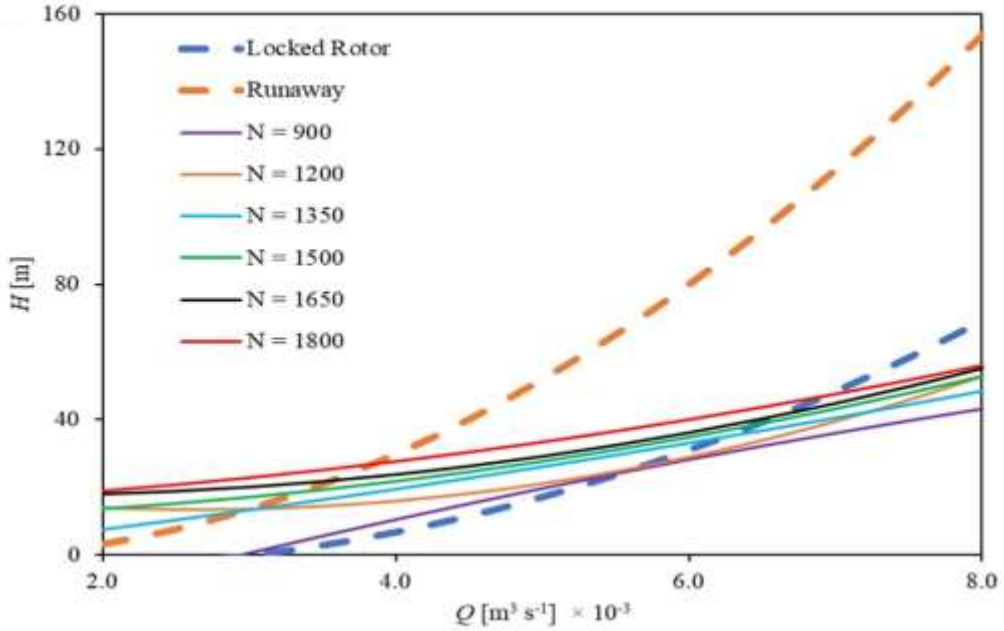
Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Dŵr Uisce

Performance analysis of a pump-as-turbine under cavitating conditions

Calvin STEPHEN[1*], Biswajit BASU[1], Aonghus MCNABOLA[1]
[*]stephec1@tcd.ie

- Pump-as-turbine (PAT) technology has gained popularity in recent years due to the growth of micro-hydropower applications
- Research has mostly focused on the performance prediction and machine selection
- Cavitation is ubiquitous with hydraulic machines, as such there is a need to understand how this technology fares in cavitating conditions
- The overall purpose of this study is to investigate the effects of cavitation on the performance of PATs over its operating range

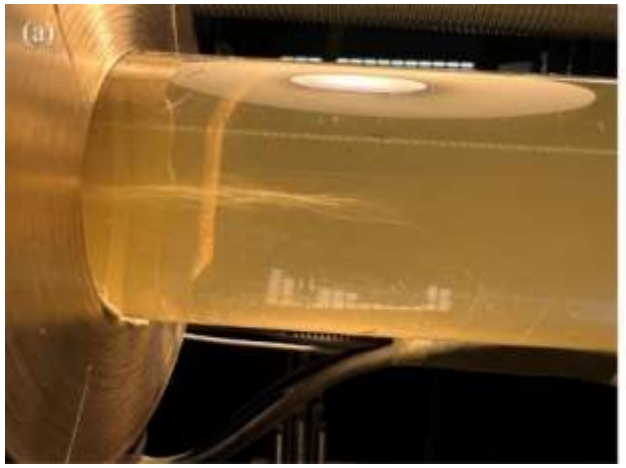


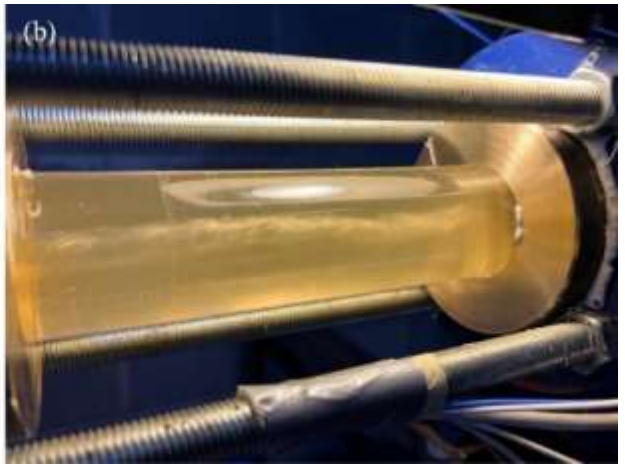
- Operation range of PAT system is limited between the runaway and the locked rotor curves.

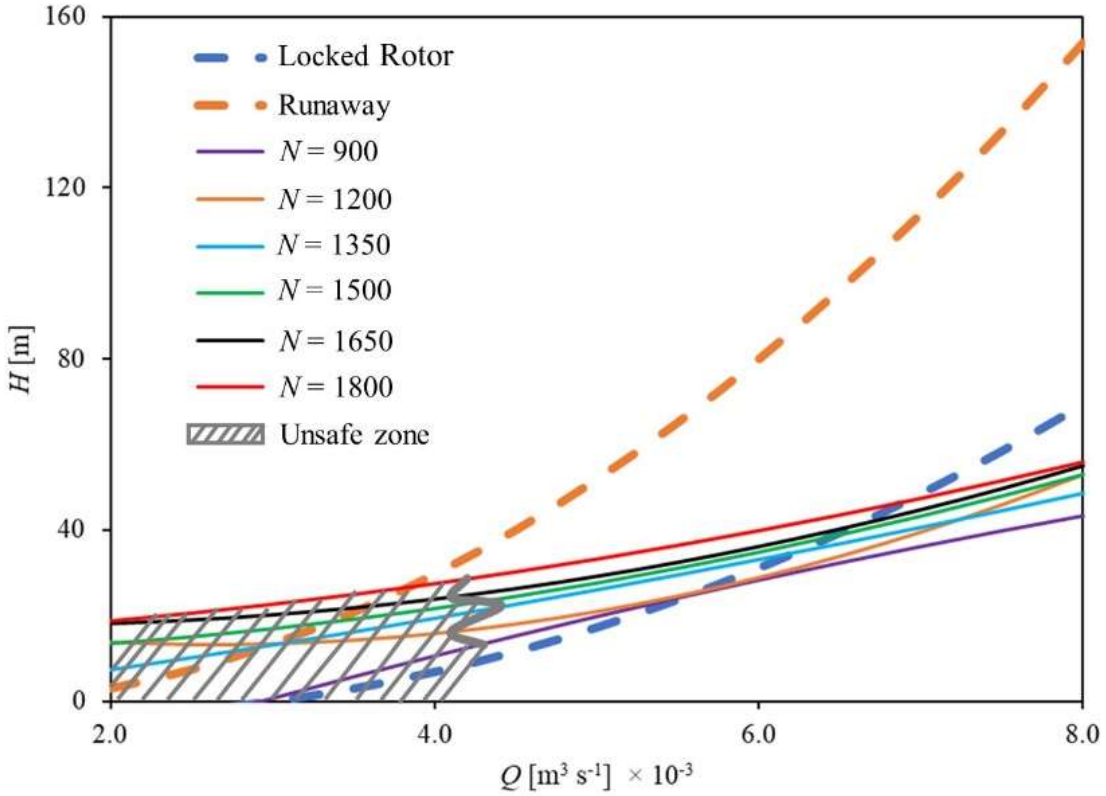
- This is what dictate what minimum and maximum flow rate is permissible through the machine

- This does not consider the machine cavitation status

- Experiments were conducted on a PAT system, and we observed that:
- at cavitation inception a clear thinner vortex structure forms at the center of the flow
- this grows into a vapor filled vortex rope as the conditions worsen
- The formation of a vapor filled vortex rope coincides with the zero-output power







- To take into consideration cavitation performance in the design of PAT systems,

  - we propose the use of the zero-output power as a limit in which operation beyond expose the machine to cavitation

- The study can be extended into the overload region and an upper limit of operation proposed

- In conclusion, cavitation in PATs can be detrimental to their operation and needs to be considered during design of such systems.
- The minimum allowable flow through a PAT can be adjusted to the flow rate value coinciding with the zero-output power.