Development and Testing of Marine Energy Technologies

Sanjay Kashyap, William States Lee College of Engineering
Dr. Michael Smith, William States Lee College of Engineering

UNIVERSITY OF NORTH CAROLINA CHARLOTTE

Water Bros WEC Introduction

- Wave Energy Converters (WEC) harness the energy of the ocean waves as a renewable energy source.
- The WaterBros WEC utilizes wave motion to mechanically power a reverse osmosis (RO) desalination system.
- A tether moored to the seafloor drives a pulley as the device moves with the waves.
- The pulley converts the wave motion into mechanical energy that pumps seawater through a reverse osmosis membrane filter, creating drinkable water.

Water Bros WEC Future

- A functional prototype for the Water Bros has been completed and will be deployed for testing at Jennette's Pier (Outer Banks).
- When the testing is complete, the next step will be to analyze the water pumping efficiency, wear patterns, and performance measures.

Fig. 1: Water Bros WEC prototype [1]

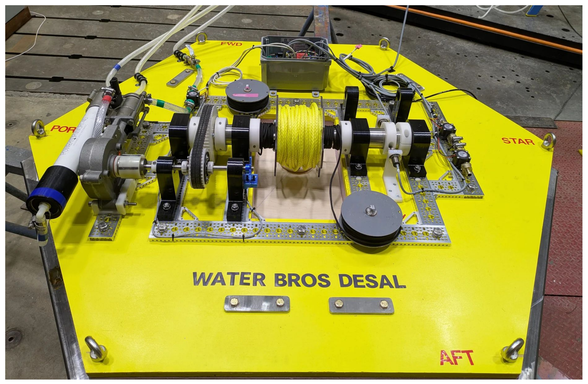

Fig. 2: Water Bros WEC prototype [1]

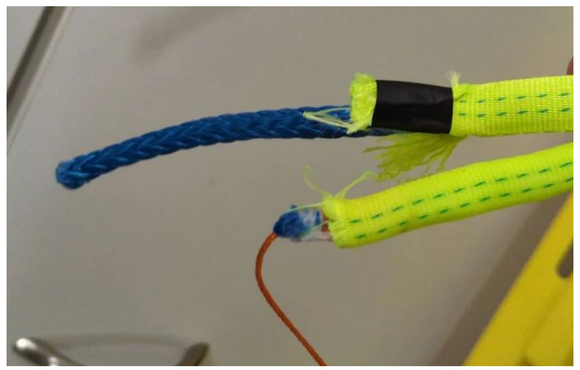

Fig. 3: Dyneema Cord inside of Tubular Webbing [2]

Contribution to the Water Bros WEC

Tethering

- The tether is made from Polyethylene fiber and is susceptible to wear from the sediments in the water.
- To solve the environmental wearing problem, TPU plastic tubing and tubular climbing webbing were researched as a protective layer around the main tether.
- The tubular climbing webbing was chosen as the TPU plastic tubing is not ideal when considering the stress induced from being knotted onto the mooring weight.

Swivel-Based Instrumented Mooring (SWIM) Device Introduction

- Utilizing multiple mooring cables for any floating mechanism, such as a WEC, is expensive to install with divers and carries the risk of the cables becoming tangled. Using only one mooring line carries the risk of the cable becoming damaged from twisting.
- The SWIM device allows free rotation of a mooring line which removes the need to install multiple mooring lines.
- There also multiple sensors within the device which measure the rotation of the cable and the load of the mooring line.

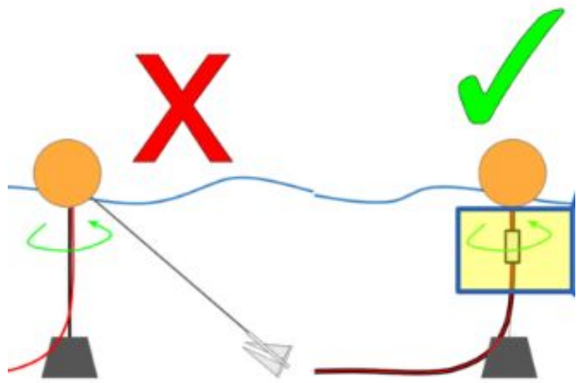

Fig. 4: WEC with SWIM device [3]

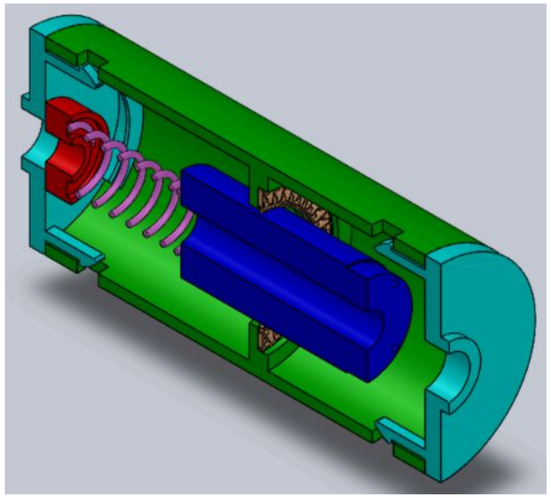

Fig. 5: SWIM Device CAD Model [3]

Contribution to the SWIM Device

Dynamic Seals

- The electrical components inside the SWIM device must be protected from seawater while still allowing the rotating connections to move freely.
- Several seal designs, including O-rings, V-rings, and spring-energized PTFE seals, have been evaluated.
- A spring-energized PTFE seal is a promising design solution due to its simplicity and effectiveness.

Future of the SWIM Device

Next Steps

- The next steps are to manufacture the sealing system and conduct testing to evaluate its waterproofing, durability, and performance in a real ocean environment.

Contribution to Marine Energy

- When completed, the SWIM device offers a more reliable and cost-effective mooring solution for wave energy converters while also reducing installation complexity.

References

[1] Water Bros. *Photograph of Water Bros Wave Energy Converter.* Copyright © 2026 Water Bros.
[2] Photograph of Water Bros WEC's Tether. Copyright © 2026 by Water Bros.
[3] M. Smith, C. Lowcher, T. Taylor. Internal Engineering Documentation, University of North Carolina at Charlotte. 2026