging from 19.1 to 210 mPa.s were used as coating liquids. The experimental set-up used a slide die delivery and steel tube edge guides. The velocity along curtain at different positions was measured by tracking small particles at different flow conditions. The measurements revealed that away from edge guides, velocity is well described by free fall effect. However, close to edge guides, liquid moves slower, revealing formation of a viscous boundary layer. The size of boundary layer and velocity near edge guides are strong function of viscosity. The critical condition was determined by examining flow rate below which curtain broke. Curtain failure was initiated by growth of a hole within liquid curtain, close to edge guides. Visualization results showed that the hole forms in a circular shape then becomes elliptical as it grows faster in vertical direction compared to horizontal direction. As viscosity rises, minimum flow rate for destabilization of curtain increased, indicating connection between interaction with edge guides and curtain stability.

[1]We would like to acknowledge the financial support from the Dow Chemical Company.

Alireza Mohammad Karim
University of Minnesota, Twin Cities

Date submitted: 13 Sep 2016 Electronic form version 1.4