Development of Novel Oscillating Water Column

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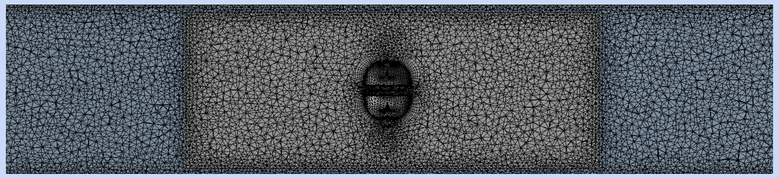
ABSTRACT

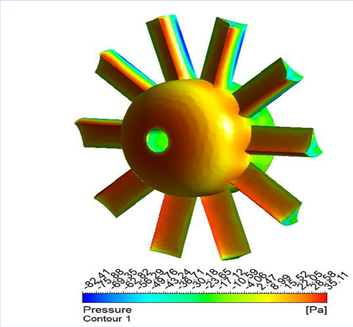
A novel Oscillating Water Column (OWC) was developed for electricity production to be used off the NC coast. The turbine and OWC geometry was selected based on the experimental and computational simulations. The maximum power of 5 micro-Watts obtained using the final project prototype with a very low overall efficiency of 0.1%.

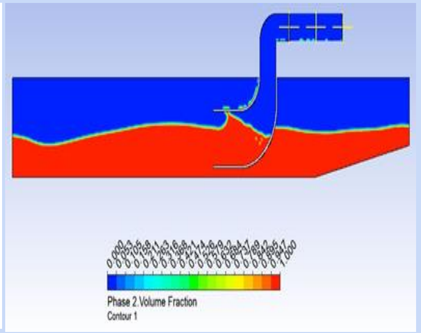
DESIGN OBJECTIVE

The goal for this project is to use experimental and computational approaches to design an OWC suited for use off the coast of NC. To satisfy the objectives for this project, the OWC must show evidence of energy production and be adapted to use off the coast of NC based on the state's environmental conditions.

NUMERICAL SIMULATIONS



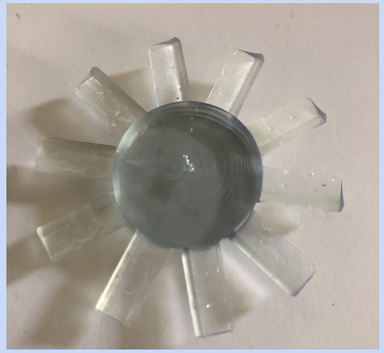


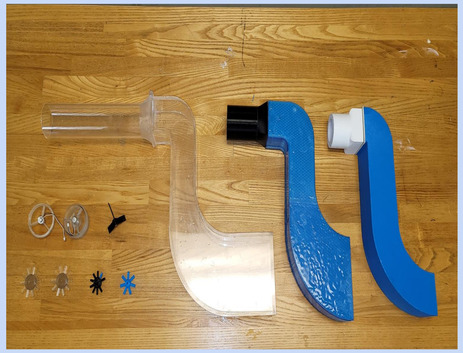


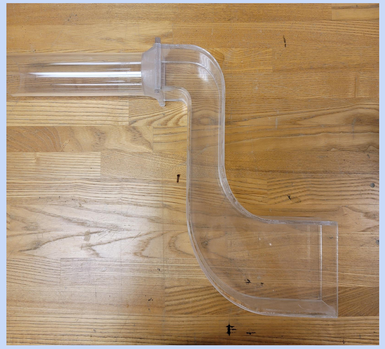
Several 3-Dimensional numerical simulations were carried out in ANSYS on the various chamber and turbine geometries to determine the power output. The simulations solved the Reynolds Averaged Navier Stokes (RANS) equations coupled with k-w SST turbulence model based on the Finite volume approach. The multiphase flow is captured employing Volume of Fluid (VOF) method.

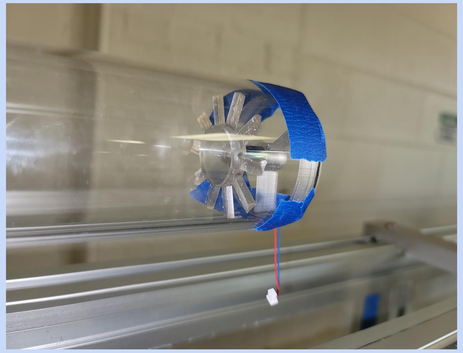
DESIGN IMPLEMENTATION

- 3 different small-scale prototypes were manufactured for experimental analysis
- The investigations took place geometry-wise, such as various neck geometries for the chamber.
- Improvements were made on the neck: adding a fillet to the inside radius of the neck
- The inlet and outlet conditions were examined, eventually making the outlet area 2x the inlet area, optimizing the overall air velocity at the outlet.

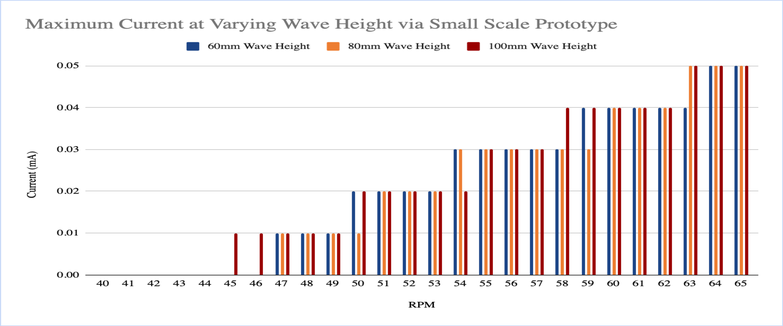




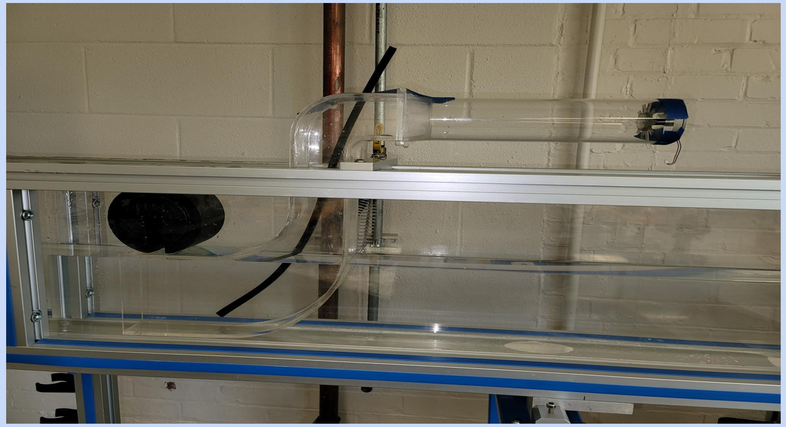




RESULTS



FINAL PROJECT PROTOTYPE



CONCLUSION

- With the chosen OWC and turbine geometry combination, the maximum power production is 5 micro-Watts with 0.1% overall efficiency.
- The electric current is almost linearly varying with the water height
- Since the efficiency of the system is very low, several other designs of turbines are being investigated
- Assemble the large-scale prototype and complete testing at the UNC-CSI wave tank