Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Entrainment in a Free Surface Plunging Jet SYED HARRIS HASSAN, PAVLOS P. VLACHOS, Purdue Univ — Ambient fluid entrainment and near-field flow characteristics of a free surface plunging jet are investigated using time resolved particle image velocimetry. The plunging height is about twice the nozzle diameter and we study five different Reynolds numbers ranging from Re_{FS} 5000 to Re_{FS} 13,070. We found that the near-field entrainment in the Re_{FS} 5000 and Re_{FS} 6086 jets is enhanced significantly than the latter cases due to mixing transition that occurs at about 2-3D_N below the free surface resulting in the breakdown of laminar vortices into smaller secondary structures. With an increase in the Reynolds number, mixing transition declines in the latter three cases as they have a more homogenous and turbulent flow structure. In addition, plunging jets show a reduction in the penetration depth of about 20-30% and the length of Zone of Flow Establishment (ZFE) of about 40-60% when compared to free jets at the same Reynolds numbers. Finally, we look into the distribution of coherent structures in the near-field over time in order to find the depth of mixing transition. The depth where primary structures breakdown into smaller secondary structures decreases as the Reynolds number is increased and is consistent with the reduction in the length of ZFE.

Syed Harris Hassan
Purdue Univ

Date submitted: 31 Jul 2015 Electronic form version 1.4