Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Fill-level symmetry and minimization of energy states in rotating tumblers with polygonal cross-sections[1] NICHOLAS A. POHLMAN, DANIEL F. PAPROCKI, JR., YUN SI, Northern Illinois University — Typically in rotating tumblers, constant rotation rates and circular cross-sections are used as they jointly produce a steady, uniform flowing layer at the free surface. On the other hand, experiments conducted in polygon-shaped tumblers produce unsteady conditions due to the rapidly changing flowing layer length. Results analyzing free surface properties indicate that the particle dynamics within the flowing layer attempt to minimize energy of the flowing system: The arithmetic difference between the angle of repose and the tumbler orientation has a functional relationship with the instantaneous flowing layer length in the form of a catenary. The peaks of the catenary are affected by the number of sides on the polygon cross-section as well as the symmetry around the critical 50% fill fraction. Furthermore, oscillation of the flowing layer position appears to affect the free surface curvature. This result is likely due to the rapidly increasing and decreasing length of the free surface and the rotational inertia of particles entering the flowing layer.

[1]Funding provided by NIU's Office of Student Engagement and Experiential Learning

Nicholas A. Pohlman
Northern Illinois University

Date submitted: 03 Aug 2012 Electronic form version 1.4