

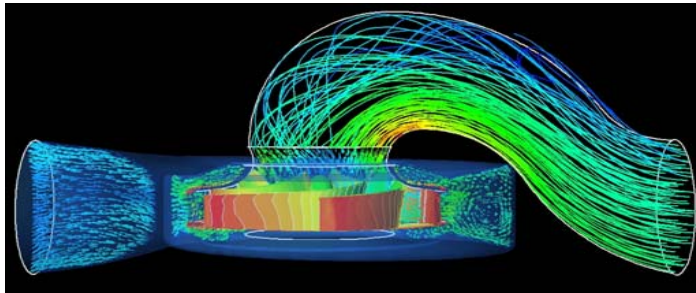
CFD in Pumps and Fluids Transient Studies

The flow field inside a centrifugal pump is very complex, three-dimensional and turbulent. When the pump operate at off-design point condition, flow recirculation and cavitations often observed and this lead to decrease of pump performance.

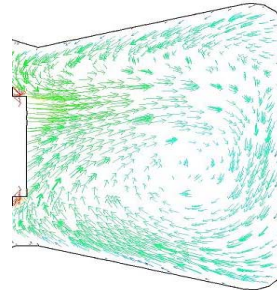
Numerical simulation has been carried out on a centrifugal pump to gain insight of the complex flow field developed within the impeller passage and volute casing. With the numerical flow visualization, much understanding can be gained.

Vortical Flow Structure and Pressure Contour

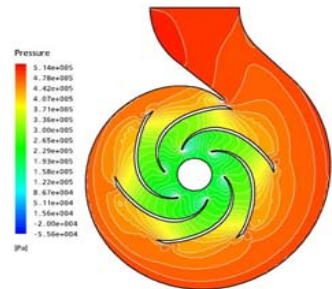
The numerical flow simulation shows that the vortical flow structure formed within the volute casing after discharging from impeller passages. The pressure contour plot revealed that the pressure within the impeller does increase along the streamline direction. The predicted characteristics curve is in good agreement with experiment result.



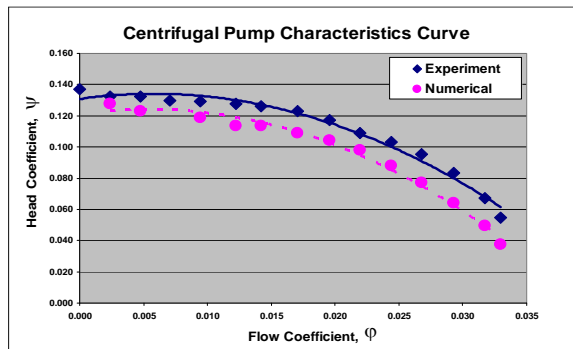
Numerical flow visualization of centrifugal pump.



Vortical flow structure inside volute casing.



Pressure contour within centrifugal pump.

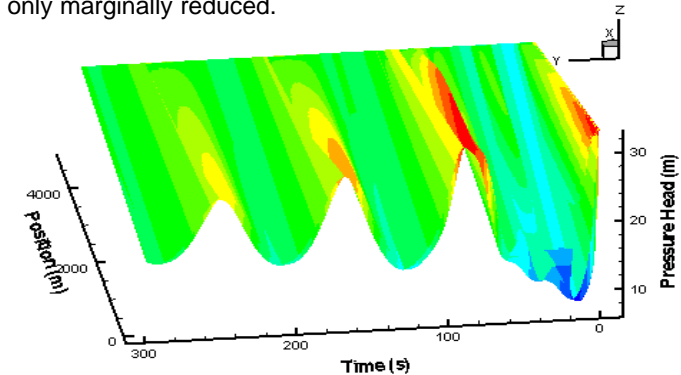


Comparison of numerically predicted and experiment characteristics curves.

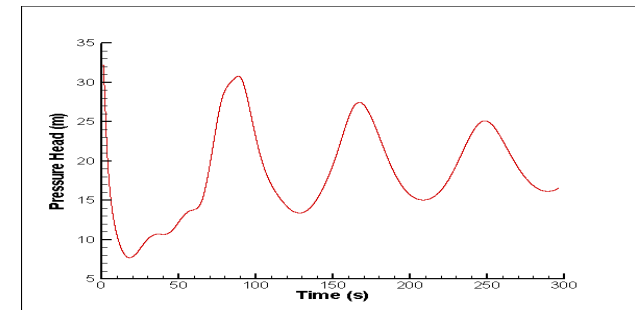
Fluid pressure transients with air entrainment

Air entrainment has marked effect on how a system behaves under fluid transient conditions. A numerical model with gas release and absorption has been developed in this work and used to compute the fluid pressure transients in the pumping mains of selected pumping installations with various flow devices. When compared with the gas free case, computations show that entrained, entrapped or released gases amplified the positive pressure peak, increases surge damping and produces asymmetric pressure. While the upsurge was considerably amplified, the down-surge was only marginally reduced.

Pressure history along the pipeline



Pressure head downstream of pump



Further studies will be carried out by using two-fluid model of two component flow to investigate fluid pressure transients with larger amount of air entrainment.

Contact: TS LEE (mpeleets@nus.edu.sg)

SH WINOTO (mpewinot@nus.edu.sg)

HT LOW (mpelowht@nus.edu.sg)